Calendar of AMS Meetings and Conferences

This calendar lists all meetings which have been approved prior to the date this issue of Notices was sent to the press. The summer and annual meetings are joint meetings of the Mathematical Association of America and the American Mathematical Society. The meeting dates which fall rather far in the future are subject to change; this is particularly true of meetings to which no numbers have been assigned. Abstracts of the meetings will appear in the issues indicated below. First and supplementary announcements of the meetings will have appeared in earlier issues. Abstracts of papers presented at a meeting of the Society are published in the journal Abstracts of papers presented to the American Mathematical Society in the issue corresponding to that of the Notices which contains the program of the meeting, insofar as is possible. Abstracts should be submitted on special forms which are available in many departments of mathematics and from the headquarters office of the Society. Abstracts of papers to be presented at the meeting must be received at the headquarters of the Society in Providence, Rhode Island, on or before the deadline given below for the meeting. Note that the deadline for abstracts for consideration for presentation at special sessions is usually three weeks earlier than that specified below. For additional information, consult the meeting announcements and the list of organizers of special sessions.

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† Please note this deadline is earlier than previously published.
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Conferences


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* Please contact AMS Advertising Department for an Advertising Rate Card for display advertising deadlines.
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Lisa A. Thompson examines “The Excellence in Mathematics, Science, and Engineering Education Act,” which authorizes over $150 million for new and existing programs in science and mathematics education, including $125 million for education and human resources programs at the National Science Foundation.

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BEYOND THE REPORTS - DEPARTMENTAL ACTION

The last few years have seen a plethora of reports on all aspects of the nation's mathematical sciences enterprise. These reports are useful in providing a springboard for debate, in distributing important information, and outlining means for change. However, it is now time to move beyond the reports and into action. Mathematical sciences departments are the natural institutions to take actions to bring about substantial, long-term change within the community.

Mathematics education, renewing the profession, resources for research, the reward structure—these issues are not new. However, they are being raised with a new urgency as the result of various forces influencing the mathematical sciences: computers, economic conditions, changing demographics, scientific and technological needs, and the growing importance of interdisciplinary research. Mathematical sciences departments need to reassess their responsibilities to adapt to the changing climate.

Major national initiatives are now addressing these issues. The community, as never before, is involved in a systematic approach to the revitalization of the profession. For example, at the National Research Council, the Board on Mathematical Sciences has launched a national plan for departmental renewal, centered on the recommendations of the update of the David Report. Another example is the Mathematical Sciences Education Board's national plan for reform of mathematics education, which includes state coalitions to facilitate local efforts and provide national coordination. How should mathematical sciences departments respond to efforts like these? How can linkages be established?

To a great degree, the success of efforts targeted toward a national approach to the revitalization of the mathematical sciences depends upon the "fit" between these programs and the college and university departments that train tomorrow's scientists, teachers, and researchers. Faculty must become involved to help insure the "fit" is a good one. Crucial to this effort is departmental commitment: a few individual faculty members, working without departmental support and recognition, cannot fully address the problems we are facing. Many different levels and modes of faculty involvement are possible, but departmental support of the entire effort is the only way to insure lasting change.

Departments should initiate open discussions of self-evaluation as a way of working toward specific actions. A discussion could center on some very basic questions, such as: What are the department's responsibilities in education (continuing, graduate, undergraduate, and precollege)? What is the department's responsibility to interdisciplinary activities (interaction with other departments or with industry)? What is the department's responsibility in increasing the number of women and underrepresented minorities who succeed in mathematics? How well is the department fulfilling its responsibilities? If the department is not responsible for some of these activities, is any other body acting on them?

In addressing these questions, the department will need to face the issue of recognition and reward for an expanded definition of scholarship and professional activity. In this area, too, a national movement can be seen: recently, the Carnegie Foundation for the Advancement of Teaching issued a report suggesting fundamental changes in the faculty-reward system to place scholarly, professional, and educational activity on an equal footing with research. How will the mathematical sciences community respond to this national trend?

The climate for change is here. As the mathematical sciences become increasingly important to economic competitiveness, education and training, and scientific research, mathematical sciences departments will play an important role in the changes to come. Departments must act now with careful self-evaluation and strong action plans based on broad departmental support and commitment.

William Jaco
Letters to the Editor

Asian Bias at UCLA?

Recently the U.S. Office of Civil Rights (OCR) completed an extensive review of graduate admissions at UCLA, focusing on the admission of Asian American students (excluding East Indians and Pakistanis). After reviewing nearly 100 programs (involving over 30,000 admissions files), they concluded that one program (Mathematics) was not in compliance under Title VI, i.e. that illegal discrimination was present in the admissions process, based on five cases in 1987 and 1988. Their findings have been reported, with varying detail and accuracy, in a number of different places in the media.

The University has been very supportive of the Mathematics Department throughout and plans to appeal this violation finding on our behalf. As we are preparing for litigation, I should not discuss the details of the case at this time. Nevertheless I do want to make some statement now to the mathematical community.

I have personally reviewed all of the files involved in the OCR investigation in Mathematics and believe that their charges are entirely unfounded. Their findings appear to be based on at least three faulty aspects of their approach: naive statistical methods which, among other things, overlook statistically valid tests showing that there is no significant difference between admission rates of comparable Asian and non-Asian applicants; a failure to systematically interview those responsible for the admissions decisions in question; and a too rigid view of the admissions process which ignores the complex interplay of factors used by the individual who made the final decisions in each case. This individual has also reviewed each of the files in question and stands by the legitimate, nondiscriminatory reasons for each of the decisions.

The current proportion of Asian students (American and foreign) in our graduate program in Mathematics is about 35%, and the corresponding figure for UCLA as a whole is about 22%. Both the University and the Mathematics Department are firmly committed to enhancing the diversity of the student body in all respects and at the same time would be eager to address and correct any validly determined findings of discrimination. We look forward to the appeal process that we believe will completely vindicate our admissions decisions in Mathematics.

Alfred W. Hales, Chair
University of California, Los Angeles
(Received October 30, 1990)

Lee Lorch Honored

Members of the AMS may be interested in the following citation accompanying an honorary degree of Doctor of Humane Letters which was conferred by the City University of New York on Professor Lee Lorch on May 25, at the commencement exercises of the City College of New York, the senior campus among its 20 campuses.

“You are a distinguished mathematician and educator who has made major contributions to the fields of Fourier Analysis and Real Analysis.

You have had an equally profound impact on the lives of minority and women mathematicians who have benefited from your efforts to expand opportunities within the American mathematical community.

In a letter to Science Magazine in 1951 you said: ‘the scientific societies, with their talk of the international character of science, must recognize its interracial character and put an end to discriminatory practices.’ As a member of the Council of the American Mathematical Society, you led a successful struggle to end the Society’s reciprocity agreements with the South African Mathematical Society.

Howard University honored you for demonstrating ‘exemplary courage and personal sacrifice in the struggle for human rights’ and for your contributions to the education of Black mathematicians.

Your commitment to equal rights goes far beyond academia and the field of mathematics. In the late 1940s you led a tenants group in the fight to desegregate Stuyvesant Town in New York City. You lost your position at a major university after inviting a Black family to live in an apartment you retained in Stuyvesant Town.

You are now Professor Emeritus of Mathematics at York University, Toronto, Canada, where you began teaching in 1968, and have also taught at Fisk, Philander Smith, Wesleyan and the University of Alberta. You have been a Visiting Professor or Research Scientist at the University of California at Berkeley, NYU’s Courant Institute and the Academy of Sciences of the USSR, among others.

When Townsend Harris founded The City College in 1847 he defined its mission with these words: ‘Open the doors to all—let the children of the rich and the poor take their seats together

Policy on Letters to the Editor

Letters submitted for publication in Notices are reviewed by the Editorial Committee, whose task is to determine which ones are suitable for publication. The publication schedule normally requires from two to four months between receipt of the letter in Providence and publication of the earliest issue of Notices in which it could appear.

Publication decisions are ultimately made by majority vote of the Editorial Committee, with ample provision for prior discussion by committee members, by mail or at meetings. Because of this discussion period, some letters may require as much as seven months before a final decision is made. Letters which have been, or may be, published elsewhere will be considered, but the Managing Editor of Notices should be informed of this fact when the letter is submitted.

The committee reserves the right to edit letters.

Notices does not ordinarily publish complaints about reviews of books or articles, although rebuttals and correspondence concerning reviews in Bulletin of the American Mathematical Society will be considered for publication. All published letters must include the name of the author.

Letters should be typed and in legible form or they will be returned to the sender, possibly resulting in a delay of publication.

Letters should be mailed to the Editor of Notices, American Mathematical Society, P.O. Box 6248, Providence, RI 02940, or sent by email to notices@ams.org, and will be acknowledged on receipt.
and know of no distinction save that of industry, good conduct, and intellect.'

City College is today part of The City University of New York, the most ethnically and racially diverse university in America. CUNY is dedicated to expanding opportunities and building bridges among people.

For your distinguished contributions in the field of mathematics and for your lifelong dedication to human rights, justice and equality, The City University of New York takes great pride today in conferring upon you the degree of Doctor of Humane Letters."

We are gratified that Lee Lorch's many contributions have been recognized, even belatedly. We only wish to note that the "major university" referred to was Penn State (see N.Y. Times, April 10, 1950, p. 1; editorial, April 11, 1950). He was, previously to that, dropped from the faculty of City College without explanation and after having officially been recommended for promotion by department vote. At that time, he was the only officer of the Tenant Committee to End Discrimination in Stuyvesant Town who was on a public payroll.

Joseph Auslander
Raymond L. Johnson
University of Maryland
(Received October 1, 1990)

Renewing U.S. Mathematics
As one who has been involved for over thirty years with mathematical research that strongly interacts with both the physics and electrical engineering (EE) world, I would like to question the wisdom of the monolithic emphasis on Physics and traditional Applied Mathematics in the Report "Renewing U.S. Mathematics" in the October 1990 Notices and the lack of any sense of contact with the current research scene in Electrical Engineering in that Report. Where are such subjects as Control, Robotics, Computer Vision, the Relation between Symbolic and Numerical Computation, Computer Programming Theory, Knowledge Representation, Biomechanics, and Applications of Category Theory, Logic and other parts of Algebra to Theoretical Computer Science?

As Dr. Sunley reports in the same issue of Notices, the mathematical world seems to have reached a plateau in terms of resources available to it: Might this deliberate (and long-standing!) rebuff to the EE side of the current research scene be explanation enough?

Robert Hermann
Boston University
(Received October 15, 1990)

Mathematics in the News
I read with interest Ethan Bolker's letter "Mathematics in the News," in the September 1988 issue of Notices. Bolker ruminates about his students' inability to recognize the 'nonsense' they have written. In response, I should like to share a few thoughts.

Surely, students "struggle hard at the edge of what they can comprehend." The question is: "Can they possibly understand what they are supposed to comprehend?" Professor Bolker cites problems with "for all" and "there exists," the universal and existential quantifiers of (first order) predicate logic. I question whether all the teachers and writers of textbooks really know what these words (or symbols) mean.

How come? The predicate calculus (or symbolic logic) is supposed to be the precise (artificial) language of "Mathematics." In a sense, the predicate calculus is as precise as can be, namely as far as the syntax is concerned. Yet, there is precision lacking. Why? Mathematicians may, or may not, agree with me that the three most important notions in (classical) mathematics as a discipline are truth, proof, and infinity. Can we have all three of these without conflict? In most instances, the predicate calculus is a transfinitist's language. It was created for this purpose. Is this language the best we can do?

Suppose a philosopher of mathematics, or a philosopher of language, demands that before we even attempt to formulate sentences about mathematical objects we must determine precisely the nature of these objects. (In such an effort we succeed with bitstreams, but we do not with sets.) Suppose a mathematician rebuilding the foundation of mathematics proclaims that it is the symbolic language of meaningless signs and sentences (formed according to rules of formation) which determine the mathematical objects. Suppose further that this mathematician proclaims not to require the notion of truth and that we are dealing with a formal game only, which nonetheless is bound to be significant. As a justification for this grandiose plan, he promises to provide us with a proof of consistency of the formal game.

Can his numerous followers ever imagine that one reason truth cannot be defined could be that truth was lacking in the first place? Will his followers ever concede that there is a possibility that the reason for the lack of an absolute proof of consistency could be the presence of a contradiction? Are students ever taught that the predicate calculus lacks precision because "for all" and "there exists" remain semantically undefined? Are students ever told that in artificial programming languages (such as Pascal) we do have a precise syntax as well as a precise semantics?

No! Not to my knowledge. Students are told that the notions "for all" and "there exists" are intuitively clear, and that's it, and that's what the "success" of mathematics is all about. More often than not, students are told that consistency is assured by established wisdom and that a proof of consistency, elusive or not, is an unnecessary luxury. So much for intellectual honesty—in the classroom or elsewhere. It has been said that "to teach is to tell little white lies once in a while." Could it be that "little white lies" make it so hard for the student to comprehend mainstream mathematics?

Gerhard F. Kohlmayr
Mathmodel Consulting Bureau
(Received October 9, 1990)
The Forum section publishes short articles on issues that are of interest to the mathematical community. Articles should be between 1000 and 2500 words long. Readers are invited to submit articles for possible inclusion in Forum to:

*Notices* Forum Editor
American Mathematical Society
P.O. Box 6248
Providence, RI 02940

or electronically to notices@math.ams.com

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### Mathematics Inside Mathematics Departments

**Toni Kasper**

*Borough of Manhattan Community College*

*City University of New York*

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**Editor's Note:** In response to "Mathematics Outside Mathematics Departments," by Solomon A. Garfunkel and Gail S. Young (*Notices*, April 1990, pages 408–411), the City University of New York Mathematics Discussion Group sponsored a panel discussion of the issues raised by the authors. Dr. Young served as moderator of the panel which otherwise consisted of Dr. Garfunkel, John Goodlet (Engineering Technology Department at the City College of New York), and Toni Kasper (Mathematics Department at the Borough of Manhattan Community College). Kasper felt that, although the audience was of good size for the occasion, the importance of the issues discussed required a more extensive broadcast. Accordingly, she wrote the following article examining the questions and criticisms presented by Garfunkel and Young.

In their article "Mathematics Outside Mathematics Departments," Solomon A. Garfunkel and Gail S. Young report that, although more and more students are taking advanced undergraduate mathematics courses, fewer and fewer of these courses are being taught within the confines of mathematics departments. Moreover, the students taking these courses are not enrolled in mathematics programs per se but are, rather, majoring in agriculture, business, engineering, science, and social science. Indeed, they remind us, "the number of mathematics Ph.D.s awarded each year has dropped steadily for more than a decade, and more than half the new doctorates are going to foreign nationals."

The picture suggested by these insights is one in which, should such trends continue, mathematics faculty could be reduced to teaching lower level courses, for the most part, if we have any students left at all. Hence, Garfunkel and Young sound the alarm and seek, via a survey of disaffected departments outside mathematics, to diagnose the problem. Apparently, if one can discover why an engineering department, for example, offers its own mathematics coursework, rejecting the mathematics department for this service, then perhaps we can meet their criticisms and reclaim "our" students. The main criticisms that emerge from their survey focus on what is perceived as a poor treatment of applications on our part, and a tendency to be too theoretical (i.e., bound to rigor and logical foundations). While we are told that, in calculus, we should emphasize skills and not the reasoning and logical organization, we also get the complaint that students are not able to use their mathematical skills in problem solving, that "What appears to be... lacking is the ability to formulate a problem quantitatively and then to solve it using the tools they learned in their calculus course."

The problems we face are much more serious, however, than what is suggested by Garfunkel and Young or by the complaints of responding non-mathematics departments. The rise, twenty-five years ago, in mathematics enrollments reported by the authors—more than doubling in the 1960s—coincided with a great expansion in higher education occurring at that time. Since the number of college students increased greatly (both in absolute numbers and as a percentage of the population), there would of course be a corresponding increase in the number of students majoring in mathematics, especially since a growth in higher education provided many job opportunities for college teaching. But then, the authors tell us, the number of mathematics bachelor degrees fell during the 1980s back to the 1960s level. This should come as no surprise. There had to come a time when the growth in higher education would level off. This in fact occurred, and hence the subsequent complaints that new Ph.D.s had little chance for academic employment. People who major in mathematics expect to teach, especially those who terminate their formal studies at the pre-doctoral level. Given the poor reputation of secondary schools for
salary and job status afforded, it is not such a shock that mathematics major enrollments suffered so steep a decline during the 1980s, especially when we also consider the allure of large salaries being offered by the commercial sector to graduates in business, law, finance, etc.

When we consider that the present level of mathematics bachelor degrees, although at the 1960s level, now includes foreign nationals, it becomes all too clear that a real loss in mathematics study has taken place. This is not a tolerable situation and we must identify the contributing causes in order to supply a remedy.

Since no population is uniform in its characteristics, the admission of a larger percentage of people to college studies required a relaxation of restrictive selection procedures. Recall that, in 1970, The City University of New York instituted its open admissions policy, whereby acceptance into one of its colleges is guaranteed to any New York City student holding a high school diploma (or its equivalent). We now have a student population different not only in numbers, but in kind. For one thing, their exposure to mathematics is much less than used to be the case. For example, a prerequisite for admission to my own college, until 1970, was three years of high school mathematics that included plane geometry, intermediate algebra, and trigonometry. After 1970, admittance required no mathematics study at all, although a student might be obliged to undertake remedial work in arithmetic and/or some elementary algebra. Throughout the 1970s and 1980s, then, gaining access to higher education gradually became more a problem of affording the cost than of qualifying on a scholastic basis. Access became more democratic academically (though few complained about the growing financial elitism). In response, no doubt, to the increasing numbers of poorly prepared students, standards were weakened, especially in "tougher" courses, mathematics being a conspicuous example. Thus, one college in our area changed its bachelor degree requirement from one college level mathematics course to either a math or science course (and the latter could be satisfied with a rather soft science course, at that).

Once colleges weakened their mathematics demands, what support remained at the secondary level for the vigorous pursuit of mathematics study? Not surprisingly, then, as the last two decades have rolled over us, incoming freshmen demonstrate less mathematical training, and fewer students express any interest in mathematics itself. How does a student discover such an interest (or talent) for a subject if deprived—by declining standards—of the chance to experience the subject matter? Sadly, the effect of this could be only to deepen the unfortunate tendency already present at the college level.

There are signs that the nation is resetting its educational compass. Recognition has come that the global economy that is now a fact of life necessitates a citizenry that is knowledgable, not just credentialed. As a local example, but an important one nevertheless, Joseph A. Fernandez, the Chancellor of the New York City school system, has recently expressed an interest in returning to the previous practice of requiring high school students to pass a course in intermediate algebra in order to graduate. Moreover, the new Chancellor of City University, Dr. W. Ann Reynolds, has voiced support for a corresponding approach at the college entry level.

These are encouraging developments, but, while we have the patient opened, let's do the whole job. For one thing, let's end the absurd practice, begun at least by the 1950s, of pretending that the people of our time can do what Isaac Newton could not: take calculus too soon. Newton entered Trinity College, Cambridge, in 1661 and graduated in 1664. During his first two years there he studied elementary mathematics. With that, and the lectures on geometry given by his teacher (Dr. Isaac Barrow), he gained the insights that led shortly after to his famed discoveries. So admirable is the calculus and its many extensions, that it is probably natural for us to want our students to experience this pleasing subject as soon as possible. Given the awkwardness of some of the techniques of analytic geometry, for example, as opposed to the more facile approach offered by the "new" method, it is understandable that the traditional studies in analytic geometry began to suffer. Also, students faced a greater number of college level math courses than did their predecessors, as the field of mathematics itself grew. Thus, whereas students had once taken separate high school courses in algebra (intermediate and perhaps advanced), trigonometry (plane and spherical), and geometry (Euclidean, solid, and analytic), much of this became condensed or eliminated altogether. Intermediate algebra and trigonometry became one course, for example, and what was left of analytic geometry became a short introduction to the calculus. This approach deprived students of the fuller exposure to mathematics that must occur if the mathematical "maturity" required for the study of the calculus is to take place. It is no wonder, then, that one of Garfunkel and Young's respondents complains that "Engineering has further suffered by the loss of more preparatory subjects such as analytic geometry." Moreover, it is equally unremarkable that we have what many describe today as a crises in the teaching of calculus. Along with insufficient preparation, the study of calculus received another blow, in more recent years, when it began to be used as a tool for inappropriate (if not downright nefarious) purposes, i.e., as evidence of a certain kind of intellectual power (often called mathematical maturity) deemed requisite for courses not involved with calculus at all. Thus, we see majors in computer science (who need study discrete methods), business, veterinary medicine, etc., obliged to pass a calculus course, to the misery of themselves and their instructors. How curious that, at the same time that we undermine the study of mathematics at the lower levels, we demand the ability to perform at the higher levels. (I suspect that what this strange dichotomy reveals is a basic lack of interest in mathematics itself but also a desire to gain respectability for one's subject matter by mathematizing the presentation to whatever extent is possible). Then, for the final coup de grace, we pack these unmotivated and undermined students by the hundreds into
huge lecture sections where they are finished off.

So the problem, then, is not so much whether mathematics faculty know and treat applications, despite the complaints of the respondents to Garfunkel and Young’s survey. Yes, we could enliven our presentations by reference to applications, and we should do so just to make it more interesting (to ourselves as well as the student body). But that does not require us to relinquish our experience with mathematics on an aesthetic basis as some engineering faculty, for example, would have us do just because they don’t relate to the subject matter in the same fashion. The complainants also make the criticism that the mathematics material their students need is spread out over too many mathematics courses, that the items they want treated “span too many math courses.” The reason for that is simple and inevitable: the topics required are logically unrelated and therefore would not naturally occur in a single mathematics course. These subjects represent tools to be used in an uncritical fashion, and that is just not how mathematicians treat—or should treat—their subject.

In summary, while training in mathematics is becoming more necessary, the failures in mathematics education grow, and these are the consequences of several practices:

1. Failure to require students to take meaningful mathematics coursework at the lower levels, with the result that they develop little interest or skill.
2. Depriving students, of whom higher mathematics is demanded, of the fuller exposure afforded by more preparatory coursework.

3. Abuses with respect to calculus coursework:

(a) using calculus as a screening device rather than for its own sake in an appropriate setting. This causes resentment among students who blame the mathematics department, which may or may not be responsible for setting this obstacle to their goals.

(b) the practice of employing gargantuan sized classes and teaching assistants who, either by inexperience or poor English language skills, are incapable of compensating for the neglect engendered by the mass treatment. Indeed, their use often exacerbates the problem.

To stem the loss of students to mathematics study, we must make the investment of providing reasonable class size, thorough preparation at the secondary level, and we must require students to undertake such study. Moreover, given the demographic changes that are underway in the United States today, we must take deliberate steps to nurture those students who could do well but have not traditionally undertaken deeper studies in mathematics, female and minority students. It is especially important to support these groups at the higher levels, but there is where they experience the saddest neglect. Unless we are ready to refocus and, to some extent reclaim older virtues, the numbers of students participating in mathematics will continue to dwindle to a precious few.
This month's column

At the intersection of mathematics, logic, and computer science, there is currently a great deal of activity in what are called "logical framework systems," or LFs. These systems aim at providing a computer environment within which to do everything we do in mathematics. In intent, at least, they go far beyond programs like Maple and Mathematica. The most obvious difference is that these systems provide a facility for the justification of everything, including the checking of all proofs and constructions.

A pioneer in this program, one far ahead of his time, was Professor N. G. de Bruijn, of the Netherlands. Starting in 1966, he led the development of the Automath project. This system is the grandfather of current logical framework systems. This month’s column is devoted to an article on these systems, written by de Bruijn, especially for the column. Following his article, I add some comments of my own, to spark some debate.

Automated Checking vs. Automated Proving

The idea of formal proof checking is much older than the computer. Leibniz and Boole had already played with the idea to replace thinking by a kind of algebraic manipulation, but in their time they did not have the means to carry this out beyond the level of simple details of mathematical discourse. As we see it today, in order to cope with all possible mathematical situations one needs some feeling for formal languages as well as for language processing algorithms. It is not so much the availability of computers, but rather the experience acquired around computers that led to the design of what I like to call justification systems. I prefer this term over proof checking systems since these systems handle much more than proofs. Some of these systems can check complete theories including whether definitions and axioms are well-formed, they can check relations between different theories, and the material that can be checked can go beyond what is called mathematics today.

The activity of theorem proving should not be confused with the one of proof checking. A justification system is not expected to invent proofs, but to verify whether some input is correct mathematics or not.

Automated theorem proving seems to be older than automated proof checking. In a general sense automatic production of proofs for all provable theorems is a very hard task, but in limited areas it might be feasible and sometimes even easy.

Automatic theorem provers may occasionally do amazing things, but they have their limitations. A justification system, on the other hand, is expected to be able to handle everything that is offered: every correct piece of mathematics should get the system’s approval, and all incorrect or incomplete material is to be rejected. An automatic theorem prover is a kind of automated professor, a justification system a kind of automated student. The professor does the harder work but has the advantage of being allowed to select topics and methods. The student seems to have the easier job, but is supposed to digest whatever is served.

Motives for Justification

What motives can one invent for setting up a justification system? (I say “invent” since motives are often afterthoughts: one starts something when it seems attractive and promises

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* N. G. de Bruijn is professor emeritus of the Department of Mathematics and Computer Science, Eindhoven University of Technology, PO Box 513, 5600MB Eindhoven, The Netherlands. He can be reached by email at wsdwnb@win.tue.nl.
some success, motives are invented afterwards as a kind of
defense.) An obvious motive is protection against human
oversight in long chains of arguments. Usually mathemati-
cians do not need such checks: in most mathematical
situations there are many possibilities to verify intermediate
steps as well as final results by means of examples and
analogies. But there are cases where a chain gets too long
to be grasped by a single brain in a limited time, which is
particularly worrying when the chain has not been produced
by a single person but by a group, possibly of both people
and machines. Then the poor reader has to rely on mecha-
nical verification of all details. I use the word “mechanical”
in the old sense of human machine-like action. In that sense
we can do pencil-and-paper work without having to think
all the time about the meaning. But in order to have any
value at all, such mechanical checking should be perfectly
organized.

A very important class of applications can be the area of
correctness proofs for computer software. In the near future
this may be a kind of work that requires and deserves the
attention of many mathematicians.

Another motive is to lighten the burden of referees of
mathematical papers. If a justification system is so easy to
handle that the average author can use it with little effort
(at present no systems are that good) then the referees (or
the thesis supervisors) can require that the authors provide
a version of their paper directly in the language of the justifi-
cation system so that the referees can run it on their
own machines. Then they need not bother about correctness
and can concentrate on whether the paper is interesting and
new. The question whether it is new, might profit from the
system as well: once there is a good justification system used
on a large scale, one can think of organizing an enormous
mathematical encyclopedia, a data bank of verified results,
and such a bank can answer all sorts of questions about its
contents.

Quite a different motive is the matter of understanding
mathematics. This can mean several things.

One way in which a justification system helps under-
standing was explained by Shankar [S]: by being forced to
convince a machine, a mathematician can sometimes trans-
form proofs with subtle errors and duplications into faultless
elegant proofs. And elegance supports understanding and
insight. But it can also work out differently. Since a machine
does not explicitly require elegance and shortness, there is
the temptation to take the easy way as soon as the machine
has accepted correctness: just go on, without bothering about
polishing.

But in a more general sense the system that we use
for explaining mathematics to a machine can give insights
into the structure of mathematics and in the difficulties that
beginners have in learning to play the game of mathematics.
I have to admit that teaching a student is not the same thing
as teaching a machine, but if teachers are unable to arrange
their arguments in a way acceptable to a machine, then
their teaching of students may be an illusion, not beyond
“teaching by intimidation and learning by imitation”.

And apart from the computer’s qualities in precision and
in speed, it has its influence in forcing us into an absolutely
rigorous form of formalization. If we are unable to leave
something to a computer, then it has not yet been sufficiently
formalized.

But not all justification systems are equally good in
helping us to teach better. I feel that we learn much more
from “framework” systems (to be discussed in this paper)
than from classical systems.

What one is forced to learn anyway is to draw a strict
borderline between language and metalanguage. Mixing
language and metalanguage is a well known source of
errors and paradoxes. The language is the only thing the
verification system checks, the metalanguage helps us to
understand what we are doing.

Absolute Safety?
One of the first questions people ask when hearing about a
justification system is whether it would guarantee absolute
dependability. This can mean two things. In the first place
there is the matter of absolute dependability of mathematics,
whatever the foundations may be. I think there is little hope
ever to get final answers to that question.

The second thing it can mean is this: once we have
accepted a rigorous formalization of some piece of math-
ematics, and we have accepted the idea that “mechanical”
verification gives a kind of absolute guarantee of correct-
ness, we ask whether this guarantee would be weakened
by leaving the mechanical verification to a machine. This
is a very reasonable, relevant and important question. It
is related to proving the correctness of fairly extensive
computer programs and checking the interpretation of the
specifications of those programs. And there is more: the
hardware, the operating system have to be inspected thor-
oughly, as well as the syntax, the semantics and the compiler
of the programming language. And even if all this would
be covered to satisfaction, there is the fear that a computer
might make errors without indicating them through some
total breakdown.

I do not see how we ever can get to an absolute
guarantee. But one has to admit that compared to human
mechanical verification, computers are superior in every
respect.

Another question people ask is whether a justification
system can justify itself. I think this is asking too much.
A justification system can never justify more than certain
fragments of itself or certain interpretations of itself.

Philosophically, I hardly think that the question of self-
justification, if it has a meaning at all, is very relevant.
If someone tries to convince us with some story, then our
doubts should not be allowed to melt away if the narrator
declares in the same convincing tone to be absolutely sure
about the truth. We should prefer to get support from a
different person.
Doing It Like Humans

Some of the principles of the organization of justification systems are copied from what we have always been doing as humans.

We explain things to our automatic student in terms of a language and according to the rules of that language we write a book, consisting of a sequence of lines, or at least a tree-shaped arrangement of lines, which excludes circular reasoning.

The organization of memory in a justification system usually follows the human pattern too. We work with short and long range memory in our brain, directly accessible written memory on our desk, books on our shelves and books in possibly far away libraries. In a computer justification system we may observe a similar organization of memory.

Another aspect in which human behavior is followed closely is the production of mathematics, starting from a kind of raw material, clever but vague ideas, and ending with a final product of stupid but strictly precise formalisms. The process looks like an assembly line in a factory. In the beginning of the conveyor belt there is the Mathematical Genius who puts his ideas on the belt. Next there is the Brilliant Mathematician who is able to write it all up in today’s publication style. The next place along the belt is taken by the Competent Mathematician. He knows the tricks of the subject, is able to supply necessary material that his predecessor did not even mention, and is able to write meticulously in every detail.

In presenting mathematics to human students we usually do not give that ultimate form, and it is questionable whether we should. After all, students should learn to fill gaps themselves. If we keep chewing all food for them they will never develop proper teeth. Nevertheless they can learn a great deal from chewed material. In this connection I mention the way Edmund Landau wrote his books on analysis and number theory.

So the final product of the Competent Mathematician is a mathematical text that requires no specialized knowledge or experience from the reader. Let me call it Landau style.

The next stages along the belt have people who transform this product into the language of the justification system. Again it will turn out that gaps have to be filled, in particular since the Competent Mathematician did not bother to give the proper references all the time and certainly did not always mention the logical derivation rules. After all, generations of mathematicians have done their work efficiently even without consciously knowing their derivation rules!

The work may be subdivided. One can think of a first stage where a person with some mathematical training inserts a number of intermediate steps whenever there is a risk that further workers along the belt might have trouble, and a second stage where the logical inference rules are supplied and the actual coding is carried out. For the latter piece of work one might think of a person with just some elementary mathematics training or of a computer provided with some artificial intelligence. But we should not be too optimistic about that: programming such jobs is by no means trivial.

Finally, at the end of the belt the Checker does the final verification. The work might be done by a human with an unusual amount of endurance, but it is much better and cheaper to leave it to a computer.

This picture of an assembly line may be a novelty for many mathematicians, since they hardly ever delegated parts of their work to people below their own level. This is quite different in other sciences.

Platonism

Some people feel that mathematical thinking depends on the existence of a real world of mathematical objects, an idea called Platonism. For communication between mathematicians this idea is irrelevant: in a mathematical discussion between a believer and a non-believer none of the two notices their different backgrounds. And of course it is irrelevant in mathematical communication with a machine. The machine does not store the mathematical objects we are talking about. The only thing it may have to store is what has been said thus far.

It is instructive to compare a justification system for mathematics with a verification system for chess. The latter has to be able to read a chess game, consisting of a sequence of lines representing the moves. It has to find out whether that sequence of moves produces a legitimate chess game or not. The chess moves are intended to update the position on the board, and actually the rules of the game express legitimacy of the next move with respect to the updated position (including a few extra bits of information since we have to know who’s move it is, as well as a few details on castling and capturing “en passant”). The chess verification system will of course store the position like a kind of Platonic reality and can even forget about all previous moves. So we get the feeling that the sequence of moves talks about the positions, that board and pieces form the reality and that the given sequence of moves is just some abstract coding of the sequence of positions.

The difference with a mathematics verifier is striking. In mathematics we have nothing but the discussion, and even if a mathematical reality would exist, none of it would be stored in or consulted by the machine.

The language of mathematics is not talking about a limited number of things. If it were, a justification system might try to take a kind of model-theoretical approach by testing every statement in that world of objects. The language of mathematics cannot be verified on the objects: there are too many of them. The only thing we can do is apply the rule that things are correct if they have been correctly said. The notion of correctness is not formulated in terms of a mathematical reality, but involves rules about how a statement should be related to material that has been said before. Many non-mathematicians who hear about verification systems get the idea that such systems can handle only “constructive” situations like finite mathematics. This confusion depends on that wrong idea of implementing mathematical reality.
I believe that every Platonist would be converted at once when having to explain his mathematics to a machine.

**Doing It Naturally**

I think that in formalizing mathematics and, in particular, in preparing mathematics for justification, it is usually elegant and as efficient as to do everything in the *natural* way. That word of course does not mean “like in nature”, it can at most mean “like normally in our culture”.

Justification can be achieved step by step, like in the assembly line mentioned before. Putting a piece of mathematics into a justification system is a process of successive refinement. We begin by a rough sketch and in various rounds we supply more and more details. The first few of these rounds belong to our cultural habits. I would call it “natural” if we proceed by successive refinement of those first rounds and “unnatural” if the line of attack has to be completely overthrown or remodelled. In that sense Boolean logic is unnatural and natural deduction is natural.

Boolean logic comes down to replacing reasoning by an algebraic machinery that is *not* a refinement of what it is supposed to implement. Similarly Descartes’ analytic geometry did not refine geometric proofs but replaced them by algebraic ones with completely different structure. Both Descartes and Boole created a beautiful and powerful theory, but I would not call their work “natural”.

But of course, since the word “natural” means “cultural”, it is subject to change. Set theory is an example for this. In my private opinion, it is unnatural to base mathematics on type-free set theory, where almost all mathematical notions are coded as elements of the Zermelo-Fraenkel universe (to be referred to as ZF). When it started, it reorganized much of the existing structure of mathematics, and could not be seen as a refinement. But later generations of mathematicians had often been exposed to ZF very early in life and would therefore call it quite natural.

Some even believe (like Cantor possibly did) that the ZF universe is not fiction but Platonic reality. This seems to be in conflict with the popular slogan “everything is a set”. That slogan means that very many things (of course not everything) can be coded in ZF. In a case like the one of the real number system, various different codings are in use. Platonism of course wants to consider the reals as a kind of reality that is independent of the way we talk about it. So we have the picture of the Platonic reals, with injections (the codings) into the Platonic ZF universe. In that picture the real reals are no sets at all.

Coming back to the idea of refinement, I must confess that it is difficult to keep it pure in the long run. The Genius at the beginning of the assembly line may look with one eye at what happens at the other end of the line and may adapt his ideas to the needs of the technology displayed there. Technical realization can have influence on design.

Moreover I am not sure that the idea of systematic refinement has an eternal value worth fighting for. After all, it is extremely conservative, and there is nothing against a revolution now and then.

**Doing It Efficiently**

A very important feature of efficient justification systems is linearity. This refers to the length of a complete account of a piece of mathematics in standard language (Landau style) compared to its translation in the language of the justification system and compared to the time a computer needs for verification. In a bad system the latter two items may grow exponentially compared to the first one, in a good system the relation is linear. It can be linear if the system makes full use of all the definitions, abbreviations, lemmas and theorems that the standard mathematical language already provides.

If the piece of mathematics in standard language contains gaps, however, or if it tacitly appeals to experience the student is assumed to have acquired thus far, then the text for the justification system might become considerably longer. But then it is not fair to put the blame on the system.

Without linearity, verification would never be feasible. In the Automath project in the early 1970s, feasibility was put to a test. The test was to push a full mathematics textbook through the justification system. The book chosen was E. Landau’s “Grundlagen der Analysis”, and Landau was followed in every detail. No attempt was made to simplify or to modernize the text. The translation was carried out by L. S. van Benthem Jutting [J] and the test was completely successful. Linearity from the beginning to the end. And computer technology of the early 1970s was good enough for this. The speed was never a problem, but memory limitations were (and would still be).

Checking a Landau-like text is not always exactly what we have in mind. There is not always a Landau so kind as to write books in a systematically detailed form. Most mathematicians hate to do that, and it should be said that in some parts of mathematics that work is more unattractive than in others. In some areas all the steps are equally elegant and interesting, whereas in other areas we see elegant steps with a lot of dull work in between. At least there should have been done dull work in between, usually suppressed by the author. In such areas people are likely to hate formal verification.

**Filling Gaps**

We would like to have an automatic student who behaves like an intelligent human student and not like one that does “mechanical” checking without “understanding”.

This indicates what we have to require from justification systems in the future. In the first place they should be able to deal with all the small gaps in any piece of mathematics, in particular gaps which can simply be filled by an appeal to a logical derivation rule. And in cases where references to previous material are needed, the machine should be able to find those, possibly guided by hints in the text.

Whatever a human student finds easy should be automated, possibly by means of some artificial intelligence. This kind of automation is hard, but I think it can be done and will be done in some of the efficient systems which are being developed today.
Computers and Mathematics

But there is more. A good human student is not just assumed to have a general aptitude in mathematical reasoning in general, but is also assumed to learn from the particular subject that is presented, recognizing situations that have been understood before. This may amount to building a kind of subconscious library of lemmas that have not been formulated explicitly in the text or even a subconscious library of methods. I think one is still very far from full automation of learning processes, so it will be a long time before we can automate the brilliant student. But for many purposes it may suffice to automate the average student.

Many mathematicians dislike pushing formalization to the extreme. The idea is that it kills intuitive thinking.

I do not entirely agree. It may be true that unnatural formalization replaces intuitive thinking by an entirely different process of formula manipulation, but natural formalization supports intuition rather than destroying it. Formalization and intuition should be each other’s best friends rather than enemies.

But part of what we call intuitive thinking is not of the kind that can be refined to proofs. That part cannot be formalized. Our brain processes are not based on logic or any other foundation of mathematics, and nevertheless they produce wonderful things. But all mathematicians agree that the results of intuitive thinking have to be justified by rigorous reasoning, even though there may be different opinions about the level of formality.

What Is a Proof?

Can a justification system check the computer proof of the four color theorem? Or, rather, is that proof really a proof?

Instead of the spectacular four color theorem I prefer discussing a simpler case. Imagine a combinatorial problem for which a computer search establishes the theorem that there are 24103 solutions. Do we consider that as a proof? Let us assume that there are correctness proofs, not just of the computer program, of the computer language compiler and operator system, but even that there is a complete description of the hardware specifications. We now buy a computer, trusting that it satisfies the specifications, we let it run and get as output that there are 24103 solutions. Is that a proof?

Of course it is not. At most we have a proof for a more complex statement: “if the abstract execution of the program on an abstract machine with the prescribed hardware leads to 24103 solutions, then there are 24103 solutions”. This statement does not even have the form of the one we have in mind; it is a companion theorem in some kind of metalanguage.

But it is reasonable to ask whether the computer search can be refined to a proof in the ordinary sense. I think that in many combinatorial search problems such a proof by refinement can be written (in the language of a justification system) by a machine and that the program producing that proof can be obtained by refinement of the computer search program. That machine-produced proof can be checked by the justification system. Possibly no human will read that proof, but nevertheless it is open for human inspection. We can inspect the general organization and if we select any detail we can convince ourselves that the proof of that part is perfect. This is not very different from the situation in standard language in cases of exceedingly long proofs that we have not written ourselves.

The use of machines for obtaining theorems was never questioned in the matter of numerical calculations. If, for example, as a step in a mathematical proof we need the fact that the product of 239 and 4649 equals 1111111, then it is not customary to require a formal proof in mathematical formalism. But it is reassuring to know that the process we carry out by the pencil-and-paper multiplication algorithm can be refined to a proof and it is not hard to have that refined proof produced automatically.

Frameworks

When designing a justification system for mathematics, there is the crucial question how to start. In our present society it is more or less accepted to say (often only as lip service) that mathematics is founded on a basis of classical predicate logic and ZF set theory. Are we to base the justification system on that foundation? Accepting this, we get what I shall call a “classical system”. But there is the alternative to start off from a more primitive level, with the possibility to present logic and set theory as explained material in the system, on an equal footing with the presentation of all other mathematical material. In that case I use the term “framework system”. Such a set-up means that “the usual way” becomes an option, possibly along with others, and that the user is allowed to be critical about the usual way.

The rules of the game in a framework system have to express how to handle mathematics and logic, more or less independently of the contents. Here “handling” involves how to work with things like definitions, assumptions, axioms, free and bound variables, substitution, proof rules, proofs, theorems. When designing the framework one has to bother about what it means to apply a definition or a theorem or a proof rule and not about what particular rules or axioms are to be taken as a basis. It is not very customary among mathematicians and logicians to discuss that framework: it is usually assumed to be available before mathematics and logic start off. But when trying to instruct a computer to follow our mathematical habits we are forced to be explicit about these matters.

Typing

When I started working on a justification system around 1966, I wanted to make something of a universal nature. I gave a great deal of thought to the framework and that led me in a quite natural way to giving a central place to the idea of typing, i.e., attaching a type to every expression. The result was the system to be called Automath [dB1]. To insiders it might be described as natural deduction with (typed) variables and lambda-typed lambda calculus (lambda-typed means that the types may again be lambda
terms), with argumentation structure depending on the idea of "proofs as objects" (others use the term "propositions as types" but I consider that to be unfortunate).

My interpretation of typing is related to the use of "is a" in English. John is a soldier, London is a town, q is a rational number and P is a point. Now let us call "soldier" a type and "John" an inhabitant of that type. In English these types play the role of substantives.

Replacing the "is a" by a colon, one gets "John : soldier", "London : town", "q : rational number" and "P : point". But unlike typed lambda calculus, natural language does not conflict with pretend that there is something like an ultimate most general say that and that does not work. In a different context one claims that John is a human being or that John is a living being. typing for John.

type the situation as follows. At some point in the discussion a possible to create a type are introduced later. But after that they have to start all over again, creating introducing that are a kind of implementation of the archetypes mentioned above. Subtyping is not to be consid­
ered as typing, but has to be described by an archetype plus a predicate.

Typing Can Implement Reasoning
Let me try to explain how a typed framework system can handle mathematical reasoning. Instead of trying to build up a complete picture, I start somewhere in the middle. We have some theorem T and want to apply it in a particular case; that application is a theorem T1. In theorem T there are some variables and some assumptions; let us just take one of each and have as an example “Let x be a real number, assume that p(x) > 3. Then q(x) < 5” (p and q are supposed to be known functions). Later we have an application. We have real numbers a and b, we know that p(a + b) > 3, and our new theorem T1 is that q(a + b) < 5. How do we convince a machine that this is an acceptable application?

The machine wants to know several things. First it needs a reference to the place where theorem T was proved. It sees that the theorem contains a typed variable and an assumption. It wants to know from us what we want to take for x, and we say a + b. The machine is able to check that this has the right type: it is a real number indeed (typing is unique and can be found by straightforward calculation, for which the machine needs no references or hints). Next the machine requires a proof of the assumption, not of the original p(x) > 3 but of the one we get upon replacing x by a + b. Let us say that p(a + b) > 3 was proved earlier. We satisfy the machine’s inquisitiveness by referring to a place where that proof γ is to be found. The machine checks this reference and then accepts all this as a proof of q(a + b) < 5.

So we have supplied a + b, which is a real number, and γ, which is a proof for p(a + b) > 3. In both cases we have the phrase “is a”, and I interpret that as typing. The types are “real number” and “proof for p(x) > 3”. Proceeding in this style we note that proofs get the same treatment as objects and in manipulations like substitution, the machine treats the two in exactly the same way. It does not even have to know whether expressions stand for objects or for proofs.

The idea to treat proofs in the same way as mathematical expressions, as representing objects, is quite natural even if we do not think of a machine that requires information from us. It can be discussed in ordinary mathematics too. Instead of getting to theorem q(a + b) < 5 by application of theorem T, we can get it by considering the proof of T as a blueprint that we just have to copy (with the proper adaptations) in order to get a proof for the application T1. So the new proof is obtained by substitution into an old proof, and that is just like substituting into a function.

With this parallelism we get the full structure of mathematical reasoning at once. A definition has the form f := P : Q, where f is a new name, P an acceptable expression and Q its type. In the proof world this form corresponds to a theorem, where P expresses the proof, Q expresses (via “proof of”) the proved statement, and f is the name of the proof. The introduction of a typed variable x : Q corresponds to an assumption. There Q represents (again via “proof of”) the proposition that is assumed and x is a name we can handle, during the lifetime of the assumption, as if it were a proof of the assumption, completely parallel to the real variable x that is treated (during its lifetime) as if it were a real number.

There is a second kind of parallelism on a different level: types can be treated the same way as objects, in the sense that they can depend on variables and also act as variables. Accordingly we have a kind of construction, similar to functions of several variables, where some of the variables are on the level of objects or proofs, and others are on the level of types. And the values of the functions can be objects as well as types.

So we have two levels of typing. On the one level (“low” typing) we say things like “3 is a natural”, on the other one (“high typing”) “natural is a type”.

Such a simple systematic framework for dealing with typing, enriched with facilities (typed lambda calculus) for handling situations with dummy variables, is sufficiently simple to be natural, yet rich enough to express almost anything we want. To take an example: the world of Greek geometry did not only handle geometrical objects and proofs, but geometrical constructions too. And a text describing a construction and proving that its result is the one we wanted, handles three kinds of low typing. Apart from the two mentioned before (with objects and proofs) we
get a third one, of the form "... is a construction for ...". And the three domains are happily intermingled, referring to one another all the time. The combination of various theories into a single formalism can be called integration (see [dB5]).

I think that this is much more natural then encoding geometrical constructions as points in the ZF universe.

**Typed Sets vs. Untyped Sets**

These frameworks based on typing can cover a very large part of formalizable mathematics, at least as much as what one has been doing with ZF. Actually, one of the things one can describe by means of the framework is ZF. But we have the alternative to build mathematics on types (with sets as subtypes). In a way that gives much more, since types can depend on all sorts of parameters (including type parameters), can be freely created as primitives (like we do with axioms), and can be introduced as variables. The only thing that we do not do is to create all our types in one stroke, by a single set of axioms. That is a very essential difference with ZF.

The type structure is also rich enough to enable us to add entirely new areas of application. I mentioned objects, proofs, geometrical constructions, but there can be much more. Like algorithms in general (of which the geometric constructions are a special case). And we might get closer to fulfilling Leibniz' dream of a general language for science.

**A Word about the Lambda Calculus**

Almost everything in framework systems depends on the notations of the lambda calculus. That is something that still seems to scare the majority of today's mathematicians. Very strange, since the lambda notation is such a great help in writing mathematics. It seems rather clumsy to live without it, in particular in fields like functional analysis. I can think of only one reason why mathematicians still don't use it: it is because Bourbaki did not do it!

The theory of lambda calculus may have difficult aspects, but the notation itself is simple. It just amounts to the use of a quantifier with a bound variable in order to build a function that is given by its values. Instead of introducing the symbol \( f \) for the function that sends every \( x \) of a set \( S \) to \( x^2 + x - 3 \), we can talk directly about that \( f \) as \( \lambda x \in S (x^2 + x - 3) \). So we do not need the letter \( f \) and we do not need the extra sentence which defines \( f \) by its values (it is a sentence in the metalanguage).

It is amazing how much can be written in terms of lambda expressions! In particular I refer to [dB4] where it is explained how a complete book written in the language of a justification system can be considered as a typed lambda expression and where the notion of correctness of the whole book just reduces to the notion of correctness of that single expression.

Nevertheless we can do at least some mathematical reasoning without lambda's. In contrast to most other framework systems, Automath has a (very natural) feature of instantiation. It has the effect that material written in some context can be used later outside that context, without any appeal to lambda abstraction.

One might say, roughly, that until the 19th century mathematics needed no lambda calculus. Almost all of it might have been written in terms of the lambda-free fragment (PAL) of Automath, using the instantiation device for the description of explicit functions. It was only during the 19th century that the notion of a function moved very slowly from the metalanguage into the language, and that made the lambda notation indispensable.

**Scope of Mathematics**

A justification system is expected to be able to handle all formalizable mathematics. But the typed framework being as simple and rich as it is, we have the right to turn the tables, and say: whatever the framework can describe, is to be called formalizable mathematics. In particular it contains all logic and computer science.

The claim is not so pedantic as it seems, since formalization does not encompass all mathematical activity. There are other wonderful things like intuitive thinking, mental pictures, heuristics, metalanguage and interpretations.

**Experiences**

It may be instructive to tell something about the experience we got in Eindhoven with teaching students to handle the Automath system. In the period 1971-1984 I gave an introductory course on Automath almost every year. Students could get credits for that course, not by passing an examination but by doing practical work. Quite often we gave them some material they were acquainted with and required them to have it checked by the system. No treatment of preceding theories was required: all known material used in the proofs could be introduced by means of axioms. The students were usually mathematics majors with about 4 years of training in pure and applied mathematics and no training at all in logic. The general rule was that they had to spend about 100 hours on their job, which included the time for attending the course. Most of them did rather well, and delivered a complete machine-checked proof.

Examples of such pieces of mathematics were: the elements of group theory, the Banach-Steinhaus theorem of functional analysis, Dirichlet's pigeonhole principle, the König-Hall theorem of combinatorics, Van der Waerden's theorem on arithmetic progressions. One student wrote a master's thesis in Automath, treating a new theory of the real number system. It took him 9 months to deliver a fully checked text plus a report about the work. It would not have taken him much less time to organize and finish the same material in ordinary textbook style.

In general it can be said that the more abstract the piece of mathematics, the smaller the gaps and the easier the justification. Less abstract fields, like combinatorics, can be hard since they may contain simple intuitive ideas for which there is no tradition of formalization.
Looking Around

It was the main purpose of this paper to try to explain what justification systems are and not to enter into details of systems. But here are some references for readers who might like to have some real information about various systems.

For the Boyer-Moore system I refer to [S]. For a survey of the Automath project to [dB3], for the Nuprl system to [C], for the Calculus of Constructions to [CH]. A way to put many framework systems in a common scheme was described in [B] (a similar scheme was already given in [dB2]).

Finally, the collection [HP] can give a good impression of what is going on in the field.

I already mentioned that I see a future in techniques of automated gap-filling in order to make justification systems useful for the working mathematician. For that particular activity I think it makes little difference whether we take a classical or a typed approach. In both cases one will do roughly the same thing.

But different justification systems may have different views on the output. I would prefer the case where the machine's output is: "I have been able to fill the gap and here is the proof written in your own language". Other systems might say: "OK, I have been able to fill the gap to my satisfaction, but my proof would have been unreadable for you, and has been put in the garbage already". I would call those systems "black box systems". They might work very fast, but slightly counter to the ethical principles of justification.

References


Some Thoughts on Mathematics, Logic, and Computers

As recently as 1977, I was able to write, in the introductory chapter of the Handbook of Mathematical Logic, (p. 22) "that there is a mathematically precise notion of \( \varphi \) provable from \( T \) which completely captures the intuitive notion '\( \varphi \) follows from \( T \) by the laws of logic alone,' for first-order \( \varphi \) and \( T \)." I went on to expand on this by explaining and giving a proof of the Gödel Completeness Theorem for first-order logic.

A lot has happened in the mean time to shake my faith in the spirit, if not the letter, of my claim.* Part of it has to do with experience gained by people working on systems like the ones de Bruijn describes. Justification systems that are useful for doing even a small part of standard mathematics just do not fit into the framework of first-order logic and its proof theory. As de Bruijn indicates, one needs a wide range of additional representational devices, including the lambda calculus notation and typing, as well as to admit of proofs themselves as objects of reference, alongside numbers, functions, what-have-you. None of this fits within the first-order scheme.

de Bruijn is not a mathematical realist. He thinks that no one would be who tried to teach mathematics to a machine. Well, he may be right. But I am a mathematical realist, one who rejects the analogy between justification systems and teaching. I think that mathematics is about something other than symbols, equations or mental acts. I think it is about numbers, functions, sets, and the like. More generally, I think mathematics is what Lynn Arthur Steen has called "the science of patterns." These patterns are real and they are the ultimate subject matter of mathematics. As mathematicians, we seek to discover the truth about them and prove them to be so.

What justifies a given law of logic? On the realist conception, the laws of logic are those moves that are guaranteed to preserve truth: if the assumptions are true, then so clearly is the conclusion. Any move that has this property is legitimate. The Completeness Theorem for first-order logic attempts to give an analysis of this notion.

Part of de Bruijn's quarrel with realism is that numbers and so on cannot be put in a machine. But then neither can they be put in a brain. What brains and machines can do is

*Here I should mention The Concept of Logical Consequence, by John Etchemendy, Harvard University Press, 1990, which has done as much as anything to shake up my complacency.
represent mathematical objects. What de Bruijn’s work, and others following him, shows is that the first-order predicate calculus is a grossly inadequate way to model the way mathematicians represent mathematical objects.

I have been drawn to the same conclusion by studying the role of diagrams in proofs and in working on Hyperproof, a (still very small) justification system that uses diagrams. On the traditional perspective, diagrams are only heuristic aids to the construction of a formal proof. But why should this be so? Why aren’t diagrams as legitimate a tool for representing mathematical situations as sentences in a formal language? And if they are, why can’t there be laws of logic that are perspicuous from this point of view that would not be perspicuous if recast in terms of sentences in a formal language?

It seems to me that there are such moves. This, however, is not the place to go into that. Rather, what is relevant here is the connection with the observation that mathematics is open-ended. The Gödel Incompleteness Theorem assures us of that at a theoretical level. It tells us that no formal system is ever going to be complete for doing mathematics. Work on justification systems, those based on formal languages, with or without the use of diagrams, shows that this theoretical possibility is a real one. We are always looking for new representational devices and the laws of logic that go with them.

Let us call a justification system observationally complete if it meets the proclaimed aim of such systems: to be able to digest and swallow any valid piece of mathematics that humans find clear and digestible. My claim is that there will never be a justification system that is observationally complete. Why? Because, by definition, any such system is going to be stuck using a given set of representational devices for representing mathematical objects and proofs, whereas mathematicians are not so constrained. We can, and do, create new forms of representation on the fly. And with any new form of representation, certain moves will be clearly seen to be laws of logic.

In making this claim, I do not intend to cast doubt on the value of work on the sorts of systems de Bruijn describes. I think a great deal can be learned from such work. And I expect that these systems will eventually become useful mathematical tools, alongside, or incorporating, programs like Maple and Mathematica. Indeed, just as we can fruitfully make use of a computer algebra program without expecting the program to solve all our problems, we should not dismiss work on logical framework systems just because the systems are limited. What I do want to cast doubt on is the idea that any such system will ever meet the proclaimed goal of observational completeness.

Mathematics just is not like chess, with its fixed set of rules. There will always be new patterns to discover and computers can help us discover them. As they are discovered, they become grist for the mathematician’s mill. We attempt to discover their truths. In this search, we will always be looking for novel ways of representing these patterns, ways appropriate to the mathematical objects at hand. Each such representational scheme carries with it its own clearly valid laws of logic, moves that we can use in giving proofs.

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**Announcing....**

**1991 MATHEMATICS SUBJECT CLASSIFICATION**

The editors of Mathematical Reviews announce the adoption of the revised Mathematics Subject Classification (MSC), prepared in cooperation with the editors of Zentralblatt für Mathematik, for use in AMS publications, including Mathematical Reviews and Current Mathematical Publications, beginning in 1991. The new classification contains significant changes in the areas

13 Commutative Rings and Algebras
16 Associative Rings and Algebras
33 Special Functions
49 Calculus of Variations and Optimal Control; Optimization
52 Convex Sets and Related Topics
81 Quantum Mechanics
82 Statistical Physics, Structure of Matter
92 Biology and Other Natural Sciences, Behavioral Science

Most of the other sections have been revised and expanded; approximately 600 more 5-digit classification lines represents a 14% increase in the size of the revised scheme. Section 19, K-theory, will be used for primary classification (it had been used only as a secondary classification in the 1985 version of the 1980 MSC).

A listing of the new classification can be found in the 1990 Annual Index of Mathematical Reviews and on the AMS e-MATH system with email address telnet e-math.ams.com (see Notices of the AMS, October 1990, p. 1029 for more information about access to e-MATH).
Strategic Planning for the Society

This article is intended to inform the AMS membership of some recent important initiatives of the AMS Long Range Planning Committee. The members of the Committee are listed below.

Robert M. Fossum, University of Illinois, Urbana-Champaign
Ronald L. Graham, AT&T Bell Laboratories
William H. Jaco, Executive Director, AMS
Franklin P. Peterson, Massachusetts Institute of Technology
Hugo Rossi (chair), University of Utah
William P. Thurston, Princeton University
M. Salah Baouendi, University of California, San Diego
Frederick W. Gehring, University of Michigan, Ann Arbor

The AMS Long Range Planning Committee (LRPC) was formed in 1984 to formulate long-term plans, priorities, and goals for the Society. At its most recent meeting in November 1990 at AMS headquarters in Providence, the LRPC conferred with the AMS Executive Committee and Board of Trustees (ECBT) to consider ways in which the Society could adapt to better serve the needs of its membership. The ECBT decided to appoint a Strategic Planning Task Force to reexamine the Society's mission and to five years.

During a discussion of strategic planning, the ECBT was asked to comment on the stated mission of the Society, “the furtherance of the interests of mathematical scholarship and research,” and to assemble a set of goals for the next several years. This discussion generated suggestions for wording the mission to include such activities as disseminating mathematical ideas to other sciences, the general public, and to students, “One thing we want to accomplish [through the Task Force] is to come to a decision on what the mission and goals are and what we want to be doing over the next five years.”

Thurston sees communication as one of the central issues. “Mathematical ideas circulate within a group of mathematicians, but not among the groups and not to other sciences and the public,” he notes. “We have a warehouse stockpiled with concepts, ideas, and theorems, but there’s no system of distribution... I think some change in the mathematical culture needs to take place to establish more communication.”

Hugo Rossi, chair of the LRPC and of the Task Force, believes that the strategic plan should articulate the role of the AMS in addressing some of the problems facing the mathematical sciences community. “The Task Force will examine the role of the researcher in mathematical education, and how that role should be coordinated with other professional groups already working in that area,” he notes. “There are also a variety of roles the AMS could play in support of research. It could support research directly, or through publications, or through public relations and national policy. The AMS is already doing some of these things. One purpose of the Task Force is to decide which are the most important.”

The AMS has come this far without a strategic plan; why does it need one now? “The profession is in a state of flux,” Rossi points out. “Among the forces that are causing it to change are the increasingly interdisciplinary...
nature of mathematical research, the decrease in the number of people entering the profession, and the need to find the next generation of mathematicians from populations not traditionally associated with the profession. In addition, there is an increasing tendency for federal funding for research to shift from emphasis on individual, self-generating projects to large-scale, programmatic ones. The AMS needs to decide how it is to deal with this flux: where to try to arrest it, where to help propel it, where and how to react to it. In order to do this, the AMS needs to be guided by a clear and dynamic conception of its mission."

One of the most important considerations is coordinating Society goals with the programs and plans of other organizations such as the Mathematical Association of America (MAA) and the Society for Industrial and Applied Mathematics (SIAM). The Task Force will try to formulate a plan that does not compete or conflict with existing efforts, but rather complements and builds upon them. "We will be getting input from other organizations as part of the planning process," says Thurston. "I think there is a lot of sentiment within the AMS that more communication and cooperation with MAA and SIAM would be beneficial all around... There may be some philosophical differences in how the MAA or SIAM would set up a program as opposed to how the AMS might do it, but I think these differences are less important than the significance of everyone cooperating in a united front."

**Activities of the Task Force**

The Task Force will help the Society formulate a coherent approach to issues facing the mathematical sciences community in a way that builds upon and enhances existing efforts. In addition, a strategic plan will help to insure that day-to-day and longer-term decisions made by AMS staff would be part of a clearly articulated plan. Most of all, it will help the AMS to prioritize its activities to best utilize Society resources.

"By generating discussions on these issues, and trying to achieve a consensus, the Task Force will set a mission statement for the Society which takes into account the changing environment and the end results the AMS wants to achieve," says Rossi. "They will formulate specific goals consistent with the mission and specific strategies to achieve those goals." These strategies may take the form of recommendations to the Executive Director, the Council, or various AMS committees. Because the Task Force is an instrument of the Board of Trustees, the Board will review the recommendations before taking any action.

The Task Force will consist of the present LRPC, AMS President Michael Artin, and Past-President William Browder. In addition, approximately five more members will be appointed to the Task Force to broaden the experience and interests of the group. The AMS Trustees have approved the hiring of a strategic planning facilitator, who will assist the Task Force and work with AMS staff to coordinate interviews, meetings, and communications connected with the planning activities. The AMS has been awarded a $25,000 grant from the Exxon Education Foundation to support the strategic planning activities and is seeking additional underwriting of this project.

**Timetable for the Plan**

Development of the strategic plan will take place over the coming months and will be centered on a specific set of activities. The first phase will consist of an audit to assess the current resources and projects of the AMS and bring into focus the key issues around which the strategic plan will be developed. To get a sense of which issues are considered to be the most important, AMS leadership and staff will be interviewed and a portion of the membership will be surveyed. Phase two of the activities will be the development and writing of a multi-year strategic plan.

In conjunction with these activities, the AMS will begin actions to achieve the goals as delineated in the plan. AMS staff, as well as Society members, will be involved in this implementation process. "The Society is a significant resource for the support of the broad mathematics community," notes AMS Executive Director William H. Jaco. "It is very exciting that we are undertaking a thorough process to investigate and plan how to best serve the community."

The Task Force is scheduled to complete its work by the summer, at which time it will present its report to the Board of Trustees. Over the next several months, reports of the activities of the Strategic Planning Task Force will be reported in Notices. Members who have thoughts and comments on this process are encouraged to communicate them to: Strategic Planning Task Force Project Manager, Timothy Goggins, American Mathematical Society, P.O. Box 6248, Providence, RI 02940; telephone 401-455-4110; electronic mail tlg@math.ams.com.

**Allyn Jackson**

Staff Writer
This month’s column is written by Lisa A. Thompson, who is the Assistant for Governmental Affairs of the Joint Policy Board for Mathematics (JPBM).

In its waning days, the 101st Congress passed comprehensive science and mathematics education legislation, the result of numerous hearings over the past two years on at least a dozen proposals from House and Senate Members, as well as President Bush. Although it endured the usual partisan sniping and interbranch differences of opinion, the package survived on its merits through the concerted efforts of influential legislators who made mathematics and science education a top priority. The bill was passed by a Congress that shares with the scientific community a belief that high quality mathematics and science education at all levels is absolutely crucial to the future of the Nation’s security and prosperity.

“The Excellence in Mathematics, Science, and Engineering Education Act” authorizes over $150 million for new and existing programs, including $125 million for education and human resources programs at the National Science Foundation (NSF). Declaring that the federal government has a “significant role in promoting the study of mathematics and science,” the package is designed to encourage American students to pursue careers in mathematics, science, and engineering; improve the quality of teaching in mathematics and science made available to all Americans; have American students rank first in the world in mathematics and science; substantially increase the number of graduates with degrees in mathematics, science, and engineering; and, substantially increase the number of women and minorities pursuing careers in mathematics, science, and engineering.

Addressing Congressional concern that some U.S. universities place too much emphasis on research at the expense of education, the act provides for a new NSF program of competitive, merit-based grants to college and university professors with records of excellence in teaching. The grants are to be used for developing innovative curriculum or teaching methods, purchase of educational equipment, support for research or professional activities, and support of teaching fellows. Criteria for the awards specifically include the commitment of the institution to improving undergraduate education and considering undergraduate instruction when determining faculty compensation and promotion, as well as demonstration that the faculty member has kept current with research in his or her field. Institutions that receive grants will be designated Centers of Excellence for Undergraduate Teaching.

The new law also authorizes a gradual increase in NSF spending on graduate fellowships to bring the number awarded to 1200 per year by FY 93, for a total cost of $37.9 million this year (FY 91) and $67.8 million in FY 93. It also directs the NSF to ensure that the number of fellowships going to women and minorities increases substantially every year through the year 2000. NSF is also authorized to spend $10 million this year on a graduate traineeship program for colleges and universities that are attended by few NSF fellows, but are committed to upgrading their capacities for high quality research and to graduating significant numbers of women and minorities in mathematics, science, and engineering.

NSF’s women and minorities programs are to be expanded with $17 million in increased support this year for institutions to make women and minority faculty members available to those that have few such faculty; for colleges and non-research universities to attract and retain women and minority faculty members; and for alliances among research universities and institutions with predominantly minority enrollment.

The Department of Education, in cooperation with NSF, is authorized by the act to spend almost $10 million this year and increased amounts in following years on three new scholarship programs that would provide money to over 6000 undergraduates every year after the fourth year of full enactment of the programs. National Science Scholarships are to be awarded each year to two high school seniors, at least one of whom is female, from every Congressional district. Each award will be up to $5000 per academic year for four years, depending on the recipient’s cost of attendance and on the amount appropriated to the Department to spend on the program. Scholars are to be chosen on the basis of demonstrated achievement in the physical, life, or computer sciences, mathematics, or engineering and must continue to major and excel in one of these fields to receive the funds. From among nominations by state review panels, the
President, in consultation with the Secretary of Education and the Director of NSF, selects the recipients.

The Robert Noyce Scholarships are for undergraduates in the third and fourth years of study majoring in and demonstrating high academic achievement in physical, life, or computer sciences, mathematics, or engineering degree programs. From among nominations submitted by a merit review panel, the President selects up to 500 recipients every year. After graduation scholarship awardees, to be known as the Robert Noyce Mathematics and Science Teaching Corps, will be required to teach in U.S. secondary or elementary schools for two to four years, depending on the number of award-years, or to repay the amount awarded plus interest. Each award will be up to $5000 per academic year required to earn the degree, and if necessary, up to $5000 for another year to complete education courses required to fulfill the obligations of the award. The amount of each scholarship will depend on the recipient’s cost of attendance and on the amount appropriated to the Department.

The National Science, Space, and Technology Corps is to be selected from among nominations by members of the House of Representatives. Every year, one high school senior who has excelled in and plans to major in the physical, life, or computer sciences, mathematics, or engineering will be chosen from every Congressional district and will receive up to $5000 per academic year for four years, depending on the recipient’s cost of attendance and on the amount appropriated to the Department to spend on the program. Awardees can attend any U.S. institution of higher education, and those institutions enrolling members of the corps will be members of the National Academy of Science, Space, and Technology. Members of the corps will be required to spend four years working in the physical, life, or computer sciences, mathematics or engineering in the employ of the United States or a U.S. company or pursuing postgraduate education in one of these fields. Those failing to complete the service obligation will be required to repay the amount of the awards with interest. All three scholarship programs provide for special consideration of the financial need of nominees and the promotion of participation by minorities and persons with disabilities.

At the precollege level, the new law allows for new and expanded programs at both NSF and the Department of Education, agencies Congress would like to see cooperate more in the area of mathematics and science education. This section of the legislation is also designed to encourage the formation of alliances among states, state education agencies, colleges, universities, nonprofit associations, and industry. The Department is authorized to make competitive, merit-based awards totalling $17 million to a network of regional consortia to disseminate exemplary instructional materials and provide technical assistance for their implementation in mathematics and science classes in elementary and secondary schools. These consortia would work with a Department-supported national clearinghouse for educational programs and materials, to which curricula developed with federal funds would be deposited. The regional consortia and the national clearinghouse are required to obtain non-federal contributions.

The Department is also provided with authority to make grants to model programs for training and instruction in the use of computers as part of precollege mathematics and science curricula, with emphasis on programs that integrate higher order analytical and problem-solving skills into the curricula. The NSF is authorized to undertake a complementary, merit-reviewed program to develop and expand the uses of innovative technologies for mathematics and science instruction.

NSF is also authorized to spend $17 million more this year on informal mathematics, science and technology education in the form of grants to public science-technology centers—museums, planetariums, libraries, zoos, aquariums, etc.—for the development of interactive exhibits and programs; replication and dissemination of effective programs; and development of new centers. And the law states that $17 million more can be spent on grants to education agencies for systemic reform of mathematics and science education, a program undertaken just recently by NSF.
Władysław Orlicz
1903–1990

Władysław Orlicz (May 24, 1903–August 9, 1990) was born in Okocim in the district of Cracow, Poland. He studied mathematics in the Faculty of Philosophy at the Jan Kazimierz University in Lwów. The Lwów School had been founded by Stefan Banach and Hugo Steinhaus, and among Orlicz’s colleagues were Z. W. Birnbaum, M. Kac, S. Mazur, J. Schauder, and S. Ulam. He was a participant in the regular meetings at the “Scottish Café”, chronicled by Ulam (1957, 1977) and by Maudlin (1981).

From 1922 through 1929 Orlicz was a teaching assistant in mathematics at the Jan Kazimierz University. He obtained his Ph.D. degree in 1928, his thesis dealing with some problems in the theory of orthogonal series. At the University of Gottingen (1929–1931) he studied with H. Bohr, M. Born, Courant, and E. Landau. He served on the faculty of the Lwów Technical University from 1931 to 1937, and when he was nominated as Associate Professor at the University of Poznań. The Second World War interrupted his work, but he returned to his position in May 1945. In 1948 Orlicz was appointed full professor, since which time he worked both as a faculty member at the University of Adam Mickiewicz and as a researcher in the Mathematical Institute of the Polish Academy of Sciences. In 1961 he became a full member of the Polish Academy of Sciences. Orlicz officially retired in 1974, but continued his seminar at the Mathematical Institute of the Polish Academy of Sciences in Poznań.

He became the main editor of Commentationes Mathematicae in 1955, and in 1962 assumed the same position for Studia Mathematica. Orlicz lectured in Canada, West Germany, and China (in Peking in 1963 there resulted a 138-page book in Chinese: Linear Functional Analysis, unfortunately never translated into English). Among other awards, Orlicz was presented the Alfred Jurzykowski Foundation Award, and has honorary degrees from York University, the Poznań Technical University, and the University of Adam Mickiewicz.

Orlicz supervised 39 doctoral theses and published 170 papers in many areas of mathematics. His name is associated with many key ideas (among them Orlicz spaces, the Orlicz category theorem, and Orlicz-Pettis theorem). In 1988, on the occasion of his 85th birthday, PWN-Polish Scientific Publishers published his “Collected Papers” in two volumes. He remained active in mathematics throughout his life, finishing the galley proof of a paper only one hour before he died. We will always remember Orlicz not only for his important contributions to mathematics but also for his generosity, enthusiasm, and interest in the work of others.

Lech Maligranda
IVIC, Caracas
Lars Erik Persson
Luleå, Sweden

Fulbright Scholars Named
The Council for International Exchange of Scholars has announced that 936 academics, professionals, and independent scholars have received awards under the Fulbright Scholar Program to lecture, consult, or conduct research abroad in 1990-1991. (Because of the crisis in the Middle East, the United States Information Agency has suspended the 1990-1991 programs in Bahrain, Iraq, Jordan, Kuwait, Qatar, Saudi Arabia, the United Arab Emirates, and Yemen.) The Fulbright program is financed and administered by the United States Information Agency. Support is also provided by participating governments and by host institutions in the United States and abroad.

Following are the names of this year's American Fulbright scholars in the mathematical sciences, with the names of their home institutions and the countries in which they are lecturing or conducting research.

RAYMOND G. AYOUB, Pennsylvania State University, Syria; RANAN B. BANERJI, St. Joseph's University, Austria; BRUCE A. BARNES, University of Oregon, Greece; THEODORE A. BURTON, Southern Illinois University at Carbondale, Hungary; JOSEPH
A. CIMA, University of North Carolina at Chapel Hill, Ireland; GREGORY M. CONSTANTINE, University of Pittsburgh, Trinidad and Tobago; STEVEN D. CUTKOSKY, University of Missouri at Columbia, India; BRUCE R. EBANKS, University of Louisville, Hungary; VIRGINIA B. FLACK, University of California at Los Angeles, Guatemala; ERDOGAN GUNEL, West Virginia University, Turkey; OTOMAR HAJEK, Case Western Reserve University, Germany; R. NEAL HART, Sam Houston State University, Oman; ALAN R. HAUSRATH, Boise State University, Botswana; THOMAS F. HIGGIN botham, Southeastern Louisiana University, Malta; CHARLES B. HUGHES, Vanderbilt University, United Kingdom; WILLIAM A. KINCAID, Wimington College, Iceland; ALLEN KLING ER, University of California, Los Angeles, India; HOWARD W. LAMBERT, Eastern New Mexico University, Costa Rica; LINDA M. LESNIAK, Drew University, Hungary; JOHN A. MITCHEM, San Jose State University, Botswana; VOJIN G. OKLOBZIJA, San Francisco State University, Peru; JON H. PEARCE, San Jose State University, Zimbabwe; ALFRED S. POSAMENTIER, City College, City University of New York, Austria; WALTER READ, California State University at Fresno, Czechoslovakia; ANDREW J. SIMO son, King College, Botswana; JEROME SPANIER, Claremont Graduate School, New Zealand; GORDON A. STEGINK, Hope College, Malawi; JOSEPH E. YUKICH, Lehigh University, France.

Nominations for the Alice T. Schafer Mathematics Prize

The Association for Women in Mathematics (AWM) calls for nominations for the Alice T. Schafer Mathematics Prize. This $1000 award is made annually to an undergraduate woman for excellence in mathematics. All members of the mathematical community are invited to submit nominations for the Prize, to be awarded in April 1991. The nominee may be at any level in her undergraduate career. The letter of nomination should include, but not be limited to, an evaluation of the nominee on the following criteria: quality of performance in mathematics, exhibition of real interest in mathematics, ability for independent work, and performance in mathematical competitions at the local or national level, if any. Supporting materials should be enclosed with the nominations. Nominations must be postmarked no later than March 29, 1991 and sent to Patricia Cross, Executive Director, AWM, Box 178, Wellesley College, Wellesley, MA 02181.

Mathematics Awareness Week: April 21-27

This year, Mathematics Awareness Week will be held April 21–27, 1991. This national event provides an opportunity for local and regional activities that heighten public awareness of the beauty and usefulness of mathematics.

The theme this year, “Mathematics: It’s Fundamental,” was chosen because the applications of mathematics, which are fundamental to progress in science, technology, industry, and society, are not fully appreciated by the public. Mathematics Awareness Week provides a forum for the mathematical community to communicate with the public on this timely theme.

Mathematics departments and faculty can observe Mathematics Awareness Week in many ways: sponsoring a mathematics competition for students in nearby high schools; serving as a guest speaker at a nearby elementary, middle, or secondary school; flying a banner proclaiming Mathematics Awareness Week above the door of your department; sponsoring a public forum where members of your community can discuss proposed changes in mathematics education; or holding a mathematical art contest for students in your department or geographic area.

Last year, colleges and universities across the country participated in Mathematics Awareness Week with a variety of activities, from showing mathematical films and videos, to writing opinion pieces about mathematics for local newspapers, to holding a mathematical “murder mystery” contest. Packets of information for use during Mathematics Awareness Week were distributed widely to the mathematical community by the Joint Policy Board for Mathematics. Check with the chair of your department to get more ideas for activities.

Since its inception in 1986, Mathematics Awareness Week has gained momentum each year and is beginning to make a cumulative impact on the nation. Help to make this year’s celebration the biggest ever.

Congress Passes NSF Budget

In November 1990, Congress signed into law a bill that contains the appropriation for the National Science Foundation (NSF) for fiscal year 1991. The total appropriation for the NSF was $2.3 billion, an increase of about 11% over last year. The Research and Related Activities portion of the budget was up about 6% to $1.7 billion.

As has been usual in recent years, Congress appropriated more money for educational programs that the Foundation asked for: a rise of 46% to $322 million.

At the time of this writing, the budget of the Division of Mathematical Sciences (DMS) had not been finalized. However, DMS officials estimate the increase for the Division will be 3–4% over last year’s budget of about $69 million. The percentage increase for DMS is about the same as for the other divisions in the Mathematical and Physical Sciences Directorate. Another action that will likely affect the DMS funding situation is the removal of the salary cap of $95,000 on principal investigator grants.

European Mathematical Society Founded

In October 1990, the European Mathematical Society came into existence under an initiative of some thirty mathematical societies from virtually every country of the European continent from the Atlantic Ocean to the Ural Mountains. The Society, founded at a historic juncture in European affairs, is an umbrella organization that will focus on activities that are best handled by an international organization.

The Society’s Statutes state, “The purpose of the Society is to promote the
development of all aspects of mathematics in the countries of Europe, with particular emphasis on those which are best handled on an international level. The Society will concentrate on those activities which transcend national frontiers and it will in no way seek to interfere with the national activities of the member societies. In particular, the Society will, in the European context, aim to promote mathematical research (pure and applied), assist and advise on problems of mathematical education, concern itself with the broader relations of mathematics to society, foster the interaction between mathematicians of different countries, establish a sense of identity amongst European mathematicians, and represent the mathematical community in supra-national institutions.”

Membership is open to organizations primarily concerned with promoting research in pure or applied mathematics in Europe, as well as to individuals. The Society is planning a major Congress in Paris in the early summer of 1992, and the possibility of a journal and a newsletter are being investigated.

The Officers of the Society are: F. Hirzebruch (president), Cz. Olech and A. Figà-Talamanca (vice-presidents), C. Lance (secretary), and A. Lahtinen (treasurer). The members of its Executive Committee are: E. Bayer, A. Kufner, P.-L. Lions, L. Márki, and A. St. Aubyn.

For legal purposes, the Society has been established under Finnish law, with its seat in Helsinki. For more information, contact: D. A. R. Wallace, Publicity Officer, European Mathematical Society, Department of Mathematics, University of Strathclyde, Livingstone Tower, 26 Richmond Street, Glasgow G1 1XH, Scotland, UK.

Lacampagne Joins NSF Staff

Carole Lacampagne, associate professor of mathematical sciences at Northern Illinois University, has taken a position as a rotator in the Division of Teacher Preparation and Enhancement at the National Science Foundation (NSF). As a program director, she is responsible for managing the review procedure for and making recommendations on grant proposals which seek to improve the quality of mathematics instruction in the schools through programs that enhance teacher effectiveness while serving as prototypes for other inservice projects. Lacampagne can be reached at the Division of Teacher Preparation and Enhancement, Room 638F, National Science Foundation, 1800 G Street, NW, Washington, DC 20550; electronic mail aclacampa@nsf.gov (Internet) or aclacampa@nsf (Bitnet); telephone 202-357-9527; fax 202-357-7009.

Center for Theoretical Study in Prague

Charles University in Prague, Czechoslovakia is developing a Center for Theoretical Study for advanced theoretical research in mathematics, the natural sciences, and the humanities. The Center is intended to help bridge the natural separation among these disciplines and to provide a forum for integrated research. The organization will also help to further Czechoslovak science and scholarship in the international arena.

The Center’s director is Ivan M. Havel, a computer scientist and brother of Vaclav Havel, president of the Czech and Slovak Federative Republic. The Center’s activities will begin with a small number of projects coordinated by scholars and scientists from Czechoslovakia and abroad. To establish long-term programs, an international advisory board has been formed.

Senior and postdoctoral researchers will hold positions at the Center lasting from three months to one year. There will also be short-term visiting scholars, as well as seminars and workshops on topics emphasizing cross-disciplinary activity.

Havel says he is pleased to report that the Center is now particularly strong in mathematics, having among its scholars-in-residence Bohuslav Balcar (topological dynamics, Boolean algebras) and Roman Kotecky (mathematical physics). Arrangements for short term visits have also been made with Thomas Jech (Pennsylvania State University), Washek F. Pfeffer (University of California at Davis), and F. Franck (McMaster University).

The Center will be funded by various foundations and through private contributions from the United States and other countries. Recently, Westinghouse Foundation awarded a $25,000 grant to support the Center’s development. The Center has also received funds from the Czech and Slovak Civic Forum Foundation.

Among the workshops planned for the next two years are: Winter School on Abstract Analysis (January 12–26, 1991), Workshop on Evolution of Interstellar Matter and Star Formation (May 21–25, 1991), and Workshop on Phase Transitions: Physics, Mathematics, Biology, and Society (1992). More information about the Center may be obtained from H. Woolf, Institute for Advanced Study, Princeton, NJ 08540; electronic mail hwoolf@guinness.ias.edu.

Members of the mathematical sciences community may also wish to contact Thomas Jech, Department of Mathematics, 215 McAllister Building, Pennsylvania State University, University Park, PA 16802; telephone 814-865-7527; email: jech@math.psu.edu.

The address of the Center is: Center for Theoretical Study, Charles University, Ovocny tr 5, 116 36 Praha 1 - Stare Mesto, Czechoslovakia (address for visitors is Celetna 20, Praha 1).

News from the Mathematical Sciences Institute Cornell University

The many aspects of partial differential equations are being explored in a special program of invited lectures at the Mathematical Sciences Institute (MSI). This past fall we heard from P. Constantin (Univ. of Chicago) on PDE’s and Fluid Mechanics, from A. Eden (Arizona State Univ.) on Exponential Attractors for Navier-Stokes Equations and from G. Ponce (Pennsylvania State Univ.) on Dispersive Equations.

On February 1, 1991 E. DiBenedetto (Northwestern University) will give a lecture on Porous Media Type Equations: How the Solutions Behave Locally and Asymptotically. From February 8-15, 1991, David Hoff (Indiana University) will give a series of three
lectures on Discontinuous Solutions of the Navier-Stokes Equations for Compressible Flow. J.-C. Saut (Université Paris-Sud) will give a series of nine lectures from March 25, 1991 through April 12, 1991 on Linear and Nonlinear Dispersive Waves, and C.I. Foias (Indiana Univ.) will discuss A Normal Form for the Navier-Stokes Equations and its Connection to Turbulence during a series of four lectures from June 5-15, 1991. Other visits are being planned. For further information, please contact E.S. Titi at Suite 321, 409 College Avenue, Ithaca, NY 14850-4697; 607-255-8005; Fax: 607-255-9003.

Now in Paperback

INTRODUCTION TO ALGEBRAIC CURVES
TRANSLATIONS OF MATHEMATICAL MONOGRAPHS, VOLUME 76
Phillip A. Griffiths

Algebraic curves and compact Riemann surfaces comprise the most developed and arguably the most beautiful portion of algebraic geometry. However, the majority of books written on the subject discuss algebraic curves and compact Riemann surfaces separately, as parts of distinct general theories. Most texts and university courses on curve theory generally conclude with the Riemann-Roch theorem, despite the fact that this theorem is the gateway to some of the most fascinating results in the theory of algebraic curves.

This book is based on a six-week series of lectures presented by the author to third- and fourth-year undergraduates and graduate students at Beijing University in 1982. The lectures began with minimal technical requirements (a working knowledge of elementary complex function theory and algebra together with some exposure to topology of compact surfaces) and proceeded directly to the Riemann-Roch and Abel theorems. This book differs from a number of recent books on this subject in that it combines analytic and geometric methods at the outset, so that the reader can grasp the basic results of the subject. Although such modern techniques of sheaf theory, cohomology, and commutative algebra are not covered here, the book provides a solid foundation to proceed to more advanced texts in general algebraic geometry, complex manifolds, and Riemann surfaces, as well as algebraic curves. Containing numerous exercises and two exams, this book would make an excellent introductory text.
Funding Information for the Mathematical Sciences

**Deadline for Faculty Enhancement Program**
The Faculty Enhancement Program at the National Science Foundation (NSF) supports seminars and conferences for groups of faculty from a number of undergraduate institutions to learn about new developments and techniques in their fields. The workshops may focus on recent developments in the mathematical sciences which have implications for instruction in lower or upper level courses. Alternatively, they could consider how better to teach introductory courses for majors or non-majors. In either case, participants learn some new mathematics and bring their new ideas back to their own institutions and regions.

The deadline for proposals is **April 15, 1991**. A list of the 1990 awardees in this program appears in the May/June 1990 issue of *Notices*, page 582-583. For more information on the program, contact: William Haver, Faculty Enhancement Program, Room 639, National Science Foundation, 1800 G Street, NW, Washington, DC 20550; 202-357-7051; email whaver@nsf.gov (Internet) or whaver@nsf (Bitnet).

**Fellowships at NIST**
The American Statistical Association (ASA) announces the ASA/NSF/NIST Senior Research Fellowship Program, which is cosponsored by the National Science Foundation (NSF) and the National Institute of Standards and Technology (NIST). The program invites applications for Fellowships and Associateships at NIST during the 1991-1992 academic year. The Fellowships are intended for senior researchers, while the Associateships are for advanced graduate students and recent Ph.D.s.

In particular, the program seeks fellows with a strong interest in collaborative, cross-disciplinary research in process modeling and optimization. Areas of research that fit NIST's research mission and facilities include: statistical approaches in materials processing and bioprocessing research; on-line quality control in automated flexible manufacturing; analysis of lifetime data from multifactor experiments; sources of variability in physical measurement procedures; calibration for manufacturing process control; variance components; design of experiments; errors in variable regression; graphical data analysis; and statistical image processing.

Stipends for the Senior Research Fellows will be commensurate with qualifications and experience, and fringe benefits will be provided. Appointments will last four to nine months. Applications are due **January 15, 1991** for Fellows and **February 15, 1991** for Associates. For application information, contact Carolee Bush, ASA/NSF/NIST Research Program, American Statistical Association, 1429 Duke Street, Alexandria, VA 22314-3402; telephone 703-684-1221. For information on research topics and other aspects of the program contact Ruth Varner, Coordinator, ASA/NSF/NIST Research Program, Statistical Engineering Division, National Institute of Standards and Technology, Administration Building, Room A337, Gaithersburg, MD 20899; telephone 301-975-2839. Women and minorities are encouraged to apply.

**OTA Congressional Fellowship Program**
The Office of Technology Assessment (OTA) is seeking outstanding candidates from academia, business and industry, and the public sector for its Congressional Fellowship Program. Up to six Fellows will be selected for one-year appointments in Washington, DC, beginning in September 1991.

OTA provides congressional committees with objective analyses of the emerging, difficult, and often highly technical issues of today. Assessments are conducted in such areas as economic competitiveness, international security, energy, advanced materials, biotechnology, neuroscience, agriculture, advanced medical technologies and services, telecommunications and information technologies, environment, education, and science policy.

Candidates must have significant experience in technical fields or management or have completed research at the doctoral level. The deadline for applications is **January 31, 1991**. For more information, contact: Congressional Fellowships, Personnel Office, Office of Technology Assessment, Congress of the United States, Washington, DC 20510-8025; telephone 202-224-8713.
1991 AMS Elections
Nominations by Petition

Vice-President or Member-at-Large
One position of vice-president and member of the Council ex officio for a term of two years is to be filled in the election of 1991. The Council intends to nominate at least two candidates, among whom may be candidates nominated by petition as described in the rules and procedures.

Five positions of member-at-large of the Council for a term of three years are to be filled in the same election. The Council intends to nominate at least ten candidates, among whom may be candidates nominated by petition in the manner described in the rules and procedures.

Petitions are presented to the Council, which, according to Section 2 of Article VII of the bylaws, makes the nominations. The Council of 23 January 1979 stated the intent of the Council of nominating all persons on whose behalf there were valid petitions.

Prior to presentation to the Council, petitions in support of a candidate for the position of vice-president or of member-at-large of the Council must have at least 50 valid signatures and must conform to several rules and operational considerations, which are described below.

Rules and Procedures
Use separate copies of the form for each candidate for vice-president, member-at-large, or member of the Nominating and Editorial Boards Committee.

1. To be considered, petitions must be addressed to Robert M. Fossum, Secretary, P.O. Box 6248, Providence, Rhode Island 02940, and must arrive by 28 February 1991.

2. The name of the candidate must be given as it appears in the Combined Membership List. If the name does not appear in the list, as in the case of a new member or by error, it must be as it appears in the mailing lists, for example on the mailing label of the Notices. If the name does not identify the candidate uniquely, append the member code, which may be obtained from the candidate's mailing label or the Providence office.

3. The petition for a single candidate may consist of several sheets each bearing the statement of the petition, including the name of the position, and signatures. The name of the candidate must be exactly the same on all sheets.

4. On the next page is a sample form for petitions. Copies may be obtained from the Secretary; however, petitioners may make and use photocopies or reasonable facsimiles.

5. A signature is valid when it is clearly that of the member whose name and address is given in the left-hand column.

6. The signature may be in the style chosen by the signer. However, the printed name and address will be checked against the Combined Membership List and the mailing lists. No attempt will be made to match variants of names with the form of name in the CML. A name neither in the CML nor on the mailing lists is not that of a member. (Example: The name Robert M. Fossum is that of a member. The name R. Fossum appears not to be.)

7. When a petition meeting these various requirements appears, the Secretary will ask the candidate whether he is willing to have his name on the ballot. Petitioners can facilitate the procedure by accompanying the petitions with a signed statement from the candidate giving his consent.

Editorial Boards Committee
Two places on the Editorial Boards Committee will be filled by election. There will be four continuing members of the Editorial Boards Committee.

The new members will be elected in a preferential ballot. The President will name at least six candidates for these three places, among whom may be candidates nominated by petition in the manner described in the rules and procedures.

The candidate's assent and petitions bearing at least 100 valid signatures are required for a name to be placed on the ballot. In addition, several other rules and operational considerations, described below, should be followed.

Rules and Procedures
Use separate copies of the form for each candidate for vice-president, member-at-large, or member of the Nominating and Editorial Boards Committee.

1. To be considered, petitions must be addressed to Robert M. Fossum, Secretary, P.O. Box 6248, Providence, Rhode Island 02940, and must arrive by 28 February 1991.

2. The name of the candidate must be given as it appears in the Combined Membership List. If the name does not appear in the list, as in the case of a new member or by error, it must be as it appears in the mailing lists, for example on the mailing label of the Notices. If the name does not identify the candidate uniquely, append the member code, which may be obtained from the candidate's mailing label or the Providence office.

3. The petition for a single candidate may consist of several sheets each bearing the statement of the petition, including the name of the position, and signatures. The name of the candidate must be exactly the same on all sheets.

4. On the next page is a sample form for petitions. Copies may be obtained from the Secretary; however, petitioners may make and use photocopies or reasonable facsimiles.

5. A signature is valid when it is clearly that of the member whose name and address is given in the left-hand column.

6. The signature may be in the style chosen by the signer. However, the printed name and address will be checked against the Combined Membership List and the mailing lists. No attempt will be made to match variants of names with the form of name in the CML. A name neither in the CML nor on the mailing lists is not that of a member. (Example: The name Robert M. Fossum is that of a member. The name R. Fossum appears not to be.)

7. When a petition meeting these various requirements appears, the Secretary will ask the candidate whether he is willing to have his name on the ballot. Petitioners can facilitate the procedure by accompanying the petitions with a signed statement from the candidate giving his consent.

Nominating Committee
Three places on the Nominating Committee will be filled by election. There will be six continuing members of the Nominating Committee.
NOMINATION PETITION FOR 1991 ELECTION

The undersigned members of the American Mathematical Society propose the name of

__________________________

as a candidate for the position of (check one):

☐ Vice-President
☐ Member-at-Large of the Council
☐ Member of the Nominating Committee
☐ Member of the Editorial Boards Committee


Name and Address (printed or typed)

__________________________

Signature

__________________________

Signature

__________________________

Signature

__________________________

Signature

__________________________

Signature

__________________________

Signature
CALL FOR SUGGESTIONS

There will be a number of contested seats in the 1991 AMS elections. Your suggestions are wanted by

THE NOMINATING COMMITTEE
for president-elect, vice-president, trustee, and five members-at-large of the council
and by

THE PRESIDENT
for three Nominating Committee members and two Editorial Boards Committee members

In Addition

THE EDITORIAL BOARDS COMMITTEE
requests suggestions for appointments to various editorial boards of Society publications.

Send your suggestions for any of the above to:

Robert M. Fossum, Secretary
American Mathematical Society
Department of Mathematics
University of Illinois
1409 West Green Street
Urbana, IL 61801
South Bend, Indiana
Indiana University
at South Bend
March 15–16

First Announcement

The eight-hundred-and-sixty-fourth meeting of the American Mathematical Society will be held at Indiana University at South Bend, South Bend, Indiana on Friday, March 15, and Saturday, March 16, 1991. All special sessions will be held in Northside Hall and all invited addresses will be in Room 113 of Northside Hall.

Invited Addresses

By invitation of the Central Section Program Committee, there will be four invited one-hour addresses. The speakers, their affiliations, and the titles of their talks where available are:

Leonid G. Makar-Limanov, Wayne State University, *title to be announced.*

Donald G. Saari, Northwestern University, *Dynamics and symmetry applied to paradoxes of voting and the social sciences.*

Stephen D. Smith, University of Illinois at Chicago, *title to be announced.*

Deane Yang, Columbia University, *Questions relating Riemannian geometry and the topology of 3-manifolds.*

Special Sessions

By invitation of the same committee, there will be eight special sessions of selected twenty-minute papers. The topics of these sessions, and the names and affiliations of the organizers, are as follows:

*Mathematical economics and dynamical systems,* Charalampos D. Aliprantis, Indiana University and Purdue University, and Carl P. Simon, University of Michigan.

*Simplical complexes associated to finite groups and their representations,* Jonathan L. Alperin, University of Chicago, and Stephen D. Smith.

*Model theory,* Steven A. Buechler, University of Notre Dame.

*Geometric topology,* Frank X. Connolly, University of Notre Dame.

*Algebraic topology,* William G. Dwyer, University of Notre Dame, and Anthony D. Elmendorf, Indiana University at South Bend.

*Noncommutative ring theory,* Gail R. Letzter, Peter Malcolmson, and Frank Okoh, Wayne State University.

*Hilbert spaces of analytic function,* John E. McCarthy, Indiana University at Bloomington.

*Probability and prediction theory,* Mohsen Pourahmadi, Northern Illinois University.

Abstracts for consideration for these sessions should have been submitted by the December 13, 1990 deadline. This deadline was previously published in the Calendar of AMS Meetings and Conferences and in the Invited Speakers and Special Sessions section of Notices.

Contributed Papers

There will also be sessions for contributed ten-minute papers. Abstracts for consideration of these sessions should have been submitted by the January 3, 1991 deadline previously published in the Calendar of AMS Meetings and Conferences. Late papers will not be accommodated.

Registration

The meeting registration desk will be located in the south wing (main entrance) of Northside Hall and will be open from 8:00 a.m. to 5:00 p.m. on Friday, March 15, and from 8:00 a.m. to noon on Saturday, March 16. The registration fees are $30 for members of the AMS, $45 for nonmembers, and $10 for students or unemployed mathematicians.

Petition Table

A petition table will be set up in the registration area. Additional information about petition tables can be found in a box in the San Francisco meeting announcement in the October 1990 issue of Notices.

Accommodations

Rooms have been blocked for participants at The Works Hotel, the Holiday Inn - Downtown, and the Ramada Inn. Participants should make their own reservations and directly mention the AMS meeting to obtain the rates listed below. All rates are subject to a ten percent tax. The AMS is
not responsible for rate changes or the accommodations offered by these hotels/motels.

Other motels located on U.S. Route 31/33 North near the Ramada Inn are: Budgeteer Motor Inn (219-272-9000); Best Inns of America (219-277-7000); Days Inn (219-277-0510); Knights Inn (219-277-2960); and Motel 6 (219-277-2960).

Holiday Inn - Downtown (2.8 miles from campus)
213 W. Washington Street, South Bend, IN 46601
Telephone: 219-232-3941
The deadline for reservations is February 27.
Flat rate $55 Single, Double, Triple Restaurant/lounge, indoor pool, and free parking. For free van transportation from airport, dial 6 from courtesy phone located at baggage pick-up.

The Works Hotel (2.5 miles from campus)
475 N. Niles Avenue, South Bend, IN 46617
Telephone: 219-234-1954
Deadline for reservations is March 1.
Single $48 Each additional adult $7 Free continental breakfast, restaurant adjacent, and free parking. For free van transportation from airport, call motel.

The Ramada Inn (6.3 miles from campus)
52890 U.S. Route 33 North, South Bend, IN 46637
Telephone: 219-272-5220
The deadline for reservations is February 22.
Single $51 Double $59 Restaurant/lounge, indoor pools, sauna, jacuzzi.

Food Service
The IUSB Cafeteria (UC2) will be serving breakfast and lunch on Friday, March 15. Other restaurants are located within 1.5 miles of the campus. Complete listings will be available at the meeting registration desk.

Parking
Free parking will be available in the student lot (P1) located north of Northside Hall.

Travel and Local Information
Michiana Regional Airport is served by several major airlines. Free shuttle service is available to the Holiday Inn - Downtown and the Works Hotel. Transportation to the Ramada Inn or other accommodations can be arranged through United Limo or cab service at the airport.
TRANSPO buses serve the IUSB campus from the downtown area of South Bend. Bus #9 leaves the downtown transfer center at approximately ten minutes before the hour (Monday – Friday), and every half-hour (Monday – Saturday) beginning at 5:00 a.m. The bus ride from downtown to the IUSB bus stop at Mishawaka Avenue and Greenlawn Avenue takes about ten minutes. Bus #10 for the return trip leaves the corner of Mishawaka and Greenlawn Avenues at approximately five minutes before the hour (Monday – Saturday). TRANSPO bus service back to the downtown area ends at 9:33 p.m. on Friday and 6:26 p.m. on Saturday. TRANSPO service is not available to or from the Ramada Inn area.

Weather
A wide range of weather is possible in the Michiana area in March. Participants are advised to note regional forecasts near the time of the meeting.

Andy Roy Magid
Associate Secretary
Norman, Oklahoma
First Announcement

The eight-hundred-and-sixty-fifth meeting of the American Mathematical Society will be held at the University of South Florida (USF), Tampa, Florida, on Friday, March 22, and Saturday, March 23, 1991. All scientific sessions will be held in the Chemistry, Engineering and Math/Physics buildings.

Invited Addresses

By invitation of the Southeastern Section Program Committee, there will be four invited one-hour addresses. The speakers, their affiliations, and the titles of their talks where available are:

Joséfiná Álvarez, New Mexico State University, Title to be announced.

Ronald A. DeVore, University of South Carolina, Columbia, Compression from wavelet decompositions.

Michel L. Lapidus, University of California, Riverside and Yale University, Can one hear the shape of a drum? From the Weyl-Berry conjecture to the Riemann hypothesis.

Donald St. P. Richards, University of Virginia, Hypergeometric functions of positivity and applications.

Special Sessions

By invitation of the same committee, there will be twelve special sessions of selected twenty-minute papers. The topics of these sessions, and the names and affiliations of the organizers, are as follows:

Harmonic analysis and applications, Joséfiná Álvarez.


Approximation theory, Ronald A. DeVore; Edward B. Saff and B. Shektman, University of South Florida, Tampa.

Finite groups and related topics, David A. Drake, Chat Yin Ho, and Geoffrey R. Robinson, University of South Florida, Tampa.

Differential geometry and mathematical physics, Paul E. Ehrlich and Stephen J. Summers, University of Florida.

Several complex variables, Paul M. Gauthier, University of Montreal.


Probability on algebraic and topological structures, Joseph G. Glover and Arunava Mukherjee, University of South Florida, Tampa.

Fractal and spectral geometry, Michel J. Lapidus; and Robert S. Strichartz, Cornell University.

Operator methods for control problems, Sung J. Lee and Y. You, University of South Florida, Tampa.

Nonlinear boundary value problems, R. Kent Nagle and Mary E. Parrott, University of South Florida, Tampa.

Hypergeometric functions on domains of positivity, jack, polynomials, and applications, Donald St. P. Richards.

Abstracts for consideration for these sessions should have been submitted by the December 13, 1990 deadline. This deadline was previously published in the Calendar of AMS Meetings and Conferences and in the Invited Speakers and Special Sessions section of the Notices.

Contributed Papers

There will also be sessions for contributed ten-minute papers. Abstracts for consideration for these sessions should have been submitted by the January 3, 1991 deadline previously published in the Calendar of AMS Meetings and Conferences. Late papers will not be accommodated.

Council

The Council of the Society will meet at 7:00 p.m. on Thursday, March 21, 1991, at the Holiday Inn - Busch Gardens, 2701 E. Fowler Avenue, Tampa, FL 33612.

Registration

The registration desk will be located in the lobby of the Math/Physics building and will be open from 8:00 a.m. to 5:00 p.m. on Friday, March 22, and from 8:00 a.m. to noon on Saturday, March 23. The registration fees are $30 for
members of the AMS, $45 for nonmembers, and $10 for students or unemployed mathematicians.

Petition Table
A petition table will be set up in the registration area. Additional information about petition tables can be found in a box in the San Francisco meeting announcement in the October 1990 issue of Notices.

Accommodations
Rooms have been blocked for participants at the following hotels or motels in the area. Because of the large number of tourists during the winter month, hotel/motel reservations should be made as soon as possible. Participants should make their own reservations directly and mention the AMS meeting. The AMS is not responsible for rate changes or the accommodations offered by these hotels. All rates are subject to a ten percent sales tax.

Embassy Suites Hotel (.5 miles from campus)
11310 North 30th Street, Tampa, FL 33612
Telephone: 1-800-EMBASSY
Deadline for reservations is March 7.
Single $79 Double $89
Complimentary full breakfast and cocktail reception, pool and jacuzzi, free shuttle service up to a three mile radius, and free parking.

Holiday Inn - Busch Gardens (1/4 mile from campus)
2701 E. Fowler Avenue, Tampa, FL 33612
Telephone: 1-800-99-BUSCH
Deadline for reservations is March 1.
Single $65 Double $65

Shoney's Inn - Tampa (2.5 miles from campus)
8602 Morris Bridge Road, Tampa, FL 33617
Telephone: 1-800-222-2222
Deadline for reservations is March 5.
One-Four People $43—$45
Complimentary coffee and cocktail reception, pool, and free parking.

Quality Suites Busch Gardens (1/2 mile from campus)
3001 University Center Drive, Tampa, FL 33612
Telephone: 1-800-228-5151
Deadline date for reservations is March 1.
Suites (One-Four persons) $69
Complimentary buffet breakfast and cocktail reception, pool, and free parking.

Food Service
The University Center Food Service will keep the Empty Keg open from 11:00 a.m. to 2:00 p.m. for conference participants. The Empty Keg is located in the basement of the University Center which is within short walking distance the meeting rooms. The Empty Keg offers a soup and salad bar, pizza, and various sandwich platters. Also open in the University Center from 7:30 a.m. until 3:00 p.m. will be Sweet Sensations, a pastry and coffee shop. Complete listings of other restaurants will be available at the meeting registration desk.

Parking
Free parking will be available to conference participants in lots 8A and 8B on the campus of USF. These lots are in close proximity to the conference site.

Travel and Local Information
Tampa International Airport (TIA) is served by all major airlines and located 15 miles from the USF campus. Travel to the campus can be secured by calling Tampa Tours (telephone 813-621-6667) prior to arrival and give the date, airline, flight number, and estimated time of arrival. The cost is $9 for one person one-way, $7 each for two to four persons one-way, and $30 for five to ten people one-way. Other transportation from TIA to USF can be obtained through limousine service (Mannone's Limousine Service @ 813-932-1797 or Limo Inc. @ 1-800-282-6817) or taxi. The cost of a taxi is approximately $24. Most major car rental companies have agencies at Tampa International Airport. Directions for participants driving to the meeting are as follow:

If traveling by automobile, participants should take I-75 around Tampa and exit west at either the Fletcher Avenue or the Fowler Avenue exit. The university is approximately three miles west. The campus can also be reached by taking I-275 through Tampa and exit east on either Fletcher Avenue or Fowler Avenue. The university is approximately one-and-one-half miles to the east. Bus service is available around the university by Hartline and bus schedules will be made available at the meeting registration desk.

FROM THE AIRPORT: Participants should take Memorial Highway south to Interstate 275 and exit north to Fowler Avenue directly to USF.

Weather and Local Attractions
The weather in Tampa in March is usually mild. The average maximum temperature is 76.1°F and the average minimum temperature is 57.2°F. The average rainfall for March is three inches.

Beaches, golf courses, Busch Gardens, Disney World, and many other attractions are located within an hour drive of the Tampa area.

Joseph A. Cima
Associate Secretary
Chapel Hill, North Carolina
Invited Speakers and Special Sessions

Invited Speakers at AMS Meetings
The individuals listed below have accepted invitations to address the Society at the times and places indicated. For some meetings, the list of speakers is incomplete.

South Bend, IN, March 1991
Leonid G. Makar-Limanov  Stephen D. Smith
Donald G. Saari  Deane Yang

Tampa, FL, March 1991
Josefina Alvarez  Michel L. Lapidus
Ronald A. DeVore  Donald St. P. Richards

Portland, OR, June 1991
Dinakar Ramakrishnan  V. S. Varadarajan
Gunther A. Uhlmann

Orono, ME, August 1991
H. W. Lenstra  Richard M. Schoen
(Progress in Mathematics Lecture) (Progress in Mathematics Lecture)

Philadelphia, PA, October 1991
Michael T. Anderson  Majorie Senechal
Abbas Bahri  Panagiotis E. Souganidis

Fargo, ND, October 1991
Ian D. Macdonald  Henry C. Wente
Harald Upmeier  Sylvia M. Wiegand

Baltimore, MD, January 1992
Michael E. Fisher  (Gibbs Lecture)

Cambridge, England, June 1992
(Joint meeting with the London Mathematical Society)
John M. Ball  Benedict H. Gross
Lawrence Craig Evans  Nigel J. Hitchin

Invited addresses at Sectional Meetings are selected by the Section Program Committee, usually twelve to eighteen months in advance of a meeting. Members wishing to nominate candidates for invited addresses should send the relevant information to the Associate Secretary for the Section who will forward it to the Section Program Committee.

Organizers and Topics of Special Sessions
The list below contains all the information about Special Sessions at meetings of the Society available at the time this issue of Notices went to the printer. The section below entitled Information for Organizers describes the timetable for announcing the existence of Special Sessions.

March 1991 Meeting in South Bend, Indiana
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: Expired
Deadline for consideration: Expired
Charalambos D. Aliprantis and Carl P. Simon, Mathematical economics and dynamical systems
Jonathan L. Alperin and Stephen D. Smith, Simplicial complexes associated to finite groups and their representations
Steven A. Buechler, Model theory
Frank X. Connolly, Geometric topology
William G. Dwyer and Anthony D. Elmendorf, Algebraic topology
Gail R. Letzter, Peter Malcolmson and Frank Okoh, Non-commutative ring theory
John E. McCarthy, Hilbert spaces of analytic functions
Mohsen Pourahmadi, Probability and prediction theory

March 1991 Meeting in Tampa, Florida
Southeastern Section
Associate Secretary: Joseph A. Cima
Deadline for organizers: Expired
Deadline for consideration: Expired
Josefina Alvarez, Harmonic analysis and applications
Ronald A. DeVore, Edward B. Saff and B. Shektman, Approximation theory
David A. Drake,Chat Yin Ho and Geoffrey R. Robinson, Finite groups and related topics
Paul E. Ehrlich and Stephen J. Summers, *Differential geometry and mathematical physics*

Paul M. Gauthier, *Several complex variables*


Joseph Glover and Arunava Mukherjea, *Probability on algebraic and topological structures*

Michel L. Lapidus and Robert S. Strichartz, *Fractal and spectral geometry*

Sung J. Lee and Y. You, *Operator methods for control problems*

R. Kent Nagle and Mary E. Parrott, *Nonlinear boundary value problems*


Donald St. P. Richards, *Hypergeometric functions on domains of positivity, jack polynomials, and applications*

June 1991 Meeting in Portland, Oregon

**Western Section**

Associate Secretary: Lance W. Small

Deadline for organizers: Expired

Deadline for consideration: July 11, 1991

Donald G. Babbitt, *Meromorphic differential equations*

M. Paul Latiolais, *Combinatorial group theory and low dimensional topology*

M. Sergei Prishepionok, *Harmonic mappings and their applications*

Dinan Ramakrishnan, *Cycles and poles of L-functions*

Kenneth A. Ross, *Fourier analysis*

John Sylvester and Gunther A. Uhlmann, *Inverse problems and applications*

August 1991 Meeting in Orono, Maine

**Associate Secretary:** Joseph A. Cima

Deadline for organizers: Expired

Deadline for consideration: May 1, 1991

(Please note that this deadline has changed)

Henrik Bresinsky, *Commutative Noetherian rings with applications in algebraic geometry*

John C. Mayer, *Continuum theory and dynamical systems*

Ali E. Ozluk and William M. Snyder, *Analytic number theory*

Stanley Rabinowitz, *Geometric inequalities for polytopes*

Gerald Schwarz, *Symmetry and differential analysis*

Chuu-Lian Terng and Karen Uhlenbeck, *Variational methods and symmetry*

Toma V. Tonev, *Function algebras and function spaces*

October 1991 Meeting in Philadelphia, Pennsylvania

**Eastern Section**

Associate Secretary: W. Wistar Comfort

Deadline for organizers: January 10, 1991

Deadline for consideration: July 11, 1991

Michael T. Anderson and Jeff Cheeger, *Recent progress in Ricci curvature and related topics*

Boris A. Datskovsky and Marvin I. Knopp, *Modular forms, arithmetic algebraic geometry*

James F. Davis, Ronnie Lee and Julius L. Shaneson, *Surgery theory*

Leon Ehrenpreis and Eric L. Grinberg, *Geometric analysis*

Janos Galambos, *Extreme value theory*

David R. Hill, *Computational experiments for numerical analysis instruction*

Nicholas Hanges and A. Alexandrou Himonas, *Applications of microlocal analysis to partial differential equations*

Bruce A. Kleiner and Robert B. Kusner, *Variational problems in low dimensional geometry*

Martin Lorenz and Shari A. Prevost, *Rings and representations*

Doris Schattschneider, *Tilings*

Halil Mete Soner and Panagiotis E. Souganidis, *Phase transitions and/or front propagation*

Daniel B. Szyld, *Numerical linear algebra*

October 1991 Meeting in Fargo, North Dakota

**Central Section**

Associate Secretary: Andy R. Magid

Deadline for organizers: January 25, 1991

Deadline for consideration: July 11, 1991

Joseph P. Brennan and Sylvia M. Wiegand, *Commutative algebra*

ADogan Gomez, *Ergodic theory*

Kendall E. Nygard, *Operations research*

James H. Olsen and Mark Pavlicic, *Mathematical foundations of computer graphics*

Warren E. Shreve, *Graph theory*

Vasant A. Ubhaya, *Approximation theory*

Abraham Ungar, *Lorentz transformations and spacetime geometry*

Harald Upmeier, *Multivariate operator theory in symmetric domains*

November 1991 Meeting in Santa Barbara, California

**Western Section**

Associate Secretary: Lance W. Small

Deadline for organizers: February 7, 1991

Deadline for consideration: July 11, 1991

January 1992 Meeting in Baltimore, Maryland

**Associate Secretary:** Lance W. Small

Deadline for organizers: April 8, 1991

Deadline for consideration: September 11, 1991

March 1992 Meeting in Tuscaloosa, Alabama

**Southeast Section**

Associate Secretary: Joseph A. Cima

Deadline for organizers: June 13, 1991

Deadline for consideration: To be announced

March 1992 Meeting in Springfield, Missouri

**Central Section**

Associate Secretary: Andy R. Magid

Deadline for organizers: June 26, 1991

Deadline for consideration: To be announced
Meetings (PCNM). They are administered by the Associate Secretary in charge of that meeting with staff assistance from the Meetings and Editorial Departments in the Society office in Providence.

Society, Special Sessions are selected by the PCNM from a list of proposed Special Sessions in essentially the same manner as Invited Speakers are selected. The number of Special Sessions at a Summer or Annual Meeting is limited. The algorithm that determines the number of Special Sessions allowed at a given meeting, while simple, is not repeated here, but can be found in "Rules for Special Sessions" on page 614 in the April 1988 issue of Notices.

Each Invited Speaker is invited to generate a Special Session, either by personally organizing one or by having a Special Session organized by others. Proposals to organize a Special Session are sometimes requested either by the PCNM or by the Associate Secretary. Other proposals to organize a Special Session may be submitted to the Associate Secretary in charge of that meeting (who is an ex-officio member of the committee and whose address may be found below). These proposals must be in the hands of the PCNM at least nine months prior to the meeting at which the Special Session is to be held in order that the committee may consider all the proposals for Special Sessions simultaneously. Proposals that are sent to the Providence office of the Society, to Notices, or directed to anyone other than the Associate Secretary will have to be forwarded and may not be received in time to be considered for acceptance.

It should be noted that Special Sessions must be announced in Notices in such a timely fashion that any member of the Society who so wishes may submit an abstract for consideration for presentation in the Special Session before the deadline for such consideration. This deadline is usually three weeks before the deadline for abstracts for the meeting in question.

Special Sessions are very effective at Sectional Meetings and can usually be accommodated. The processing of proposals for Special Sessions for Sectional Meetings is handled in essentially the same manner as for Annual and Summer Meetings by the Section Program Committee. Again, no Special Session at a Sectional Meeting may be approved so late that its announcement appears past the deadline after which members can no longer send abstracts for consideration for presentation in that Special Session.

The Society reserves the right of first refusal for the publication of proceedings of any Special Session. These proceedings appear in the book series Contemporary Mathematics.

More precise details concerning proposals for and organizing of Special Sessions may be found in the “Rules for Special Sessions” or may be obtained from any Associate Secretary.

Information for Organizers
Special Sessions at Annual and Summer Meetings are held under the supervision of the Program Committee for National Meetings (PCNM). They are administered by the Associate Secretary in charge of that meeting with staff assistance from the Meetings and Editorial Departments in the Society office in Providence.

According to the “Rules for Special Sessions” of the Society, Special Sessions are selected by the PCNM from a list of proposed Special Sessions in essentially the same manner as Invited Speakers are selected. The number of Special Sessions at a Summer or Annual Meeting is limited. The algorithm that determines the number of Special Sessions allowed at a given meeting, while simple, is not repeated here, but can be found in “Rules for Special Sessions” on page 614 in the April 1988 issue of Notices.

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June 1992 Meeting in Cambridge, England
(Joint Meeting with the London Mathematical Society)
Associate Secretary: W. Wistar Comfort
Deadline for organizers: September 28, 1991
Deadline for consideration: To be announced

January 1993 Meeting in San Antonio, Texas
Associate Secretary: Joseph A. Cima
Deadline for organizers: November 11, 1992
Deadline for consideration: To be announced

August 1993 Meeting in Vancouver, British Columbia, Canada
Associate Secretary: Lance W. Small
Deadline for organizers: April 13, 1992
Deadline for consideration: To be announced

January 1994 Meeting in Cincinnati, Ohio
Associate Secretary: Joseph A. Cima
Deadline for organizers: April 5, 1993
Deadline for consideration: To be announced

January 1996 Meeting in Orlando, Florida
Associate Secretary: Lance W. Small
Deadline for organizers: April 12, 1995
Deadline for consideration: To be announced

Proposals for Special Sessions to the Associate Secretaries
The programs of Sectional Meetings are arranged by the Associate Secretary for the section in question:
Western Section
Andy R. Magid, Associate Secretary
Department of Mathematics
University of Oklahoma
601 Elm PHSC 423
Norman, OK 73019
Electronic mail: g.magid@math.ams.com
(Telephone 405-525-6711)

Central Section
Lance W. Small, Associate Secretary
Department of Mathematics
University of California, San Diego
La Jolla, CA 92093
Electronic mail: g.small@math.ams.com
(Telephone 619-534-3590)

Eastern Section
W. Wistar Comfort, Associate Secretary
Department of Mathematics
Wesleyan University
Middletown, CT 06457
Electronic mail: g.comfort@math.ams.com
(Telephone 203-347-9411)

Southeastern Section
Joseph A. Cima, Associate Secretary
Department of Mathematics
University of North Carolina, Chapel Hill
Chapel Hill, NC 27599–3902
Electronic mail: g..cima@math.ams.com
(Telephone 919-962–1050)

As a general rule, members who anticipate organizing Special Sessions at AMS meetings are advised to seek approval at least nine months prior to the scheduled date of the meeting. No Special Sessions can be approved too late to provide adequate advance notice to members who wish to participate.
Invited Speakers and Special Sessions

Proposals for Special Sessions at the June 29-July 1, 1992, meeting in Cambridge, England, only should be sent to Professor Fossum at the Department of Mathematics, University of Illinois, Urbana, IL 6180, Telephone: 217-244-1741, Electronic mail: rmf@math.ams.com

Information for Speakers

A great many of the papers presented in Special Sessions at meetings of the Society are invited papers, but any member of the Society who wishes to do so may submit an abstract for consideration for presentation in a Special Session, provided it is received in Providence prior to the special early deadline announced above and in the announcements of the meeting at which the Special Session has been scheduled. Contributors should know that there is a limitation in size of a single Special Session, so that it is sometimes true that all places are filled by invitation. Papers not accepted for a Special Session are considered as ten-minute contributed papers.

Abstracts of papers submitted for consideration for presentation at a Special Session must be received by the Providence office (Editorial Department, American Mathematical Society, P. O. Box 6248, Providence, RI 02940) by the special deadline for Special Sessions, which is usually three weeks earlier than the deadline for contributed papers for the same meeting. The Council has decreed that no paper, whether invited or contributed, may be listed in the program of a meeting of the Society unless an abstract of the paper has been received in Providence prior to the deadline.

Electronic submission of abstracts is available to those who use the \TeX typesetting system. Requests to obtain the package of files may be sent electronically via the Internet to abs-request@math.ams.com. Requesting the files electronically will likely be the fastest and most convenient way, but users may also obtain the package on IBM or Macintosh diskettes, available free of charge by writing to: Electronic Abstracts, American Mathematical Society, Publications Division, P.O. Box 6248, Providence, RI 02940, USA. When requesting the abstracts package, users should be sure to specify whether they want the plain \TeX, \AmS-\TeX, or the \LaTeX package.

Number of Papers Presented

Joint Authorship

Although an individual may present only one ten-minute contributed paper at a meeting, any combination of joint authorship may be accepted, provided no individual speaks more than once. An author can speak by invitation in more than one Special Session at the same meeting.

An individual may contribute only one abstract by title in any one issue of Abstracts, but joint authors are treated as a separate category. Thus, in addition to abstracts from two individual authors, one joint abstract by them may also be accepted for an issue.

Site Selection for Sectional Meetings

Sectional Meeting sites are recommended by the Associate Secretary for the Section and approved by the Committee of Associate Secretaries and Secretary. Recommendations are usually made eighteen to twenty-four months in advance. Host departments supply local information, ten to twelve rooms with overhead projectors for contributed paper sessions and special sessions, an auditorium with twin overhead projectors for invited addresses, and registration clerks. The Society partially reimburses for the rental of facilities and equipment, and for staffing the registration desk. Most host departments volunteer; to do so, or for more information, contact the Associate Secretary for the Section.

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LIE ALGEBRAS AND RELATED TOPICS

Georgia Benkart and J. Marshall Osborn, Editors

Contemporary Mathematics, Volume 110

The 1984 classification of the finite-dimensional restricted simple Lie algebras over an algebraically closed field of characteristic $p > 7$ provided the impetus for a Special Year of Lie Algebras, held at the University of Wisconsin, Madison, during 1987-88. Work done during the Special Year and afterward put researchers much closer toward a solution of the long-standing problem of determining the finite-dimensional simple Lie algebras over an algebraically closed field of characteristic $p > 7$.

This volume contains the proceedings of a conference on Lie algebras and related topics, held in May 1988 to mark the end of the Special Year. The conference featured lectures on Lie algebras of prime characteristic, algebraic groups, combinatorics and representation theory, and Kac-Moody and Virasoro algebras. Many facets of recent research on Lie theory are reflected in the papers presented here, testifying to the richness and diversity of this topic.

1980 Mathematics Subject Classifications: 17, 20, 22, 58
ISBN 0-8218-5119-5, LC 90-44712,
ISSN 0271-4132
313 pages (softcover), October 1990
Individual member $26$, List price $44$,
Institutional member $35$
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Prepayment required: Order from American Mathematical Society, P.O. Box 1571, Annex Station, Providence, RI 02901-1571, or call toll free 800-321-4AMS (321-4267) in the continental U.S. and Canada to charge with Visa or MasterCard.

36 NOTICES OF THE AMERICAN MATHEMATICAL SOCIETY
Mathematics Sessions
at the AAAS Annual Meeting

Washington, DC, February 14–19, 1991

The annual meeting of the American Association for the Advancement of Science (AAAS), February 14–19, 1991, in Washington, DC, will feature many outstanding expository talks by prominent mathematicians. These talks include the following symposia (three-hour sessions) and invited addresses cosponsored by Section A (Mathematics) of the AAAS and the Society. In addition, there will be special events during the meeting to celebrate the 20th anniversary of the Association for Women in Mathematics, including the symposium, “Mathematics in the public policy arena” listed below.

The AMS helps to support mathematical activities at the AAAS meetings by contributing to the sponsorship of speakers in mathematical symposia it cosponsors with the AAAS. In addition, the Society has a committee to act as a liaison with AAAS. The AMS believes that strengthening its ties with AAAS helps to create new opportunities for mathematicians to interact with scientists from all disciplines.

The names and affiliations of the organizers follow (speakers’ names are given in parentheses):

- **Robotics and mathematics**, organized by **Bhubaneswar Mishra**, New York. (Jerrold E. Marsden, Bhubaneswar Mishra, and Jacob T. Schwartz), Tuesday, February 19, 2:30 p.m.

- **The geometry and topology of DNA**, organized by **DeWitt L. Sumners**, Florida State University. (Nicholas R. Cozzarelli, DeWitt L. Sumners, and James H. White), Monday, February 18, 2:30 p.m.

- **Mathematics in the public policy arena**, organized by **Mary W. Gray**, American University, **Jill P. Mesirov**, Thinking Machines Corporation, and **Mary Beth Ruskai**, University of Lowell. (Ingrid Daubechies, Mary W. Gray, Barbara J. Grosz, Fern Y. Hunt, and Mary Wheeler), Monday, February 18, 2:30 p.m.

- **Voting: Mathematical foundations and political realities**, organized by **Alan D. Taylor**, Union College. (Steven J. Brams, Samuel Merrill III, and William Zwicker), Monday, February 18, 8:30 a.m.

- **Mathematics in the material sciences**, organized by **David S. Kinderlehrer**, Carnegie-Mellon University. (Morton Gurkin, Richard James, Robert V. Kohn, and Mitchell B. Luskin), Sunday, February 17, 2:30 p.m.

- **Mathematics in times of social upheaval**, organized by **Sanford L. Segal**, University of Rochester. (Charles Edwin Ford, Charles Gillespie, Aleskey Levin, Larry Owens, David E. Rowe, and Sanford L. Segal), Monday, February 18, 8:30 a.m.

- **Mathematics and mathematics education: Beyond reports**, organized by **Ronald G. Douglas**, SUNY at Stony Brook. (William Bowen, Ernest L. Boyer, Edward E. David, Jr., Ralph E. Gomory, Mary Good, Philip A. Griffiths, William E. Kirwan, II, Frank Press and Alvin W. Trivelpiece), Friday, February 15, 8:30 a.m. and 2:30 p.m.

- **Calculus reforms: Some examples**, organized by **Thomas W. Tucker**, Colgate University. (James Callahan, Edward D. Gaughan, Deborah Hughes Hallet, David A. Smith, and J. Jerry Uhl, Jr.), Saturday, February 16, 8:30 a.m.

- **Frontiers of physical sciences: A mathematics lecture by Neil J. A. Sloane**, AT&T Bell Laboratories. Friday, February 15, 8:30 a.m. and 2:30 p.m.

In addition, Section A of the AAAS will sponsor various symposia that will especially interest mathematicians and mathematics educators. These symposia include:

- **Science and mathematics education in the United States: A report from the Longitudinal Study of American Youth**

- **Structuring the college environment for success in learning science and mathematics**

- **Urban initiatives in precollege science and mathematics: A model program**

- **Minority mathematics and science education: Successful programs at community colleges**

- **Implications of mathematics curriculum reform for science education**

- **Sophisticated uses of single computers**

- **Global initiatives in high-performance computing and networking**

The above symposia represent only a few of the approximately 150 AAAS program offerings that will broaden the perspectives of students and professionals alike. Indeed, AAAS annual meetings showcase American science and deserve greater mathematical participation. The Section A Committee seeks organizers and speakers who can present substantial new material in understandable ways. This task is not easy, but the outstanding success of the mathematics symposia at last year’s AAAS annual meeting in New York helps to support mathematical activities at AAAS meetings by contributing to the sponsorship of speakers in mathematical symposia it cosponsors with the AAAS.
Orleans proved that effort and inspiration can accomplish wonders. That year’s mathematics program demonstrated that first-rate mathematical researchers can also effectively reach a broad and diverse scientific audience.

Section A of the AAAS knows that increasing the representation and participation of mathematicians at AAAS annual meetings offers an important means for deepening public awareness and appreciation of the manifold ways that mathematics contributes to science and society. The Secretary of Section A welcomes suggestions for symposia topics and individuals who might organize them.

For details about the symposia, see the September 7, 1990, issue of Science. Participants are invited to attend the Section A Committee meeting, 6:00 p.m. to 8:00 p.m., February 16, 1991, in the Presidential Room of the Shoreham Hotel. The committee meeting is open to all who wish to stimulate interest in activities of the mathematical sciences within the AAAS. Symposia proposals for future AAAS meetings should be sent to: Warren Page, Secretary of Section A, AAAS, Department of Mathematics, New York City Technical College of the City University of New York, 300 Jay Street, Brooklyn, NY 11201.
Joint Summer Research Conferences in the Mathematical Sciences

University of Washington, Seattle, June 22 to August 2, 1991

The 1991 Joint Summer Research Conferences in the Mathematical Sciences will be held at the University of Washington, Seattle, from June 22 to August 2. It is anticipated that the series of conferences will be supported by grants from the National Science Foundation and other agencies.

There will be eight conferences in eight different areas of mathematics. The topics and organizers for the conferences were selected by the AMS, Institute of Mathematical Statistics (IMS), and the Society for Industrial and Applied Mathematics (SIAM) Committee on Joint Summer Research Conferences in the Mathematical Sciences. The selections were based on suggestions made by the members of the committee and individuals submitting proposals. The committee considered it important that the conferences represent diverse areas of mathematical activity, with emphasis on areas currently especially active, and paid careful attention to subjects in which there is important interdisciplinary activity at present.

The conferences emulate the scientific structure of those held throughout the year at Oberwolfach. These conferences are intended to complement the Society’s program of annual Summer Institutes and Summer Seminars, which have a larger attendance and are substantially broader in scope. The conferences are research conferences and are not intended to provide an entree to a field in which a participant has not already worked.

It is expected that funding will be available for a limited number of participants in each conference. Others, in addition to those funded, will be welcome, within the limitations of the facilities of the campus. In the spring a brochure of information will be mailed to all who are requesting to attend the conferences. The brochure will include information on room and board rates, the residence and dining hall facilities, travel, local information, and a Residence Housing Form to use to request on-campus accommodations. Information on off-campus housing will also be included in the brochure. Participants will be responsible for making their own housing and travel arrangements. Each participant will be required to pay nominal registration and social fees.

Those interested in attending one of the conferences should send the following information to the Summer Research Conference Coordinator, Meetings Department, American Mathematical Society, Post Office Box 6887, Providence, RI 02940 or by E-Mail: CAK@MATH.AMS.COM on the Internet.

Please type or print the following:
1. Title and dates of conference desired
2. Full name
3. Mailing address
4. Telephone number and area code for office, home and electronic-mail address
5. Member of AMS, IMS, or SIAM? If AMS, please give member code
6. Your scientific background relevant to the topic of the conference
7. Financial assistance requested; please estimate cost of travel
8. Indicate if support is not required and if interested in attending even if support is not offered.

The deadline for receipt of applications is March 1, 1991. Requests to attend will be forwarded to the Organizing Committee for each conference for consideration after the deadline of March 1. All applicants will receive a formal invitation and notification of financial assistance from the AMS. Requests received past the deadline will be returned. Funds available for these conferences are limited and individuals who can obtain support from other sources should do so. Women and members of minority groups are encouraged to apply and participate in these conferences.

Any questions concerning the scientific portion of the conference should be directed to the chair or any member of the Organizing Committee.

The Joint Summer Research Conferences in the Mathematical Sciences are under the direction of the AMS-IMS-SIAM Committee on Joint Summer Research Conferences in the Mathematical Sciences. The following committee members chose the topics for the 1991 conferences: John A. Burns, Fan R. K. Chung, Leonard Evens, Martin Golubitsky, Anthony W. Knapp, Ingram Olkin, Emanuel Parzen, Stewart B. Priddy, Stephen Simpson and Gregg J. Zuckerman.

Descriptions of the subject matter of each of the 1991 conferences appeared in the November issue of Notices, pages 1278–1279; they were accompanied by lists of members of the respective Organizing Committees.

N.B. Lectures begin on Sunday morning and run through Thursday.
Positive Definite Unimodular Lattices with Trivial Automorphism Groups

Etsuko Bannai
(Memoirs of the AMS, Number 429)

In this book, the author proves that there exists a lattice with trivial automorphism group in every genus of positive definite unimodular \( \mathbb{Z} \)-lattices of rank \( m \) (with \( m \geq 43 \) for the odd unimodular case and \( m \geq 144 \) for the even unimodular case). Siegel's mass formulas for lattices (for both orthogonal and hermitian cases) are used in the proof. In addition, the author shows that, for those positive definite unimodular \( \mathbb{Z} \)-lattices in the given genus and of rank \( m \), the ratio of the mass of classes with nontrivial automorphisms to the mass of all classes approaches 0 very rapidly as \( m \) increases. The book is intended for researchers and advanced graduate students in the areas of number theory and quadratic forms.

1980 Mathematics Subject Classification: 10
ISBN 0-8218-2491-0, LC 90-31824, ISSN 0065-9266
70 pages (softcover), May 1990
Individual member $10. List price $16.
Institutional member $13
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1991 Summer Research Institute

Algebraic Groups and Their Generalizations

Pennsylvania State University, University Park, July 8–28

The thirty-ninth Summer Research Institute sponsored by the American Mathematical Society will be devoted to Algebraic groups and their generalizations and will take place at the Pennsylvania State University, University Park, Pennsylvania. Members of the Organizing Committee are: Igor Frankel, Yale University; Eric Friedlander, Northwestern University; William Haboush (chair), University of Illinois Urbana-Champaign; Jens Jantzen, University of Oregon, Eugene; and Brian Parshall, University of Virginia.

It is anticipated that the institute will be partially supported by a grant from the National Science Foundation. Proceedings of the institute will be published in the AMS series Proceedings of Symposia in Pure Mathematics.

This topic was selected by the 1989 AMS Committee on Summer Institutes and Special Symposia whose members at the time were: Steven L. Kleiman (chair), Haynes R. Miller, Raghavan Narasimhan, Brian Parshall, and Thomas C. Spencer.

While several recent conferences have been devoted to the theory of algebraic groups, it has been some time since there has been an extended conference devoted to the core subject itself. Meanwhile, the subject has undergone a most remarkable expansion and transformation.

The first of these developments is the one that began with observations by Jantzen and Deodhar that certain composition factors in Verma modules occurred with multiplicity. This led to the work of Kazhdan and Lusztig relating these multiplicities to the representative theory of Weyl groups and Hecke algebras and the intersection homology of generalized Schubert cells, work culminating in the Kazhdan-Lusztig conjectures. The solutions to these conjectures by Bernstein and Bielenson and by Kashiwara have made algebraic analysis and the theory of the derived category part of the substance of representation theory which has led to a new way of understanding the subject as a whole.

The second major development begins with the observation by Kac and Moody that relaxation of the positivity conditions on the Cartan matrix leads to a new class of infinite dimensional simple Lie algebras and the subsequent exploitation of this fact by Kac, Lepowsky, and others to develop a representation theory and a group theory for these Lie algebras. This has led to the development of a meaningful infinite dimensional group theory by Kac, Peterson, Matthieu, and others.

The third major change begins with Woronowicz’s discovery of a “non-commutative” deformation of the algebra of functions on a Lie group. This has inspired the development of the theory of quantum groups particularly by Drinfeld. Lusztig has formulated arithmetic quantizations of the Kostant $Z$-forms of semi-simple Lie algebras which allow the formulation of statements concerning the representation theory of semi-simple groups which have the theory over fields of positive characteristic as a specialization.

Through these developments a major reformulation of the vocabulary of algebraic group theory has taken place. Though conferences on various aspects of the theory of algebraic groups have taken place, no conference has focused on the general theory for some time. The summer institute will attempt to present this new knowledge as a corpus stressing overall structure, both common elements and special features that mark off one area from another. Thus certain topics, such as Kazhdan-Lusztig theory and the idea of induced representation as well as the higher derived functions of induction viewed as expressions of the structure of homogeneous spaces, are common threads while other topics such as vertex operators and related matters are based on unique aspects of special situations. Both types of ideas should be studied and juxtaposed. Similarly, certain quantization theories couched in analytic terms can be compared to the Lusztig quantization. It is hoped that these juxtapositions can be organized to result in fertile exchanges of ideas.

There are plans for major lecture series on quantum groups, Kac-Moody Lie algebras and groups, Hecke algebras, and on the representation theories associated to these objects. In addition, a series of talks will be devoted to induction in its various guises and to the geometry of homogeneous spaces and their compactifications, especially as they relate to representation theory. Directly related topics such as transformation spaces and quotients might also be discussed particularly in so far as they can be applied to or viewed as applications of the main topics. For example, transformation spaces can be related to orbit methods and to questions concerning the intersection homology of homogeneous spaces which in turn might bear on the combinatoric aspects of representation theory.

A tentative list of the topics to be addressed follows. Please note, however, that the program is subject to change.

Week One:

General theory of quantum groups and algebras, Kac-Moody Lie algebras and root systems, basic Kac-Moody group theory, finite dimensional representations in positive
characteristic, infinitesimal structures, flag varieties, Bruhat decomposition and generalized Schubert cells in the finite and infinite dimensional cases, standard bases for representations, and loop groups.

Week Two:

Theory of quantum groups and algebras continued, Kac-Moody groups, the representation theory of quantum groups and of Kac-Moody groups and algebras, character formulae, Hecke algebras and Weyl groups, triangulated categories and derived categories in representation theory, D-modules induced representations, the derived functors of induction, homogeneous spaces, transformation spaces, almost homogeneous spaces, infinitesimal analogues, loop groups and affine Kac-Moody groups, and vertex operators.

Week Three:

Arithmetic quantizations (the Lusztig quantization), quantum groups and representation theory in positive characteristic, Kazhdan-Lusztig polynomials and their generalizations, the intersection homology of Schubert cells and its relation to Kazhdan-Lusztig theory, infinite dimensional analogues, D-modules and orbit methods, D-modules in positive characteristic and other models of infinite dimensional theory and quantum group theory.

Accommodations will be available in the campus residence halls for participants; cafeteria style meals will be available. All facilities will be accessible to the handicapped. Information on housing, dining, travel, and the local area will be sent to invited participants in the spring. Each participant will pay a registration fee and a social fee to cover the costs of social events scheduled during the institute.

Those interested in receiving an invitation to participate in the institute should send the following information to Summer Institute Conference Coordinator, American Mathematical Society, Post Office Box 6887, Providence, RI 02940, prior to April 1, 1991 or through electronic mail to WSD@MATH.AMS.COM.

Please type or print the following:
1. Full name;
2. Mailing address;
3. Telephone number and area code for office and home;
4. Which week or weeks you wish to attend;
5. Your scientific background relevant to the institute topic;
6. Financial assistance requested;
7. Indicate if support is not required, and if interested in attending even if support is not offered.

Requests for invitations will be forwarded to the Organizing Committee for consideration up to the deadline of April 1, and applicants selected will receive formal invitations and notification of financial assistance beginning in mid-May.

CRYPTOLOGY AND COMPUTATIONAL NUMBER THEORY

Carl Pomerance, Editor
Proceedings of Symposia in Applied Mathematics, Volume 42

In the past dozen or so years, cryptology and computational number theory have become increasingly intertwined. Because the primary cryptologic application of number theory is the apparent intractability of certain computations, these two fields could part in the future and again go their separate ways. But for now, their union is continuing to bring ferment and rapid change in both subjects.

This book contains the proceedings of an AMS Short Course in Cryptology and Computational Number Theory, held in August 1989 during the Joint Mathematics Meetings in Boulder, Colorado. These eight papers by six of the top experts in the field will provide readers with a thorough introduction to some of the principle advances in cryptology and computational number theory over the past fifteen years. In addition to an extensive introductory article, the book contains articles on primality testing, discrete logarithms, integer factoring, knapsack cryptosystems, pseudo-random number generators, the theoretical underpinnings of cryptology, and other number theory-based cryptosystems. Requiring only background in elementary number theory, this book is aimed at non-experts, including graduate students and advanced undergraduates in mathematics and computer science.

All prices subject to change. Free shipment by surface; for air delivery, please add $6.50 per title. Prepayment required. Order from American Mathematical Society, P.O. Box 1571, Annex Station, Providence, RI 02940-1571, or call toll free 800-321-4AMS (321-4267) in the continental U.S. and Canada to charge with VISA or MasterCard.

1980 Mathematics Subject Classification: 11, 94
ISBN 0-8218-0155-4, LC 90-1248,
ISSN 0160-7634
171 pages (hardcover), December 1990
Individual member $34, List price $57,
Institutional member $46
To order, please specify PSAPM/42NA


**PROGRAM:** Emphasis will mainly be on algebraic and geometric aspects.

**CALL FOR PAPERS:** Application deadline for postdoctoral fellowships: April 1, 1991.

**INFORMATION:** A. Björner, Dept. of Mathematics, KTH, S-100 44 Stockholm, Sweden, or D. Laksov, Institut Mittag-Leffler, Auråvagen 17, S-182 62 Djursholm, Sweden.

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January 1991


**INFORMATION:** D. Plante, AMS, P.O. Box 6248, Providence, RI 02940.

16–19. Joint Mathematics Meetings, San Francisco, CA. (Including the annual meetings of the AMS, AWM, MAA, and NAM)

**INFORMATION:** H. Daly, AMS, P.O. Box 6887, Providence, RI 02940.


21–25. IMA Workshop on Statistical Thermodynamics and Differential Geometry of Microstructured Material, University of Minnesota, Minneapolis, MN. (Nov. 1990, p. 1283)


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February 1991


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Titi, Mathematical Sciences.

**PROGRAM:** A series of three lectures will be given during this week by David Hoff (Indiana Univ.)

**INFORMATION:** E.S. Titi, Mathematical Sciences Institute, Cornell University, 409 College Ave., Ithaca, NY 14850; 607-255-8005.


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(Received date change from Sep. 1990, p. 934)


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18–23. Ninth International Seminar on Model Optimization in Exploration Geo-
Meetings and Conferences

physics, with a Workshop on Geophysical Data Inversion in Archeological Site Investigation, Berlin, Free University of Berlin, Mathematical Geophysics Group and Archeological Institute. (Oct. 1990, p. 1136)


March 1991


4–15. Workshop on Mathematical Physics and Geometry, Trieste, Italy. (Sep. 1990, p. 934)


7–10. International Conference on Differential Equations, Cadi Ayyad University, Marrakech, Morocco. (May/Jun. 1990, p. 612)


Program: P. Eberlein (Univ. of North Carolina) will give the seventh series of the W. H. Roever Lectures in Geometry. His topic will be The structure of non-positivity curved manifolds. There will be five lectures, one each day, beginning with an overall introduction to the topic that will be appropriate for a general mathematical audience. In the last two lectures, the interplay between negative curvature and ergodic theory will be discussed, including recent work of many authors on smoothness of horocyclic foliations, marked length spectrum, entropy, and related topics. The titles of these lectures will be: 1. Introduction and sketch of main results; 2. Geometry on the sphere at infinity; 3. Relationship between the fundamental group and geometry; 4. Rigidity theorems I; 5. Rigidity theorems II and open problems.

Information: L. Conlon, Chairman, Roever Lectures Committee, Washington University, Campus Box 1146, One Brookings Dr., St. Louis, MO 63130-4899.


13–16. Twenty-Second Annual Iranian Mathematics Conference, Ferdowsi University of Mashhad, Iran. (Sep. 1990, p. 934)


Program: The objective of the conference is to discuss a number of current research topics in complex differential geometry.

Conference Topics: Einstein-Hermitian connections, the Yang-Mills Higgs functional, harmonic metrics and flat bundles, invariant connections, the gauge group action on connections, Bianchi-type identities for hermitian metrics, and the use of twistor bundle in the study of minimal surfaces.


15–16. Central Section, Indiana University, South Bend, IN.

Information: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

16–23. Sixth Conference in Geometric Rigidity and Hyperbolic Dynamics, Penn State Univ., State College, PA.

Program: The conference explores the synthesis of several branches of dynamics (smooth dynamical systems, ergodic theory, symplectic dynamics) with other mathematical disciplines (Lie groups and symmetric spaces, differential geometry, group representations, number theory), centered around the phenomenon of rigidity.


Information: W. Drady, Dept. of Math., Penn State Univ., University Park, PA 16802; 814-865-2266; email: rigidity@math.psu.edu.


17–24. Sixth International Conference on Geometry, University of Haifa, Israel. (May/Jun. 1990, p. 612)


22–23. Southeastern Section, University of South Florida, Tampa, FL.

Information: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.


24–29. Mathematical Approaches to DNA II (The Genome: DNA to Protein Structure), Santa Fe, NM. (Dec. 1990, p. 1453)


Invited Speakers: S.L. Adian (Steklov), H. Brezis (Paris), A.M. Odlyzko (AT&T Bell Labs), G.R. Brightwell (LSI), C.J.B. Brookes (Cambridge), A.P. Carbery (Sussex), C.M. Goldie (QM), F.C. Kirwan.
Meetings and Conferences


Information: G.R. Burton, School of Math. Sci., Univ. of Bath, Claverton Down, Bath BA2 7AY; tel: 0225 826218; email: grb@uk.ac.bath.maths.

* 25–April 12. Linear and Nonlinear Dispersive Waves, Mathematical Sciences Institute, Cornell University, Ithaca, NY.

Program: A series of nine lectures will be given by J.-C. Saut (Université Paris-Sud).

Information: E.S. Titi, Mathematical Sciences Institute, Cornell Univ., 409 College Ave., Ithaca, NY 14850; 607-255-8005.


April 1991


* 1–7. JAMI Workshop and Conference on Algebraic and Complex Geometry, Johns Hopkins Univ., Baltimore, MD.

Program: The conference will consist of invited lectures on April 4–7 and will follow a more informal workshop on April 1–3.


Information: Johns Hopkins Univ., Dept. of Math., Baltimore, MD 21218.


8–12. Seventh International Conference on Data Engineering, Kobe, Japan. (Apr. 1990, p. 500)


10–12. Fourth International Conference on Rewriting Techniques and Applications (RTA-91), Como, Italy. (Jul/Aug. 1990, p. 743)


15–19. IMA Workshop on Variational Problems, University of Minnesota, Minneapolis, MN. (Sep. 1990, p. 935)


20–21. Wabash Extramural Modern Analysis Miniconference, Indiana University-Purdue University, Indianapolis, IN. (Dec. 1990, p. 1453)

21–24. SUPER!: Supercomputing by University People for Education and Research, Park City, UT. (Nov. 1990, p. 1284)


21–May 4. NATO ASI Finite and Infinite Combinatorics in Sets and Logic, Banff, Canada. (Dec. 1990, p. 1453)


26–28. First Eugene Lukacs Symposium, Bowling Green State University, Bowling Green, OH. (Dec. 1990, p. 1453)


May 1991


13–18. IMA Workshop on Degenerate Difusions, University of Minnesota, Minneapolis, MN. (Sep. 1990, p. 935)


* 17–18. Annual Regional Group Theory Conference, Bucknell Univ., Lewisburg, PA.

Information: H. Smith or M. Ward, Dept. of Math., Bucknell Univ., Lewisburg, PA 17837; email: howsmith@bucknell.edu.
Meetings and Conferences

21–24. Quantization and Microlocal Analysis, Reims, France.

PROGRAM: This international conference is part of a special year on Semiclassical methods sponsored by the French C.N.R.S. and the D.R.E.D. (Ministry of National Education). Its purpose is to bring together people interested in Partial Differential Equations, Harmonic Analysis and Pseudodifferential analysis around the loose theme of quantization.


INFORMATION: A. Unterberger, Dept. de Math., Univ. de Reims, Moulin de la Housse, B.P. 347, 51062 Reims Cedex, France; tel: (33) 26.05.32-16.


30–31. Special Session on Polymer Configurations: Nonlinear and Nonlocal Diffusion Problems, University of Minnesota, Minneapolis, MN. (Nov. 1990, p. 1286)


June 1991


INFORMATION: Conference in Honor of Moshe Zakai, Dept. of Electrical Engineering, Technion, Haifa 32000, Israel; tel: 972-4-294676; email: zo@techsel.bitnet.

5–15. A Normal Form for the Navier-Stokes Equations and Its Connection to Turbulence, Mathematical Sciences Institute, Cornell University, Ithaca, NY.

PROGRAM: A series of four lectures will be given by Ciprian Foias (Indiana Univ.);


9–28. NSF Faculty Workshop on Computer-Aided Instruction in Linear Algebra and Differential Equations, University of New Hampshire, Durham, NH.

PROJECT DIRECTORS: L.L. Zia, H. Bechtell.

INFORMATION: Applications should be postmarked no later than March 15, 1991. Participation will be limited to thirty faculty. Direct preliminary inquiries to: CAI Workshop, Dept. of Math., Univ. of New Hampshire, Durham, NH 03824; 603-862-2320; email: Lzia@unh.unh.edu.


PURPOSE: The theme of the conference will be the properties of spaces and loop spaces in the presence of a finiteness condition, including in particular: classifying spaces, loop space decompositions, finite H-spaces and rational/algebraic h­motopy. Our hope is for a "workshop" atmosphere that will lead to an exchange of ideas and techniques among these various subareas. Younger mathematicians, including graduate students, are particularly welcome.

INFORMATION: S. Halpern, Scarborough Campus, Univ. of Toronto, 1265 Military Trail, Scarborough, Ontario M1C 1A4; email: halper@lake.scar.toronto.edu; 416-287-7265; Fax: 416-287-7013. Accommodation will be available from Sunday, June 9 to Saturday, June 16.

11–July 5. Miniworkshop on Nonlinearity: Fractals, Pattern Formation, Trieste, Italy.

CHAIRMAN: H.A. Cerdeira, Trieste.

INFORMATION: International Centre for Theor. Physics, P.O. Box 586, Miramare, Strada Costiera 11, I-34100 Trieste.

13–15. Western Sectional Meeting, Portland State University, Portland, Oregon.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.


Meetings and Conferences


INFORMATION: M. Pappalardo, Dept. of Math., Univ. of Pisa, Via Buonarroti, 2, 56100 Pisa, Italy, Fax: 0039-50-599524; email: pappalar@dm.unipi.it.

* 20–27. NP-Completeness: The First 20 Years, Erice (Trapani), Sicily.


PROGRAM COMMITTEE: Korte (Germany), Lawler (U.S.), Lucertini (Italy), Luccio (Italy), Rinnoy Kan (The Netherlands), Toth (Italy), Welsh (U.K.).

INFORMATION: G. Gallo, Dept. of Comp. Sci., Univ. of Pisa, Corso Italia, 40 56100 Pisa, Italy; Fax: 0039-50-510226.


* 23–30. International Category Theory Meeting, Montreal, Quebec, Canada.


* 24–27. Barsotti Memorial Symposium on Algebraic Geometry, Abano Terme, Italy.

PROGRAM: A series of invited addresses on algebraic geometry, most of which will deal with areas of algebraic geometry enriched by the mathematical heritage of the late Iacopo Barsotti. Facilities for supplementary informal gatherings will be provided.


INFORMATION: INRIA-Rocquencourt, Relations Exterieures, Bureau des Colloques–ICLP '91, Domaine de Voluceau, BP 105, F-78153 Le Chesnay Cedex.


26–28. Local Communications Systems: LAN and PBX, Palma, Balearic Islands, Spain.

INFORMATION: Univ. de les Illes Balears, Dept. de Matematiques i Informatica, Cra. de Valldemossa, km. 7.6, 07071 Palma, Spain.


July 1991


* 1–26. NSF Geometry Institute - Geometry in the Machine Age, Mount Holyoke College, South Hadley, MA.

PROGRAM: Amherst, Hampshire, Holy Cross, Mount Holyoke, Smith, and Williams Colleges and the University of Massachusetts at Amherst will host this NSF-funded Institute. The first year will focus on Optimization Problems in Geometry. The institute will bring together geometry researchers, high school faculty, education researchers, and undergraduate and graduate students. Substantial interaction between the groups is expected. Forty geomet- rizers are being sought who have 1) an established research program (or active research interests) in the area of focus (e.g. minimal surfaces, calibrations, harmonic maps, isoparametric foliations) and 2) an openness to educational activities and willingness to engage in discussion with members of our profession outside of university mathematics departments. To apply send a letter of interest, a research plan, and a CV listing two references to the address below. Preference will be given to individuals who can stay the entire month. Lodging, meals and transportation will be covered by the Institute and participants not supported by regular NSF grants will receive a modest stipend. The institute will help arrange suitable child care for accompanying children.


INFORMATION: D. O'Shea, NSF RGI Program, Five Colleges, Inc., P.O. Box 740, Amherst, MA 01004; email: geometry@mhc.bitnet or geometry@math.umass.edu.


* 2–5. International Conference on Complexity: Fractals, Spin Glasses and Neural Networks, Trieste, Italy.


INFORMATION: International Centre for Theor. Physics, P.O. Box 586, Miramare, Strada Ca-tiera 11, I-34100 Trieste.


7–12. Fifth Gregynog Symposium on Differential Equations, University of Wales, UK. (Nov. 1990, p. 1287)


* 7–20. Eighth International Conference on Probability in Banach Spaces, Bowdoin College, Brunswick, ME.

PROGRAM: The first week will focus on probability in separable Banach spaces while the emphasis of the second week will be empirical processes. The meeting is intended to bring together analysts, probabilists, statisticians and theoretical computer scientists who have been working on different aspects of related problems. Two mini-courses have been arranged and five speakers have agreed to deliver hour addresses. The remainder of the schedule will be filled by talks from the participants.
Meetings and Conferences


INVITED SPEAKERS: Mini-Courses: M. Talagrand—Majorizing Measures (first week); E. Gine, J. Zinn—Empirical Processes and the Bootstrap (second week).

Hour Addresses: A. de Acosta, E. Bohlhausen, M. Marcus, G. Pisier, G. Schechtman.

INFORMATION: M.G. Hahn, Dept. of Math., Tufts Univ., Medford, MA 02155; 617-628-5000 x2363; email: mahhn@jade.cc.tufts.edu.


CONFERENCE TOPICS: Approximation of solutions of partial differential equations on closed subsets of N-dimensional Euclidean space or Riemann surfaces by globally defined solutions; characterizing domains in N-dimensional Euclidean space such as balls, annuli, strips, cylinders etc. by means of quadrature formulae; best \( L^1 \) and best \( L^\infty \) approximation; and related topics.

INVITED SPEAKERS: The list that was mentioned in the Oct. issue was only a partial list.


INFORMATION: G. Pilz, Institut für Mathematik, Universität Linz, A-4040 Linz, Austria.

*14–27. 1991 NATO Advanced Study Institute: Probabilistic and Stochastic Methods in Analysis, with Applications, Castelvecchio Pascoli (Lucca), Italy.

PROGRAM: The institute will be divided into four sections: 1) Wavelets and fractals; 2) Applications in engineering; 3) Stochastic calculus; 4) Applications in mathematics. The institute is supported by NATO, AFSOR, ONR, Prometheus Inc.

INVITED SPEAKERS: J.J. Benedetto (Univ. of Maryland and Prometheus Inc.) - Stationary frames and spectral estimation; G. Benke (MITRE Corp.) - Random trigonometric polynomials and their applications; G. Brown (Univ. of New South Wales and Prometheus Inc.) - Normal numbers and dynamical systems; P. Can­narsa (Univ. of Pisa and Prometheus Inc.) - Stochastic optimal control; J.P. Kahane (Univ. of Paris-Orsay) - Some continuations of the work of Paley and Zygmund on random trigonometric series; G. Kallianpur (Univ. of North Carolina and Prometheus Inc.) - Stochastic differential equations in infinite dimensions; S. Mallat (Courant Institute) - Characterization of singularities from wavelet transform maxima; Y. Meyer (Univ. of Paris-Dauphine) - Wavelets and applications; D.J. Newman (Temple Univ. and Prometheus Inc.) - Probability in logic; J. Peyriere (Univ. of Paris-Orsay) - On the multifractal analysis of measures; A. Papoulis (Polytechnic Univ. of NY) - Topics in sampling theory; B. Saffari (Univ. of Paris-Orsay and Prometheus Inc.) - Applications of probability methods to some extremal problems in Fourier analysis; W. Schempp (Univ. of Siegen) - Quantum Holography.

CALL FOR PAPERS: February 1, 1991: Deadline for receipt of request to participate, the title and abstract of the paper you would like to present (optional), and an indication if you will require financial support. NOTE: Preference will be given to people who communicate by electronic mail and who agree to prepare their paper (if presenting one) in \( \TeX \) (any version). Also, there is special support available for U.S. citizens who are upper-level graduate students or have recent PhDs.

INFORMATION: J. Byrnes, Prometheus Inc., 21 Arnold Ave., Newport, RI 02840; email: asi@cs.umb.edu; 401-849-5389 or 401-841-5048.


15–17. International Symposium on Symbolic and Algebraic Computation (ISSAC '91), Bonn, Germany.

PROGRAM: The conference will feature original research contributions, demonstrations of hardware and software and invited lectures.

CONFERENCE TOPICS: Algorithms, lang­uages and systems for symbolic and algebraic computation; Automatic theorem proving and programming; Computational geometry, group theory and number theory; Interface/integration of symbolic, nu­meric, graphics computing; Applications of computer algebra in science, engineer­ing and education.

INFORMATION: ISSAC '91 Conference Office, C. Harms, GMD. Schloß Birlinghoven, P.O. Box 1240, D-5205 St. Augustin 1, Tel: 49-2241-142473; Tele­fax: 49-2241-142618; email: gf1022@dbnmgd21.bitnet.


PURPOSE: The objective of the meeting is to facilitate communication among biologists, ecologists, economists, engineers, mathematicians, physicists and other scientists who share an interest in resource modelling.

INVITED SPEAKERS: A. Laurec (IFREMER, Paris, Fr.), Population dynamics in fisheries; R. Marga­fle (Univ. of Barcelona, Spain), Ecology; M. Sykes (Univ. of Up­psala, Sweden), Management models in forestry; M. Usher (Univ. of York, U.K.), Succession models in forestry; J. Wage­nsberg (Univ. of Barcelona, Spain), Theoretical biology and nonequilibrium dynamics; and others pending.


INFORMATION: P. Rubies, Inst. de Cien­cias del mar, P. Nacional s/n, 08039 Barcelona, Spain; tel: 3-310 64 16; Fax: 3-319 98 42; email: ccicm@ceab.es.bitnet.

*15–August 2. Conference on Recent Develop­ments in Differential Equations and Eco­logical Modeling, University of Wyoming, Laramie, WY.

PROGRAM: Mornings will be devoted to lectures by the speakers which will address selected important and recent develop­ments in differential equations and eco­logical modeling. Afternoons will be devoted to discussions, work sessions and/or talks which will assist in the incorporation of these ideas and concepts into college courses at all levels. Funds to cover living costs and a few small stipends are available. See advertisement in this issue of Notices.

INVITED SPEAKERS: The main speakers will be H.I. Freedman, University of Alberta and P.E. Waltman, Emory University, Both will lecture for the entire three weeks.

INFORMATION: A.D. Porter, Mathematics Department, P.O. Box 3036, University Station, University of Wyoming, Laramie, WY 82071-3036.
Meetings and Conferences

August 1991


7-14. 1991 ASL, European Summer Meeting (Logic Colloquium '91) in conjunction with the Ninth International Congress of Logic, Methodology and Philosophy of Science, Uppsala, Sweden. (Dec. 1990, p. 1456)

8-11. Joint Mathematics Meetings, University of Maine, Orono, ME. (including the summer meetings of the AMS, AWM, MAA, and PE)


14-16. Short Conference on Uniform Mathematics and Applications (International Conference on Quasi-Uniformities and Related Structures), Bern, Switzerland. (Sep. 1990, p. 937)


18-24. The Third Conference of the Canadian Number Theory Association, Queen’s University, Kingston, Ontario. (Sep. 1990, p. 938)


19-23. NSF-CBMS Regional Research Conferences in the Mathematical Sciences: Qualitative and Structured Matrix Theory, Georgia State University, GA. (Dec. 1990, p. 1456)


September 1991


3-6. Seventeenth International Conference on Very Large Data Bases (VLDB ‘91), Barcelona (Catalonia, Spain).

Program: VLDB conferences are a truly international forum for identifying, encouraging and exchanging ideas and experiences on research, development and novel applications of database management systems and techniques. Like its predecessors, this conference aims at bringing together researchers, developers and users of database management systems from academia and industry, to share this information and explore new and challenging issues.

Conference Topics: Logic, deductive, and knowledge base systems; extensible, temporal and multi-media databases; active and real-time database systems; advanced applications and requirements; object-oriented and semantic databases; data models, languages, and user interfaces; data structures, access methods, and complex objects; database theory and algorithms; query optimization, database
design, and performance; storage management, database machines, and parallelism; database integrity and security; concurrency control, transaction processing, and recovery; distributed and heterogeneous databases.

CALL FOR PAPERS: Original papers of up to 5,000 words in length are invited on topics including, but not limited to, those listed above. Send five copies of double-spaced manuscript, in English, including keywords, to one of the program chairs by February 15, 1991: A. Semadas, INESC, Rua Alves Redol, 9, 7º. Apartado 10105, P-1017 Lisboa Codex (Portugal), Internet (US): ineslaacs%sole@relay.eu.net; (Europe) acs%sole@inesc.uct.pt or acs@inesc.pt or G.M. Lohman, IBM Almaden Research Center, Dept. K35, Bldg. 801, 800 Harry Rd., San Jose, CA 95120-6099 (U.S.A.); internet: lohman@ibm.com or bitnet: lohman@almaden.

INFORMATION: VLDB '91 - DIFINSA, Av. Republica Argentina, 63, Entr. 4º, E-08023 Barcelona, Catalonia (Spain); tel: 34-3-418.80.67; Fax: 34-3-418.44.07.

* 3–6. Functional Integration and its Applications, Trieste, Italy.


INFORMATION: Intern. Centre for Theor. Physics, P.O. Box 586, Miramare, Strada Costiera 11, I-34100 Trieste.

* 3–10. Applied Mathematics in the Aerospace Field. Erice (Trapani), Sicily.


INFORMATION: A. Salvetti, Dept. Ingneria Aerospaziale, Univ. di Pisa, Via Diotsalvi, Pisa, Italy; Fax: 0039-50-500987; Tel: 0039-50-550200.

4–10. IMA Tutorial, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1139)


CHAIRMAN: Jan de Lange.


9–27. School on Dynamical Systems, Trieste, Italy. (Sep. 1990, p. 938)


11–13. IFAC/IFIP/IMACS Symposium on Robot Control (SYROCO '91), Vienna, Austria. (Oct. 1990, p. 1140)

11–14. Fourth SIAM Conference on Applied Linear Algebra, Univ. of Minnesota, Minneapolis, MN. (Nov. 1990, p. 1288)


October 1991


7–11. Workshop on Stochastic and Deterministic Models, Trieste, Italy. (Sep. 1990, p. 938)

7–11. IMA-INRIA Workshop on Transfer of Mathematics to Industry in the U.S. and France, University of Minnesota, Minneapolis, MN. (Dec. 1990, p. 1458)


INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.


14–18. IMA Workshop on Sparse Matrix Computations: Graph Theory Issues and Algorithms, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1140)

16–18. SIAM Workshop on Micromechanics, Leesburg, VA. (Nov. 1990, p. 1288)

* 18–19. Differential and Delay Equations, Iowa State University, Ames, Iowa.

PROGRAM: Meeting on the occasion of the retirement of George Seifert.


INFORMATION: A.M. Fink, Iowa State University of Science and Technology, Dept. of Math., 400 Carver Hall, Ames, Iowa 50011; 515-294-1752; si.mth@isunws.bitnet.


CHAIRMEN: J.O. Berger, West Lafayette; J. Leh, Darmstadt; D. Plachky, Münster.


Meetings and Conferences

November 1991


9–10. Western Sectional Meeting, University of California, Santa Barbara.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

11–15. IMA Workshop on Combinatorial and Graph-Theoretic Problems in Linear Algebra, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1140)


25–26. Central Section, North Dakota State University, Fargo, ND.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

December 1991


2–9. SIAM Conference on Combustion, St. Petersburg, FL. (Nov. 1990, p. 1289)


January 1992


CHAIRMEN: B. Korte, Bonn; K. Ritter, München.


*5–8. Second Caribbean Conference on the Fluid Dynamics, University of the West Indies, St. Augustine, Trinidad.


INVITED SPEAKERS: J. Lighthill (U.K.), T. Tzdyvar (U.S.A.), A. Davenport (Canada), J. Delery (France), J.P. Brill (U.S.A.), G.S. Ackers (U.S.A.), S.M. Ali (Canada), T.E. Unny (Canada), G.A. Barenblatt (Russia).

CALL FOR PAPERS: Papers from all areas of Newtonian and non-Newtonian Fluid Dynamics are solicited. An award will be made to the authors of the best paper. Abstracts of about 500 words should be submitted in duplicate not later than March 31, 1991 to: Editorial Committee, CACOFD '92, Dept. of Math., The Univ. of the West Indies, St. Augustine, Trinidad, W.I.

INFORMATION: H. Ramkisson, Chair, Organizing Committee, Dept. of Math., The Univ. of the West Indies, St. Augustine, Trinidad; Fax: 809-662-4414.

*8–11. Joint Mathematics Meetings, Baltimore, MD. (including the annual meetings of the AMS, AWM, MAA and NAM)

INFORMATION: H. Daly, AMS, P.O. Box 6248, Providence, RI 02940.


CHAIRMEN: G. Iooss, Nice; H. Kielhöfer, Augsburg; J.E. Marsden, Berkeley; J. Scheurerle, Hamburg.


*13–17. IMA Workshop on Linear Algebra, Markov Chains, and Queueing Models, University of Minnesota, Minneapolis, MN. (Oct. 1990, p. 1141)


February 1992

*2–8. Thermodynamische Materialtheorien, Oberwolfach, Federal Republic of Germany.

CHAIRMEN: W. Bürger, Karlsruhe; I. Müller, Berlin.


CHAIRMEN: W. Hackbusch, Kiel; R. Rannacher, Heidelberg; O. Widlund, New York.


CHAIRMEN: G. Frank, Berlin; S. Rucheweyh, Würzburg; K. Strebel, Zürich.


CHAIRMEN: S. Bosch, Münster; L. Gerritz, Bochum; A. Ougs, Berkeley.


The following new announcements will not be repeated until the criteria in the last paragraph in the box at the beginning of this section are met.
March 1992


Chairmen: H.-W. Henn, Heidelberg; H. Miller, Cambridge; D. Puppe, Heidelberg.


Chairmen: R. Grübel, Delft; G. Kersting, Frankfurt.


August 1992


Call for papers: Papers will be accepted in all areas of theoretical and applied mechanics, but the following three topics will receive special attention as subjects of mini-symposia: Instabilities in solid structural mechanics, sea surface mechanics and air-sea interaction, biomechanics. The submitting author should prepare 6 copies of an Extended Summary of about 500 words and an Abstract of 100-150 words. The abstract must be typed double-spaced on a single page. The above material should be submitted to arrive before January 15, 1992 to the address below.

Information: A. Solan, Secretary IC TAM 1992, Faculty of Mechanical Engineering, Technion–Israel Institute of Technology, Haifa 32000, Israel.

CALL FOR SUGGESTIONS

AMS Reprint Series

Changes in tax laws have made it less profitable and sometimes even unprofitable for commercial publishers to keep books in print. As a result, some good books have been allowed to go out of print. The Society has established a reprint series as a service to the mathematical community. The Series will contain books of lasting interest and value. A Committee on Reprinted Books has been appointed to judge the suitability of available books for reprinting. Suggestions of books to be included should be sent to:

Director of Publication
American Mathematical Society
P.O. Box 6248
Providence, RI 02940

It would be helpful if a short description and information such as the original publisher were included.
New AMS Publications

NOETHER-LEFSCHETZ THEORY AND THE PICARD GROUP OF PROJECTIVE SURFACES
Angelo Felice Lopez
(Memoirs of the AMS, Number 438)

This book deals with the study of curves lying on general members of families of smooth projective surfaces over the complex numbers. The guiding philosophy is that the set of curves on such surfaces is as small as it can possibly be; more precisely, this means that the group of classes of Cartier divisors (or, equivalently, the group of line bundles called the Picard group) of a general surface has the lowest possible rank given by the geometry of the family.

The focus of the book is Noether-Lefschetz theory, the study of the locus of smooth surfaces in \( \mathbb{P}^3 \) whose Picard group is not \( \mathbb{Z} \). The first part of the book presents a brief survey of basic concepts and results, together with some natural questions arising in the theory. In the second part, a deformation-theoretic technique introduced by Griffiths and Harris is used to determine the Picard group of a general surface in \( \mathbb{P}^3 \) containing a fixed curve. This idea is generalized in the third part to families of surfaces in higher projective spaces, namely complete intersection surfaces in \( \mathbb{P}^n \) and projectively Cohen-Macaulay surfaces in \( \mathbb{P}^4 \).

Contents
Part I: A brief survey of Noether-Lefschetz problems: The
Noether-Lefschetz theorem; Components of the Noether-Lefschetz locus; Higher dimensional problems; Part II: The Picard group of a general surface containing a space curve: Some classical facts; The results; Part III: The Picard group of some general surfaces in \( \mathbb{P}^n \): The generalization of Theorem II.3.1 in \( \mathbb{P}^{n-2} \); The Picard group of general residual surfaces in \( \mathbb{P}^4 \); The Picard group of general projectively Cohen-Macaulay surfaces in \( \mathbb{P}^3 \).

1980 Mathematics Subject Classifications: 14J05, 14C22, 14J25, 14M12
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EXTRAPOLATION THEORY WITH APPLICATIONS
Bjorn Jawerth and Mario Milman
(Memoirs of the AMS, Number 440)

In the last few decades, interpolation theory has become an established field with many interesting applications to classical and modern analysis. In this book, the authors develop a general theory of extrapolation spaces, which is a complement to the familiar theory of interpolation spaces. Their results allow an extension of the classical extrapolation theorem of Yano to scales of Banach spaces. They give applications to classical and modern analysis, including extreme forms of Sobolev imbedding theorems, rearrangement inequalities for classical operators, and Nash-Moser implicit function theorems.

Use the order form in the back of this issue or call 800-321-4AMS (800-321-4267) in the U.S. and Canada to use VISA or MasterCard.

JANUARY 1991, VOLUME 38, NUMBER 1
THEORY AND APPLICATIONS OF DIFFERENTIABLE FUNCTIONS OF SEVERAL VARIABLES. XIII
S. M. Nikol'skii, Editor
(Proceedings of the Steklov Institute, Volume 187)

This collection of papers deals with investigations into various problems in the theory of differentiable functions of several variables and the application of this theory to differential equations and numerical methods of solution. Among the topics covered are: embeddings of various spaces of differentiable functions and their dependence on the domain of definition, multipliers and bases in weighted spaces, various approximations of smooth functions and their representation with the use of series and integrals, spectral problems related to ordinary differential operators with singular coefficients, solutions of regular partial differential equations with emphasis on their behavior at infinity, and a block method for approximate solution of the Laplace equation.

Contents

ISBN 0-8218-3135-5, LC 68-1677, ISSN 0081-5438

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The following publication originally appeared in the September 1990 issue of Notices. It is being reprinted here with the corrected Table of

FESTSCHRIFT IN HONOR OF I. I. PIATETSKI-SHAPIO, PARTS I–II
S. Gelbart, R. Howe, and P. Sarnak, Editors
(Israel Mathematical Conference Proceedings, Volume 2–3)

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56 NOTICES OF THE AMERICAN MATHEMATICAL SOCIETY
Miscellaneous

Personals
Arjun K. Gupta, Professor and former Chair of the Department of Mathematics and Statistics, Bowling Green State University, has been awarded the Olscamp Research Award in recognition of his outstanding scholarly achievements.

Deaths
James H. Case, of the University of Utah, died on October 23, 1990, at the age of 62. He was a member of the Society for 36 years.
Edwin E. Floyd, of the University of Virginia, died on December 9, 1990, at the age of 66. He was a member of the Society for 15 years.
Cletus O. Oakley, Professor Emeritus at Haverford College, died on November 12, 1990, at the age of 91. He was a member of the Society for 62 years.

Robert R. Stoll, Professor Emeritus at Cleveland State University, died on November 4, 1990, at the age of 75. He was a member of the Society for 51 years.
Liang Zhongchao, of the Oceanographic Institute of Qingdao, died on October 17, 1990. He was a member of the Society for one year.
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Applicants in combinatorics are sought for a tenure-track appointment at the rank of assistant professor expected to be made beginning September 1991. Preference given to candidates in discrete optimization, coding theory, cryptology, extremal set theory, or association schemes.

Some temporary one-year appointments at the rank of assistant professor are also expected beginning September 1991. Preference given to applicants in differential equations. Those in algebra, analysis, combinatorics, linear algebra or probability considered. Research interests compatible with current faculty.

Excellence required in both teaching and research for all positions. Send resume and arrange for at least three letters of recommendation to be sent to James Wall, 120 Math Annex, Auburn University, AL 36849-5307. Minorities and women are encouraged to apply. Auburn University is an Equal Opportunity/ Affirmative Action Employer.

THE UNIVERSITY OF ALABAMA AT BIRMINGHAM
Department of Mathematics

Applications are invited for one or more anticipated tenure or tenure-track positions. Preference will be given to strong candidates whose research interests are compatible with those of our current faculty; this includes numerical PDE/Scientific computation, mathematical physics, partial differential equations, nonlinear analysis, dynamical systems, including topological dynamics, differential topology and differential geometry. Faculty members have access to the Alabama Supercomputer (using a Sun Station and a T-1 line to a Cray X-MP/24). Rank and salary will be subject to qualifications. Send as soon as possible a curriculum vitae, selected reprints, and three letters of reference to Search Committee, Department of Mathematics, University of Alabama at Birmingham, Birmingham, AL 35294. UAB is an Affirmative Action/Equal Opportunity Employer.

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ics, The University of Alabama, Box 870350, Tuscaloosa, AL 35487-0350. UA is an AA/EOE.

UNIVERSITY OF SOUTH ALABAMA
Department of Mathematics and Statistics

Several tenure-track positions starting September 1, 1991. Appointment will be made at the Assistant Professor or possibly Associate Professor level. Applicants must have a Ph.D. in Mathematics (earned or anticipated by 9/1/91). Strong research potential and a commitment to excellence in teaching are required. The successful candidate for appointments as Associate Professor must also demonstrate significant research accomplishments. Preference will be given to areas complementing existing research specialties. Salaries will be competitive. Applications will be accepted until positions are filled, but should be completed by 1/31/91 to ensure consideration. Please send detailed resume and arrange to have three letters of recommendation sent to Dr. Suzanne McGill, Chair; Department of Math/Stat; University of South Alabama; Mobile, AL 36688. An Equal Opportunity/Affirmative Action Employer.

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UNIVERSITY OF ARIZONA
Department of Mathematics
Tucson, Arizona 85721

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Tenure-track positions. Excellent research record or potential, strong commitment to teaching required. Fields should complement but not duplicate existing department research strengths in algebra, arithmetic geometry, computational science, differential equations, dynamical systems, fluid mechanics, differential geometry, mathematical physics, nonlinear analysis, nonlinear science, number theory, and probability. 

Postdoctoral Fellowships (Research Associate). Applicants with strengths in all areas compatible with department interests, but specifically geometry and mathematical physics are encouraged to respond. In addition, special Center of Excellence Awards in nonlinear optics and fluid mechanics are available.

The Mathematics Department will also have several visiting positions for next year.

We encourage early application. Deadline date will be February 1, 1991 or whenever positions are filled. Women and minority applicants are especially welcome. Send applications to: Alan C. Newell, Head Department of Mathematics University of Arizona Tucson, Arizona 85721, USA

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UNIVERSITY OF ARIZONA
Chairman
Program in Applied Mathematics

The University of Arizona invites nominations and applications for the position of Chairman of the Interdisciplinary Program in Applied Mathematics, effective July 1, 1991. The Chairman will be responsible for administering the Program, which offers degrees at the masters and doctoral level, and for fostering interdisciplinary research involving applications of mathematics. The Chairman of the Program reports directly to the Vice President for Research. He or she will also hold a faculty appointment in the Department of Mathematics and/or other relevant Departments.

The Program is extremely active with a strong international reputation. There are more than 80 graduate students currently enrolled and the Program has 85 participating faculty members drawn from departments throughout the University. The University of Arizona is a major research and teaching institution of more than 35,000 students. It is located in Tucson, which offers many recreational and cultural opportunities. The University has demonstrated a strong commitment to interdisciplinary research and the Program in Applied Mathematics plays a leading role in this endeavor.

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1. Strong intellectual leadership.
2. Academic experience related to mathematics and its applications.
3. Experience in, and commitment to, graduate student education.
4. Management and organizational skills.

The deadline for applications is February 1, 1991 or whenever the position is filled. Nominations and applications should be sent to: Professor Alan C. Newell, Department of Mathematics, University of Arizona, Tucson, AZ 85721.

The University is an Equal Opportunity/Affirmative Action Employer and welcomes women and minority applicants.

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Applications are invited for two tenure-track positions at the rank of Assistant Professor for the Fall of 1991. We will consider candidates in the areas of algebra, analysis, topology, applied mathematics or mathematical physics. Requirements include receipt of a Ph.D. by the Fall of 1991, demonstrated record or potential in research, and a strong commitment to teaching. Responsibilities include teaching 9-12 hours, depending on research and/or other contributions. Send vita and three letters of recommendation to Mary Rosen, Hiring Committee Chair, Dept. of Mathematics, California State University, Northridge, Northridge, CA 91330 by February 15, 1991 for full consideration. Women and minorities are especially encouraged to apply. CSUN is located in a Northwestern suburb of Los Angeles and is in proximity to Cal. Tech., USC, and UCLA. An Equal Opportunity/Affirmative Action, Title IX, Section 504 Employer.

CALIFORNIA STATE UNIVERSITY SAN BERNARDINO

Department of Mathematics

Applications are being accepted for the position of Assistant Professor or Associate Professor (tenure-track); a Ph.D. in mathematics education with at least a bachelor's degree in mathematics is required. Successful candidates will be expected to teach twelve hours per week, participate in scholarly activities, and help implement a new MAT program. Current salary range is $30,276-$52,896 dependent upon qualifications and experience. Applicants should submit a letter of application, vita, three letters of recommendation and all transcripts. Applications received after February 1, 1991, cannot be guaranteed consideration. Materials should be sent to: Dr. John Sarli, Chair, Department of Mathematics, California State University, 5500 University Parkway, San Bernardino, California 92407. AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION, SECTION 504, TITLE IX EMPLOYER.

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Applications are invited for the position of Assistant Professor or Associate Professor (tenure-track); a Ph.D. in Mathematics or Statistics. All specializations within Mathematics will be considered.

Mathematics Position. Candidates with a strong background in mathematics are encouraged to apply with a demonstrable interest in other scholarly activities. A Ph.D. in Mathematics or Statistics is required. The successful candidate will be expected to teach twelve hours per week, participate in scholarly activities, and help implement a new MAT program. Current salary range is $30,276-$52,896 dependent upon qualifications and experience. Applicants should submit a letter of application, vita, three letters of recommendation and all transcripts. Applications received after February 15, 1991, cannot be guaranteed consideration. Materials should be sent to: Professor Alan C. Newell, Department of Mathematics, University of Arizona, Tucson, AZ 85721.

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Applications are invited for a tenure-track position in the Department of Mathematics at the assistant professor or associate professor level. Preference will be given to applicants with experience and expertise in an applied mathematical science, including differential equations, numerical analysis, applied statistics, and computer science.

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Occidental College is a selective private college of the liberal arts and sciences with 1650 undergraduate students, a college faculty of 133, and a mathematics faculty of nine. Occidental is located in northeast Los Angeles, a fifteen minute drive from downtown Los Angeles and ten minutes from Pasadena.

Salary is competitive. An excellent benefits package includes a choice of health care plans, tuition grants for children of faculty, and a mortgage subsidy program.

Completed applications, including a current resume, a statement of professional goals, and three letters of reference (at least one evaluating teaching performance and potential) should be received by February 16, 1991. Address all materials to Faculty Search Committee, Department of Mathematics, Occidental College, Los Angeles, CA 90041.

Occidental College is an Equal Opportunity/Affirmative Action Employer and encourages applications from women and ethnic minorities.

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Applications are invited for a tenure-track position in the Department of Mathematics at the assistant professor or associate professor level. Preference will be given to applicants with experience and expertise in an applied mathematical science, including differential equations, numerical analysis, applied statistics, and computer science.

Excellence in teaching and substantial professional achievement are the major expectations. The normal teaching schedule is two courses during each of three ten-week terms; new faculty members are released from one course during the initial year. Each faculty member receives a sabbatical term every three years; some institutional support for extended leaves is available.

Occidental College is a selective private college of the liberal arts and sciences with 1650 undergraduate students, a college faculty of 133, and a mathematics faculty of nine. Occidental is located in northeast Los Angeles, a fifteen minute drive from downtown Los Angeles and ten minutes from Pasadena.

Salary is competitive. An excellent benefits package includes a choice of health care plans, tuition grants for children of faculty, and a mortgage subsidy program.

Completed applications, including a current resume, a statement of professional goals, and three letters of reference (at least one evaluating teaching performance and potential) should be received by February 16, 1991. Address all materials to Faculty Search Committee, Department of Mathematics, Occidental College, Los Angeles, CA 90041.

Occidental College is an Equal Opportunity/Affirmative Action Employer and encourages applications from women and ethnic minorities.

OCCIDENTAL COLLEGE

Director, Academic Excellence Program in Mathematics and Chemistry, Occidental College. Faculty position to direct a workshop based excellence program for the first year classes in mathematics and chemistry, work closely with the faculty in the two departments in coordinating the program's operation, advise math and science students particularly minority students concerning opportunities in science. The successful candidate must have an advanced degree in mathematics or chemistry, possess strong communication and administrative skills, and experience working with student groups in a multicultural environment. To apply, submit a letter of application, a resume, transcripts, and three letters of reference by 20 January 1991 to: Dr. Chris Craney, Chemistry Department, Occidental College, 1600 Campus Road, Los Angeles, CA 90041. Occidental College is an Equal Opportunity/Equal Employment Employer and especially invites applications from women and minorities.
POMONA COLLEGE
Claremont, CA

Pomona College seeks to hire a tenure-track Assistant Professor of Mathematics, preferably with postdoctoral experience. Excellent candidates from all fields of mathematics will be seriously considered, but preference will be given to applied mathematicians. Pomona College, a highly selective liberal arts college with intellectually gifted students, is one of the Claremont Colleges, which together provide an active professional community of over 30 mathematicians, an excellent research library, weekly Mathematics Colloquia, research seminars, and clinics in applied mathematics. We are looking for someone who can continue Pomona’s tradition of excellent and innovative teaching and who will actively participate in the mathematical life of the Claremont Colleges.

Applications are to be sent to: The Search Committee, Department of Mathematics, Pomona College, Claremont, CA 91711-6348. Applications received by January 31, 1991, will be given full consideration. Applications must include vita and letters of recommendation, including letters evaluating teaching, graduate school transcripts, and a description, written for the non-specialist, of research accomplishments and plans. Please let us know if you will be attending the January AMS meeting in San Francisco.

Pomona College is an Affirmative Action/Equal Opportunity Employer and encourages applications from minority candidates and women.

UNIVERSITY OF CALIFORNIA
LOS ANGELES
Department of Mathematics

TEMPORARY POSITIONS
(1) Two E. R. Hedrick Assistant Professorships. Applicants must show very strong promise in research and teaching. Salary $38,500. Three year appointment. Teaching load: four quarter courses per year, which may include one advanced course in the candidate’s field. Preference will be given to applications completed by January 1, 1991.

(2) Subject to administrative approval, several Research Assistant Professorships in Computational and Applied Mathematics. Applicants must show very strong promise in research and teaching. Salary $38,500. One year appointment, probably renewable up to two times. Teaching load: at most four quarter courses per year, which may include one advanced course in the candidate’s field. Preference will be given to applications completed by January 1, 1991.

Applications should include one advanced course in the candidate’s field. Preference includes letters evaluating teaching, graduate school transcripts, and a description, written for the non-specialist, of research accomplishments and plans. Please let us know if you will be attending the January AMS meeting in San Francisco.

UNIVERSITY OF CALIFORNIA, RIVERSIDE
Position in Pure and Applied Mathematics

APPLICANTS are invited to apply for several faculty positions in Mathematics, including one at the level of Assistant Professor of Mathematics. The department is interested in strong candidates who can contribute to the diversity of the discipline. A doctoral degree is required. Salary range: $33,900-$38,200. Initial application deadline is January 1, 1991. Applications received after that date will be considered.

Applications are to be sent to: Professor Richard Block, Chair, Department of Mathematics, University of California, Riverside, CA 92521-0135 by January 22, 1991. UCR is an Affirmative Action/Equal Opportunity Employer.

UNIVERSITY OF CALIFORNIA, RIVERSIDE
Position in Algebra or Combinatorics

Applications and nominations are invited for a tenure-track position in Algebra or Combinatorics beginning July 1, 1991. The position is at the rank of Assistant or Associate Professor; candidates in all areas of geometric analysis will be considered. Excellence in research and teaching is required. Established criteria of the University of California determine salary and rank. To assure full consideration, applicants should send their curriculum vita and list of publications and have at least three letters of recommendation sent to:

Professor Richard Block, Chair
Department of Mathematics
University of California
Riverside, CA 92521-0135


UNIVERSITY OF CALIFORNIA, SANTA CRUZ
Department of Mathematics

Applications and nominations are invited for a tenure-track position in Analysis beginning July 1, 1991 or later. The position is at the rank of Assistant or Associate Professor; candidates in all areas of classical and modern analysis (including probability theory) will be considered. Excellence in research and teaching is required. Established criteria of the University of California determine salary and rank. To assure full consideration, applicants should send their curriculum vita and list of publications and have at least three letters of recommendation sent to:

Professor Richard Block, Chair
Department of Mathematics
University of California
Santa Cruz, CA 95064


UNIVERSITY OF CALIFORNIA, LOS ANGELES
Department of Mathematics

REGULAR POSITIONS IN PURE AND APPLIED MATHEMATICS

Subject to administrative approval, two regular positions in pure and applied mathematics. The six specific search areas are as follows:

1. Logic and mathematical computer science
2. Algebra (including algebraic geometry and representation theory, number theory and combinatorics)
3. Geometry and topology (including dynamical systems and geometric partial differential equations)
4. Analysis and differential equations (including Lie groups and mathematical physics)
5. Statistics, probability and game theory
6. Applied and computational mathematics

Very strong promise in research and teaching is required. Positions initially budgeted at the assistant professor level. Applicants must show very strong promise in research and teaching. Salary range: $33,900-$38,200. Teaching load: four quarter courses per year. Preference will be given to those who can continue Pomona’s tradition of excellent and innovative teaching.

Applications should include one advanced course in the candidate’s field. Preference includes letters evaluating teaching, graduate school transcripts, and a description, written for the non-specialist, of research accomplishments and plans. Please let us know if you will be attending the January AMS meeting in San Francisco.

Pomona College is an Affirmative Action/Equal Opportunity Employer and encourages applications from minority candidates and women.

UNIVERSITY OF CALIFORNIA, RIVERSIDE
Position in Geometry

Applications and nominations are invited for a tenure-track position in Geometric Analysis beginning July 1, 1991. The position is at the rank of Assistant or Associate Professor; candidates in all areas of geometric analysis will be considered. Excellence in research and teaching is required. Established criteria of the University of California determine salary and rank. To assure full consideration, applicants should send their curriculum vita and list of publications and have at least three letters of recommendation sent to:

Professor Bun Wong, Chair
Department of Mathematics
University of California
Riverside, CA 92521-0135


UNIVERSITY OF CALIFORNIA, SANTA CRUZ
Department of Mathematics

Applications and nominations are invited for a tenure-track position in Algebra or Combinatorics beginning July 1, 1991. The position is at the rank of Assistant or Associate Professor; candidates in all areas of Algebra and Combinatorics will be considered. Excellence in research and teaching is required. Established criteria of the University of California determine salary and rank. To assure full consideration, applicants should send their curriculum vita and list of publications and have at least three letters of recommendation sent to:

Professor Richard Block, Chair
Department of Mathematics
University of California
Santa Cruz, CA 95064


UNIVERSITY OF CALIFORNIA, LOS ANGELES
Department of Mathematics

Applications and nominations are invited for a tenure-track position in Analysis beginning July 1, 1991 or later. The position is at the Assistant Professor level; candidates in all areas of classical and modern analysis (including probability theory) will be considered. Excellence in research and teaching is required. Established criteria of the University of California determine salary. To assure full consideration, applicants should send their curriculum vita and list of publications and have at least three letters of recommendation sent to:

Professor David Rush, Chair
Analysis Hiring Committee
Department of Mathematics
University of California
Los Angeles, CA 90024-1555

lished Assistant Professorships in Mathematics are named in honor of our founding chairman, J.W.T. Youngs. In addition, we also expect to have several other visiting positions. We invite applications from qualified mathematicians in all fields. Appointees will be expected to teach, pursue their research, and perform some department or university service. The J.W.T. Youngs Fellow positions are available for a two-year period with the possibility of an extension for a third year. The other visiting positions are available for periods ranging from one quarter to the full academic year, with a possible extension to a second year. J.W.T. Youngs Fellows will be appointed at the Assistant Professor level only, while the other visiting positions may be at either the Assistant, Associate, or Full Professor level, as appropriate. Minimum Qualifications: Ph.D. in Mathematics and a demonstrated excellence in research and teaching or potential for excellence. Salary Range: $33,900 – $56,300 commensurate with qualifications and experience. Available: Fall 1991. Application Deadline: January 15, 1991. Please refer to position #90-19. UCSC is an affirmative action/equal opportunity employer.

Applicants should send vitae, three letters of reference, and information about their teaching and research experience to:

Harold Widom, Chair
Recruitment Committee
Mathematics Department
University of California
Santa Cruz, CA 95064

UNIVERSITY OF SOUTHERN CALIFORNIA
Los Angeles, California

The Department of Mathematics wishes to fill several tenure-track Assistant Professorships and possibly tenure positions at Associate Professor and Professor. Visiting positions (at all levels) and postdoctoral appointments will also be available. The department is particularly interested in applicants who work in the areas of: Algebraic Geometry, Analysis, Geometry, Number Theory, Numerical Analysis, Partial Differential Equations, and Statistics, but strong candidates in all areas are encouraged to apply.

Applicants for assistant professorships must show strong research promise. Applicants for senior positions must have an outstanding record of research and scholastic achievement. Address inquiries to: Chair of Appointments Committee, Department of Mathematics-DRB 155, University of Southern California, Los Angeles, CA 90089-1113. USC is an Equal Opportunity/Affirmative Action Employer. Women and minorities are especially encouraged to apply.

Ph.D. is required. The average weekly teaching load is 7 1/2 hours. Generous support for faculty development such as travel, teaching off-loads, and summer research. Send resume and 3 letters of reference to K. M. Rangaswamy, Chairman. Screening will begin on Feb. 1, 1991 and continue until filled.

COLORADO
COLORADO STATE UNIVERSITY
Chair
Center for Science, Mathematics and Technology Education

Colorado State University, Colorado's land-grant university, invites nominations and applications for the position of Director of the newly formed Center for Science, Mathematics and Technology Education (CSMATE). The Center serves as a focal point for research aimed at improvement and innovations in science, mathematics and technology instruction at all levels—elementary through university. The Director is expected to obtain extramural funding through contracts and grants supporting the initiation and enhancement of programs that will address the needs and aspirations of K-16 science, mathematics and technology students, teacher educators, and administrators. The Director must have a strong interest in discipline-based science, mathematics and technology education with teaching experience at the undergraduate and graduate levels, evidence of successful fund-raising for projects and experience in program administration. The Director must provide leadership for and have the ability to work with diverse constituencies in the educational arena and have experience in coordinating programs across educational institutions and government agencies. An earned Doctorate is required.

Interested parties should request a full job description. Applications should include a letter of interest, a current resume' and the names, addresses and telephone numbers of three references. The closing date for applications is January 31, 1991. The deadline may be extended if a suitable candidate is not found. The position is available July 1, 1991 or sooner. Applications and nominations should be sent to:

Dr. Thomas A. Gorell, Chair
CSMATE Director Search Committee
College of Natural Sciences, C-138
CSU
Colorado State University
Fort Collins, CO 80523
Fax (303) 491-0528

CSU is an EEO/AA employer. E.O. Office: 314 Student Services Bldg.

UNIVERSITY OF COLORADO AT COLORADO SPRINGS
Department of Mathematics
Colorado Springs, CO 80933-7150

Applications are invited for a tenure-track Assistant Professor position for Fall 1991. Preferred area of research interest: probability theory. However, consideration will also be given to exceptionally strong candidates if their area of expertise is consistent with present research interests: harmonic analysis, computer vision and algebra. Current faculty expertise in probability theory includes percolation theory, population genetics and theory of large deviations. Applicants should have significant research accomplishments or exceptional research promise and evidence of good teaching.

Applications should include a letter of application, curriculum vitae, and three letters of recommendation. Initial screening will begin February 1,
The Department of Mathematics at Trinity College invites applications for a tenure-track position, at the rank of assistant professor, beginning in the academic year ’91-’92. The normal teaching load is five semester-courses per year (“1/2”). While we will be happy to receive applications from those with any specialty, we will be particularly interested in algebraists, logicians, and persons whose research interests might intersect with current department members’ areas: complex analysis, functional analysis, geometry, graph theory, combinatorics, and mathematical statistics. Requirements for the position: Ph.D. in mathematics, evidence of teaching excellence at the undergraduate level, and evidence of promise in research and, interest in curriculum development.

Applicants should send a c.v., three letters of reference (at least one of which addresses teaching) and a statement of teaching and research interests to:

Search Committee Chair
Dept. of Mathematics
Trinity College
Hartford, CT 06106

No decision will be made prior to January 21 after which position may be filled at any time.

Representatives of the Department will attend the employment register at the joint Annual Meetings in San Francisco in January 1991. Trinity College is an Equal Opportunity/Affirmative Action Employer. Women and members of minority groups are especially encouraged to apply.

UNIVERSITY OF SOUTHERN COLORADO
Department of Mathematics
Pueblo, CO 81001-4901

Applications are invited for at least one tenure-track assistant professor position for Fall 1991. Doctorate in Mathematics in numerical analysis, optimization, modeling, or combinatorics is required. Evidence of commitment to teaching excellence necessary. Active research desirable. Send letter of application, resume, graduate transcripts, and three letters of reference to Search and Screen Committee. Evaluation of applications will begin 7 February 1991 and continue until position is filled. USC is an AA/EO employer.

CONNECTICUT
TRINITY COLLEGE

The Department of Mathematics at Trinity College invites applications for a tenure-track position, at the rank of assistant professor, beginning in the academic year ’91-’92. The normal teaching load is five semester-courses per year (“1/2”). While we will be happy to receive applications from those with any specialty, we will be particularly interested in algebraists, logicians, and persons whose research interests might intersect with current department members’ areas: complex analysis, functional analysis, geometry, graph theory, combinatorics, and mathematical statistics. Requirements for the position: Ph.D. in mathematics, evidence of teaching excellence at the undergraduate level, indications of promise in research, and interest in curriculum development.

Applicants should send a c.v., three letters of reference (at least one of which addresses teaching) and a statement of teaching and research interests to:

Search Committee Chair
Dept. of Mathematics
Trinity College
Hartford, CT 06106

No decision will be made prior to January 21 after which position may be filled at any time.

Representatives of the Department will attend the employment register at the joint Annual Meetings in San Francisco in January 1991. Trinity College is an Equal Opportunity/Affirmative Action Employer. Women and members of minority groups are especially encouraged to apply.

THE AMERICAN UNIVERSITY
Faculty Vacancies in Mathematics and Statistics
Assistant Professor position available for 1991-1992

One tenure-track position in mathematics. Additional temporary positions in mathematics and/or statistics may also become available.

Qualifications: Ph.D. in mathematics and evidence of strong teaching and scholarship is required. Those with experience in actuarial science are especially invited to apply.

Responsibilities: Undergraduate and graduate teaching, scholarship, student advising, and university service.

Competitive salary, commensurate with qualifications and experience. Position subject to final budgetary approval. Send c.v. and names of three references. Preference given to applications received by March 1, 1991.

Professor Robert W. Jernigan
Chair, Department of Mathematics and Statistics
The American University
4400 Massachusetts Avenue, N.W.
Washington, D.C. 20052

An EEO/AA University; minorities and women candidates are encouraged to apply.

THE GEORGE WASHINGTON UNIVERSITY
Department of Mathematics
Washington, D.C. 20052


FLORIDA
FLORIDA ATLANTIC UNIVERSITY

Florida Atlantic University invites applications for three Assistant Professorships in the Department of Mathematics for August 1991. Candidates are expected to show a strong commitment to undergraduate teaching and promise in research. Candidates must have a Ph.D. in Mathematics or must complete a Ph.D. in Mathematics by August 1991. Salary is com-
petitive. Areas of research in the department include Algebra, Analysis and Combinatorics. The department instituted a Ph.D. program in 1988 and has grown substantially over the last few years. Applicants from all research fields are invited.

Applications, vita, list of publications and three letters of recommendation should be sent to:
Professor S.C. Locke, Chairman
Hiring Committee
Department of Mathematics
Florida Atlantic University
Boca Raton, Florida 33431
Telephone: (407) 367-3350
Bilnet: LockeSC@servax

Application deadline is February 28, 1991. Florida Atlantic University is an Affirmative Action/Equal Opportunity Employer. Women and minorities are especially encouraged to apply.

FLORIDA INTERNATIONAL UNIVERSITY

The Department of Mathematics announces tenure-track positions beginning August 1991. These positions are usually at the beginning Assistant Professor level. Candidates must have a Ph.D. in Mathematics and a commitment to research and quality teaching. Qualified candidates in all areas of Mathematics will be considered.

Teaching load consists of no more than five 3-credit courses per academic year. Send resume and arrange for three letters of recommendation to be sent to: Recruitment Committee, Department of Mathematics, Florida International University, Miami, FL 33199.

Florida International University is an Equal Opportunity/Affirmative Action Employer. It is a member of the State University system of Florida, with approximately 22,000 students. The department offers bachelor’s and master’s degrees. Tenure-Track Position:

NEW COLLEGE OF USF

Tenure-track position in Mathematics starting Fall, 1991, pending budgetary approval. Duties consist of two classes per semester, plus individual or group tutorials and supervising senior theses (these are required for all students). New College is a small, highly selective liberal arts college with a student/faculty ratio of 10:1. We have a system of contracts and written evaluations rather than grades. A report released by the Independent Colleges Office ranks us sixth in productivity of Ph.D.s for students who graduated between 1970 and 1982. Continuing faculty in Mathematics are an Analyst, an Algebraist/Computer Scientist, and an Algebraic Geometer. Women and minority candidates are especially encouraged to apply. Submit application by January 31 with vita, three letters of recommendation, and a statement on your teaching philosophy to Tony Horowitz, Division of Natural Sciences, New College, 5700 N. Tamiami Trail, Sarasota, FL 34243-2197. New College of the University of South Florida is an AAEO employer.

GEORGIA INSTITUTE OF TECHNOLOGY

The Center for Dynamical Systems and Non-linear Studies expects to have some long and short-term visiting positions beginning Fall 1991. These positions are in nonlinear differential equations, dynamical systems, computational methods and related areas. In addition to a resume and at least three letters of reference, candidates should send a summary of future research plans to Professor Jack K. Hale, Director, CDSNS, Georgia Institute of Technology, Atlanta, GA 30332-0190. Georgia Tech, a member of the University System of Georgia, is an Equal Opportunity/Affirmative Action Employer.

GEORGIA SOUTHERN UNIVERSITY

Department of Mathematics/Computer Science
Statesboro, GA 30460

MATHEMATICS/COMPUTER SCIENCE: Send letter of application, vita, unofficial transcripts of all college work, evidence of dedication to outstanding teaching and three letters of reference or placement file to: Prof. Elizabeth Hardy, Landrum Box 8093. Deadline: February 1, 1991.

One Tenure-Track Position: Assistant or Associate Professor, doctorate in a mathematical science required; Ph.D. or Ed.D. in mathematics education preferred. Primary interest in mathematics education required. One Tenure-Track Position: M.A. or M.S. in computer science or a mathematical science required; Ph.D. or M.S. in computer science preferred. One Tenure-Track Position: M.A. or M.S. in a mathematical science and experience required. Primary duties will include teaching freshman-level mathematics. A second position is possible. Several Temporary Instructor positions may be added in the area of teaching freshman-level mathematics. Master’s degree in mathematics required.

MATHMATICS/DEVELOPMENTAL STUDIES: Three tenure-track (no time limit) positions. Master’s degree required; two to three years’ teaching experience preferred. Duties will include teaching developmental studies and freshman/sophomore-level mathematics courses. Send letter of application, vita, unofficial transcripts of all college work, evidence of dedication to outstanding teaching and three letters of reference or placement file to: Prof. Susan Groover, Landrum Box 8093. Deadline: January 14, 1991. Starting date is: September 1, 1991. The names of applicants and nominees, resumes, and other general non-evaluative information are subject to public inspection under the Georgia Open Records Act. Georgia Southern is an Affirmative Action, Equal Opportunity Institution.

KENNESAW STATE COLLEGE
Mathematics Department
P.O. Box 444
Marietta, GA 30061

At least one tenure-track position in Mathematics at the level of Assistant Professor beginning in September 1991. A Ph.D. is required with a strong commitment to undergraduate education as well as an interest in scholarly activities. Statistics preferred; other areas considered. Salary and rank are competitive and commensurate with credentials and experience. The college is located in Northwest Metro Atlanta, and enrolls over 10000 day and evening students in undergraduate and graduate programs. The department of Mathematics has 19 full-time faculty and shares 6 others with the Department of Computer Science. Send resume and a list of three references to Dr. Christopher Schaufele, Chair, Search Committee. Position will remain open until filled, but to ensure consideration, apply before Feb. 1, 1991. A/EEOE.

UNIVERSITY OF GEORGIA
Department of Mathematics
Athens, GA 30602

The department has tenure-track positions available for the 1991-92 academic year at the assistant professor level. In addition there may be some visiting positions available. The salary will be commensurate with the applicant’s abilities and experience. The principle requirement is excellence in teaching and research. Some preference will be given to areas in which the department is already well represented. Send
curriculum vitae and four letters of recommendation to Richard E. Bouldin Head (address above) by January 15, 1991. UGA is an Equal Opportunity/Affirmative Action Employer.

### ILLINOIS

**DEPAUL UNIVERSITY**

Department of Mathematical Sciences

Applications are invited for a tenure-track position at the assistant professor level beginning in September 1991. A Ph.D. in Mathematics is required. We will consider strong candidates in any field of research.

DePaul University is primarily an undergraduate institution. The Department of Mathematics has undergraduate and graduate programs in Mathematics, Applied Mathematics, and Mathematics Education. Strong commitment to teaching is essential. The official teaching load is nine quarter courses/year, but a reduction to seven quarter courses/year for research is customary.

Applicants should send a curriculum vitae and 3-4 letters of recommendation, at least one of which pertains to teaching, to: Hiring Committee, Department of Mathematics, 2219 N. Kenmore, Chicago, Illinois, 60614. Applications from women and members of minority groups are encouraged. AFA/EOE.

### ILLINOIS STATE UNIVERSITY

**MATHEMATICS DEPARTMENT, ILLINOIS STATE UNIVERSITY.** Illinois State University announces a tenure-track position in mathematics at the assistant or associate professor level. Applicants should have a Ph.D. by August 1991; a research interest in the areas of applied probability, combinatorial optimization, graph theory, operations research, or statistics; and a strong research record or potential. Candidates should also have sufficient background to teach a variety of undergraduate mathematics courses, and be committed to quality teaching. To apply, send vita, three letters of recommendation and official transcripts by February 1 to: Dr. Jane D. Swafford, Department of Mathematics, Illinois State University, Normal, IL 61761. AA/EOE Employer.

### NORTHERN ILLINOIS UNIVERSITY

Department of Mathematical Sciences

Anticipated assistant professorship with a specialization in differential or algebraic geometry or topology. Ph.D. or equivalent and strong potential in research and teaching required. Preference will be given to candidates who have two or three years experience and an ongoing research program. Application (vita) plus three letters of reference and description of research program should be sent to: Geometric Topology Position, c/o Professor William D. Blair, Chair, Department of Mathematical Sciences, Northern Illinois University, DeKalb, IL 60115 by February 15, 1991. EO/AAE.

### NORTHWESTERN UNIVERSITY

Department of Mathematics

2033 Sheridan Road,
Evanston, Illinois 60208–2730

Applications are invited for one or more tenure-track positions starting September 1991. Although priority will be given to young, exceptional research mathematicians (no more than seven years after Ph.D.), more senior candidates with very exceptional credentials may be considered for a tenured position. Fields of interest of the department include Algebra, Analysis, Dynamical Systems, Probability, Partial Differential Equations, and Topology. Northwestern is an affirmative action, equal opportunity employer committed to fostering a diverse faculty, so women and minority candidates are especially encouraged to apply. Candidates should arrange that at least three letters of recommendation be sent to Chair, Personnel Committee, Department of Mathematics, Northwestern University, Evanston, Illinois. In order to receive full consideration, applications should be received by February 15, 1991. Hiring is contingent upon eligibility to work in the United States.

### NORTHWESTERN UNIVERSITY

Mathematics Department

2033 Sheridan Road,
Evanston, Illinois 60208–2730

The Mathematics Department will sponsor an Emphasis Year in algebraic topology, cohomology of groups, and related topics. This program will include 2-year Assistant Professor positions starting September 1991 and possible visiting positions for more senior mathematicians for part or all of the academic year.

Applications should be sent to Prof. Mark E. Mahowald at the department address and include a curriculum vitae and three letters of recommendation. In order to ensure full consideration, an application must be received by February 15, 1991.

Northwestern University is an Affirmative Action/Equal Opportunity employer. Hiring is contingent upon eligibility to work in the United States.

### DEPAUW UNIVERSITY

Department of Mathematics and Computer Science

Applications are being accepted for a tenure-track position in mathematics. Requirements include a Ph.D. in mathematics (any specialty), excellence in teaching, achievement or promise in research, and commitment to the goals of a liberal arts college. Duties include teaching twelve hours per week, maintaining scholarship or research, and service to the University through advising, committee work, and the like.

Applicants should send a letter indicating interest in teaching in a liberal arts setting, transcripts, vita, and three letters of recommendation with at least one addressing the applicant's demonstrated teaching ability to Underwood Dudley, Mathematics Department, DePauw University, Greencastle, Indiana 46135. Women and minorities are encouraged to apply.

Applications will be accepted until the position is filled. DePauw is an Affirmative Action, Equal Opportunity Employer.

### INDIANA STATE UNIVERSITY

Chairperson

Department of Mathematics and Computer Science

The Department of Mathematics and Computer Science, Indiana State University, invites applications for the position of Chairperson. Applicants should have a doctorate in Mathematics or Computer Science, a record of successful teaching and research, and a commitment to promoting research, teaching, and other scholarly activities. Applicants should also possess the leadership skills necessary to chair a large department which has diverse teaching and research responsibilities. The Computer Science area is undergoing active development, so familiarity with Computer Science curricular issues is desirable.

The Department offers B.S. and B.A. degrees in Mathematics, Mathematics Education and Computer Science, as well as M.S. and M.A. degrees in Mathematics and Mathematics Education. It is developing an M.S. degree in Computer Science.

Salary and rank are commensurate with qualifications and experience. Please send a
letter of application and vita, and have three letters of recommendation sent to:
Chairperson Search Committee
Department of Mathematics and Computer Science
Indiana State University
Terre Haute, IN 47809

The application deadline is February 1, 1991. Applications received after this date cannot be guaranteed consideration. U.S. citizenship or eligibility for U.S. employment will be required. Indiana State University is an Equal Opportunity/Affirmative Action Employer.

INDIANA UNIVERSITY-PURDUE UNIVERSITY AT INDIANAPOLIS (IUPUI)
Department of Mathematical Sciences

The Department of Mathematical Sciences at IUPUI is seeking applicants for a tenure-track position in Mathematics Education (at the Assistant Professor level) to begin in August, 1991. Applicants must have an earned doctorate by the starting date, a strong background in an area of mathematics, and a serious commitment to research and teaching.Responsibilities include teaching undergraduate and graduate level courses in mathematics and mathematics education, conducting inservice workshops for teachers in mathematics, and participating in research and curriculum development in 9-12 and post-secondary levels.

IUPUI is a rapidly growing comprehensive urban university with over 28,900 students. The department offers programs of study leading to Purdue University B.S., M.S., and Ph.D. degrees. The university offers competitive salaries and provides excellent fringe benefits. Send resume and three letters of recommendation to Prof. Bart S. Ng, Chair, Department of Mathematical Sciences, IUPUI, 1125 E. 38th Street, Indianapolis, IN 46205-2810. Closing date: January 15, 1991. Late applications will be considered until positions are filled.

IUPUI is an Affirmative Action/Equal Opportunity Employer. Women and minority candidates are encouraged to apply.

INDIANA UNIVERSITY SOUTHERN INDIANA

Department of Mathematics and Computer Science

Applications are invited for one or more tenure-track positions starting in the fall semester of 1991-92. The Department currently has twenty-five faculty. It has bachelor degree programs in Mathematics, Mathematics Education, and Computer Science. It also has master degree programs in Mathematics and Mathematics Education. The Department is especially interested in applicants with doctoral degrees in Statistics or Computer Science, but all specialties are encouraged to apply.

Please send a letter of application, vita, and have three letters of reference sent to:
Chairperson
Department of Mathematics and Computer Science
Indiana State University
Terre Haute, IN 47809

Interviews will begin in March 1991. Indiana State University is an Equal Opportunity/Affirmative Action Employer.

INDIANA UNIVERSITY-PURDUE UNIVERSITY AT INDIANAPOLIS (IUPUI)
Department of Mathematical Sciences

The Department of Mathematical Sciences at IUPUI is seeking applicants for two tenure-track positions to begin in August 1991. Rank is open depending on qualifications. Applicants must have an earned doctorate by the starting date, a strong research record or excellent research potential, and a commitment to quality graduate and undergraduate teaching. Some preference may be given to applicants in algebra. However, strong applicants from other areas of pure and applied mathematics are encouraged to apply.

IUPUI is a rapidly growing comprehensive urban university with over 28,000 students. The department offers programs of study leading to Purdue University B.S., M.S., and Ph.D. degrees. The university offers competitive salaries and provides excellent fringe benefits. Send resume and three letters of recommendation to Prof. Bart S. Ng, Chair, Department of Mathematical Sciences, IUPUI, 1125 E. 38th Street, Indianapolis, IN 46205-2810. Closing date: January 15, 1991. Late applications will be considered until positions are filled.

IUPUI is an Affirmative Action/Equal Opportunity Employer. Women and minority candidates are encouraged to apply.

INDIANA UNIVERSITY AT SOUTH BEND
Dept. of Mathematics and Computer Science

Applications are invited for one or more tenure-track positions in mathematics at the assistant professor level with a starting date of August, 1991. Applicants must have Ph.D. in mathematics or show substantial progress toward completion and should have a commitment to excellence in teaching and to continuing research. Specialization in any area of mathematics will be considered, but we especially seek candidates who have an interest in teaching applied mathematics courses. The department currently has 13 full-time faculty. Mathematics students may graduate with a B.A. in Mathematics or a B.S. in Applied Mathematics. The regular teaching load at IUSB is nine credit hours. Salaries are competitive and the fringe benefits package is excellent. IUSB is an Equal Opportunity/Affirmative Action employer; women and minority candidates are encouraged to apply. Applications accepted until January 30, 1991. Send vita to John P. Russo, Chair, Department of Mathematics and Computer Science, Indiana University at South Bend, South Bend, IN 46634.

IOWA STATE UNIVERSITY

The Department of Mathematics of Iowa State University invites applications to fill three tenure-track positions for the 1991-92 academic year. Start up funds will be available for the successful applicant for each position. The areas of interest and the level are: (1) a senior position in numerical analysis or computational mathematics, (2) an entry level position in control theory and (3) an entry level in mathematics education. The successful candidate for each position is expected to have a strong interest in teaching at both the graduate and undergraduate level and maintain an active research program in his or her chosen area. In addition, candidates for the senior position are expected to have a strong research record, be willing to build a strong research group in numerical analysis or computational mathematics, to interact with colleagues in related areas and to seek outside funds for their research.

We will begin screening applications December 15, 1990. However, we shall continue to accept applications until the positions are filled.

Iowa State University is an Affirmative Action/Equal Opportunity Employer. Women and minorities are encouraged to apply.

Applications and three letters of recommendation should be sent to Howard A. Levine, Chair, Department of Mathematics, Iowa State University, Ames, Iowa 50011.

UNIVERSITY OF NORTHERN IOWA
Assistant Professor of Mathematics

We have a new tenure-track position for an assistant professor to aid in teaching our general education courses and to support our majors and graduate students. Applicants should have a doctorate in a core area of mathematics and be committed to quality teaching and scholarship at a comprehensive university.

Appointment is for the academic year beginning in August 1991. Salary is highly competitive; fringe benefits are excellent. Application screening begins February 15, 1991. For more information contact Philip East, Mathematics and Computer Science, University of Northern Iowa, Cedar Falls, Iowa 50614 (319)273-2631 EAST@ISCSVAX.UNI.EDU.

An affirmative action/equal opportunity educator and employer.

KANSAS STATE UNIVERSITY
Department of Mathematics

Subject to budgetary approval, applications are invited for several tenure-track and visiting positions commencing August 18, 1991; rank and salary commensurate with qualifications. All fields will be considered, but for the tenure-track positions preference will be given to candidates in Numerical Analysis, Partial Differential Equations, Global Analysis, and Geometric Topology.
(especially Low-Dimensional). Applicants must have strong research credentials and a commitment to excellence in teaching. We require a Ph.D. in mathematics or an accepted Ph.D. dissertation with only formalities to be completed. Letter of application, current vita, description of research and three letters of recommendation should be sent to:

Louis Pigno
Department of Mathematics
Cardwell Hall 137
Kansas State University
Manhattan, KS 66506

Deadline: February 1, 1991. AA/EOE

UNIVERSITY OF KANSAS
Department of Mathematics

Applications are invited for a visiting assistant professor position commencing August 16, 1991 or as negotiated. (The availability of this position is contingent upon final administrative approval.) Preference will be given to candidates whose research interests mesh well with those of present mathematics department faculty. Require Ph.D. or Ph.D. dissertation accepted with only formalities to be completed. Application, detailed resume with description of research and three recommendation letters should be sent to C.J. Himmelberg, Chairman, Department of Mathematics, 405 Snow, University of Kansas, Lawrence, KS 66045-2142.

Deadlines: February 1, 1991 for first consideration, then monthly until August 1, 1991.
The University of Kansas is an AA/EOE.

KENTUCKY
CENTRE COLLEGE

Faculty Position, Computer Science/Math. A one-year full-time teaching (sabbatical replacement) position starting September 1, 1991. The successful candidate will teach traditional undergraduate courses in mathematics and computer science, offer special topics courses in computer science in her/his area of expertise, and conduct student-faculty collaborative research. Advanced degree in mathematics or computer science required, Ph.D. preferred. Rank and salary dependent on qualification. Consideration of qualifications will begin Feb. 15; send inquiries & vita to Dr. John Ward, Dean of the College, Centre College, Danville, KY 40422. EOE

MOREHEAD STATE UNIVERSITY
Department of Mathematical Sciences
Assistant Professor of Mathematics

Morehead State University invites applications and nominations for a tenure-track position of Assistant Professor of Mathematics beginning August 1991. Responsibilities: Teach twelve hours per semester (reassigned time for research possible) of primarily undergraduate courses in mathematics together with scholarly production and service. Qualifications: Ph.D. in mathematics is required. A strong commitment to quality instruction is expected. Preference will be given to those applicants with experience and/or training in computing. Review of credentials begins January 10, 1991; applications accepted until January 31, 1991. Submit letter of application, resume, graduate transcripts and three letters of recommendation, to:

OFFICE OF PERSONNEL SERVICES
MOREHEAD STATE UNIVERSITY
MM 101
MOREHEAD, KY 40351

MSU is an EEO/AA employer.

LOUISIANA
LOUISIANA STATE UNIVERSITY
Department of Mathematics
Baton Rouge, LA 70803; (504)388-1534

The department anticipates openings for the 91–92 academic year primarily at the Assistant Professor level, but invites applications for positions at all professorial-rank levels including visiting and tenure-track positions. Essential qualifications include competitive research, good teaching and a Ph.D. or equivalent by August 1991. Preferred fields include areas of combinatorics and graph theory and algebraic number theory. Strong candidates in other areas are encouraged to apply. Application deadline is March 1, 1991. To apply, specify your interests, enclose a full resume, and arrange for at least three persons to send letters of evaluation to Dr. Jimmie Lawson, Chairman (address above).

LSU IS AN EQUAL OPPORTUNITY UNIVERSITY.

LOUISIANA STATE UNIVERSITY
Department of Mathematics
Baton Rouge, LA 70803; (504)388-1534

We anticipate openings for full and part-time Instructors and Teaching Associates starting in August 1991, to teach freshman/sophomore courses, including developmental mathematics. The teaching load averages 12 hours of class per week. Applicants should have completed at least 18 graduate credit hours in mathematics and hold a master's degree (in mathematics for Instructor positions). Application deadline is April 1, 1991. To apply, specify your interest, enclose a full resume, and arrange for at least three persons to send letters of evaluation to Dr. Jimmie Lawson, Chairman (address above).

LSU IS AN EQUAL OPPORTUNITY UNIVERSITY.

TULANE UNIVERSITY
Department of Mathematics
New Orleans, LA 70118

Applications are invited for a tenure-track position in Applied Analysis/PDE at the Associate or Assistant Professor level, depending on qualifications. Besides a Ph.D. degree in Mathematics and teaching experience, candidates should have a demonstrated ability to carry out high quality research and be willing to participate in the teaching program at graduate and undergraduate levels. Applicants should submit a detailed vita and a list of publications with at least 3 letters of recommendation or the names of referees to Professor David Yang, Screening Committee, at the above address. The search will remain open until the position is filled. Tulane is an Equal Opportunity/Affirmative Action Employer.

MARYLAND
MORGAN STATE UNIVERSITY
Department of Mathematics and Computer Science

Three tenure-track positions including department chair. Ph.D. in mathematics or computer science required. The normal teaching load is 12 credit hours per semester (6 for the department chair). The successful applicants will be expected to maintain an active research program and to participate in the usual faculty service activities. The closing date for applications is January 31, 1991. Candidates should send letters of application, resumes, and three letters of recommendation to Nathaniel Knox, Acting Chairman, Department of Mathematics and Computer Science, Morgan State University, Baltimore, MD 21239. AA/EOE.

UNITED STATES NAVAL ACADEMY
Mathematics Department

Annapolis, Maryland 21402-5002

We anticipate one or two tenure-track appointments at the assistant professor level, commencing August 1991. Ten month salary, commensurate with experience and qualifications. Research opportunities exist for augmenting salary during summer. Applicants must possess Ph.D., have a commitment to excellence in teaching and be capable of pursuing independent research. Send inquiries and applications to J. M. D'Archangelo. Required of each applicant are a resume, transcripts, and three letters of recommendation discussing applicant's teaching and research. The Naval Academy is an EO/AA employer.

UNIVERSITY OF MARYLAND
UNIVERSITY COLLEGE
Teach in Asia or Europe

The University of Maryland University College seeks excellent teachers for openings on U.S. military bases overseas. Appointments begin August 1991. Requirements include M.A. or Ph.D., recent college teaching experience, and U.S. citizenship. Preference to teach in another discipline desirable. Benefits include transportation and military base privileges (PX, commissary, etc.). Frequent travel and the cost of schooling make these positions difficult for those with children. Send resume to Dr. Ralph E. Millis, Assistant to the President, Overseas Programs, The University of Maryland Univer-
University College, College Park, MD 20742-1642. AA/EEO.

MASSACHUSETTS

AMHERST COLLEGE

Applications are invited for a one-year visiting position in Mathematics, preferably at the Assistant Professor level, beginning in August 1991.

Amherst College is a private, undergraduate college which emphasizes both research and teaching. We attract bright students, possess a lively faculty, and have an administration committed to a vigorous program in mathematics.

The Department of Mathematics and Computer Science consists of seven mathematicians and three computer scientists. We are located in the Seeley G. Mudd building, which also houses classrooms, seminar rooms, a library for mathematics and computer science, and the academic computer center. Research facilities include computers in most faculty offices and a network of Sun workstations.

Amherst College is part of a five college consortium that also includes the University of Massachusetts and Hampshire, Mount Holyoke and Smith Colleges. There are numerous faculty seminars held at Amherst and the University, and Boston is less than two hours away.

If some anticipated leaves take place and if we receive authorization from the administration, the position may be extended to a second (and possibly third) year given satisfactory performance in the first year.

Applications should hold a Ph.D. in mathematics. Please submit a vita, three references, and transcripts from both your graduate and undergraduate institutions. All applications received by February 15 are assured of consideration.

Amherst College is an Affirmative Action/Equal Opportunity Employer and encourages applications from minorities and women.

Reply to: Professor David A. Cox, Chair Department of Mathematics and Computer Science Amherst College Amherst, MA 01002.

Send electronic mail to: dacox@amherst.bitnet or dac@cs.amherst.edu

BOSTON UNIVERSITY

Department of Mathematics

The Department of Mathematics at Boston University invites applications for two anticipated positions in the area of Dynamical Systems.

One position is a permanent position at the Assistant Professor level. The successful applicant should have a strong commitment to research and teaching. The Department also seeks applications for a Visiting Assistant Professorship in this field. Applications and 3 letters of reference should be sent to: Search Committee, Department of Mathematics, Boston University, 111 Cummington St., Boston, MA 02215. AA/EOE.

EXECUTIVE OFFICER

COUNCIL ON UNDERGRADUATE RESEARCH

Applications, nominations or inquiries are invited for the position of Executive Officer of the Council on Undergraduate Research. CUR is a national society dedicated to the advancement of scientific research by students and faculty at primarily undergraduate colleges and universities. Membership is available and open to anyone with such an interest. CUR is currently organized into biology, chemistry, geology, mathematical sciences, physics/astrophysics and astrophysics, and at-large sections governed by 12 Councillors elected by the membership. CUR publishes a quarterly newsletter and directories of research at undergraduate institutions, holds semi-annual conferences for science faculty, administrators, and representatives of federal funding agencies and private foundations, sponsors undergraduate summer research fellowships, and provides consultants to undergraduate science departments. The Executive Officer will coordinate the activities of the volunteer councilors, administer all CUR programs, and maintain liaisons with other scientific organizations. Candidates should have at least one organizational talent and experience in scientific research at primarily undergraduate institutions. The initial appointment is for a three year term, renewable after review. The salary is competitive with academic salaries at professorial levels. Further information, write to Professor Stuart B. Crampton, President, Council on Undergraduate Research, Department of Physics, Williams College, Williamstown, MA 01267. AA/EOE.

TUFTS UNIVERSITY

Department of Mathematics

Medford, MA 02155

Assistant Professorship, tenure-track, beginning Sept. 1, 1991. Ph.D., promise of strong research and evidence of strong teaching ability required. Preferred areas: number theory, group theory, numerical analysis, differential geometry, PDEs and mathematical physics. Teaching load two courses per semester. Send c.v. and have three letters of recommendation sent to Richard Weiss, Search Committee Chair, by Feb. 12, 1991. Tufts is an EO/AA employer.

HILLSDALE COLLEGE

Department of Mathematics

Hillsdale, MI 49242

An independent, coeducational, liberal arts college of 1100 students, seeks a mathematician for a tenure-track position as Assistant Professor of Mathematics to begin August 1991. A candidate should hold the Ph.D. in mathematics, and should expect to teach all levels of undergraduate mathematics. In addition to a 12-hour teaching load per semester, duties will include academic advising and college service. A commitment to quality liberal arts education and experience in undergraduate teaching of mathematics will be important. Salary will be competitive and commensurate with qualifications. Send letter of application, resume, and three letters of reference to: Prof. Mark J. Watson, Chairman, at the above address by January 31, 1991, for full consideration. AA/EOE.

MICHIGAN TECHNOLOGICAL UNIVERSITY

Department of Mathematical Sciences

Applications are invited for the following positions, starting Sep. 3, 1991. (1) At least two tenure-track positions at the Assistant/Associate level in Applied Mathematics. Areas of special interest include fluid mechanics, mathematical modeling, computational mathematics and partial differential equations. (2) One tenure-track position in Combinatorics. Areas of special interest include pure and applied combinatorics, combinatorial optimization, coding theory, cryptology and combinatorial designs. Appointment at the non-entry level require substantial record of published research. Requirements include a Ph.D. in Mathematics, excellence in research or potential for such, as well as a commitment to teaching at the undergraduate and graduate level. (3) In addition, the department expects to fill several Visiting Assistant Professorships. Please send a letter of application, resume and three letters of recommendation to: Recruitment Committee, Department of Mathematical Sciences, Michigan Technological University, 1400 Townsend Drive, Houghton, MI 49931-1295. Applications will be accepted until February 15, 1991. MTU is an equal opportunity educational institution/equal opportunity employer.

CARLETON COLLEGE

Department of Mathematics

and Computer Science

Northfield, MN 55057-4025

One, and possibly two, two-year non-tenure-track positions beginning September 1991, with the possibility of renewal. Ph.D. required. Teach six courses per year in mathematics, computer science and/or statistics. Preference given to individuals who can teach in two of these areas. Excellent teaching skills essential. Deadline February 15; applications accepted until positions are filled. Affirmative Action/Equal Opportunity Employer; applications specifically invited from women and minorities. Send letter of application, resume, graduate transcript(s), and three recent letters of reference to Jack Goldfeather, Chair.

Carleton College is a highly selective, liberal arts college 35 miles south of Minneapolis/St. Paul. Department has 12 full-time members. Computing resources available to department members include 12 NeXTs, 3 Mac IIIs, a DEC Micro VAX II running Ultrix, a Raster Tech 3/35 graphics workstation, several Transputer

MICHIGAN
equipped parallel processing workstations, and a variety of microcomputers.

**MISSISSIPPI**

**THE UNIVERSITY OF MISSISSIPPI**
Department of Mathematics

The Department invites applications for a tenure track position at the Assistant or Associate Professor level beginning August 19, 1991. Applicants should hold the Ph.D. degree, and should be committed to excellence in teaching and a productive ongoing program of research. To ensure consideration, submit a letter of application, vita, and three letters or recommendation by March 1, 1991, to: Search Committee, Department of Mathematics, University of Mississippi, University, MS 38677. The University of Mississippi is an Equal Opportunity/Affirmative Action Employer.

**SOUTHWEST MISSOURI STATE UNIVERSITY**

Southwest Missouri State University Department of Mathematics. One or more tenure-track and/or visiting positions in Mathematics and Statistics, beginning Fall 1991. Rank and salary will be commensurate with qualifications. Applicants must have a Ph.D. in Mathematics or Statistics, evidence of excellence in teaching, and a commitment to continued research. For all positions preference given to applicants with research interests compatible with those of the current faculty. Duties include teaching, research, and service. Applications will be reviewed as received and will be accepted until the positions are filled or until February 15, 1991—the final deadline for all application materials. Send vita and graduate transcripts, and have three letters of reference sent to: Clayton Sherman, Acting Head, Department of Mathematics, Southwest Missouri State University, Springfield, MO 65804-0094. AA/EOE.

**MISSOURI**

**NORTHEAST MISSOURI STATE UNIVERSITY**
Department of Mathematics and Computer Science
Kirksville, Missouri 63501

Several tenure-track, assistant professorships available August 1991. Requirements include Ph.D., commitment to excellence in undergraduate teaching, and evidence of potential for research and other scholarly activity. Expertise in statistics is needed for at least one position. Other preferred areas of expertise include analysis, combinatorics, differential equations, applied mathematics, logic, and computer science. Teaching loads average nine hours per week. Northeast is a selective, liberal arts and sciences university with an enrollment of almost 6,000. A complete application requires a letter of application, vita, transcripts of graduate and undergraduate study, and at least three letters of reference. Send to Lanny Morley, Head, Division of Mathematics and Computer Science. Northeast is an Equal Opportunity Employer.

**NEBRASKA**

**UNIVERSITY OF NEBRASKA-LINCOLN**

Applications are invited for a tenure-track position at the Assistant Professor level beginning in the fall of 1991. Candidates must have a Ph.D. in mathematics or expect to receive their degree by August of 1991. Candidates must have excellent teaching potential and an outstanding research potential in an area which will complement the existing expertise in the department. Applications accepted from qualified candidates in all areas of mathematics, but candidates in numerical analysis, differential geometry, operations research, operator theory and combinatorics are particularly urged to apply. Women and minority candidates are also encouraged to apply. Send vita and three letters of recommendation to Search Committee Chair, Department of Mathematics and Statistics, University of Nebraska-Lincoln, Lincoln, NE 68588-0323. The review of applications will begin January 22, 1991, or until the positions are filled. The application deadline is January 22, 1991.
begin February 1, 1991, and continue until a candidate is selected.

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**NEW HAMPSHIRE**

**DARTMOUTH COLLEGE**

John Wesley Young

Research Instructorship

The John Wesley Young Research Instructorship is a two-year post-doctoral appointment for promising new or recent Ph.D.'s whose research interests overlap a department member's. Current departmental interests include areas in algebra, analysis, algebraic geometry, combinatorics, computer science, differential geometry, logic and set theory, number theory, probability and topology. Teaching duties of four ten-week courses spread over two or three quarters typically include at least one course in the instructor's specialty and include elementary, advanced and (at instructor's option) graduate courses. Nine-month salary of $32,500 supplemented by summer (resident) research stipend of $7,150 (two-thirds). Send letter of application, resume, graduate transcript, thesis abstract, description of other research activities and interests if appropriate, and 3 or preferably 4 letters of recommendation (at least one should discuss teaching) to Phyllis Bellmore, Department of Mathematics and Computer Science, Dartmouth College, Hanover, New Hampshire 03755. Applications completed by February 1 will receive first consideration. Dartmouth is committed to Affirmative Action and encourages applications from African Americans, Asian Americans, Hispanics, Native Americans and women. Specific questions on the selection process can be directed to Richard E. Williamson, Recruiting Chair.

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**UNIVERSITY OF NEW HAMPSHIRE**

Department of Mathematics

Durham, NH 03824

The Department of Mathematics expects to have tenure-track positions in applied mathematics and statistics available in the Fall Semester, 1991. While each position is at the assistant professor level, outstanding applicants at all ranks will be considered. We are particularly interested in candidates with a strong research potential in the applied mathematical areas of numerical analysis or dynamical systems and an interest in interdisciplinary research. Successful applicants are expected to have a strong commitment to teaching and research. Preference will be given to those applications received by February 1, 1991. Send resume and names of three references to L. D. Meeker, Chairperson, Mathematics Department, University of New Hampshire, Durham, NH 03824. UNH is an AA/EEO Employer.

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**HOBART AND WILLIAM SMITH COLLEGES**

Department of Mathematics and Computer Science

Two Assistant Professor, tenure-track positions starting in September 1991. Salary is competitive.

For the first position applicants should have a Ph.D. in computer science or a Ph.D. in mathematics and experience in computer science. Duties include teaching undergraduate computer science, participating in the Colleges' Interdisciplinary General Curriculum, and the possibility of teaching some mathematics (depending on interests and qualifications).

For the second position applicants should have a Ph.D. in mathematics; specialty open, but preference may be given to algebraists, applied mathematicians, or those with demonstrated computer science expertise. Duties include teaching undergraduate mathematics, participating in the Colleges' Interdisciplinary General Curriculum, and the possibility of teaching some computer science (depending on interests and qualifications).

For both positions a strong commitment to teaching and promise of continued scholarly activity is required. Teaching load: two courses per trimester. Hobart College for men and William Smith College for women are coordinate, four year, liberal arts colleges committed to teaching and interdisciplinary study with a combined enrollment of 1900 students. Within an hour's drive are three major universities: Cornell, Rochester, and Syracuse.

Send detailed resume, three letters of recommendation (at least one including comments on teaching), and undergraduate and graduate transcripts (photocopies acceptable) to: Prof. Kevin Mitchell, Faculty Box 75, Department of Mathematics and Computer Science, Hobart and William Smith Colleges, Geneva, NY 14456. Evaluation of applications will begin December 15, 1990 and will continue until the position is filled. Women and minorities are strongly encouraged to apply. An Equal Opportunity/Affirmative Action Employer.

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**NEW JERSEY**

**RUTGERS UNIVERSITY, CAMDEN**

The Mathematical Sciences Department seeks highly qualified applicants for a research oriented assistant professorship. This is a tenure track position at a competitive salary with a teaching load of one course for the first two years. At least one year beyond the Ph.D. and one significant publication are necessary to be considered. Send C.V., a minimum of three letters of recommendation, and reprints/preprints as soon as possible to: Search Committee, Mathematical Sciences Department, Rutgers University, Camden, NJ 08102 AA/EOE

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**NEW YORK**

**CLARKSON UNIVERSITY**

The Department of Mathematics and Computer Science at Clarkson University invites applications for tenure track positions in mathematics. Ph.D. in mathematics or a closely related discipline is required. Rank and salary are negotiable. Strong candidates in all areas are encouraged to apply. We are especially interested in new colleagues with interests in differential and algebraic geometry, probability and statistics, and computational mathematics.

The university is located in upstate New York close to the scenic Adirondack and Thousand Island regions. The concentration of college campuses in the vicinity creates a rich cultural environment with a high quality of life without the problems of major cities.

Applications including vita and names of three references should be submitted to Professor A. Fokas, Department of Mathematics and Computer Science, Clarkson University, Potsdam, NY 13699. Clarkson University is an equal opportunity/affirmative action employer and encourages applications from women and minorities.

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**AMERICAN MATHEMATICAL SOCIETY**

Classified Advertisements

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NOTICES OF THE AMERICAN MATHEMATICAL SOCIETY
UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
Department of Mathematics
Chapel Hill, NC 27599-3250

Applications are invited for tenure-track appointments effective Fall 1991. Rank and salary depend on qualifications and budget considerations. Ph.D., exceptionally strong research program and commitment to excellent teaching required. Send curriculum vitae, abstract of current research program and four letters of recommendation to: Search Committee Chair, Mathematics Department, CB #3250 Phillips Hall, UNC at Chapel Hill, Chapel Hill, NC 27599-3250. EO/AA Employer. Women and minorities are encouraged to identify themselves voluntarily. Completed applications received by February 1, 1991 are assured of full consideration.

Cleveland State University Department of Mathematics

MATHEMATICS/ASSISTANT PROFESSOR: Applications are invited for the position of Assistant Professor starting September 1991. The Department has 22 members and offers a B.S. and M.A. in mathematics and a B.S. in computer science. Send letter of application and resume to Richard D. Carmichael, Department of Mathematics and Computer Science, Wake Forest University, Winston-Salem, NC 27109. AA/EO employer.
Opportunity Employer. Applications will continue to be accepted until the position is filled.

THE OHIO STATE UNIVERSITY AT NEWARK  
Department of Mathematics  
ASSISTANT PROFESSOR, MATHEMATICS - The Ohio State University at Newark is seeking an Assistant Professor for a full-time, tenure track position in the Mathematics Department. DUTIES INCLUDE: Teach undergraduate courses in Mathematics. Ability and willingness to teach elementary statistics course is desirable. Conduct research and render appropriate Campus, Departmental, and university service. QUALIFICATIONS INCLUDE: Ph.D. in Mathematics. Some experience at the college or university level is preferred. TENURE: Full-time, 9 month, tenure track position. STARTING DATE: November 1, 1991. STARTING SALARY: Negotiable; comprehensive benefits package. To assure consideration, send vita and three letters of reference written directly to the search committee by 3/29/91 to Coordinator, Human Resources, Mathematics Search, The Ohio State University, Drive, Newark, Ohio 43055. OSU at Newark is an Equal Opportunity/Affirmative Action Employer.

OKLAHOMA  
THE UNIVERSITY OF OKLAHOMA  
Department of Mathematics  
601 Elm Avenue, Room 423  
Norman, Oklahoma 73019-0315  
Applications are invited for two anticipated tenured or tenure-track positions in Mathematics beginning Fall 1991. One position at the associate professor level, with preference given to applicants with research interests in the areas of Geometry, Topology, or Analysis. One Assistant Professor position at the entry level with preference given to research interests compatible with those of our current faculty. Candidates must have a Ph.D. degree, demonstrated excellence in research, and a strong commitment to high-quality teaching. Duties include research, normally teaching six credit hours per semester, and Departmental and University service appropriate to rank. Salary will be commensurate with qualifications and experience. There may also be 2 to 3 credit hours of graduate teaching, commensurate with research. The University of Oklahoma is an Equal Opportunity/Affirmative Action Employer. Applications should be visiting positions. Candidates should send their vita and have at least three letters of reference sent to Dr. Ruediger Landes, Search Committee Chair, Department of Mathematics, University of Oklahoma, 601 Elm Avenue, Room 423, Norman, Oklahoma 73019-0315. Initial screening begins December 15, 1990 and every two weeks thereafter. Applications will be accepted until the positions are filled. The University of Oklahoma is an Equal Opportunity/Affirmative Action Employer. OU has a policy of being responsive to the needs of dual-career couples.

PENNSYLVANIA  
COMMUNITY COLLEGE OF PHILADELPHIA  
Mathematics Dept. at Community College of Philadelphia invites applications for an expected tenure-track Asst. Professorship position beginning Fall 1991. The Department is actively engaged in course development. It has recently received grants from NSF and CASET. Teaching load is 12 credit hours/semester. Outstanding benefits. Candidate must have a Ph.D. or master’s + 3 years college teaching in mathematics and a commitment to quality teaching, both remedial and college level. Demonstrated strength in course development is essential. Candidate should provide clear evidence of strong background in mathematics, together with ability to bring to the first 2 years, mathematics topics usually delayed until later. Send curriculum vitae and 3 letters of recommendation by March 1, 1991 to J. Mason, Head, Dept. of Mathematics, COMMUNITY COLLEGE OF PHILADELPHIA, 1700 Spring Garden St., Phila., PA 19130. Women and minorities are encouraged to apply. AA/EOE.

LAFAYETTE COLLEGE  
Department of Mathematics  
Easton, PA 18042  
Tenure-track position at the rank of Assistant Professor beginning in late August 1991. Preference for a candidate able to help with teaching statistics at all undergraduate levels. Women and minorities are especially encouraged to apply. Teach undergraduate mathematics, help to develop our undergraduate mathematics program, pursue scholarly development. Lafayette offers liberal arts and engineering in a small (2000) highly selective private college close to Philadelphia and New York City. Send resume, 3 reference letters and telephone numbers (office and home) to Chair, Mathematics Search Committee. Review of applications will begin after January 20, 1991, and will continue until the position is filled. Lafayette is an Equal Opportunity Employer.  

UNIVERSITY OF PITTSBURGH  
Department of Mathematics and Statistics  
The department invites applications for the following positions, which will be available for September 1991 if funding permits.  
1. Assistant Professor in the area of partial differential equations.  
2. Assistant Professor in some branch of pure mathematics other than differential equations. Applicants are especially encouraged in algebra and geometric or algebraic topology, but all areas will be considered. Requirements include outstanding research accomplishment and potential commensurate with experience and ability and interest in excellent teaching. Applicants should send resume and arrange to have at least three letters of recommendation sent to: S. Hastings, Chairman, Department of Mathematics and Statistics, University of Pittsburgh, Pittsburgh, PA 15260. The University of Pittsburgh is an Equal Opportunity/Affirmative Action Employer. Women and minorities are especially encouraged to apply.  

WEST CHESTER UNIVERSITY  
Mathematics and Computer Science Department  
West Chester, PA 19383  
Applications are invited for a tenure track position at the assistant or associate professor level starting September 1991. Candidates must possess a strong commitment to teaching and research and have completed the Ph.D. in mathematics by the starting date. Preference will be given to candidates with specialties in combinatorics, algebraic groups, or functional analysis. Salary and fringe benefits are competitive. Send resume, graduate transcript and three letters of recommendation to the Mathematics Search Committee at the above address. Closing date March 15, 1991. AA/EOE. Women and minorities are encouraged to apply.

RHODE ISLAND  
PROVIDENCE COLLEGE  
Assistant Professor of Mathematics  
A tenure-track position will be available in August 1991. Duties include teaching the full range of undergraduate Mathematics. Ph.D. in Mathematics required. Send letter of application and resume to Mr. Frank Ford, Chair, at Math/CS Department, Providence College, Providence, R.I. 02918 by Mar. 1st and have transcripts and three letters of recommendation sent directly to the same address. At least one of the letters of recommendation must address teaching ability. Providence College is a Roman Catholic four-
year liberal arts college conducted under the auspices of the Dominican Friars and is an Equal Opportunity Affirmative Action Employer.

ROGER WILLIAMS COLLEGE
Bristol, RI 02809
School of Science and Mathematics
The School of Science and Mathematics of Roger Williams College welcomes applications for a full time faculty position, subject to funding approval, in mathematics beginning September 1991. The School offers majors in mathematics and computer science and provides support courses for College programs in science, engineering, business, architecture, psychology, and general education. The college enrolls approximately 2100 full time and 1700 part time students in a variety of liberal arts and professional programs. It is situated in historic Bristol, RI on a bluff overlooking Mount Hope Bay. We seek candidates who would enjoy teaching undergraduates a variety of major and service courses. The normal teaching load is 4 courses/12 contact hours. Doctorate and full time college teaching experience required. Salaries are competitive; fringe benefits excellent.

Send a letter of application, curriculum vita, and three letters of reference to: Faculty Search Committee, School of Science and Mathematics, Roger Williams College, Bristol, RI 02809. Applications received by February 1, 1991 will be given first consideration. Roger Williams College is an affirmative action/equal opportunity employer.

THE UNIVERSITY OF RHODE ISLAND
Assistant Professor position (tenure track) possibly available starting September 1991. Ph.D. in Mathematics required. Preference will be given to applicants in differential equations, combinatorics, control theory and classical and functional analysis. Please submit, by 2/28/91, a letter of application indicating the title of the position applied for and a vita, and have three letters of reference sent to: L. Pakula, Search Committee Chair, Assistant Prof., Mathematics (021098) Position, THE UNIVERSITY OF RHODE ISLAND, P.O. Box G, Kingston, RI 02881. An Affirmative Action/Equal Opportunity Employer.

SOUTH CAROLINA
CLEMSON UNIVERSITY
Department of Mathematical Sciences
Applications are invited for anticipated tenure-track positions at the assistant professor level, and possibly higher levels. The Department of Mathematical Sciences includes the areas of algebra/combinatorics, analysis, computational mathematics, operations research, and statistics. Applicants with specialties in any of these areas are encouraged to apply. Desired attributes for candidates include an interdisciplinary research orientation in the mathematical sciences and an interest in innovative applications. Candidates should have strong potential or demonstrated capability for effective research and teaching. All of the above areas of the mathematical sciences are integrated into degree programs at the B.S., M.S., and Ph.D. levels. In addition, the department jointly administers a Ph.D. program in management science with the Department of Management. Applications will be accepted until any approved positions are filled. Applicants should indicate in the cover letter their research specialties. Vita and three reference letters should be sent to: Professor R. D. Rengeisen, Head File M Department of Mathematical Sciences Clemson University Clemson, SC 29634-1907 Clemson University is an AA/EO Employer.

COKER COLLEGE
Department of Science and Mathematics
Coker College invites applications for two tenure-track positions in mathematics. Candidates must have a Ph.D. and demonstrate the potential for high quality teaching and continuing scholarly activity. Duties begin August 1991 and include teaching college algebra, all levels of calculus and some combination of the following: differential equations, probability and statistics, discrete mathematics, and/or computer science courses. Total teaching load is 12 semester hours per semester with approximately one-quarter of the load to be taught in the evening program. Rank and salary commensurate with experience. Coker College is a private, four-year liberal arts college in Hartsville, SC. Heavily endowed, no courses have more than 20 students and many upper level courses have only three or four. Independent study courses are encouraged. Deadline for applications is February 4, 1991. Send a letter of application, curriculum vitae, and three references to Professor Kaye Crook, Chair, Mathematician Search Committee, Department of Science and Mathematics, Coker College, Hartsville, SC 29550. AA/EOE.

THE CITADEL
Applications are invited for a tenure track position at the assistant or associate level. Qualifications include a Ph.D. in a mathematical science or computer science, a firm commitment to undergraduate teaching, and a continuing program of research. Preference will be given to individuals with qualifications in the areas of statistics, computing, or information science. Salary is competitive.

The Citadel is a state-supported liberal arts, military college offering undergraduate degrees in the Arts, Sciences, Engineering, Education, and Business Administration. The department offers bachelor's degrees in mathematics and computer science. Generous support for faculty research is available. Send a resume and three letters of reference to: Stephen D. Comer, Search Committee, Department of Mathematics/Computer Science, The Citadel, Charleston, SC 29409. Email: comer@citetel.bitnet.

Review of applications will begin March 1. Women and minorities are encouraged to apply. The Citadel is an equal opportunity/affirmative action employer.

THE UNIVERSITY OF SOUTH CAROLINA
Department of Mathematics
Applications are invited for anticipated tenure-track faculty positions at all ranks. Applications in all areas of mathematics will be considered. The department is building on existing research strengths and is increasing the scope of its programs in applied mathematics. The Ph.D. degree or its equivalent is required, and all appointments will be consistent with the department's commitment to excellence in research and teaching at the graduate and undergraduate levels. A resume, containing a summary of research accomplishments and goals, and four letters of recommendation should be sent to: Dr. Colin Bennett, Chairman Department of Mathematics University of South Carolina Columbia, South Carolina 29208

The closing date for applications is January 31, 1991. The University of South Carolina is an Affirmative Action/Equal Opportunity Employer.

WINTHROP COLLEGE
Mathematics Department
Rock Hill, SC 29733

Winthrop College is seeking a tenure-track faculty member at the assistant level. Salary will be competitive and documentation of teaching excellence will merit special consideration. Winthrop is a state supported comprehensive college of South Carolina, located approximately 20 miles south of Charlotte, NC, with an enrollment of 5000 students. An application, vita, and three letters of reference are required. Deadline is March 8, 1991. Winthrop College is an Equal Opportunity Institution and an Affirmative Action Employer. Applications are to be sent to: Dr. Ron C. Goosby, Chair, Department of Mathematics, Winthrop College, Rock Hill, SC 29733.

TENNESSEE
MEMPHIS STATE UNIVERSITY
Department of Mathematical Sciences
The Department of Mathematical Sciences is seeking applications for one tenure-track position each in DE/Applied Mathematics and Statistics at the assistant/associate professor level. Current areas of research in DE/Applied Mathematics include nonlinear boundary value problems, functional differential equations, dynamical systems and mathematical modeling. In Statistics, current areas of research include applied statistics, biostatistics, survival analysis, risk assessment, stochastic modeling and statistical computing. The Department has excellent in-house library and computing facilities.
and offers degrees at all levels through the Ph.D. One additional faculty position is anticipated. Applicants must have a Ph.D. by September 1, 1991 and a strong potential for excellence in teaching and research.

Selection begins on January 31, 1991. Applications will continue to be accepted until all positions are filled. Women and minorities are strongly urged to apply. Successful candidates must meet Immigration Reform Act criteria of 1986. Applicants should submit a resume and direct three letters of reference to: Cecil C. Rousseau, Interim Chair Department of Mathematical Sciences Memphis State University Memphis, TN 38152

An Equal Opportunity/Affirmative Action University.

UNIVERSITY OF TENNESSEE
AT CHATTANOOGA
Department Head

The University of Tennessee at Chattanooga invites applications for Head of the Department of Mathematics. A Ph.D. in a mathematical science and at least five years of college mathematics teaching experience are required. Applicants should provide evidence of leadership in curriculum development, teaching, public service and research/scholarly activities. In this primarily undergraduate institution, the faculty is expected to exhibit excellence in teaching while maintaining a strong commitment to research and public service. The mathematics department has 21 faculty members including a Chair of Excellence in applied mathematics. Located in a very scenic metropolitan area of 400,000, UTC has a student enrollment of 7800. Send applications with current vita to: Dr. Paul L. Gaston, Dean, College of Arts and Sciences, 119 Holt Hall, UTC, Chattanooga, TN 37403-2598. Applications received by January 31, 1991, will be assured full consideration. Women and minorities are encouraged to apply. UTC is an Equal Opportunity Employment/Affirmative Action/Title IX Section 504 Institution.

UNIVERSITY OF TENNESSEE
Department of Mathematics

The Mathematics Department of the University of Tennessee, in an effort to significantly improve its research position, seeks to fill a tenure-track assistant professorship or junior associate professorship. Employment begins August 1991. The Department's interests are in the areas of algebra, analysis, applied mathematics, differential equations, geometry, mathematical ecology, numerical analysis, probability, and topology. Substantial research accomplishments and promise, as well as dedication to teaching are paramount. Interested applicants should arrange to have a vita, three reference letters, and a research statement sent to Professor John B. Conway, Mathematics, University of Tennessee, Knoxville, TN 37996-1300. Review of applications will begin December 1 and will continue until the position is filled. UTC is an EEO/AA Title IX/Section 504 Employer.

UNIVERSITY OF TENNESSEE
Position Available. Assistant/Associate professor of Mathematics and Ecology. The University of Tennessee, Knoxville. A tenure-track joint appointment in the Department of Mathematics and the Graduate Program in Ecology is available starting fall 1991. Applicant is expected to interact with a large group of mathematical and theoretical ecologists at UTK and Oak Ridge National Laboratory (Environmental Sciences Division), have or establish an active research program, teach a variety of undergraduate and graduate courses in mathematics, and lead graduate seminar courses in the Ecology Program. A Ph.D. in mathematics, ecology, or related area is required as well as previous teaching experience. Area of expertise in mathematical ecology is open. Submit a c.v., transcripts, brief plan of future research, and three letters of recommendation to: Dr. Thomas G. Hallam, Chair, Math Ecology Search Committee, Department of Mathematics, University of Tennessee, Knoxville, TN 37996-1300. Review of applications will begin December 31, 1990 and will continue until the position is filled. UTC is an EEO/AA Title IX/Section 504 Employer.

TEXAS
ANGELO STATE UNIVERSITY
Department of Mathematics

Angelo State University is seeking applications for a tenure track position at the Assistant Professor level for Fall 1991. Candidates must hold the Ph.D. degree in mathematics. Teaching load is twelve hours per semester at a nine-month salary of $32,775 to $35,159, depending upon academic qualifications and college teaching experience, plus opportunity for summer teaching at the same monthly salary rate and other University benefits. Job requirements include ability to communicate effectively with undergraduate students, dedication to excellence in teaching, and strong commitment to high academic and professional standards. Inquiries should be directed to: Dr. J. M. Bailey, Head Department of Mathematics Angelo State University San Angelo, Texas 76909

Angelo State University has one of the most modern and attractive campuses in the nation and is fully accredited by the Commission on Colleges of the Southern Association of Colleges and Schools. The University student body of 6,300 ranks first among regional universities and third among all state universities in Texas in the high percentile ranking of entering freshmen in their high school graduating classes. The University offers one of the largest and most distinctive academic scholarship programs in the nation which attracts outstanding students from throughout the world.

Angelo State University is an equal opportunity/affirmative action employer.

LAMAR UNIVERSITY
Beaumont, Texas

The Department of Mathematics seeks applications for a tenure-track Assistant/Associate Professor position beginning Fall 1991. Applicants must hold an earned Ph.D., should be active researchers in Applied Mathematics and/or Numerical Analysis/Scientific Computing, and have a strong commitment to teaching.

Lamar is a state supported educational and research institution of approximately 12,000 students. The Department, which is located within the College of Engineering, offers the B.A., B.S., and M.S. degrees in Mathematics and has 16 full-time faculty.

For the approximately 250,000 people in the Beaumont area, there are eight museums, a symphony orchestra, ballet, opera, and other theatrical productions. Other facilities and events are found in Houston 85 miles west. Nearby outdoor recreational opportunities include two of the largest freshwater lakes in Texas, the Big Thicket National Preserve, four national forests, the Gulf of Mexico, and a large inland saltwater lake.

Salary and rank are commensurate with qualifications and experience. Send a resume and three letters of recommendation to: Dr. John R. Canon, Chair; Department of Mathematics; Lamar University; P.O. Box 10047; Beaumont, TX 77710. Full consideration will be given to completed applications received before March 15, 1991. Lamar is an EEO/AA employer.

RICE UNIVERSITY
Department of Mathematics

Applications are invited for a tenure-track assistant professorship. There is a possibility of an upgrade to associate or full professorship for an exceptional senior candidate. Candidates must have an extremely strong research background and good teaching skills. Preference will be given to applicants in low-dimensional topology, although outstanding candidates in analysis, geometry, and topology will also be considered. Please send a curriculum vitae and at least 3 letters of recommendation to: Appointments Committee, Department of Mathematics, Rice University, P.O. Box 1892, Houston, Texas 77251.

Rice University is an Equal Opportunity/Affirmative Action Employer.

TEXAS A&M UNIVERSITY
Department of Mathematics

The Department of Mathematics invites applications for one or more positions in the fields of algebra and topology. The department expects to make several appointments in these fields during the next 3 to 5 years in order to expand our algebra and topology group. Currently, we
have active researchers in algebraic geometry, combinatorics, algebraic K-theory and cyclic homology, noncommutative ring theory, knot theory, and general topology. We are particularly interested in modern algebraists who can interact with the people presently at Texas A&M and in algebraic topologists.

Texas A&M University is a major research institution with a total enrollment of 42,000. It ranks in the top seven universities nationally in extramural research funding and in the top five universities in the number of national merit finalists currently enrolled.

To apply, please send a curriculum vitae and have at least three (3) letters of recommendation sent to Prof. H. E. Lacey, Head, Department of Mathematics, Texas A&M University, College Station, TX 77843-3368.

Texas A&M University is an Equal Opportunity/Affirmative Action Employer. Women and minorities are encouraged to apply.

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Texas A&M University
Department of Mathematics

The Department of Mathematics at Texas A&M University hopes to fill several tenure-track and visiting positions which begin in the fall semester 1991. All areas will be considered. To apply, please send a curriculum vitae and have at least three (3) letters of recommendation sent to Prof. H. E. Lacey, Head, Department of Mathematics, Texas A&M University, College Station, TX 77843-3368.

Texas A&M University is an Equal Opportunity/Affirmative Action Employer. Women and minorities are encouraged to apply.

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The University of Texas at San Antonio
Department of Mathematics

Applications are invited for several positions beginning Fall Semester 1991. Salary and rank are commensurate with qualifications. The selected candidates must have excellent credentials in research and teaching. The desired area of expertise are Differential or Algebraic Geometry, Computational Geometry, Partial Differential Equations, Functional Analysis, Statistics and Applied Mathematics. A resume with three letters of recommendation should be sent to:

Dr. Danny Dyer
University of Texas at Arlington
Department of Mathematics
Box 19408
Arlington, Texas 76019

ATTN: RECRUITING CHAIRMAN

The University of Texas at Arlington does not discriminate on the basis of race, sex, color, religion, national origin, age, handicap, or veteran status in provision of educational opportunities or employment opportunities and benefits. The University of Texas at Arlington is an Affirmative Action/Equal Opportunity Employer.

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University of Texas at Arlington
Department of Mathematics

Applications are invited for several positions beginning Fall Semester 1991. Salary and rank are commensurate with qualifications. The selected candidates must have excellent credentials in research and teaching. The desired area of expertise are Differential or Algebraic Geometry, Computational Geometry, Partial Differential Equations, Functional Analysis, Statistics and Applied Mathematics. A resume with three letters of recommendation should be sent to:

Dr. Danny Dyer
University of Texas at Arlington
Department of Mathematics
Box 19408
Arlington, Texas 76019

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The University of Texas at San Antonio
Department of Mathematics and Statistics

Applications and nominations are invited for one or more tenure-track positions at the assistant or associate level beginning September 1991. A Ph.D. (or its equivalent) in one of the mathematical sciences is required. Preference will be given to applicants with research interests in nonlinear partial differential equations, dynamical systems, numerical partial differential equations or numerical optimization; however, highly qualified applicants in other areas will be considered.

Excellence in research and a demonstrated commitment to both graduate and undergraduate teaching are required.

Utah State University, located in the Wasatch Range of the Rocky Mountains, offers competitive salaries and excellent medical, retirement and professional benefits.

Applications, including resume and three letters, should be submitted to:

Russell C. Thompson
Search Committee
Department of Mathematics and Statistics
Utah State University
Logan, UT 84322-3500

Review of applications will begin February 1, 1991, and will continue until the position is filled.

Utah State University is an Equal Opportunity/Affirmative Action Employer.

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Lyndon State College
Lyndonville, Vermont

Tenure-track position in Department of Mathematical Sciences, with concentration in Algebra. Ph.D. for award of tenure; may consider for employment candidates with A.B.D. and in active pursuit of doctorate. Teaching assignment will range from introductory service courses to upper-division math major courses. Experience in mathematics education programs a plus. Salary is commensurate with experience; generous fringe benefits package is provided without employee contribution. Academic year opens August 27, 1991.

Lyndon State College is a vigorously growing comprehensive institution with degrees through the master's level. Nestled in the mountains of Vermont's Northeast Kingdom, Lyndon enrolls 1175 undergraduates and 200 graduate and non-degree students, and employs 60 full-time and 50 adjunct faculty.

Lyndon's faculty are especially attentive to an academically diverse student body, including a growing number of non-traditional students. The College's mission emphasizes personal attention to individuals. Faculty are active in campus governance and community service, while effective teaching is an important measure for continued employment. Successful candidates will also demonstrate ability to work harmoniously with colleagues in the department. Prior teaching experience is desirable unless noted.

Send letter of application and vita (listing at least three references) to Chair, Faculty Search Committee, c/o Associate Dean Hruska, Lyndon State College, Lyndonville, VT 05851.

Closing date: February 1, 1991. Lyndon, as an equal opportunity employer, invites applications from women and minorities and handicapped persons.

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Christopher Newport College

Christopher Newport College Mathematics Tenure Track Position at the assistant professor or instructor rank for 1991–92 academic year. Salary is competitive. Ability and potential in teaching and research. Should be interested in being involved in the education of undergraduates and in the other activities of a faculty.
Applications are invited for a tenure-track appointment, subject to budgetary approval, at the level of Assistant Professor beginning with the 1991-92 academic year. A Ph.D. and strong research potential are required. Preference will be given to candidates with postdoctoral experience. Primary areas of interest are algebraic and differential geometry, discrete mathematics, dynamical systems, and computationally oriented mathematics. Applications will be accepted until March 15, 1991 or until position is filled. Applicants should send a vita and arrange to have three letters of reference submitted to Chair, Search Committee, Department of Mathematics, Virginia Tech, Blacksburg, VA 24061-0123. Women and minorities are encouraged to apply. Virginia Tech is Equal Opportunity/Affirmative Action Employer.

WASHINGTON

WESTERN WASHINGTON UNIVERSITY

Applications are invited for tenure-track and visiting positions to begin Fall 1991. Successful candidates will be expected to be active in research, to interact at the research level with current department members, and to be effective teachers with a commitment to both undergraduate and graduate education.

Candidates in the following areas of mathematics are especially sought: discrete mathematics (particularly graph theory), modeling, optimization, and statistics. A Ph.D. is required. A demonstrated interest in the use of computers for instructional purposes and in the integration of applications of mathematics into classroom material is desirable.

Rank and salary are open, but a substantial research record will be required for appointments above the Assistant Professor level. The normal teaching load for research faculty is two courses per quarter.

Western Washington University is located on Bellingham Bay in an area of outstanding natural beauty within an hour’s drive of the Seattle and Vancouver, B.C., metropolitan areas and the Cascade Mountains. The department has a strong undergraduate program with a somewhat different flavor and a flourishing Master’s program with about twenty students.

Applications should be sent to Professor Thomas T. Read, Chairman, Department of Mathematics, Western Washington University, Bellingham, WA 98225-1063.

Interested candidates should submit a letter of application, complete transcripts, a vita, and three letters of recommendation addressing the candidate’s qualifications in teaching and research. Deadline for applications is February 1, 1991; later applications will be considered if positions remain available. Positions are subject to the continuing availability of funds. The University is an EOE/AA employer.

WISCONSIN

UNIVERSITY OF WISCONSIN-RIVER FALLS

Mathematics Faculty Position

Applications are invited for two tenure-track positions at the assistant professor level beginning September 1, 1991. Ph.D. in mathematics or a closely related discipline is required. Applicants must have strong commitments to excellence in undergraduate education and continuing scholarly activity. The current full-time teaching load averages 12 credit hrs./week; other responsibilities include advising students and departmental, college, and university work. Salaries are competitive.

The University of Wisconsin-River Falls is located in west central Wisconsin, 30 miles east of St. Paul and Minneapolis, Minnesota. Enrolling 5,200 students, the university offers bachelor’s and master’s degrees in the colleges.

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
Department of Mathematics

Applications are invited for a tenure-track appointment, subject to budgetary approval, at the level of Assistant Professor beginning with the 1991-92 academic year. A Ph.D. and strong research potential are required. Preference will be given to candidates with postdoctoral experience. Primary areas of interest are algebraic and differential geometry, discrete mathematics, dynamical systems, and computationally oriented mathematics. Applications will be accepted until March 15, 1991 or until position is filled. Applicants should send a vita and arrange to have three letters of reference submitted to Chair, Search Committee, Department of Mathematics, Virginia Tech, Blacksburg, VA 24061-0123. Women and minorities are encouraged to apply. Virginia Tech is Equal Opportunity/Affirmative Action Employer.

WEST VIRGINIA

WEST VIRGINIA UNIVERSITY
Department of Mathematics

The Department of Mathematics intends to make several faculty appointments that will commence August 1991. One appointment may be at the Associate rank; others will be at the Assistant rank. Candidates are expected to have a Ph.D. in mathematics or equivalent with a strong record or demonstrated potential in both research and teaching. Preference will be given to applicants whose research interests complement those currently in the Department in algebra, analysis, applied, or numerical analysis, discrete mathematics. Normal responsibilities include research and a two course teaching assignment per semester at the graduate or undergraduate level. Applications and inquiries should be directed to James Lightbourne, Department of Mathematics, West Virginia University, Morgantown, WV 26506. Applicants should submit a vita and three letters of reference (senior applicants may choose to submit names of references). To insure consideration, application materials must be received by January 15, 1991. WSU is an Affirmative Action/Equal Opportunity Employer. Qualified women and minorities are especially encouraged to apply.
WYOMING

THE UNIVERSITY OF WYOMING
A Senior Position in Mathematics
Education in the College of Education
and The Department of Mathematics
of The College of Arts and Sciences

The only four-year university in Wyoming, the University of Wyoming has an enrollment of approximately 12,000 students. If you are interested in joining a faculty which is designing innovative teacher education programs including elements of teaming and interdisciplinary approaches, your application is invited. Candidates should have a doctorate in mathematics or mathematics education and have a demonstrated ability to interact in both the Mathematics Department and College of Education. Preference will be given to candidates who have had a minimum of three years teaching experience.

The position will entail the development and teaching of methods courses in mathematics education for both elementary and secondary education majors. In addition, the successful applicant will be expected to conduct graduate level seminars in mathematics education and to work with the mathematics department in developing and teaching mathematics courses and training graduate teaching assistants.

The position also involves some undergraduate advising as well as directing Masters and Ph.D. students. Participation in outreach and coordination of the K-9 mathematics curriculum in our laboratory school will also be expected. Rank open. Salary to $60,000 depending upon experience and qualifications. A personal microcomputer, graduate assistance and an adequate travel budget will be provided. In addition, a reduced teaching load to accommodate funding and research activities will be made available. Screening will begin February 1 and continue until the post is filled. AA/EEO.

Send resume and three to five letters of reference directly to: Prof. Stephen E. List, Chair Search and Screen Committee Department of Mathematics/Computer Systems University of Wisconsin-River Falls River Falls, WI 54022 Applications will be received until March 1, 1991 or until position is filled.

(UW-RF is an Equal Opportunity/Affirmative Action Employer. Women and minorities are encouraged to apply.)

THE UNIVERSITY OF WYOMING
Department of Mathematics
Junior Position in Pure Mathematics

The Department of Mathematics invites applications for a tenure-track assistant professor position in pure mathematics. Areas of interest include Functional Analysis, Matrix Theory, Group Theory and Algebraic/Computational Combinatorics. The department has a strong Applied Mathematics group with collaborative interests in scientific computation. Research areas overlapping these interests are particularly encouraged. Excellence in teaching as well as productive scholarship is required. Minorities and women are especially solicited.

Salary is competitive and includes a startup travel/equipment package. Applicants should send a curriculum vitae, a description of research interests, and have three letters of reference sent to: W. G. Bridges, Head Department of Mathematics Box 3036, University Station Laramie, WY 82071

Email inquiries should be sent to cowboy@uwyo.bitnet. Applications completed by January 15, 1991 will receive first consideration. The University of Wyoming is an Affirmative Action/Equal Opportunity Employer.

UNIVERSITY OF BRITISH COLUMBIA
Mathematics Department, Room 121, 1984 Mathematics Road Vancouver, B.C., Canada, V6T 1Y4

The Mathematics Department at the University of British Columbia expects to have a number of post-doctoral fellowships, sessional lectureships and visiting positions at the Assistant, Associate and Full Professor level for the year starting July 1, 1991, subject to the availability of funds. We also expect a number of summer session teaching positions during the months of May through August 1991. A Ph.D. or equivalent and University teaching experience and evidence of high potential for research in Mathematics are required. Since some positions will be partially supported by research grants, these positions will be filled by persons having research interests relating to the grant holders. The salary will be commensurate with experience and research record.

Applications, including C.V. and names of references, should be sent to: The Head, Department of Mathematics, University of British Columbia, Vancouver, B.C. Canada V6T 1Y4. Applications received after January 31, 1991 will be considered only if vacancies remain to be filled. The University of British Columbia offers equal opportunity for employment to qualified male and female candidates. In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada. The University of British Columbia is committed to the Federal Government's employment equity program and encourages applications from all qualified individuals.

UNIVERSITY OF WATERTLOO
Pure Mathematics Department

The University invites applications for a tenure-track position in Pure Mathematics at the University of Waterloo. This position is a bridging appointment in anticipation of retirement in 1993. Subject to budgetary approval, the appointment could be made as early as July 1, 1991, to a candidate with very strong research and teaching qualifications.

The University is committed to increasing the complement of female faculty members. Applications from women mathematicians are particularly welcome. However, both female and male applicants in any area of pure mathematics will be considered.

Duties will include research, and teaching at all levels. Salary will depend on the candidate's qualifications. A Ph.D. is required for consideration.

In order to be considered for an appointment in 1991, applications must arrive by February 11,
1991. An application should contain a curriculum vitae of the candidate plus three letters of reference sent directly from the referees.

The University intends wherever possible to fill its vacancies with assistant professors. In accordance with Canadian immigration requirements, this advertisement is directed at Canadian citizens and permanent residents. The University of Waterloo encourages applications from qualified women and men, members of visible minorities, native peoples, and persons with disabilities.

Please send applications to:
Dr. F. A. Zorzitto, Chair
Department of Pure Mathematics
University of Waterloo
Waterloo, Ontario N2L 3G1

GERMANY

UNIVERSITÄT BONN
Research Institute of Discrete Mathematics
Director: Professor Bernhard Korte
Postdoctoral Fellowships on Discrete Mathematics


These awards are intended for young mathematicians and computer scientists with exceptional research promise in Discrete Mathematics and its applications. The postdoctoral fellows are invited to take part in all research activities of the Institute, however, teaching of one graduate course per semester is expected.

An award for a full academic year will range between DM 36,000 and DM 39,600 depending upon qualifications and experience. The awards are not subject to German income tax.

Applications should include a vita, a bibliography, two letters of reference, and a research plan. To be eligible for the 1991–92 competition, a complete application should be on hand by February 28, 1991.

Send application to: Prof. Hans Jürgen Prömel, Research Institute of Discrete Mathematics, University of Bonn, Nassestrasse 2, D-5300 Bonn 1, W. Germany.

UNIVERSITY OF BIELEFELD
Department of Mathematics

Starting October 1st, 1990, a college for postgraduate and postdoctoral studies in mathematics will be instituted at Universität Bielefeld.

The main areas of research are: finite, discrete and Lie groups, potential theory, representation theory, topology, K-theory, combinatorics, numerical analysis, information theory and statistics.

Further information and application forms may be obtained from: Prof. Dr. Andreas Dress, Fakultät für Mathematik, Universität Bielefeld, Postfach 8040, 4800 Bielefeld 1, West-Germany (Telefax: (0521) 106-4743).

HONG KONG

HONG KONG BAPTIST COLLEGE
Principal Lecturer/Senior Lecturer/Lecturer in Mathematics Department

Highly-motivated applied mathematicians interested in both research and teaching are invited to apply for faculty positions commencing September 1991. Baptist College is a government-funded institution with a student body of 3000. Our congenial department of twelve lecturers offers a comprehensive BSc(Hons) curriculum and MPhil by research. We expect to launch a Ph.D. program in 1991. Typical teaching load is two subjects per semester. There is significant micro/minicomputer support for teaching and research. The College and the government provide research funding support.

Applicants should have a Ph.D. in mathematics or a related discipline and expertise in some area of applied mathematics (broadly defined). Appointments to senior positions are based on demonstrated teaching excellence, substantial research accomplishment, and the ability to provide academic leadership.

Depending on qualification and experience, salary ranges from HK$192,420 to HK$333,300 p.a. for Lecturer (approx. 1US$=HK$7.78); HK$348,460 to HK$463,500 p.a. for Senior Lecturer and HK$413,940 to HK$534,060 p.a. for Principal Lecturer. Benefits include housing assistance for overseas appointees as well as local appointees on a minimum salary of HK$290,700 p.a., medical/dental benefits, education allowance for children, vacation leave and passage, baggage allowances for overseas appointee only. Initial appointment will be on 2-year contract with a gratuity of 15% to Lecturer and 25% to Senior Lecturer & above payable upon satisfactory completion of contract. Appointment may be renewed on contract or permanent terms. To apply send complete curriculum-vitae to the Personnel Section, Baptist College, 224 Waterloo Road, Kowloon, Hong Kong [Fax: 852-338-8084]. Candidates should also ask at least three referees to write to the College on their suitability for the post without delay. Deadline for application is 15 February 1991. For more information about the Department contact Fred J. Hickernell, Head, E-mail:fred@bc750.hkbc.hk.

Both English and Chinese are used in teaching and administration.

Applications are invited for a Department of Mathematics Lecturer/Assistant: Lecturer (2 posts) (Ref. no. 108/509/2/90) Applicants should possess a Ph.D. degree in Pure/Applied Mathematics. In addition to participation in the activities of the Board of Studies in Mathematics, the appointees are expected to undertake research in their fields of specialization and be responsible for teaching at the undergraduate (including Part-Time Degree Programme) and postgraduate levels. The posts are tenable from August 1991.

Annual Salary-Lecturer: HK$279,900 - 317,580 by 2 increments BAR, HK$336,420 - 467,700 by 7 increments; Assistant Lecturer: HK$203,940-260,940 by 3 increments (approx. exchange rate: US$1=HK$7.8; £1=HK$15.3) Grade and salary will be commensurate with qualifications and experience.

Conditions of Service: The University offers a competitive remuneration package. For superannuable appointment, benefits include leave with full-pay, contributory superannuation scheme (University 15%, appointee 5%), medical and dental care, education allowances for children, housing benefit for an appointee with annual salary of HK$298,740 or above (with appointee contributing 7.5% of salary towards the provision of housing benefits). Appointment may also be made on fixed term contract which carries equivalent benefits including where applicable, contract-end gratuity (15% of basic salary) in lieu of superannuable benefits. fringe benefits will be packaged flexibly including cash payment options subject to mutual agreement.

Application Procedure: Send full resume in duplicate, giving full particulars as well as names and addresses of 3 referees, together with copies of certificates/diplomas, testimonials and recent publications to the Personnel Section, the Chinese University of Hong Kong, Shatin, Hong Kong before January 31, 1991. Please quote the reference number and mark "Recruitment" on cover.

THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY
Department of Mathematics

The Hong Kong University of Science and Technology is a new publicly funded research University. The first intake of students will be in October 1991 at both undergraduate and graduate levels including the doctorate. Enrollment is expected to grow to 7,000 FTE by 1996-1997. The medium of instruction is English. Applications are invited for the following positions:

Professor: Minimum US$79,600 p.a.

The Department will place major emphasis on applications with an appropriate component of pure mathematics to preserve the integrity of the discipline. Research areas will be highly interdisciplinary and will include scientific computation, statistics, fluid and solid mechanics.

THE CHINESE UNIVERSITY OF HONG KONG

The Chinese University of Hong Kong (founded 1963) offers comprehensive programmes up to Ph.D. level in the Humanities, Business Administration, Science, Medicine, Social Science, Education, Engineering and Architecture. Current student enrollment is 8,000 full-time equivalent, which will expand to 11,500 by 1994-95. The University is very active in promoting research and consultancies and liaising with industry and the business sector worldwide.
mathematical physics, analysis, algebra, geometry, etc.

Applicants should have a Ph.D. degree in the relevant fields. Appointees at the senior level are expected to have a distinguished record in research and have demonstrated an ability to develop research programs; appointees at Lecturer level are expected to have outstanding potential to develop research in his/her own fields. Responsibilities include relevant fields. Courses per semester, and postgraduate teaching not exceeding two.

Lecturer

and postgraduate teaching not exceeding two

Courses per semester.

Lecturer

depend on qualifications. Specific fields of interest include

- Numerical Analysis
- Dynamical Systems
- Computational Geometry
- Nonlinear PDE
- Parallel Computing
- Computer Vision

and physics-oriented mathematics.

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The goal of the program is to foster interaction in this interdisciplinary field which involves electrical engineers, computer scientists, semiconductor physicists and mathematicians, from both university and industry. The program will particularly encourage participation of numerical and mathematical analysts with backgrounds in ordinary and partial differential equations and help get them involved in the mathematical aspects of semiconductor models and circuits. Leading engineers in semiconductors will be invited to present the significant industrial issues as well as to concentrate on those models which are most relevant to mathematicians. The main topics of the program are:

Week 1, July 15–19 1991 ................................... PROCESS MODELING
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Week 4, August 5–9, 1991 .................................... CIRCUIT ANALYSIS

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P. Degond  M. Law  R. E. O'Malley  T. Seidman  J. Vlach
C. Gardner  Y. LeCoz  O. Palersinki  M. Sever  M. Ward
C.W. Gear  W. Liniger  L. R. Petzold  K. Singhal  P. Yang
D. Gerber

Some partial support is still available for researchers (including graduate students) who are, or wish to become, familiar with the subject. Preference will be given to those who participate in the entire program. For details write to Avner Friedman, Director, at the above address.
Mathematical Aspects of Numerical Grid Generation
Edited by José E. Castillo

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Contents: Preface; Introduction; E. Castillo and S. Steinberg; Intrinsic Algebraic Grid Generation; P.M. Knappe; Elliptic Grid Generation and Confocal Mapping; C.W. Mason; Surface Grid Generation and Differential Geometry; Z.U.A. Warsi; Harmonic Maps in Grid Generation; A. Dvinsky; Mathematical Aspects of Harmonic Grid Generation; S.S. Sritharan; Harmonic Maps and Grid Generation; G. Liao; Continuum Variational Formulation; J.E. Castillo; Discrete Variational Grid Generation; J.E. Castillo; Bifurcation of Grids on Curves; S. Steinberg and P.J. Roache.

March 1991 / Approximately 176 pages / Softcover / Frontiers in Applied Mathematics
List Price: $24.50 / SIAM Member Price: $19.60

Large-Scale Numerical Optimization
Thomas F. Coleman and Yuying Li

This volume contains timely developments in large-scale optimization as well as practical developments in interior point methods. It discusses special techniques and new methods regarding parallel techniques for optimization and includes leading researchers among its contributors.


December 1990 / xii + 255 pages / Softcover / Proceedings in Applied Mathematics
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The Method of Equivalence and Its Applications
Robert B. Gardner

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The ideas of Élie Cartan are combined with the tools of Felix Klein and Sophus Lie to present in this book the only detailed treatment of the method of equivalence. An algorithmic description of this method, which finds invariants of geometric objects under infinite dimensional pseudo-groups, is presented for the first time.

As part of the algorithm, Gardner introduces several major new techniques. In particular, the use of Cartan’s idea of principal components that appears in his theory of Repere Mobile, and the use of Lie algebras instead of Lie groups, effectively a linear procedure, provide a tremendous simplification. One must, however, know how to convert from one to the other, and the author provides the Rosetta stone to accomplish this. In complex problems, it is essential to be able to identify natural blocks in group actions and not just individual elements, and prior to this publication, there was no reference to block matrix techniques.

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and Spyros S. Magliveras, Editors

Contemporary Mathematics, Volume 111

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Mathematical Impressions

Anatolii T. Fomenko

"I think of my drawings as if they were photographs of a strange but real world, and the nature of this world, one of infinite objects and processes, is not well known. Clearly there is a connection between the mathematical world and the real world.... This is the relationship I see between my drawings and mathematics."—Anatolii Fomenko, in the Introduction

Anatolii Fomenko is a Soviet mathematician with a talent for expressing abstract mathematical concepts through artwork. Some of his works echo those of M.C. Escher in their meticulous rendering of shapes and patterns, while other pieces seem to be more visceral expressions of mathematical ideas. Stimulating to the imagination and to the eye, his rich and evocative work can be interpreted and appreciated in various ways—mathematical, aesthetic, or emotional.

This book contains 84 reproductions of works by Fomenko (23 of them in color). In the accompanying captions, Fomenko explains the mathematical motivations behind the illustrations as well as the emotional, historical, or mythical subtexts they evoke. The illustrations carry the viewer through a mathematical world consisting not of equations and dry logic, but of intuition and inspiration.

Since the mid-1970s, Fomenko has created more than 280 illustrations. Not only have his images filled pages of his own numerous books on geometry, but they have also been chosen to illustrate books on other subjects, such as statistics, probability, and number theory. In addition, his works have found their way into the Soviet scientific and popular press and have been displayed in more than 100 exhibits in the Soviet Union, Holland, India, and much of Eastern Europe.

Fomenko describes his images as "deep reflections about the essence of being and about the place of modern man—in particular, the learned man—in the stormy and unpredictable world surrounding him." His illustrations are the product of a sensitive, aesthetically attuned mind diving deep below the surface of modern mathematics and emerging with great stories to tell.

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Nonwellfounded sets were originally a part of set theory but were later banned because they were thought to be implicated in the paradoxes of set theory. (An example of a nonwellfounded set is \( a = (1, 2, a) \), with the usual definition of an ordered triple.) However, in recent years, they have been finding their way back into set theory as researchers have shown that nonwellfounded sets are far from incoherent and in fact have many useful applications in computer science, artificial intelligence, and cognitive science. This videotaped expository lecture presents a fascinating look at the use and theory of nonwellfounded sets. Illuminating the subject with clarity of exposition and with carefully chosen examples, Barwise first motivates the subject with a discussion of applications, then moves on to the theory. This lecture would be accessible and appealing to anyone with a background in undergraduate mathematics.

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SOME APPLICATIONS OF GROUP REPRESENTATIONS
Nolan Wallach

In this videotaped lecture, Nolan Wallach presents examples of applications of Lie theory that show how the subject has gone beyond its original roots in an unexpected way. Lie initially envisioned his theory as a way of solving differential equations by reducing the number of variables. As Wallach demonstrates, Lie theory is often used today to set certain problems in a larger context by increasing the number of variables. Although the system then becomes larger, it often becomes simpler because one can use the power of abstraction in representation theory and exploit symmetries in the new, larger system. Using examples from differential equations and classical and quantum mechanics that demonstrate this principle, Wallach presents a lucid and engaging lecture. The lecture should be accessible to advanced undergraduates or graduate students with strong backgrounds in analysis.

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FIFTY YEARS OF MATHEMATICAL REVIEWS
Saunders Mac Lane

Mathematical Reviews celebrated its fiftieth anniversary at the Joint Mathematics Meetings in Louisville, Kentucky in January 1990. This historic event was highlighted by a lecture by Saunders Mac Lane, whose broad knowledge, long memory, and caustic wit made this videotaped lecture entertaining and insightful. Starting with the origins of MR, Mac Lane tells a story peppered with many anecdotes. He culled some of the amusingly scathing reviews that have appeared in MR and even discovered a case of what might be a record for getting the largest number of papers out of a single theorem. In addition, he gives a sense for the way MR has expanded and changed over the years. The lecture is a fitting tribute from one great influence in mathematics to another.

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