Commentary

In My Opinion

Internet Time

One of the pleasures of mathematics is its timelessness: Euclid's theorems are as useful and correct as they were two millennia ago. But if mathematics is timeless, the world is not; it is moving to Internet time. It is hard to imagine the little food shops along the streets of Rome being replaced by `myfood.com`, but the fact is that globalization and the Internet are having a profound impact on our daily lives. Five years ago few had heard of the Web; now `Amazon.com` is stealing market share from the corner bookstore and Blackwells at Oxford. Toysrus is online, as are Charles Schwab, United Airlines, and even the Louvre. The CEO who hasn't thought about the Internet is the CEO who is on her way out the door.

And at the academy? Universities and colleges have put up Web sites listing academics, athletics, faculty, and research. Some faculty post their research papers. (A *very* informal survey shows that this appears to happen more frequently in physics and computer science, less frequently in mathematics.) Some professors post course-related materials: syllabi, homework solutions, occasional course notes. But by and large, academic teaching has been barely affected by the Web.

The revolution is happening, whether we want it or not. The world is moving to the Internet. If video enables distance learning, the Web does so even more easily. This new technology may completely revamp the academy. Lest we be complacent because universities survived the threat of video courses, note that the Web is a very different beast. The Internet provides instant access to massive amounts of information to anyone with a PC and a modem.

What will these changes mean for mathematics departments? We like to argue that teaching is interactive and cannot be duplicated from afar. This is a weak argument when undergraduate classes run to two hundred and more. If a Web-based course can present the material at a hundredth of the cost of the traditional model, the fact that the Web-based education is not personal will not matter. The Web offers certain advantages. Web courses can be offered when and where a student wants them. Web courses are easily customized, an important consideration when an increasing percentage of students are members of the work force returning for advanced training.

Universities must face the Internet revolution. It behooves university and college leaders to structure education in a Web world.

There is another important issue for mathematicians. How will mathematics research function in the Internet world? The question seems foolish at first. After all, a theorem is a theorem is a theorem. A proof will remain true no matter how many networked machines search for a counterexample. But those arguments may miss the point. The real issue is, will mathematics matter in an Internet world?

Over the centuries mathematical questions have arisen from a variety of sources. For example, two millennia ago research problems arose from the mathematics of astronomy, geography, optics, and war; four centuries ago mathematics was driven by the calculations of the planets and the heavens, by physics, and by art. In the 1700s military needs added a large new source of mathematical problems. In the nineteenth century much mathematical research derived from questions of physics and electromagnetism.

In the last several weeks three fruitful areas of mathematical research have caught my attention. One was cryptography, without which e-commerce could not exist. Another was model checking; using logic to check the correctness of programs, model checking has been remarkably effective in the design of integrated circuits. The third was load balancing: how to shift loads on the Web so that when everyone is checking CNN for the latest report on the hurricane in Honduras, access time remains fast. Mathematics provides the solutions for all of these. In all three cases, the research was done by computer scientists. Even worse—from the point of view of mathematics departments and mathematicians—is that these topics are rarely taught by mathematics departments. Cryptography is mathematics, model checking is mathematics, load balancing is mathematics, but all three are taught and researched in computer science departments.

A knowledge of the classics was once central to the notion of what it meant to be an educated person; now the field is optional. Mathematics is central to science and engineering, yet mathematicians have frequently disconnected from the study of mathematics in those fields. The information revolution will have as profound an effect on the world as the industrial revolution did. The organization and access of massive amounts of information is a deep and fundamentally mathematical problem. Mathematicians largely sat out the computer science revolution; will mathematicians now opt to venture from their ethereal worlds in order to explore and develop the Internet world? If not, I fear that the study and practice of mathematics will be increasingly marginalized.

—Susan Landau
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