
MINI-PROJECTS
BASED ON
Shahriar Shahriari, *Approximately Calculus*, AMS, 2006.

A mini project from this text consists of a small number of related problems. These can be done either by a single student as an independent project or by a group of students as part of a group assignment. I have identified a number of possible mini-projects below. I ask my students to solve the problems and then to write them up neatly in the form of a short paper. The audience for their paper should be their fellow students. Many of the projects involve proofs and students may have to go through several drafts to get them right. The projects are of varying degrees of difficulty and you may have chosen to do some of them in the regular course of the term.

- (1) **Arithmetic-Geometric Mean Inequality.** Problems 1.3.17, 7.3.30, 7.3.31, 7.5.13, and 7.5.14.
- (2) **Pseudo-primes and Carmichael Numbers.** Problems 3.3.1 to 3.3.11.
- (3) **Dynamical Systems and a Proof of Fermat's Theorem.** Problems 3.4.14 to 3.4.22.
- (4) **Public Key Cryptography.** Problems 3.3.13 to 3.3.17 and 3.5.1 to 3.5.6.
- (5) **The limit free methods of Descartes and Apollonius-Wallis for finding tangents.** Problems 4.1.14 and 4.1.15.
- (6) **Linear Approximation of Differentiable Functions.** Problems 4.3.10 to 4.3.13.
- (7) **The Symmetric and Lanczos Derivatives.** Problems 4.2.15 to 4.2.17, Problems 5.1.19 to 5.1.21, Problem 8.3.15, and Problem 9.1.19.
- (8) **The Sieve of Eratosthenes.** Problems 6.2.1 to 6.2.4.
- (9) **The Mean Value Theorem.** Problems 8.3.4 to 8.3.8 and either Problem 8.3.11 or Problem 8.3.12.
- (10) **Finding a good Taylor Approximation.** Problems 8.4.15 and 8.4.16.
- (11) **Halley's Method for Finding Roots.** Problems 9.2.3 to 9.2.6.

- (12) **Gauss' Logarithmic Integral.** Problems 12.3.1 to 12.3.4.
- (13) **The Order of an Approximation Method.** Problems 13.2.1 to 13.2.5.
- (14) **Curvature.** Problems 13.3.2 to 13.3.8.
- (15) **Padé Approximants.** Problems 13.4.1 to 13.4.7.
- (16) **Definition of a limit of a sequence.** Problems 14.1.1 to 14.1.6 and Problem 14.3.13.
- (17) **Dedekind cuts and Existence of $\sqrt{2}$.** Problems 14.3.16 to 14.3.19.
- (18) **Proof of the Ratio Test.** Problems 15.2.17 and 15.2.18.
- (19) **The Undamped Pendulum.** Problems 18.3.7 to 18.3.9.