Numerical Analysis on a Pocket Calculator

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Course Description

Numerical methods are procedures for arriving at approximate answers. A simple example is square roots. We know that the square root of 9 is 3. What is the square root of 10 though? What procedure would one follow, somewhat analogous to long division, to arrive at an answer? It isn't obvious at all! Some kind of trial and error is in order, but how is that systematized? Newton had a procedure, and we will learn it in this course. Of course he didn't have a programmable calculator. So the next question is, with a programmable calculator, how can one efficiently automate Newton's procedure? Or, since your calculator has a square root key, for this particular example, you might wonder, how does the calculator get the answer? We will investigate these questions using smartphone emulations of the HP-25 calculator. Four subjects will emerge:

1. Operation and programming of a stack-based calculator, the Hewlett-Packard 25
2. General applications that were in the calculator's target market: games, finance, navigation, and surveying
3. Statistics: linear regression, exponential, logarithmic, and power law curve fitting, standard deviations and correlation coefficients (r-squared), t-test and χ-squared hypothesis tests
4. Numerical analysis: Newton's root-finding method, Euler's method for first-order differential equations, numerical integration

There is a rich variety of background needed to deeply understand these subjects. Our classes will have a mix of developing the needed background and programming the Hewlett-Packard 25. In other words, we will constantly mix theory with concrete and pragmatic considerations. The subjects are influenced by what Hewlett-Packard considered to be the HP-25's target market and by the capabilities of the calculator. This peculiar combination of constraints means that we will be taking a tour of a wide variety of subjects that mattered to practicing scientists and engineers in the mid-1970s. These subjects matter just as much today.