Collaborative Research: Learning Discrete Mathematics and Computer Science via Primary Historical Sources

Janet Barnett, Guram Bezhanishvili, Hing Leung, Jerry Lodder,
David Pengelley, Inna Pivkina, Desh Ranjan

http://www.cs.nmsu.edu/historical-projects

1 Historical Projects we plan to develop

- **Program Correctness**. One of the greatest accomplishments in computer science has been the development of scientific principles for reasoning about program correctness [50]. Many textbooks in algorithm design discuss program correctness briefly, mostly focusing only on the concept of loop invariants. In Robert Floyd's landmark 1967 paper [24], program correctness is initially considered for flowchart programs. In this project, the students will first analyze in detail the correctness of a flowchart program taken from Floyd's paper. Next, they are asked to apply the same proof ideas to argue the correctness of an assembly program (whose structure resembles closely a flowchart program) that computes the integer square root of a number. A challenging task is to establish the correctness proof of a Quicksort implementation [25]. Projects of various difficulty levels will be written for the study of program correctness, one focusing on the basic ideas of a correctness proof, another developing flowchart and assembly programs, and a third exploring high level programming language constructs. Emphasis is on the "sets of axioms and rules of inference which can be used in proofs of the properties of computer programs" [35], and the "basis for formal definitions of the meanings of programs in appropriately defined programming languages, in such a way that a rigorous standard is established for proofs about computer programs, including proofs of correctness, equivalence, and termination" [24]. The projects are designed for advanced undergraduate courses in the analysis of algorithms. Primary Author: PI Hing Leung.