

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

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

1 Historical Projects we plan to develop

- **Induction and Recursive Thought.** A proof method that is intimately related to recursive thinking is the method of mathematical induction, often being difficult for undergraduate students to comprehend and master. Working with Dr. David Pengelley, Desh will devise projects that explore the history of “inductive proofs” and help students think of proof by induction as a natural proof method. In particular, we would like to develop integrated projects that involve use of inductive proofs to prove the correctness of recursive procedures. A historical source that seems intriguing and ripe for use in these projects is Dedekind’s 1888 paper “Was sind und was sollen die Zahlen?” (translate as “The Nature and Meaning of Numbers”) [18]. In this essay, where Dedekind (1831–1916) strives to “lay a foundation for the part of logic that deals with the theory of numbers,” Dedekind argues for accepting the method of defining a function by induction. In the preface to the first publication of this essay, Dedekind says “As such main points I mention . . . the proof that the form of argument known as complete induction (or the inference from n to $n + 1$) is really conclusive and that therefore the definition by induction (or recursion) is determinate and consistent.” This should bring forth the intimate connection between recursion and induction. It will also be interesting to see how recursive definitions came to play a central role in the theory of computing and in this respect Turing’s and Church’s original papers [64, 12] are interesting sources. Finally, Desh plans a project around the integration of recursion as an explicit construct in modern programming languages. The projects are authored for introductory to intermediate courses in discrete mathematics and computer programming. Primary Author: Senior Researcher Desh Ranjan.