Book Title
Book Editors
IOS Press, 2003

Understanding Student Answers In Introductory Physics Courses

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Abstract.
Many problems in introductory physics courses require the student to formulate a system of algebraic equations. The correct answer can be expressed in many ways, using different variable names, different numbers of variables, and different numbers of equations, that may contain numeric substitutions for variables. Understanding the student's answer involves being able to determine the mapping from the equations, variables and constants to the principles, properties and objects of the problem. Our earlier work solved the mapping problem, but only for problems where numerical values were not used. This is not true for most problems currently assigned for homework at the introductory physics level. This paper describes how our technique has been extended to reason about systems of equations that contain a mix of variables and numerical constants. The technique has been evaluated on 639 student submissions to three problems from the ANDES physics tutoring system. The evaluations show that the technique can effectively determine (1) the mapping of the student's variables to the objects and properties in the problem, (2) the correctness of each student equation, and (3) the completeness of the student's submission.

Keywords. Mathematics and science education, Physics Algebraic Equations

FULL PAPER SUBMISSION

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