Christopher J. MacLellan
HCII, PhD Student

Thesis Proposal

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Computational Models of Human Learning:

Applications for Tutor Development and Theory Testing

Committee

Kenneth R. Koedinger
HCII, Psychology

Vincent Aleven
HCII

John R. Anderson
Psychology, HCII

Pat Langley
CS, Univ. of Auckland

Abstract:
Intelligent Tutoring Systems are effective for improving students' learning outcomes. However, constructing tutoring systems that are pedagogically effective has been widely recognized as a challenging problem. What is needed is a tool that leverages prior learning science theory to support tutor design, building, and testing. The proposed thesis explores how computational models of *apprentice learning*, or computer models that learn interactively from worked examples and correctness feedback, can be used to support these tutor development phases.

In my prior work, I created the Apprentice Learner Architecture, which leverages a computational theory of apprentice learning to instantiate alternative models that align with the theory. I have used this architecture to search for two kinds of models: 1) models that fit human behavior and 2) efficient models. Instructional designers can use **human-like models** as learner "crash dummies" to simulate students interacting with the tutors. I have used one of these models to correctly predict which of two fractions tutor designs will yield better student performance. In other work, I have used **efficient models** to make tutor authoring easier for non-programmers. Like humans, apprentice learner models can be taught by domain experts through worked examples and feedback. I showed that the time needed to author an Algebra tutor by interactively training an apprentice learner model is less than half the time needed to author a tutor using another state-of-the-art authoring-by-demonstration approach.

In my proposed work, I plan to develop new apprentice learner models that better fits the human tutor data than my initial models, and I aim to show the variety of ways that simulated data from these models can be used as a substitute for actual classroom data. Next, I plan to demonstrate the generality of these models by simulating student behavior in seven tutoring systems that teach multiple kinds of knowledge across multiple domains. I will use each tutor to test different aspects of my models and the computational theory underlying them. Finally, I plan to showcase the authoring capabilities of apprentice learner models by using them to author tutoring systems for two complex domains, experimental design and Python programming. Ultimately, the goal of this work is to develop a Model Human Learner—similar to Card, Moran, and Newell's (1986) Model Human Processor—that encapsulates psychological and learning science findings in a format that researchers and instructional designers can use to create effective tutoring systems.

Document: http://www.christopia.net/proposal