Deploying Adaptive Learning Environments to Overcome Background Deficiencies and Facilitate Mastery of Computer Engineering Content

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Overview

The purpose of this project is to **develop and pilot test a set of adaptive learning course materials to improve mastery of computer engineering.** The interventions proposed will target a sequence of introductory digital logic courses that are found in every accredited computer engineering program in the U.S.

Motivation

Can an adaptive, e-learning environment that provides personalized instruction improve student understanding of computer engineering?

Student Interest – Students lose interest when course material is either too hard or too easy.

Background Deficiencies - Students often lack the necessary prerequisite knowledge in introductory engineering courses due to their varied backgrounds and different high school curriculums.

Large Entry Level Courses – The sheer number of students in introductory courses prevents teachers from providing personalized instruction.

Prerequisite Gates - Failure in prerequisite courses can prevent students from accessing numerous higher level courses. This leads to increased time and cost, which lowers chances of graduation.

True 2+2 Transfer – Community colleges often don't offer lower level engineering courses that are prerequisite s for junior level courses. This prevents students from graduating in 2 years post-transfer.

Increasing Diversity – Generic example problems often don't promote the value of engineering. This makes engineering less attractive to females and 1st generation college students.

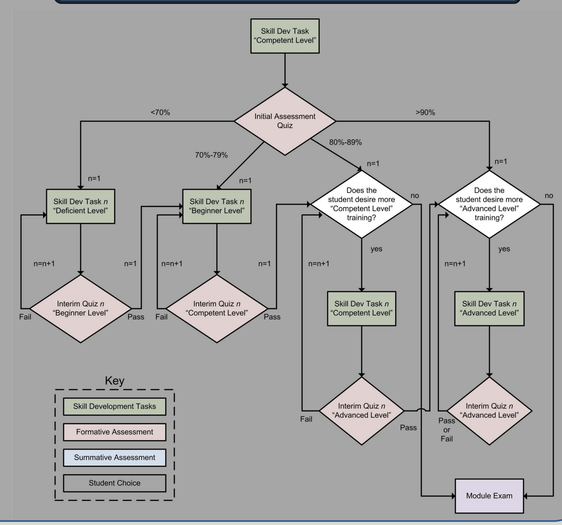
Adaptive e-Learning

Expert Model

- Core computer engineering learning objectives based on accepted concept inventories.
- 13 topics containing 57 specific learning modules and 109 learning outcomes.

Topic 1 – Analog vs. Digital	Topic 8 – VHDL (Part 2)
Topic 2 – Number Systems	Topic 9 – Behavioral Modeling
Topic 3 – Digital Circuits	Topic 10 – Memory
Topic 4 – Combinational	Topic 11 – Programmable Logic
Topic 5 – VHDL (Part 1)	Topic 12 – Arithmetic
Topic 6 – MSI Logic	Topic 13 – Computer Systems
Topic 7 – Sequential Logic	

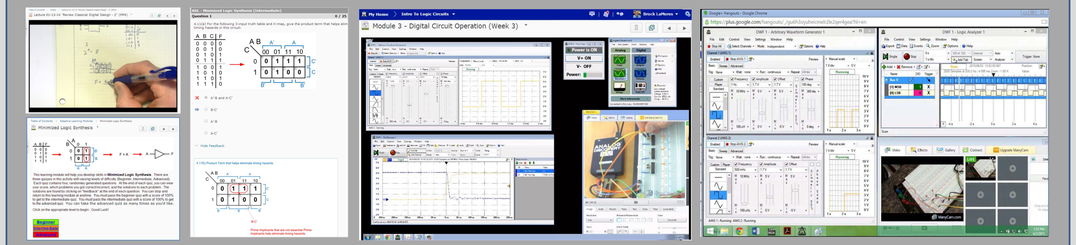
Student Model



Research Highlight - Using examples that are relevant to a student's background/demographic can increase interest and motivation. The final adaptive learning system will consider student backgrounds when personalizing the learning material.

Instructional Model

- Designed for broad scale adoption through online deployment.
- Heavy emphasis on "doing" through design exercises and laboratory experiments.
- Emphasis on cost to facilitate adoption through low cost lab kit.



- Reading & lecture videos for knowledge building.
- Exercise problems with solutions to build application & analysis skills.
- Lab exercises to build synthesis skills.

Research Highlight - Portable lab kits have become affordable enough for broad deployment. This work studies how they can impact remote learning of computer engineering and how different student demographics use them.

Current Status

The course material is being deployed at four diverse institutions (MSU-Bozeman, MSU-Billings, Flathead Valley Community College, and Salish Kootenai Tribal College). This will allow a baseline of knowledge to be established and also overcome logistical obstacles of broad deployment. Once found, adaptive modules will be introduced and the impact measured.

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