Sabbatical Proposal for Spring 2010  
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Introduction
Enrollment in undergraduate computer science and engineering programs has suffered from two problems, dropping enrollments of female students since the mid ’80s and dropping enrollments and retention overall since 2000. Research into the reasons behind the first problem has been sparse but increasing over the past decade. There has been much speculation as to the reasons for the second problem but little research. Rather, efforts have focused on ways to engage millennial students in the introductory undergraduate computer science courses to improve retention and in K-12 courses and outreach programs to raise interest in the discipline. Carnegie Mellon’s Alice project has produced an interactive, animation-based programming environment that is aimed at addressing both problems and is sufficiently flexible for use from middle school to the first semester undergraduate level. The proposed sabbatical will entail the development and presentation of Alice-based curricular units. If arrangements can be made, I will present the units at regional middle and high schools. If not, I will make arrangements to work through after-school, outreach, and gifted programs. The former arrangement would have the added benefit of educating area technology teachers in the Alice programming environment and its use. If it is not possible to present the units in area schools, I will invite technology teachers to observe the units being presented in the alternate venues. In either case, I will gather data on the impact that the use of Alice has on the attitudes of the students.

Objectives
1. Gather, analyze, and submit for publication data on the impact that Alice has on the attitudes of middle and high school students with regard to computer science and engineering in general, and computer programming in particular. Present these results at a Mathematics Colloquium during the Fall 2010 semester.
2. Advance the use of Alice at the middle and high school levels of regional school districts.
   a. Introduce middle and high school students to the installation and use of Alice.
   b. Introduce regional middle and high school teachers to Alice, and assist them in its use.
3. Develop curricular units appropriate for various middle and high school levels and submit them to the free online repository of such materials maintained by Carnegie Mellon.

Detailed Description
Alice is best described by the following excerpt from www.alice.org:

“Alice is an innovative 3D programming environment that makes it easy to create an animation for telling a story, playing an interactive game, or a video to share on the web. Alice is a freely available teaching tool designed to be a student’s first exposure to object-oriented programming. It allows students to learn fundamental programming concepts in the context of creating animated movies and simple video games. In Alice, 3-
D objects (e.g., people, animals, and vehicles) populate a virtual world and students create a program to animate the objects.

“In Alice’s interactive interface, students drag and drop graphic tiles to create a program, where the instructions correspond to standard statements in a production oriented programming language, such as Java, C++, and C#. Alice allows students to immediately see how their animation programs run, enabling them to easily understand the relationship between the programming statements and the behavior of objects in their animation. By manipulating the objects in their virtual world, students gain experience with all the programming constructs typically taught in an introductory programming course.” [http://www.alice.org/index.php?page=what_is_alice/what_is_alice]

Traditional introductory computer programming courses generally have students solving problems such as computing the area of a rectangle given the length and width of its sides, and calculating discounts and sales tax on a series of supposed purchases. The students interface with their programs using a command line, text-based interface such as the one in Figure 1.

![Figure 1: Text-based Interface of a Traditional Programming Environment](image)

Today’s students, sometimes called *millennial students*, find this programming environment archaic and boring. Having grown up with robotic toys such as *Furby*, computer-based pets such as *Catz* and *Dogz*, and video games galore, today’s students expect more when they interact with computers and are turned off by computer programming when it is presented in this text-based context. Compounding the problem is the precise nature of production computer programming languages where a missing semicolon or one misspelled word can render
a program totally dysfunctional. This leads to frustration as does the complex nature of production programming languages. It is no wonder that few students select computer programming as a high school elective.

The researchers of the Alice project have spent more than a decade developing a programming environment that introduces computer programming to students in a way that engages them through the use of computer animations and prevents the frustration caused by syntax errors through the click-and-drag coding environment shown in Figure 2. One of the Alice innovators, Dr. Randy Pausch, stated it well at a 2006 SIGCSE presentation when he talked about having students learn “one hard thing at a time.” Alice allows the students to learn fundamental programming language constructs such as sequential statement execution, variables, objects, conditionals, selection, loops, method calls, parameters, and algorithm development in an environment that prevents syntax errors. Plus, its use of animation engages students from the start and it is sufficiently robust to keep them engaged.

![Figure 2: Alice Programming Environment](image)

I have used Alice in a summer outreach program for middle school students at Bloomsburg University in both 2007 and 2008, I attended Carnegie Mellon’s Alice Summer Workshop 2008, and I incorporated Alice in our CPTR125 Introduction to Computer Science class in the Fall 2008 semester. In this proposed sabbatical, I will extend and tailor curricular materials for use with middle and/or high school students where this is their first formal introduction that students receive in computer programming. Through contacts provided by the
Education Department, I will attempt to make arrangements with school districts in the region to teach a 2-week unit (or a 1-week unit in districts with block scheduling) using Alice in the technology course where students learn keyboarding, word processing, and the like. This is generally done in 8th or 9th grade. The week prior to the unit, I will work with the teacher or technology coordinator to install Alice on the school’s computers, review the file storage arrangements provided for the students, and test the environment. During the unit, the teachers will be in attendance to maintain discipline but more importantly to learn Alice along with the students. In the event that such arrangements cannot be made, I will make arrangements to work with students in after school programs, outreach programs, and other available venues.

The belief is that this introduction will have a positive impact on the students’ perceptions of computer programming and their perceptions of the disciplines of computer science and engineering. To measure that impact, I will develop a survey form and administer it before the unit begins and again at the conclusion of the unit. Arrangements will be made to administer this survey to groups of students that will not participate in the Alice unit and therefore serve as a control group. Comparisons of the responses on the two administrations of this survey to those students learning Alice will yield insight into the impact of Alice on the attitudes of the participants. Comparisons of the responses between the control group and the participants on the survey will yield insight into whether or not it was the exposure to Alice that was responsible for attitude changes. In all cases, surveys will be coded for gender (pink for girls and blue for boys) so that analysis can be performed on the basis of gender as well.

The exact content of the survey forms is yet to be determined and I am aware that I will need to work with faculty members in the social sciences in order to properly formulate the survey questions. The members of the Education Department have been extremely helpful already in providing contact information for area schools as well as insights into potential qualitative analysis that I might incorporate. I will also be contacting the Alice researchers to see if there are specific questions they would like to have included on the forms. (I am also going to ask if they will donate textbooks for the participating teachers such as the ones distributed to their workshop participants.) At the suggestion of the Education Department, the first survey will include questions so that analysis can be performed based on school district characteristics, e.g. high income suburban v. urban v. rural, on the availability and use of technology by students (e.g. home computer, cell phone, and iPod ownership). A relationship may be found between this data and the attitudes of the students toward computing. I am also aware that I will need assistance from Gene Sprechini for the statistical analyses of the data.

The curricular units developed will be added to the free online repository maintained by Carnegie Mellon. A proposal for a speaking presentation detailing the content and results of the project will be submitted to a regional or national conference. A paper describing the project and the results of the analyses described above will be submitted to a refereed journal.
Schedule
Spring/summer 2009 – Develop curriculum materials and survey forms. Complete the background checks required for placement in public schools.
Fall 2009 – Contact local school districts, after school programs, etc. to make arrangements to administer survey forms and teach Alice units.
January – Administer survey forms to all groups of students
January through June – In each participating venue, administer pre-unit survey forms, teach the Alice unit with teacher in attendance, then administer post-unit survey forms.
June – Administer survey forms to all groups of students
Summer 2010 – Analyze and summarize data collected, develop presentation, and write paper.
Fall 2010 – Present findings at Mathematics Colloquium.

Improvements to the Academic Program
At the present time, the only place in Lycoming’s academic program where Alice is used is in CPTR125 Introduction to Computer Science, the first course in the computing minors and a required course for mathematics and actuarial mathematics majors. This sabbatical will have little, if any, impact on this course.

Course Schedule
The following Computer Science courses are scheduled for the spring 2010 semester:

- CPTR246 Principles of Advanced Programming (assuming sufficient enrollment)
- CPTR248 Programming Language Design
- CPTR332 Introduction to Web-based Programming

Each course involves three lecture sections and a two-hour lab. The first two have historically been my responsibility, but staffing issues in both CS and Math have resulted in shifting them to Geoffrey Knauth, and he is prepared to teach all three courses.

Since David Haley’s retirement, I have taught one section of MATH106 Combinatorics every spring. At the present time, there are no plans to offer this course in Spring 2010. This may result in no sections of Combinatorics being offered in the 2009-2010 academic year, depending on the demand for Fall 2009 courses CPTR247 Data Structures and MATH216 Discrete Mathematics. I believe it is fair to say that the department’s inability to offer Combinatorics is not a result of my proposed sabbatical but rather a result of the loss of David’s tenure line.