An Innovative Approach with Alice for Attracting K-12 Students to Computing

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Motivation – Declining Enrollments, Few Women
How do we Teach Science?

- Physics – experiments
- Chemistry - experiments
- Biology - experiments
How do we Introduce Computer Science?

- Write a calculator
- Write a banking program
- Etc…

```java
public class Simple {
    public static void main(String[] args) {
        System.out.println("Hello World!");
    }
}
```
Why Can’t the Introduction of Computer Science be exciting?

• Programming – it’s always been
  – Hands-on
  – Interactive
  – Frustrating!

• What’s missing?
  – Not Getting Exciting Results
    • Easily
    • Right away
Our Approach to Making CS Exciting – Teach Alice

Outline

• What is Alice?
• What CS can you teach with Alice?
• Successes with Alice
• How we plan to integrate Alice into K-12
What Is Alice?

• A modern programming tool
  – 3-D graphics
  – 3-D models of objects

• Animation
  – Objects can be made to move around virtual world (a simulation or video game)

• Developed at Carnegie Mellon University
  – Randy Pausch
  – www.alice.org
The Power of Alice

- Automatically keeps track of 3-D objects
  - What objects are in the virtual world
  - Types of objects
  - Positions of objects in the world
Classes and Objects

• Classes
  – In Alice, classes are predefined as 3D models
  – Local Gallery of Objects
  – Web Gallery

• Objects
  – An object is an instance of a class
    • Class: Chicken
    • Objects: Chicken, Chicken2, Chicken3
Objects in Alice

- Objects already exist
- Objects have parts
Object Position

• Objects
  – Are positioned in 3D space
  – Have six degrees of freedom
Program Demo

<table>
<thead>
<tr>
<th>Do in order</th>
<th>Do together</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken.Neck.Head</td>
<td>Chicken</td>
</tr>
<tr>
<td>turn right</td>
<td>move</td>
</tr>
<tr>
<td>0.25 revolutions</td>
<td>up</td>
</tr>
<tr>
<td>more...</td>
<td>1 meter</td>
</tr>
<tr>
<td></td>
<td>more...</td>
</tr>
<tr>
<td></td>
<td>roll right</td>
</tr>
<tr>
<td></td>
<td>say</td>
</tr>
<tr>
<td></td>
<td>Whoa.... Now I'm dizzy....</td>
</tr>
<tr>
<td></td>
<td>move down</td>
</tr>
<tr>
<td></td>
<td>1 meter</td>
</tr>
<tr>
<td></td>
<td>more...</td>
</tr>
<tr>
<td></td>
<td>move forward</td>
</tr>
<tr>
<td></td>
<td>10 meters</td>
</tr>
<tr>
<td></td>
<td>more...</td>
</tr>
</tbody>
</table>
Teach Computer Science Concepts with Alice

- Conditional and Repetition
- Methods, functions
- Events
- Inheritance
- Recursion
- Lists, Arrays
Methods

- Built-in methods
- Write class methods
- Write world methods
Inheritance

• Dragon

• FlyingDragon
Example – parameters and events

- People are trapped in a burning building
- Select which person will be rescued
Parameters

- Types and number of parameters must match with arguments

Call

```plaintext
firetruck.savePerson whichFloor = burningBuilding.thirdFloor
whichPerson = randomGirl3
howFar = 3
```
Events

• Default event

• Other events
Three Events

• The argument sent to parameters depends on which person is mouse clicked.

• Note - we positioned fire truck so distance from floor X is X meters (to floor 3 is 3 meters)
Example – Lists - WacAMole

- List of Moles
- Randomly moves one of them up and down
- Counter to keep track of score
- Event: when click on object, search through list to see if object is a mole
Example - Arrays

• Shuffle, then sort by height
Function to return object with the tallest height from an Array
Successes with Alice - Success with At-Risk Students

• Study of at-risk students in college
  – Less success in math/little or no programming
  – Average grade in CS 1
    • Exposed to Alice: 3.0
    • Not exposed to Alice: 1.2 gpa
  – Went on to CS 2
    • Exposed to Alice: 88%
    • Not Exposed to Alice: 47%

– Stephen Cooper et al. – SIGCSE 2004
CompSci 4 – Alice Class at Duke

- Lecture for 10-20 minutes
- Students work on problem with computers in pairs
- Bring students back together
Success - Alice attracts diverse group

- **At Duke**
  - CompSci 4 Spring 2005
    - 22 preregister, 30 enroll (12 female + 3 African Amer.)
  - CompSci 4 Fall 2005
    - 20 preregister, 31 enroll (17 female – 1 African Amer.)
  - CompSci 4 Fall 2006 – 2 sections
    - 64 students, 33 female, 7 African Amer.
  - Advertised in school paper
    - picture of ice skater
    - Web site of animations
CompSci 4 Student Projects
Success - Alice Excites 4th-6th Grade Girls

- Duke Femmes Event, April 07
- 60 girls – 4 groups of 15
- Taught them Alice for an hour
- Handout to take home
Thank you from 4th Grade Girl

Dear Susan,
Thank you for showing me the Alice program. I think it's really cool. I got my mom to download it, and I've created a show world. Again, I think Alice is really cool and thank you for showing it to me.

From [name]
Success – Alice Symposium

- Duke University – June 19-21, 2006
- Over 100 college and high school faculty came to learn Alice
Integrating Alice into K-12 Collaborative NSF Proposal

- Teach high school and middle school teachers Alice
- Six regions of the country
  - Durham, NC
  - Virginia Beach, VA
  - San Francisco, CA
  - Denver, CO
  - Charleston, SC
  - Mississippi
Durham Site – K-12

• High School and Middle Schools near Durham
• June 2008 – 3 week workshop on Alice
  – Teachers/Duke Students develop materials
  – Includes 1 week Alice Camp for kids
• Academic Year 2008-09
  – Integrate Alice into a course/program
  – Duke students provide support
Future of Alice

• Alice 3.0 – includes Sims Characters
  – Drop Alice into Eclipse/Java

• StoryTelling Alice – easier version for middle school kids
  – Caitlin Kelleher, PhD Thesis, CMU
  – Multiple Scenes, Easier to move characters
Alice Software – is free!

- Runs on Mac and PC
- My Alice Materials web site
  www.cs.duke.edu/csed/alice
- Textbooks available – more coming…
  - Learning to Program with Alice by Dann, Cooper, and Pausch
- Download from web
  www.alice.org