Integrating Computing into K-12 Disciplines Via Alice

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Outline

• Introduction and Motivation for Adventures in Alice Programming and other work
• What is Alice?
• Integrating Alice into middle schools
• Alice in a High School programming course
• Demo
• Conclusion and Future Work

Why Schools Should Teach Computer Science (CS) – (from NCWIT.org)

• Computer Science gives students vital 21st century skills
  – C.S. underlies most innovation today
• C.S. means rewarding careers
  – Predicted shortage of technical jobs in the future
  – Wide range of options in CS (health, environment, finance, arts, security ...)
• C.S. is more than just technology
  – CS teaches design, logical thinking and problem solving
  – Students don’t understand that C.S. is much more than keyboarding, PowerPoint, and spreadsheets

Why Alice?

• Lots of other great tools for teaching programming
  – Greenfoot
  – Scratch
• Alice is easy to use, drag-and-drop, objects already exist
• Attractive to both girls and boys
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.
  - CompSci 4 Fall 2007 – 2 sections
    - 84 students - > 50% female
  - CompSci 4 Fall 2008 – 2 sections
    - 100 students - > 50% female
  - Same for Spring 2009, Fall 2009...
  - Advertised in school paper
    - picture of ice skater
    - Web site of animations

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

Where could Alice help in decisions?

- Students in middle school are starting to form decisions on careers
- They have exposure to Teachers, Doctors, Astronauts, etc.
- They learn about Biology, Physics, Chemistry
  - BUT DON’T KNOW WHAT COMPUTER SCIENCE IS
  - K-12 Teachers can help expose students to CS

Bring on Alice Virtual Worlds!

- Alice is
  - Hands-on!
  - Interactive!
  - Visual!
  - Less Error prone
  - Exciting Results right away!

- Alice has the potential to excite kids about computer science in the same way that experiments excite kids about chemistry, physics and biology!
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Alice Programming Language

• Create interactive stories or games
• Learn programming in an easy way, drag-and-drop your code
• Alice is free: www.alice.org
• Problem solving with visual feedback
  – Logical thinking
  – Objects are visual
• Along the way, learn computer science concepts:
  – Loops, classes, methods, functions, arrays

Alice Developed by Randy Pausch

• Carnegie Mellon University
• Virtual Reality Researcher
• Wrote the Last Lecture
• Died of Pancreatic Cancer in 2008

The Alice Team – Alice is free!

www.alice.org
Alice Programming Language

- Has libraries of 3D objects
- Keeps Track of objects you select

Objects Have Multiple Parts that are moveable

Object Position

- Objects
  - Are positioned in 3D space
  - Have six degrees of freedom

Alice Code is Easy to Learn

Select Code, Drag-and-Drop code in program
Play Alice Animation

- Chicken rises, cow turns head and talks

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Adventures in Alice Programming

- 2-week Teacher workshops
  - Over 200 teachers, middle school, high school, some elementary
  - All disciplines
  - Teach Alice, Develop Lesson Plans
  - One-week followup workshop
  - Summers 2008-2015, funding for lodging

- Main Sites:
  - Duke University, Durham, NC
  - Charleston/Columbia, SC
  - Oxford, Mississippi

Adventures in Alice Programming Grades 5-12 Outreach

www.cs.duke.edu/csed/alice/aliceInSchools
Free Curriculum Materials/Lesson plans

- Over 60 free Alice Tutorials (from getting started to specific topics, sample projects)
- Teacher lesson plans available
- Most students use Alice for projects – instead of poster, report
- Subject teachers using Alice
  - Language Arts
  - Mathematics
  - Science
  - History
  - Foreign Language
  - Music, Art
  - Media, Technology
  - Business
- middle school and high school, some elementary

Using Alice in Middle/High Schools

- Teachers
  - Examples in lecture
  - Make interactive quizzes
  - Make worlds on concepts for students to view
- Students
  - Projects (in place of a poster, a model)
  - To take or build quizzes
  - To view and answer questions about a world
  - Older students can do more with Alice.

Our Free Materials
Over 60 Tutorials

1. Getting started tutorials
   - 1-4 hours
2. Tutorials on CS topics
   - Methods, conditionals, lists, etc
   - Variables (timers/scores).
3. Animation tutorials
   - Lights, camera, scene change, billboards, invisible objects,

New getting Started Tutorial – 3 part
Example: Getting Started Tutorial teaches:

- Placing objects
- Moving objects
- Setting up Camera tripods and moving between views
- Using built in methods and writing your own
- Gluing objects together
- Adding sound, 2D pictures to enhance world

Sample tutorial: Scene Change

Most Recent Focus
Tutorials for Projects in different disciplines

Language Arts – Animate a story
Project: Book Report

Science – Population Change

Science Example
How a volcano is formed
Foreign Language simple

Cooking Spanish – More detailed

Cooking Spanish – setting the table

Most of our focus on math

Math Example – Plotting Numbers
Math Example

Math Example - Percents

Math Example – Random Sample

Math Example – Scientific Notation

INSTRUCTIONS

- Today we are going to learn about probability and sampling by looking at two boxes containing red and blue balls.
- In a **simple random sample**, each ball has an equal probability of being selected, regardless of box.
- In a **stratified random sample** of these marbles, each ball has an equal probability of being selected—once a box is selected, we choose balls from that box only.
- Type S to see a simple random sample or T to see a stratified random sample.
Math Example – Rounding Numbers

Math Stories to Attract Girls
- Danica McKellar

Math Story on Variables

Simple Game – Control, earn points
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Alice Programming Course

- CompSci 4 at Duke
  - Non-majors
  - [www.cs.duke.edu/courses/fall11/cps004](http://www.cs.duke.edu/courses/fall11/cps004)
  - Cover lists, arrays, inheritance, sorting
Concepts in Alice course

- Classes, objects, methods, parameters
- Inheritance
- Storyboards
- Conditionals, looping constructs
- Random numbers
- Events
- Recursion
- Arrays, Lists

Example – while loop

Example - Inheritance

- Start with a chicken object
- Rename it to TalentedChicken
  - Change its color
  - Resize it larger
  - Add new methods (jump, fly, scurry)
  - Add events for this chicken
- Save this new class TalentedChicken that inherits from the Chicken class

Example - List

The Alice Team Summer 2008
Example – Arrays
Shuffle, then Selection Sort

Games Created by
Duke CompSci 4 Students

- Non-majors
- Most never programmed before
- Final projects after 10 weeks of Alice
- 50% of students are women

Game: Candyland
Select girl and boy to play
Click on red and green buttons to move them.

Game: Frogger – Get frog across road
Game: Tic Tac Toe

Game: DDR
Click on arrow keys,
Player moves foot to square

Game: Dating Game

Game: Rumble Putt

Game: Sarah Palin’s Seaplane Adventure
Sarah Palin’s Seaplane Adventure (cont)

Game: Scarab Beetles take over

Variables – Scores/Timers

Game: Eragon

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Let’s build an Alice World

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Conclusions and Future Work

• Teachers excited - see different ways to use it
• Projects best for integrating into a course
• In middle school, Multimedia/Business Technology seems the best place for more extensive teaching of Alice
  – Pairing up with a teacher in another discipline
• Website has tutorials, sample worlds, lesson plans
• Future
  – Workshops through 2015
  – Alice Symposium 2013
  – Other formats for tutorials?

Adventures in Alice Programming web site
www.cs.duke.edu/csed/alice/aliceInSchools

Questions?