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

• 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
Grades 5-12 Outreach

www.cs.duke.edu/csed/alice/aliceInSchools
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
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

By Betty Stone
Animated by Deborah Nelson

KITTY STORY
Project: Book Report

Charlotte's Web
by E.B. White
Science – Population Change
Science Example
How a volcano is formed
¡Bienvenido al programa de cocinar!
Cooking Spanish – More detailed

Vamos a hacer pan de plátanos!
Cooking Spanish – setting the table
Most of our focus on math

Math Example – Plotting Numbers

I am going on a bike ride
Math Example

Score: 0

\[ f(x) = 0x + 0 \]
Math Example - Percents

Score: 0.0
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 – Scientific Notation
Math Example – Rounding Numbers

Rounding World

Choose the level of difficulty by clicking on the handle

- **Level 1**: round numbers up to the hundreds
- **Level 2**: round numbers up to the thousands
- **Level 3**: round numbers up to the millions

START → 100
Math Stories to Attract Girls

• Danica McKellar
Math Story on Variables

A variable like \( x \) is just a placeholder for a number.
Simple Game – Control, earn points

To win this game, you must steer the boat through each ring and beat the clock. You receive one point for each ring, and there are 10 rings, so if your score is less than 10 at the end, you lose!
Adventure Game – Find objects in order
New Project – Keyboarding Game
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Alice Programming Course

• CompSci 4 at Duke
  – Non-majors
  – 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

Sort by height
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

Questions:
1 2 3 4

Choose Contestant!
Game: Rumble Putt
Game: Sarah Palin’s Seaplane Adventure

Todd's snow machine has broken down... and it's up to you to save him!

Sarah Palin's Seaplane Adventure

Instructions  Play  Credits

Taking Flight
Sarah Palin’s Seaplane Adventure (cont)
Game: Scarab Beetles take over
Variables – Scores/Timers

Game: Eragon

4 tasks to win the game
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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?