Adventures in Alice Programming

Susan Rodger
Duke University
Haverford College
World of Computing
Haverford, PA
April 19, 2010
www.cs.duke.edu/csed/alice

Over thousands of years, the volcano builds up...

Supported by the National Science Foundation Collaborative Grant ESI-0624642, NSF Supplement DRL-0826661, two CRA distributed mentor awards, and three Faculty Awards from International Business Machines.
Outline

• Motivation and background
• Introduction to Alice Programming
• Alice in Duke Course
• Alice Examples and Lesson Plans in K-12
• Usage of Alice by K-12 Students
• Summary
Computer Science Declining Enrollments, Few Women

Figure 1. Computer Science Listed as Probable Major Among Incoming Freshmen
Source: HERI at UCLA
Many students don’t know what Computer Science is when they come to college!

• Not taught in middle schools and many high schools
• What they think it is:
  – “keyboarding, spread sheets, word processing....”
• VERY EXCITING ........ NOT!
If taught, how do we introduce CS?

```java
public class Simple {
    public static void main(String[] args) {
        System.out.println("Hello World!");
    }
}
```

• Write a calculator
• Write a banking program
• Etc...
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
  – Too textual-based, including errors
  – Not appealing to today’s kids in which media and technology are a part of their life!
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!
Alice Programming Language

• Create interactive stories or games
• Learn programming in an easy way, drag-and-drop your code
• Problem solving with visual feedback
  – Logical thinking
• 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 Demo: Kitty Story – children’s book on handicapped child

By Betty Stone
Animated by Deborah Nelson

KITTY STORY
Let’s visit Little Kitty the kitty. She lives with her Daddy, her Mommy, and her sister, Moon Song.
Let's look at your x-ray Kitty.

Sometimes Her mom takes her to the Doctor so that she can check out her knee. Sometimes that hurts a bit and sometimes it doesn't.
At night, her mom or dad puts leg splints on her knees. Kitty does not like this one little bit! She does a good job of crying.
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

Moo Moo Moo
Versions of Alice

• Alice 2.2
  – Good for Middle School/High School introduction to programming and for college as intro to programming
  – Supported, will be around for awhile

• Alice 3
  – Good for High School / College programming course to lead into a Java course
  – IN BETA VERSION NOW – still buggy

• StoryTelling Alice - Caitlin Kelleher
  – Written as prototype, not supported
  – PhD Thesis under Pausch
CompSci 4 – Alice Class at Duke

- Full semester course on Alice for non-majors
- 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.
  - 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
Concepts in Duke Alice course

• Classes, objects, methods, parameters
• Inheritance
• Storyboards
• Conditionals, looping constructs
• Random numbers
• Events
• Recursion
• Arrays, Lists
Example – while loop

```
World.chase

World.chase

No parameters

No variables

Do in order

While

goldfish distance in front of shark more... > 0.5

Do in order

shark point at goldfish duration = 0 seconds style = abruptly more...

Do together

shark.swim

goldfish.flee

shark.eat what = goldfish
```
Example - Inheritance

• Start with a chicken object

• Rename it to TalentedChicken
  – Change its color
  – Resize it larger
  – Add new methods (jump, go around an object)
  – Add events for this chicken

• Save this new class TalentedChickent that inherits from the Chicken class
List Example - Sort animals by height

Start

Put Tallest two in place ...

All in place!
Example with ArrayVisualization
Swapping two elements in an array

• Swap the objects at positions 0 (fanDancer) and 3 (duckPrince)
• Add in an ObjectVisualization, this is like a variable for an object. (same folder where ArrayVisualization is)
Swapping objects at 0 and 3 (cont)

• Only one element at a time can be in a slot in the array. To swap two elements, you have to move one of them out temporarily.

• Move object at index 0 to objectVisualization (this frees up slot 0)
Swapping objects at 0 and 3 (cont)

- Now you can move the item in slot 3 over to slot 0 (note the duckPrince moved over)
- Now slot 3 is empty
Swapping objects at 0 and 3 (cont)

• Now move the object that was originally in slot 0 and was saved temporarily in the ObjectVisualization, over to slot 3
Array Example

- Shuffle Array
- Sort Array – sort by heights
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
- Spring 05, Fall 05, Fall 06, Fall 07, Fall 08, Spring 09, Fall 09
Game: Candyland

Select girl and boy to play

Click on red and green buttons to move them.
Game: Frogger – Get frog across road
Game: Eragon

4 tasks to win the game
Game: Tic Tac Toe

Score: 4.0

Game: DDR

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

Questions:
1 2 3 4

Choose Contestant!
Game: Rumble Putt

By Greg Halperin
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

BREAKING NEWS
SCARAB INVASION CAUSES MASS PANIC IN CITY

IF NOTHING IS DONE, THE CITY WILL BE DESTROYED

Life: 100.0
Score: 0
Energy: 50.0
Problem – Few students major in CS

• Students come to college with their mind made up on their career! This choice is based on what they know.
• Students don’t know what computer science is when in middle and high school
• They like Alice, but not staying with computer science
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

  — THEIR EXPOSURE is SPREAD SHEETS, POWERPOINT, etc.
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
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 [4th Grade Girl]
Adventures in Alice Programming
Grades 5-12 Outreach

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

- Integrate Alice into high school and middle schools by training teachers
- Six sites:
  - Durham, NC
  - Charleston, SC
  - Virginia Beach, VA
  - Denver, CO
  - Oxford, MS
  - San Jose, CA
- Durham site focuses on Middle Schools in NC

www.cs.duke.edu/csed/alice/aliceInSchools
Duke: Adventures in Alice site

• Summer 2008 and 2009
  – 1-week and 3-week Teacher workshops
    • Over 130 teachers, mostly middle school, some high school
    • Only a few had ever programmed before
    • Taught them Alice, Developed Lesson Plans
  – 1-week middle school camps
    • Taught Alice
    • Lots of time to build their own Alice worlds
Targetting all subject teachers

- Subject teachers using Alice
  - Language Arts
  - Mathematics
  - Science
  - History
  - Foreign Language
  - Music, Art
  - Media, Technology
  - Business

- Mostly Middle school, some Elementary, and some high school subject teachers (physics, chemistry, etc)
How to Use 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.
Free Materials - Introductory Tutorials

1. Simple, Short (15 min) tutorials to try Alice
   - Add an object, use built-in methods
2. One hour starting tutorials
   - Writing methods, simple events, camera
3. Four part tutorials if more time/more detail
   - More detailed on placement of objects, writing methods, events, camera control
   - Animating a skateboarder
   - Adding sound and images
Many short tutorials on CS Topics

- Programming – sequential and “at the same time”
- Methods (teaching characters how to walk)
- Events (buttons and birds)
- Looping
- Conditionals (making a choice)
- Functions (how tall are you)
- Lists (objects moving in unison)
- Variables (timers/scores)
Other “Fun” Topics Blended in

- Storyboards
- Changing camera views
- Scene changes and lighting
- Fading in/out
- Making Billboards
- Making objects invisible and visible
- Sounds
- Glueing objects to others
Game: Break the Pinata

- Timer/Score
Alice examples: Science Example: How volcano is formed

Today, we are going to see how HOT SPOT volcanoes form.
How a volcano is formed (cont)

Deep under the earth's crust heat from the core makes the mantle move like a lava lamp.
How a volcano is formed (cont)

Over thousands of years, the volcano builds up...
How a volcano is formed (cont)

And emerges above the ocean as an island.
Math Example:
Teacher Lesson Plan on quadrant plane

- Click on lighthouse
- Enter x,y position
- Objects randomly move
5. What type of tree is the treehouse on?

- maple
- oak
- a magic tree of no special type
- elm
- I don't know

Score: 5.0
Other Ideas for Projects

- Story from Ancient Egypt
- Spanish Quiz in which you see a word and have to click on the object the word represents
- Animate a scene from a book you have read or a poem you have written
- Create a world about school safety
- Memory game – remember a random color sequence
- Math Quiz – Answer the questions

Alice worlds for these and more are on our website.
Other Teacher Lesson Plans

• Math
  – Finding surface area
  – Rate of Change and Slope

• Science
  – Create a food chain
  – Sun, Earth and Moon system
  – Tornados
  – Physics – Newton’s law of gravity
  – Alternative Energy
Other Teacher Lesson Plans (cont)

• History/Social Studies
  – The continents – view world and answer questions
  – Animated overview of Japan
  – Animated overview of Egypt

• English
  – Write and animate a poem
  – Animate a poem or scene from a story
  – Write a movie trailer
Developed special Alice worlds or classes

• Superground class – has all the grounds and tutorial explains how to fade in and fade out

• Quiz classes – template for making quizzes OR use the quiz tutorial
Alice with K-12 students in a camp. What type of objects did they use?

• Girls top five
  – People, animals, environments, nature, 3D-text

• Boys top five
  – Vehicles, people, buildings, scifi, special effects
Typical Boy Example
SciFi, vehicles, fire
More fire
And more fire
And more fire!
Girl Examples – Dancing chicken
Girl Example 2 - Egypt

behind me is where mummy's lye.
Girl Example 3 – Attack of the lemurs

Hello I'm the chief of this island and we welcome you.
Girl Example 4 - carnival
Girl Example 5 – rescue baby
How did the Students use Alice?

- Examined worlds to see which concepts they used

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>at least once</th>
<th>3+ times</th>
</tr>
</thead>
<tbody>
<tr>
<td>parameters</td>
<td>34%</td>
<td>17%</td>
</tr>
<tr>
<td>loop</td>
<td>57%</td>
<td>23%</td>
</tr>
<tr>
<td>list</td>
<td>45%</td>
<td>8%</td>
</tr>
<tr>
<td>simple event</td>
<td>57%</td>
<td>34%</td>
</tr>
<tr>
<td>4 arrow event</td>
<td>60%</td>
<td>26%</td>
</tr>
<tr>
<td>if statement</td>
<td>43%</td>
<td>11%</td>
</tr>
<tr>
<td>vehicle property</td>
<td>88%</td>
<td>46%</td>
</tr>
<tr>
<td>camera controls</td>
<td>80%</td>
<td>51%</td>
</tr>
<tr>
<td>scene change</td>
<td>51%</td>
<td>26%</td>
</tr>
<tr>
<td>color property</td>
<td>66%</td>
<td>17%</td>
</tr>
</tbody>
</table>

CS Topics

Basic topics
Summary - Alice can introduce and excite students about computer

- Integrate Alice into all disciplines, all levels (K-12 and college)
- Alice can be used for projects
  - To tell stories
  - To solve problems
  - All while learning about programming concepts
- Older students can go more in depth with Alice
- All our materials are Free (over 40 tutorials, videos, sample Alice worlds, links to materials for Duke class)
  - www.cs.duke.edu/csed/alice/
Web site

• Adventures in Alice Programming
  www.cs.duke.edu/csed/alice
Questions?