Introduction to Modeling

CS1316: Representing Structure and Behavior

Today's story

- What's the point of this course?
- What's a model?
- What are data structures?
- Why Java?
- Details on the course
- Getting set up for the course

The Point of this Course

- Real computer-based media developers rarely work in terms of pixels and samples
  - Computer musicians deal in terms of notes, instruments, patches, and other structures.
  - Computer animators deal in terms of characters, movement, scenes, and other structures
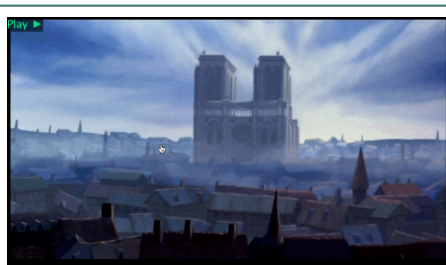- Bottom-line: They *structure* their media.

(Some) Motivating Questions for the Course

- How did the wildebeest charge over the ridge in *The Lion King*?
- What *is* a piece of music?
- Who will win the World Series in 2007?
- Should we cover our mouths when we cough?

The Wildebeests in *The Lion King*

Play ▶

The Villagers in *The Hunchback of Notre Dame*

Play ▶

The answer: Modeling and Simulation

- Lion King scene does <u>not</u> use traditional drawn cel animation.
- Instead Disney:
  - <u>Modeled</u> the structure of wildebeest,
  - <u>Modeled</u> the behavior of wildebeest (how they stampede),
  - Then started a computer *simulation* that *executed* the model…and "filmed" the output.


What's "modeling"?

- Describing things in the world in terms of their *structure* and *behavior.*
  - *F=ma* (Force=mass * acceleration) is part of a *model* of the world that describes what happens when one thing hits another.
  - Maps *model* physical spaces and their physical relationships
- On a computer, we can *execute* these models: Make them work, plug values into equations, move things in space, see what happens.
  - That's *simulation*: Executing a model
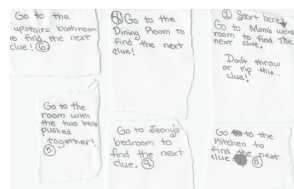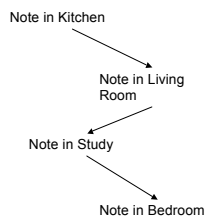

What's a data structure?

- A way of organizing information.
- Different *physical* structures organize space differently.
  - Skyscrapers vs. ranch homes.
  - Trees vs. snail shells
- Data structures organize the information we use in our programs in different ways.

Data structures you know

	Age	Eye Color
Matt	13	Brown
Jenny	7	Blue
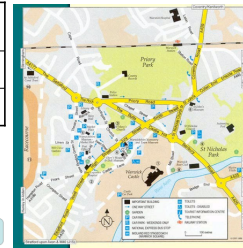
Data structures that you'll come to know

Note in Kitchen
Note in Living Room
Note in Study
Note in Bedroom

### Data structures have different *properties*

- Arrays and tables keep things organized right next to one another.
  - Makes it easy to find something in the array or table
  - But if you want to insert something *new*, you have to move everything over.
- Linked lists and trees keep track of relationships with *links* (or *edges*)
  - Easier to insert new things

Thought experiment: Adding a second of silence into a sound

- Assuming that there's room for another second in the sound…
- We copy samples from the insertion point to the end of sound down one second:
  setSampleValueAt(sound,soundIndex+oneSec, getSampleValueAt(sound,soundIndex))
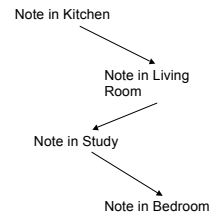- Then we can insert oneSec's worth of 0's into the insertion point
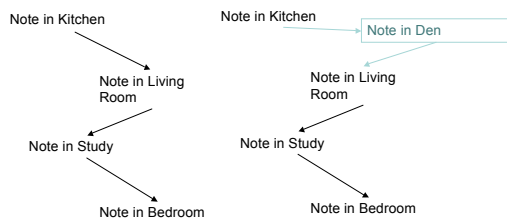
How that looks visually

Here is some sound

Here is some sound
One second

000000000000000Here is some sound
One second
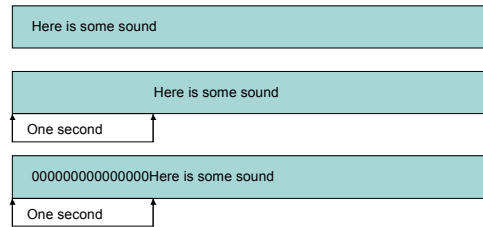
Inserting into a table

1		Age	Eye Color
	Matt	13	Brown
	Jenny	7	Blue

		Age	Eye Color	2
	Matt	13	Brown	
	Jenny	7	Blue	

3		Age	Eye Color
	Matt	13	Brown
	Jenny	7	Blue

		Age	Eye Color	4
	Katie	9	Brown	
	Matt	13	Brown	
	Jenny	7	Blue	

Inserting into a linked list

Note in Kitchen

Note in Living Room

Note in Study

Note in Bedroom

Inserting into a linked list

Note in Kitchen

Note in Living Room

Note in Study

Note in Bedroom

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Note in Living Room

Note in Study

Note in Bedroom

Modeling and Simulations are about data structures

- The visual structure of wildebeest is a *tree* or *graph*.
- Tracking which does something next is a *queue*.
- All of the wildebeest to stampede are stored in a *list*.
- The images to be used in making wildebeest run are usually stored in a *list*.

Learning objectives in the course

Computer Science Learning Objectives

- Students will be able to program Java classes and methods based on modification.
- Students will learn how to use and manipulate several core data structures: Arrays, linked lists, trees, stacks, and queues.

Media Learning Objectives

- Students will be able to explain the role of data structures in structuring and manipulating data, especially multimedia.
- Students will be able to explain key issues of modern animations, such as sound synchronization and moving objects in layers.
- Students will be able to discuss the properties, strengths, and weaknesses of the different structuring approaches for media.
- Students will be able to design, define, and implement some simulations.
- Students will be able to explain the value of computation for modeling and simulation.

Why are we using Java? (Why aren't we using Python?)

- Java is faster than Python
  - We can do more operations in less time, so we can do more complicated media in less time.
- Java is more well-known than Python.
  - So there's more "resume value" than Python.
- If you take more CS, it'll probably be in Java.
  - More CS classes are being taught now in Java than in other programming languages.

General flow of course

- Introduction to Java
  - Manipulation of pictures and sounds (as in CS1315)
  - Manipulating music and turtles
- Using arrays, linked lists, and trees
  - With music, pictures, and sounds
  - Creating animations using arrays, lists, and trees
  - Generalized linked lists and trees
- Creating simulations
  - Predator/prey, disease propagation models, movement of people
  - Different kinds of random
    - Sorting our events
  - Simulations with *resources*
    - Resource *queues*
  - Creating animations with simulations

Class website (Class CoWeb)

- http://coweb.cc.gatech.edu/cs1316
  - Links to other on-line materials you'll need
  - Syllabus and all slides
  - Homework assignments
    - We'll use Sakai (Tsquare) for turnin and grades

Reaching me (Colin Potts)

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Recitations

- Mon/Wed 6:00-7:45pm (CoC Bldg 101)
- WE WILL HAVE (shortened) RECITATIONS THIS WEEK!
  - It'll be help on installing DrJava and other files.
- *Always* feel free to bring your laptop computer to recitation for help!

Course text

- Course notes
- Available in Engineer's Bookstore and also on website
- *Reading the text* **is required.**
  - You get to choose your medium.
- *BUT* **for the most part**: Your text is the course slides.

Grading policy

- 20% for four in-class quizzes.
  - Pre-quiz on-line, not graded nor turned in.
  - Top three grades will count for you
- 30% for nine homeworks
- 50% for three exams
  - Two midterms worth 25% (12.5% each)
  - One final worth 25%
- No curve. 90, 80, 70, 60 cutoffs

Homework

- Collaborative, but you *should* do it on-your-own as much as you can.
  - (1) You'll want to create your own media.
  - (2) You'll learn the coding better on your own, so you'll do better on exams.
  - You <u>must</u> acknowledge collaborators!
- First homework is due soon: Building a picture function.
- Last four homeworks are required to be *pair-programming* exercises
- No credit for late homeworks, due 7pm EDT

Homeworks for Summer 2007 (Tentative)

- HW1: Implement one new image method in Picture
- HW2: Create a Picture collage
- HW3: Create four-part music
- HW4: Use Weaving and Repeating to create music
- HW5: Create new picture list manipulations
- HW6: Create an animation with sound effects
  - HW 6.5 (extra credit) Create a walking character
- HW7: Build a GUI for changing a picture
- HW8: Simulate an ecosystem
- HW9: Simulate a stampeding crowd scene

What you need to do to get started

- Install Java SDK.
  - http://www.java.sun.com
  - Java 1.4.2 or 1.5 for Windows. (You should already have it for Macintosh.)
- Install DrJava
  - http://www.drjava.org
- Install JMusic
- Install Java code for class from website or CD
- (Probably want to download text and slides.)