Today

- Computer science
- Look at Jython
- Look at some cool image things
- Pixels
Why study CS?

• What is computer science about?
• What do computers really understand?
• Media Computation: Why digitize media?
• It is all about communications and process
What is CS about?

- Computer science is the study of “recipes”
- Computer scientists study...
  - How the recipes are written (algorithms, software engineering)
  - The units used in the recipes (data structures, databases)
  - What can recipes be written for (systems, intelligent systems, theory)
  - How well the recipes work (human-computer interfaces)
“Recipes” = Programs

- Key concept: The COMPUTER does the recipe!
- Make them as hard, tedious, complex as you want!
- Crank through a million genomes? No problem!
- Find one person in a 30,000 person campus? Sure.
- Process a million dots in an image or a bazillion sound samples?
- That’s media computation
“Recipes” for all occasions (er, purposes)

• Some people specialize in crepes or barbeque
• Computer scientists can also specialize on special kinds of recipes:
  • create pictures, sounds, movies, animations (graphics, computer music)
  • still others look at emergent properties of computer “recipes”
  • what happens when lots of recipes talk to one another (networking, non-linear systems)
What do computers understand?

• It’s not really multimedia at all.
  • It’s unimedia (Nicholas Negroponte)
  • Everything is 0’s and 1’s

• Computers are not intelligent at all

• The only data they understand is 0’s & 1’s

• They can only do the most simple things with those 0’s & 1’s
  • Move this value here
  • Add, multiply, subtract, divide these values
  • Compare these values, and if one is less than the other, go follow this step rather than that one.
Key Concept: ENCODINGS

• interpret these numbers any way we want.
• encode information in those numbers
• Even the notion that the computer understands numbers is an interpretation
• encode the voltages on wires as 0’s and 1’s, eight of these defining a byte
• can interpret as a decimal number
How do they do it?
(Computers, that is)

- adding and comparing happens in the **Central Processing Unit (CPU)**.
- The CPU talks to the **memory**
  - Think of memory as a sequence of millions of mailboxes, each one byte in size, each of which has a numeric address
- The **hard disk** provides 10 times or more storage than in memory (60 billion bytes versus 512 million bytes), but is millions of times slower
- The **display** is the monitor or LCD (or whatever)
Layers of encodings...

- One encoding, **ASCII**, defines an “A” as 65
- If there’s a byte with a 65 in it, and we decide that it’s a **string**, POOF! It’s an “A”!
- We can **string** together lots of these numbers together to make usable text
- “77, 97, 114, 107” is “Mark”
- “60, 97, 32, 104, 114, 101, 102, 61” is “<a href="” (HTML)"

*Hey, what about pictures, video, and MP3?*
Layered?

“60, 97, 32, 104, 114, 101, 102, 61” is “<a href=“

• A number is just a number is just a number but don't forget the context...
• If you have to treat it as a letter, there’s a piece of software that does it
• For example, ASCII associates 65 with the graphical representation for “A”
• If you have to treat it as part of an HTML document, there’s a piece of software that does it
• That understands that “<A HREF=“ is the beginning of a link
• That part that knows HTML communicates with the part that knows that 65 is an “A”
“Multi”media is “Uni”media

• But that same byte with a 65 in it might be interpreted as...
• A very small piece of sound (e.g., 1/44100-th of a second)
• The amount of redness in a single dot in a picture
• The amount of redness in a single dot in a picture which is a single frame in a full-length motion picture
Software (aka “recipes”)

• Computer programs manage all these layers
• How do you decide what a number should mean, and how you should organize your numbers to represent all the data you want?
• That’s **data structures**
• If that sounds like a lot of data, it is
• To represent all the dots on your screen probably takes more than 3,145,728 bytes
• Each second of sound on a CD takes 44,100 bytes!!
Let's hear it for Moore's Law

- Gordon Moore, one of the founders of Intel, made the claim that (essentially) computer power doubles for the same dollar every 18 months.
- This has held true for over 30 years.
- Go ahead! Make your computer do the same thing to every one of 3 million dots on your screen. It won't take much time!
Why digital media?

• Digitizing media is encoding media into numbers
• Real media is analogue (continuous). Except for movies and TV ...
• To digitize it, we break it into parts where we can’t perceive the parts.
• By converting them, we can more easily manipulate them, store them, transmit them without error, etc.
How can this be?

- Why don’t we perceive the breaks?
- We can only do it because human perception is limited.
- We don’t see the dots in the pictures, or the gaps in the sounds.
- We can make this happen because we know about
  - physics (science of the physical world)
  - psychophysics (psychology of how we perceive the physical world)
Why should you study recipes?

• To understand better the recipe-way of thinking (called "algorithmic" thinking)
• It’s influencing everything, from computational science to art (yup, there is something called “algorithmic art”)
• It is becoming part of everyone’s notion of a liberal education
• That’s the process argument
• BTW, to work with and manage computer scientists
• AND...to communicate!
• Writers, marketers, producers communicate through computation

We’ll take these in opposite order
Computation for communication

- All media are going digital
- Digital media are manipulated with software
- You are limited in your communication by what your software allows
- Thinking algorithmically will make you a better user of software.

What if you want to do something that Microsoft or Adobe or Apple doesn’t let you do?
Programming as communication skill

- want something your tools don’t allow, program it yourself
- want to understand what your tools can or cannot do, need to understand what the programs are doing
- If you care about preparing media for the Web, for marketing, for print, for broadcast... then it’s worth your while to understand media and manipulation of media
- Knowledge is Power; Knowing how media work is powerful and freeing
Knowing about programming is knowing about process

- **Alan Perlis**
- One of the founders of computer science
- Argued in 1961 that Computer Science should be part of a liberal education: Everyone should learn to program.
- Perhaps computing is more critical to a liberal education than Calculus
- Calculus is about rates, and that’s important to many.
- Computer science is about process, and that’s important to everyone.
A Recipe is a statement of process

- A recipe defines how something is done
- In a programming language that defines how the recipe is written
- When you learn the recipe that implements a Photoshop filter, you learn how Photoshop does what it does.
- And that is powerful.
- **Programming is about Communicating Process**
  - A program is the most concise statement possible to communicate a process
  - That’s why it’s important to scientists and others who want to specify how to do something understandably in the most precise words as possible
The programming language we will be using is called Python. Python—was invented by Guido van Rossum & researchers across the Internet.

- [http://www.python.org](http://www.python.org)
- It’s used by companies like Google, Industrial Light & Magic, Nextel, Disney Animation, and others.

The kind of Python we’re using is called Jython.

- It’s Java-based Python.
- [http://www.jython.org](http://www.jython.org)

We’ll be using a specific tool to make Python programming easier, called JES.

- Yeah, we did invent that one.
A note to those with previous experience...

• We start with functional programming
• Move to object-oriented programming in 10 weeks
• Jython (our version of Python) is built on Java so uses Java classes and methods
• Jython is more forgiving than Java
  • implicit rather than explicit typing
  • variable scoping not an issue
  • global name-space; names of functions, classes, objects can only be re-used; parameters are NOT part of name
If you did not understand this, don’t worry. It was not meant for you.

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Demo of Jython

Name not found globally.
A local or global name could not be found. You need to define the function or variable before you try to use it in any way.
>>> print hello
The error was: hello
Name not found globally.
A local or global name could not be found. You need to define the function or variable before you try to use it in any way.
>>> print pickAFile()
/Users/steveharrison/Desktop/2984 Media Computation/class demos/copyBarb2
>>>
The Wooden Mirror

- Video
- How does it work?
- Color?
- Look up "DLP"
How about a picture of pictures? (mosaics)
Digitizing pictures as bunches of little dots

- We digitize pictures into lots of little dots
- Enough dots and it looks like a continuous whole to our eye
  - Our eye has limited resolution
  - Our background/depth acuity is particularly low
- Each picture element is referred to as a *pixel*
Both the Wooden Mirror and the mosaic images are made of pixels

- *Wooden Mirror* pixels are squares of wood flipping back and forth
- mosaic images are small pictures, each the same size

- How many pixels are needed to make picture you understand? See [www.guimp.com](http://www.guimp.com) (its 16 x 16 pixels)
Pixels

- Pixels are *picture elements*
  - Each pixel object knows its **color**
  - It also knows where it is in its **picture**
Coming attractions

- Read chapters 1 & 2
- Online Quiz 1 due on Friday at 2:00 PM
  (the quiz is on the reading)
- Friday is in 1080 Torgersen! NOT HERE.
- For Monday:
  - read Chapter 3
  - Quiz 2 due Monday @ 10:00 AM