Introduction to CS111
Part 2: Big Ideas

CS111 Computer Programming
Department of Computer Science
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What is Computer Science?
- It’s not really about computers.
- It’s not really a science.
- It’s about imperative (“how to”) knowledge as opposed to declarative (“what is”) knowledge.
- Imperative knowledge is expressed via algorithms = computational recipes.
- “A computer language … is a novel formal medium for expressing ideas about methodology, not just a way to get a computer to perform operations. Programs are written for people to read, and only incidentally for machines to execute.” -- Harold Abelson and Gerald J. Sussman

Four big ideas
- Four important concepts are at the core of this course:
  1. Abstraction;
  2. Modularity;
  3. Divide, Conquer and Glue;
  4. Models
- These interrelated ideas are important in almost every discipline, but they’re at the core of CS.
- We will illustrate these ideas in several ways.
- Our goal is to help you think about problem solving in new ways.

Big idea #1: Abstraction

Contract / API
Implementer / Designer
User / Client
Big Idea #2: Modularity

- Large systems are built from components called modules.
- The interfaces between modules are designed so they can be put together in a mix-and-match way.
- In computer programming, the goal is to design packages for maximum reusability.

Big Idea #3: Problem Solving Strategies

Example: Divide-Conquer-Glue

Divide

- problem P into subproblems.

Conquer

- each of the subproblems.

Glue (combine)

- the solutions to the subproblems into a solution S for P.

Big Idea #4: Models

- Need simple models to understand complex artifacts and behaviors.
- We'll draw lots of diagrams to predict what programs will do.

What will you build with these ideas?

We'll start with numerical calculations and graphics

- What is your name? Valentine
- How many classes are you taking this semester? 5
- What is the average time in class per week this semester? 2.5
- How many hours per week do you spend on extracurricular activities (including jobs)? 15
- How many hours per day do you sleep on average? 8
- Weekly time profile for Valentine:
  - 37.5 class hours: .......................... .......................... .......................... .......................... ..........................
  - 15.0 extracurricular hours: ..........................
  - 59.5 free hours: ..........................
  - 56.0 sleep hours: ..........................

- Harry Potter
- Lovely Day
Define functions to capture common patterns

Apply problem solving strategies like Divide/Conquer/Glue to draw quilts

Write text-based games with conditionals

Tic-tac-toe

Use the power of iteration to generate graphics and write games

Rock, paper, scissors
Learn Data Structures: Lists and Dictionaries

Perform Data Analysis and Visualization

Problem solving with Recursion

Object-Oriented Programming
On to Python! Unlearn what you have learned

I don’t think that word means what you think it means

Python Intro Overview [Continues on Friday]

- **Values:**
  - `10` (integer),
  - `3.1415` (decimal number or float),
  - `'wellesley'` (text or string)

- **Types:** numbers and text: `int`, `float`, `str`
  - `type(10)`
  - `type('wellesley')`

- **Operators:** `+`, `-`, `*`, `/`, `%`,
- **Expressions:** (they always produce a value as a result)
  - `len('abc') * 'abc' + 'def'`

- **Built-in functions:** `max`, `min`, `len`, `int`, `float`,
  - `str`, `round`, `print`, `raw_input`
Example with cs1graphics

Version annotated to display coordinates for reference points.

From cs1graphics import *

paper = Canvas(400, 550, 'yellow')
head = Circle(50, Point(200,150))
paper.add(head)

# The torso
torso = Rectangle(100, 200, Point(200, 300))
torso.setFillColor('gray')
paper.add(torso)

# SOME CODE OMITTED
message = Text('If I only had a heart!', 20)
paper.add(message)
motage.setFontColor('red')
motage.moveTo(200, 25)

Defines names used in this program:
Canvas, Rectangle, Text, etc.

Assignment statement that:
1. Creates object, assigns it to a variable
2. Displays an empty canvas

Statement: method call to display circle object on canvas window

Statement: method call to change object's internal state, also visible on the canvas.

Statement: method call to change reference point and display object in new position.

Expressions vs. Statements

They always produce a value:

10
10 * 20 - 100/25
max(10, 20)
int("100") + 200
fav
fav + 3
"pie" + " in the sky"

Expressions are composed of values, operators, variables, functions, and any combination of them.

They perform an action (that can be visible, invisible, or both):

print(10)
age = 19
paper = Canvas(400, 550, 'yellow')
paper.add(head)

Statements may contain expressions, which are evaluated before the action is performed.

print('She is ' + str(age) + ' years old.')