CSE 160 Wrap-Up

Ruth Anderson

UW CSE 160

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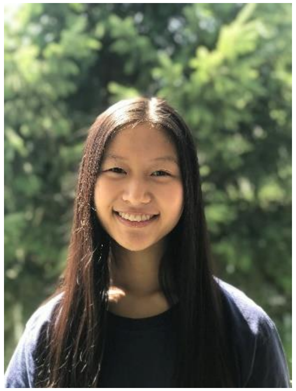
Progress in 10 weeks

10 weeks ago: you knew no programming

Goals:

- **Computational problem-solving**
- **Python** programming language
- Experience with **real datasets**
- **Fun** of extracting understanding and insight from data, and of mastery over the computer
- Ability to go on to more advanced **computing** classes

Today: you can write a useful program to solve a real problem



Thanks!

Why do you care about processing data?

- The world is awash in data
- Processing and analyzing it is the difference between success and failure
  - for a team or for an individual
- Manipulating and understanding data is essential to:
  - Astronomers
  - Biologists
  - Chemists
  - Economists
  - Engineers
  - Entrepreneurs
  - Linguists
  - Political scientists
  - Zoologists
  - … and many more!

Programming Concepts

- Variables
- Assignments
- Types
- Programs & algorithms
- Control flow: loops (for), conditionals (if)
- Functions
- File I/O
- Python execution model
  - How Python evaluates expressions, statements, and programs

Data structures: managing data

- List
- Set
- Dictionary
- Tuple
- Graph

- List slicing (sublist)
- List comprehension: shorthand for a loop

$f(x) = x^2$

Functions

- **Procedural abstraction**
  - avoid duplicated code
  - the implementation does not matter to the client
- Using functions
- Defining functions

Data abstraction

- Dual to procedural abstraction (functions)
- A module is: operations
- An object is: data + operations
  - Operations: create, query, modify
  - Clients use the operations, never directly access data
  - The representation of the data does not matter to the client
  - Programmer defines a class.
    Each instance of a class is an object.

Testing and debugging

- Use small data sets to test your program
- Write enough tests:
  - Cover every branch of each boolean expression
    - especially when used in a conditional expression (if statement)
  - Cover special cases:
    - numbers: zero, positive, negative, int vs. float
    - data structures: empty, size 1, larger
- Assertions are useful beyond tests
- Debugging: after you observe a failure
  - Divide and conquer
    - In time, in data, in program text, in development history
    - this is also a key program design concept
  - The scientific method
    - state a hypothesis; design an experiment; understand results
- Think first ("lost in the woods" analogy)
  - Be systematic: record everything; have a reason for each action

Data analysis

- Statistics
  - Run many simulations
  - How uncommon is what you actually saw?
- Graphing/plotting results

Program design

How to write a **function**:

1. Choose name, arguments, and documentation string
2. Write tests
3. Write body/implementation

How to write a **program**:

1. Decompose into parts (functions, modules)
   - Each part should be a logical unit, not too large or small
2. Write each part
   - Define the problem
   - Choose an algorithm
   - In English first; test it via manual simulation
   - Translate into code

When necessary, use *wishful thinking*

- – Assume a function exists, then write it later
- – Can test even before you write it, via a stub

Speed of algorithms

- Affected primarily by the number of times you iterate over data
- Nested looping matters a lot

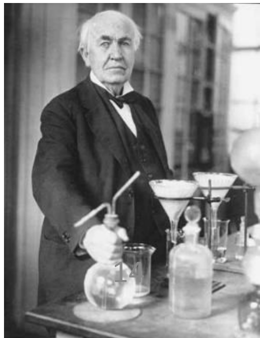
Data!

- DNA
- Images
- Social Networks
- 2D points and Handwriting Samples
- Election Results

What you have learned in CSE 160

- Compare your skills today to 10 weeks ago
  - Bottom line: The assignments would be easy for you today
    - This is a measure of how much you have learned
- **There is no such thing as a “born” programmer!**
- Your next project can be more ambitious

> Genius is 1% inspiration and 99% perspiration.
> Thomas A. Edison



Go forth and conquer

System building and scientific discovery are fun!

- It’s even more fun when your system works

Pay attention to what matters

- Use the techniques and tools of CSE 160 effectively

Final Exam

- Topics: Everything in the course up to and including List Comprehensions is fair game.
  - Part 1 - similar to the midterm: writing small functions, although now dictionaries, sets, and tuples could be involved.
  - Part 2 - short answer questions and code writing that involves writing less than an entire function.
- Released by 5pm Mon 12/14, due by 5pm Thurs 12/17
- Similar Policies to Midterm – Groups of up to 6