Introduction to Data Programming

CSE 160
University of Washington
Winter 2021
Rob Thompson

Slides based on previous versions by Ruth Anderson, Michael Ernst and Bill Howe

Agenda for Today

- What is this course?
- Course logistics
- Python!

Welcome to CSE 160!

CSE 160 teaches basic, key programming concepts with an emphasis on real data manipulation tasks from science, engineering, and business

Goal by the end of the quarter: Given a data source and a problem description, you can independently write a complete, useful program to solve the problem (practical knowledge)

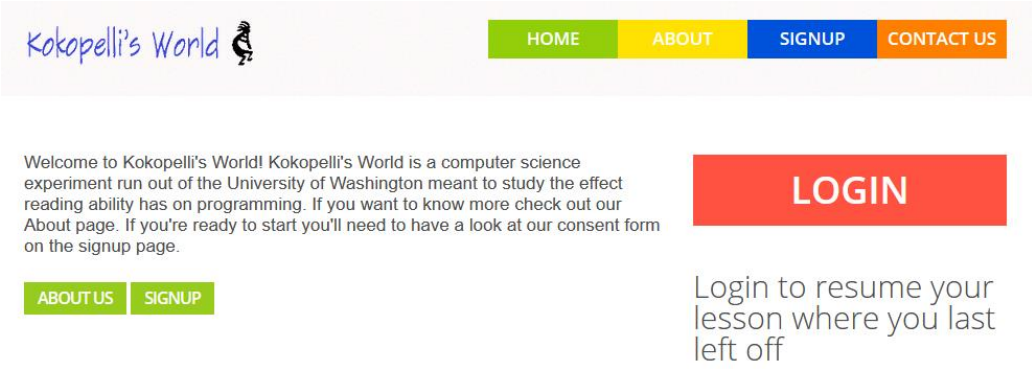
Course staff

- Lecturer:
  - Rob Thompson
- TAs:
  - David Chang
  - Niamh Froelich
  - Zoe Kaputa
  - Austin Jenchi
  - Joely Nelson
  - Wilson Tang
  - Amanda Ong
  - Jack Venberg
  - Brian Zhu
  - Kushagra Kumar

- We're all here for you, so don't hesitate to ask for help

About Rob

- Forever-Student at UW: undergrad in Computer science and Physics, PhD in Computer Science
- Teaching CS: for ~4 years, 1 as lecturer
- Research Focus: Educational programming environments, effects of dyslexia on children learning to program
- Fun Fact: A big part of the data analysis presented in my defense used Python scripts, it's relevant at all levels!



Course Learning Objectives

- Computational problem-solving
  - Writing a program will become your “go-to” solution for data analysis tasks
- Basic Python proficiency
  - Including experience with relevant libraries for data manipulation, scientific computing, and visualization.
- Experience working with real datasets
  - astronomy, biology, linguistics, oceanography, open government, social networks, and more.
  - You will see that these are easy to process with a program, and that doing so yields insight.

What this course is not

- A “programming language course” in Python
  - …though you will become proficient in the basics of the Python programming language
  - …and you will gain experience with some important Python libraries
- A data analysis / “data science” / data visualization course
  - There will be very little statistics knowledge assumed or taught
- A “project” course
  - the assignments are “real,” but are intended to teach specific programming concepts
- A “big data” course
  - Datasets will all fit comfortably in memory
  - No parallel programming

How to succeed

- No prerequisites
- **Non**-predictors for success:
  - Past programming experience
  - Enthusiasm for games or computers
- Programming and data analysis are challenging
- Every one of you can succeed
  - There is no such thing as a “born programmer”
  - Work hard
  - Follow directions
  - Be methodical
  - *Think* before you act
  - Try on your own, then ask for help
  - Start early

"It's a great time to be a data geek."

-- Roger Barga, Microsoft Research

"The greatest minds of my generation are trying to figure out how to make people click on ads"

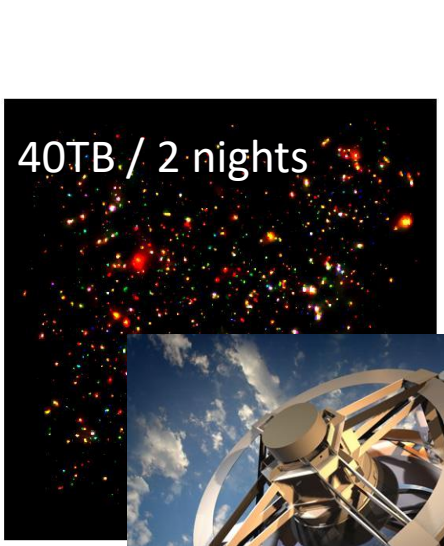
-- Jeff Hammerbacher, co-founder, Cloudera

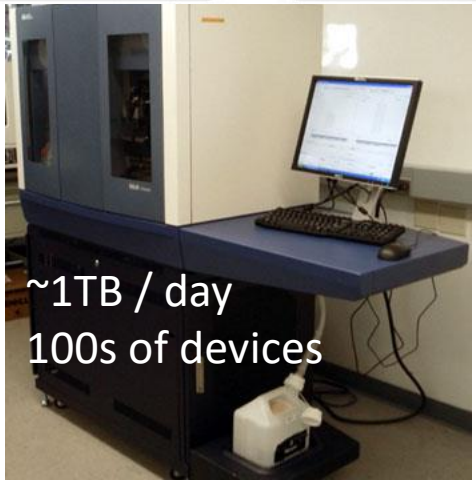
All of science is reducing to computational data manipulation

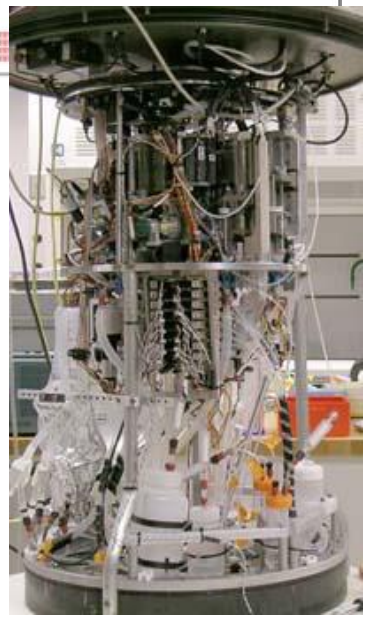
Old model: "Query the world" (Data acquisition coupled to a specific hypothesis)

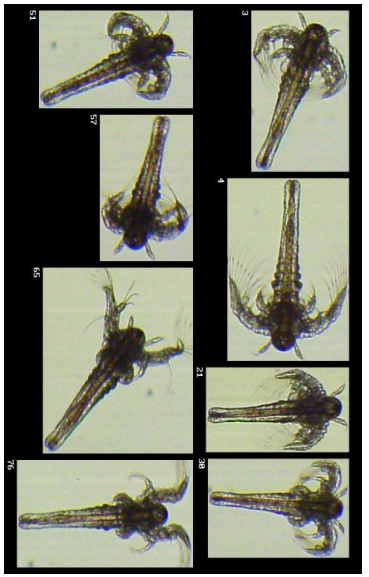
New model: "Download the world" (Data acquisition supports many hypotheses)

- **Astronomy: High-resolution, high-frequency sky surveys (SDSS, LSST, PanSTARRS)**
- **Biology: lab automation, high-throughput sequencing,**
- **Oceanography: high-resolution models, cheap sensors, satellites**









Slide from Bill Howe, eScience Institute

Example: Assessing treatment efficacy

	A	B	C	D	E	F	G	H	I	J
1	fu_2wk	fu_4wk	fu_8wk	fu_12wk	fu_16wk	fu_20wk	fu_24wk	total4type_fu	clinic_zip	pt_zip
2	1	3	4	7	9	9	9	12	98405	98405
3	2	4	6	7	8	8	8	8	98405	98403
4	0	0	0	0	0	0	0	0	98405	98445
5	3	4	5	5	5	5	5	5	98405	98332
6	0	0	0	0	0	0	0	8	98405	98405
7	2	2	2	2	2	2	2	2	98405	98402
8	1	2	5	6	8	10	10	14	98405	98418
9	1	1	2	2	2	2	2	2	98499	98406
10	0	0	1	2	2	2	2	6	98405	98404
11	0	0	0	0	0	0	0	0	98405	98402
12	1	1	2	2	4	4	4	4	98405	98405
13	1								98404	98404
14	2								98499	98498
15	0								98499	98445
16	1								98499	98405
17	1								98499	98498
18	1	3	3	3	3	3	3	3	98499	98499
19	1	1	4	5	7	7	7	7	98499	98371

number of follow ups within 16 weeks after treatment enrollment.

Zip code of clinic

Zip code of patient

Question: Does the distance between the patient's home and clinic influence the number of follow ups, and therefore treatment efficacy?

Python program to assess treatment efficacy

```
# This program reads an Excel spreadsheet whose penultimate
# and antepenultimate columns are zip codes.
# It adds a new last column for the distance between those zip
# codes, and outputs in CSV (comma-separated values) format.
# Call the program with two numeric values:  the first and last
# row to include.
# The output contains the column headers and those rows.

# Libraries to use
import random
import sys
import xlrd        # library for working with Excel spreadsheets
import time
from gdapi import GoogleDirections

# No key needed if few queries
gd = GoogleDirections('dummy-Google-key')

wb = xlrd.open_workbook('mhip_zip_eScience_121611a.xls')
sheet = wb.sheet_by_index(0)

# User input:  first row to process, first row not to process
first_row = max(int(sys.argv[1]), 2)
row_limit = min(int(sys.argv[2]+1), sheet.nrows)

def comma_separated(lst):
  return ",".join([str(s) for s in lst])

headers = sheet.row_values(0) + ["distance"]
print comma_separated(headers)

for rownum in range(first_row,row_limit):
   row = sheet.row_values(rownum)
   (zip1, zip2) = row[-3:-1]
   if zip1 and zip2:
      # Clean the data
      zip1 = str(int(zip1))
      zip2 = str(int(zip2))
      row[-3:-1] = [zip1, zip2]
      # Compute the distance via Google Maps
      try:
         distance = gd.query(zip1,zip2).distance
      except:
         print >> sys.stderr, "Error computing distance:", zip1, zip2
         distance = ""
    # Print the row with the distance
    print comma_separated(row + [distance])
    # Avoid too many Google queries in rapid succession
    time.sleep(random.random()+0.5)
```

23 lines of executable code!

Course logistics

- Website: http://www.cs.washington.edu/cse160
  - See the website for all administrative details
- Homework 0 - due Friday
  - Preliminary Survey are due Wednesday
  - All of this listed and detailed on the website
- Questions? robthomp@cs.washington.edu

Introductions on Ed Board

- Name
- Major
- Interesting Fact or maybe what you did over break.
- Feel free to try making a video!