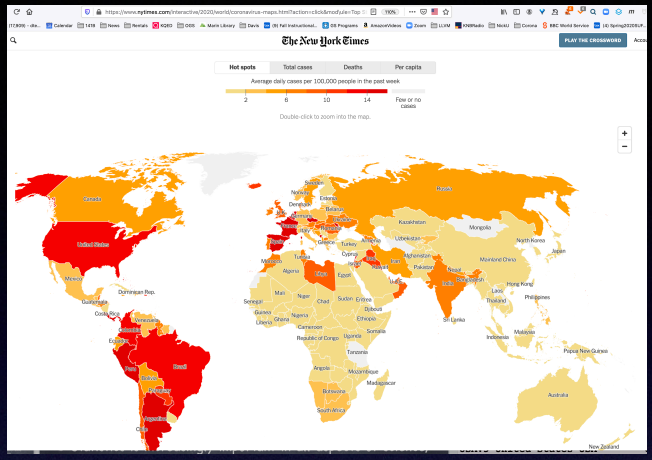
STA141B
Data and Web Technologies for Data Analysis
Spring 2022

Instructor: Duncan Temple Lang

Quick Links: Canvas Piazza

Motivation

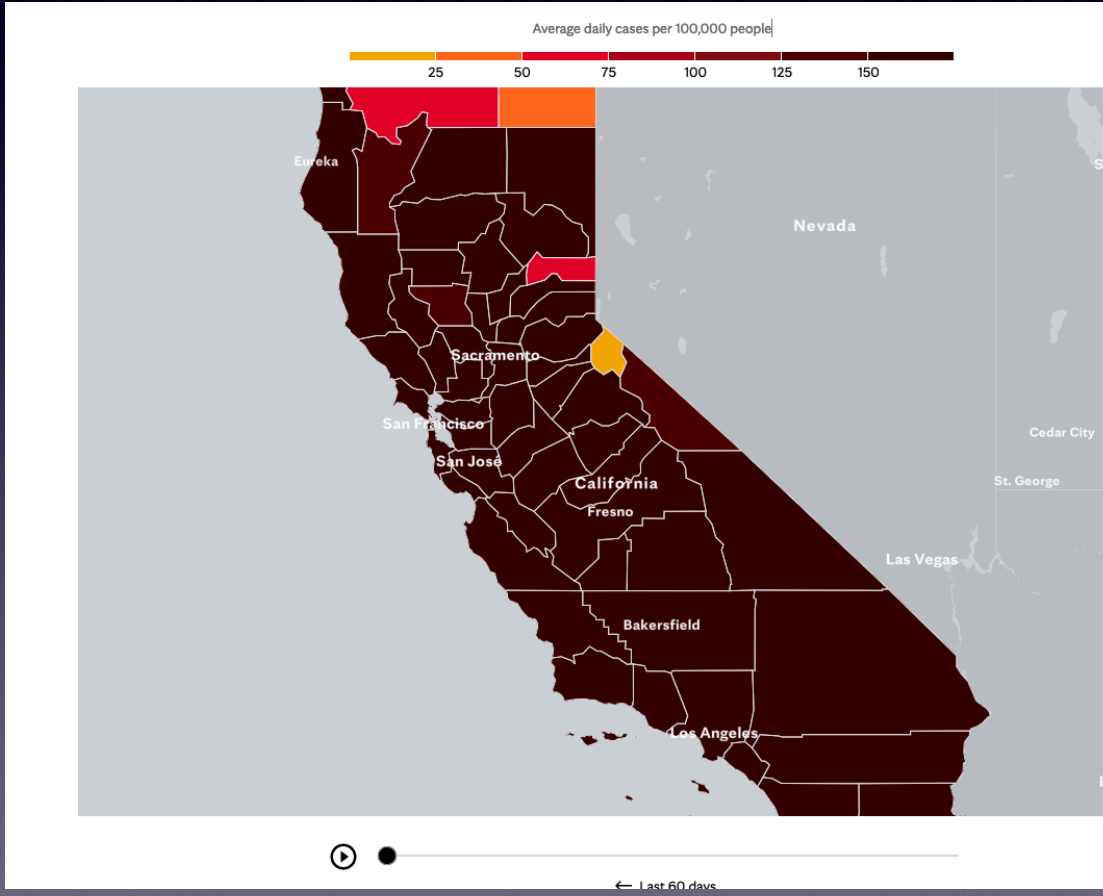


- So much more data available today
  - Online and from digital devices
- We want to be able to integrate datasets to
  - explore new questions
  - verify other people's claims and conclusions
  - provide different views

Example

- Recent COVID time lapse in CA
- Animate it over time to see change.
- Display the curves for several countries over time on the same plot.
- How do we get the data?
- How to integrate other data?
  - Air quality
  - Demographics
  - …

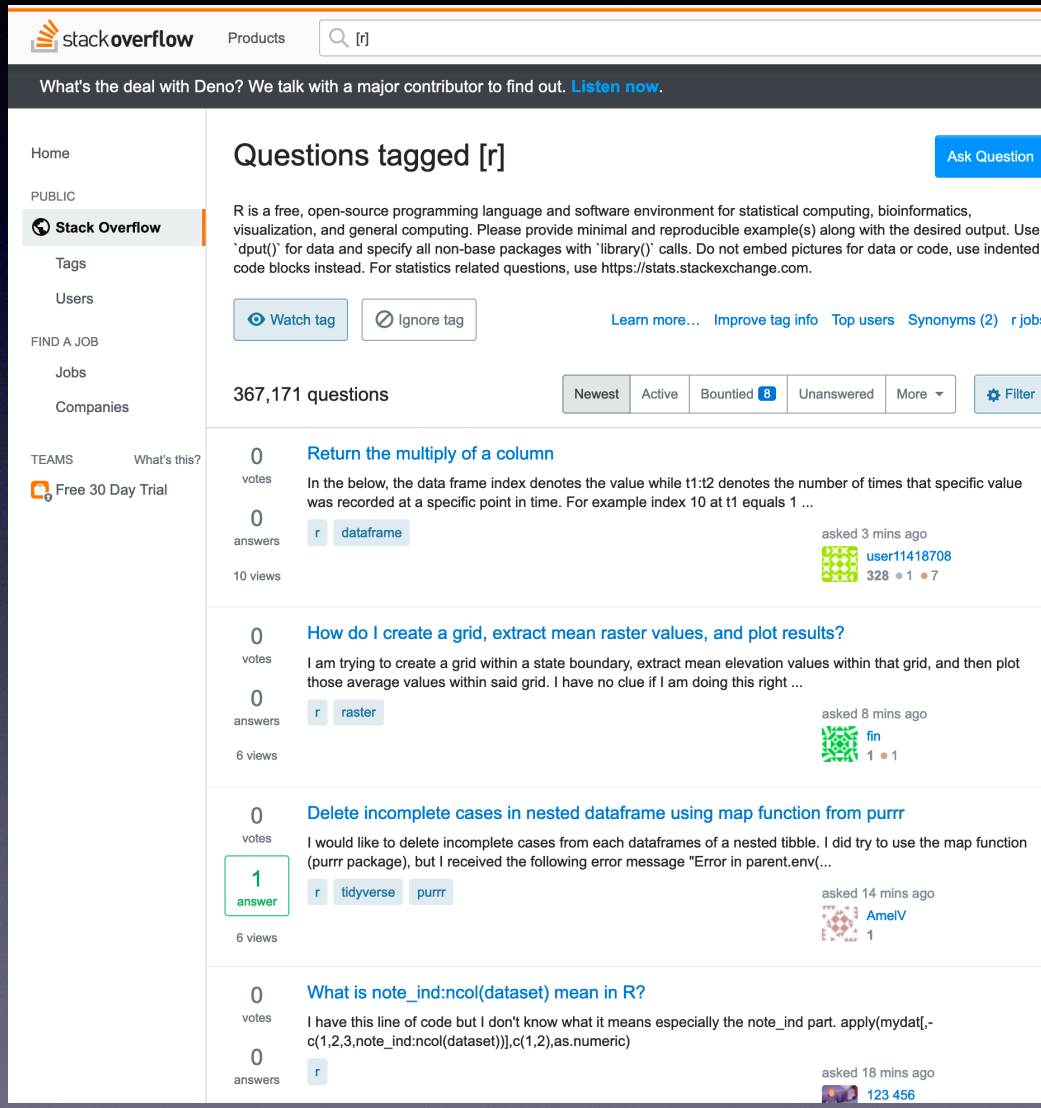
https://www.mayoclinic.org/coronavirus-covid-19/map/california



StackOverflow - R Questions and Answers

https://stackoverflow.com/questions/tagged/r

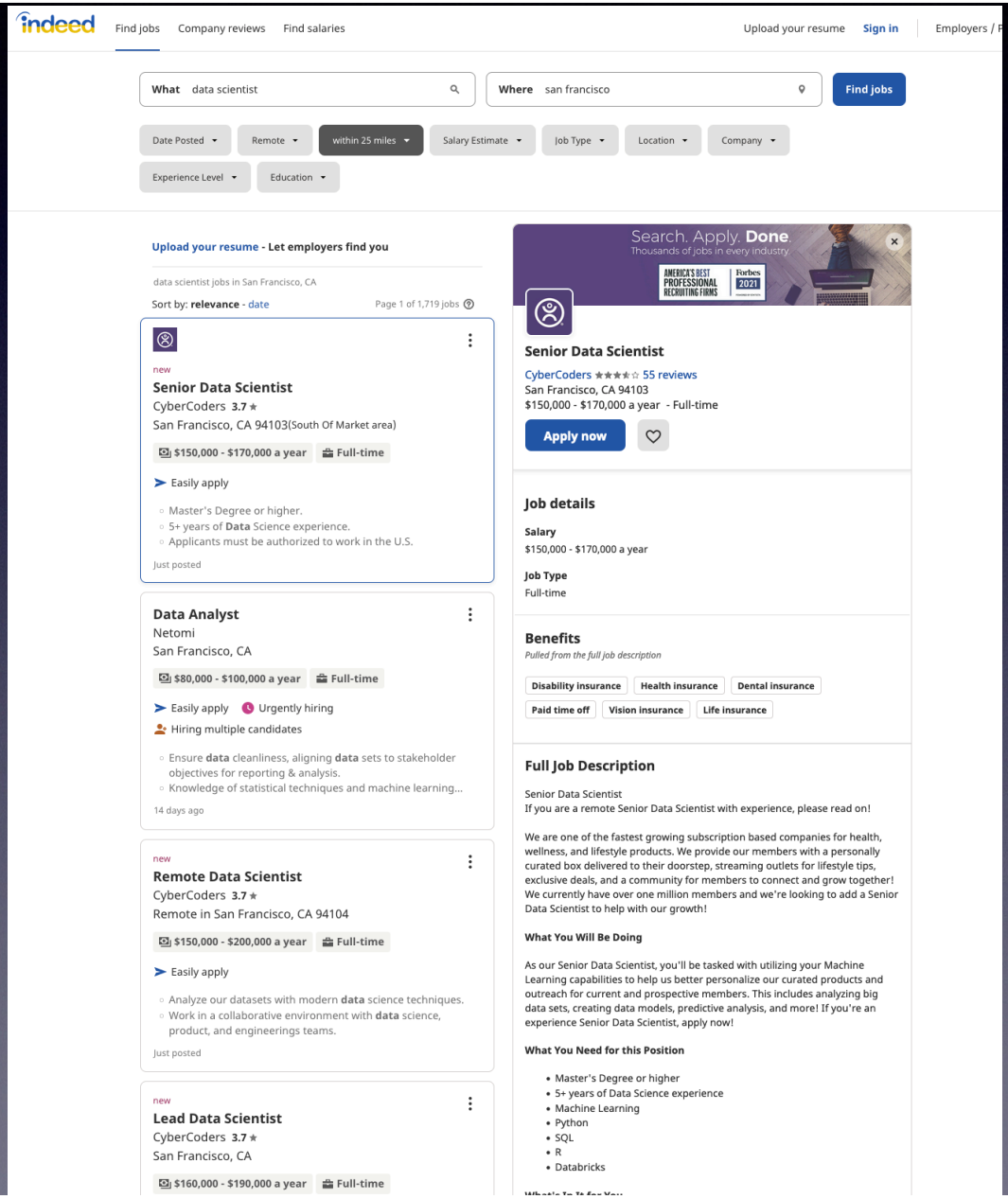
- How do we programmatically mine this for interesting information
  - Names of popular functions
  - People who provide good answers
  - How to write good questions
- How do we get the data?



Job Postings

https://www.indeed.com/jobs?q=data+scientist&l=san+francisco

- Look at job postings for different types of jobs
  - Salary distribution
  - What are typical required skills
  - Level of education.
- Integrate with cost of living of cities.
- How do we get the data?



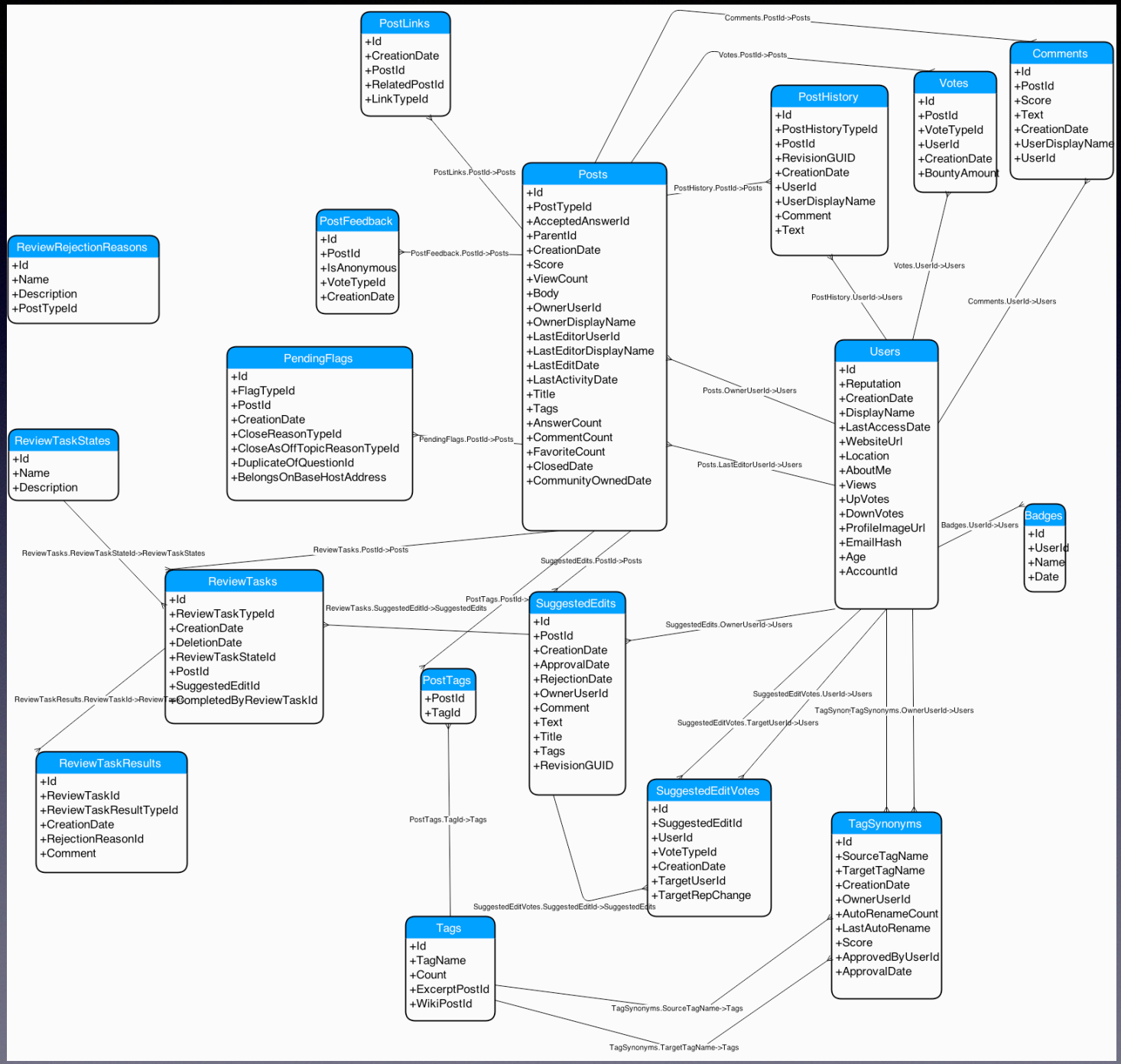
Non-standard Data Formats

```
# timestamp=2006-02-11 08:31:58
# usec=250
# minReadings=110
t=1139643118358;id=00:02:2D:21:0F:33;pos=0.0,0.0,0.0;degree=0.0;00:14:bf:b1:97:8a=-38,2437000000,3;00:14:bf:b1:97:90=-56,2427000000,3;00:0f:a3:39:e1:c0=-53,2462000000,3;00:14:bf:b1:97:8d=-65,2442000000,3;00:14:bf:b1:97:81=-65,2422000000,3;00:14:bf:3b:c7:c6=-66,2432000000,3;00:0f:a3:39:dd:cd=-75,2412000000,3;00:0f:a3:39:e0:4b=-78,2462000000,3;00:0f:a3:39:e2:10=-87,2437000000,3;02:64:fb:68:52:e6=-88,2447000000,1;02:00:42:55:31:00=-84,2457000000,1
t=1139643118744;id=00:02:2D:21:0F:33;pos=0.0,0.0,0.0;degree=0.0;00:14:bf:b1:97:8a=-38,2437000000,3;00:0f:a3:39:e1:c0=-54,2462000000,3;00:14:bf:b1:97:90=-56,2427000000,3;00:14:bf:3b:c7:c6=-67,2432000000,3;00:14:bf:b1:97:81=-66,2422000000,3;00:14:bf:b1:97:8d=-70,2442000000,3;00:0f:a3:39:e0:4b=-79,2462000000,3;00:0f:a3:39:dd:cd=-73,2412000000,3;00:0f:a3:39:e2:10=-83,2437000000,3;02:00:42:55:31:00=-85,2457000000,1
```

More Complex Formats

```
## Player version 2.1.3
## File version 0.3.0
## Format:
## - Messages are newline-separated
## - Common header to each message is:
##   time     host   robot  interface index  type   subtype
##   (double) (uint) (uint) (string)  (uint) (uint) (uint)
## - Following the common header is the message payload
0000000000.100 16777343 6668 laser 00 004 001  +0.000  +0.000   0.000   0.156   0.155
0000000000.200 16777343 6668 position2d 00 004 001 -00.040 +00.000 +0.000 +00.440 +00.380
0000000000.200 16777343 6668 position2d 00 001 001 -14.000 -07.000 +0.785 +00.000 +00.000 +00.000 0
0000000000.200 16777343 6668 laser 00 001 001 0001 -3.1416 +3.1416 +0.01740495 +2.0000 0361 1.838  0 1.807  0 1.778  0 1.749  0 1.723  0
1.697  0 1.673  0 1.650  0 1.628  0 1.607  0 1.587  0 1.568  0 1.550  0 1.533  0 1.517  0 1.501  0 1.486  0 1.472  0 1.459  0 1.446  0 1.434  0 1.423  0
1.412  0 1.402  0 1.392  0 1.383  0 1.375  0 1.367  0 1.359  0 1.352  0 1.346  0 1.340  0 1.334  0 1.329  0 1.324  0 1.320  0 1.316  0 1.313  0 1.310  0
1.307  0 1.305  0 1.303  0 1.302  0 1.301  0 1.300  0 1.300  0 1.300  0 1.301  0 1.302  0 1.303  0 1.305  0 1.307  0 1.310  0 1.313  0 1.316  0 1.320  0
1.324  0 1.329  0 1.334  0 1.340  0 1.346  0 1.352  0 1.359  0 1.367  0 1.375  0 1.383  0 1.392  0 1.402  0 1.412  0 1.423  0 1.434  0 1.446  0 1.459  0
1.472  0 1.486  0 1.501  0 1.517  0 1.533  0 1.550  0 1.568  0 1.587  0 1.607  0 1.628  0 1.650  0 1.673  0 1.697  0 1.723  0 1.749  0 1.778  0 1.807  0
1.838  0 1.843  0 1.905  0 1.941  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0
2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0
2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0
2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.000  0 2.0001.607  0 1.618  0 1.630  0 1.642  0 1.65
0 1.669  0 1.683  0 1.701  0 1.716  0 1.738  0 1.765  0 1.774  0 1.811  0 1.817  0 1.852  0 1.864  0 1.885  0 1.921  0 1.941  0 1.978  0 2.000  0 1.944  0
1.889  0 1.835  0 1.838  0
```

Relational Databases



Complexity

- Data from many different types of sources
  - Web pages, Web services, databases, FTP servers, github, …
- in many different formats
  - CSV, Excel, XML, JSON, YAML, PDF, …
  - Structured, semi-structured and free-form text.
- Different Domain Specific Languages to manipulate data - SQL, XPath, Regular Expressions, CSS selectors

Learning Goals

- Learn important and commonly used technologies to access and manipulate data.
- Learn fundamental concepts and data technology architectures so you can quickly embrace new technologies
- Be able to get data from many different sources and formats.
- Strengthen and Master programming knowledge
- Deeper experience with R.

Syllabus/Topics

- R fundamentals
- Text Processing and Regular Expressions
- Relational Databases & SQL
- Web Scraping & APIs (Application Programming Interfaces)
- Interactive Data Visualization - Web-based, HTML, JavaScript, SVG, CSS from R.

Additional/Optional Topics

- If we have time and you are interested
  - Advanced aspects of R
  - UNIX shell basics
  - Version Control (git)

Making sense of the Data

- The focus is on computing, but we also take this opportunity to explore real data and to do common sense data analysis.
- This does not necessarily mean using complex, sophisticated statistical methodology (unless it is appropriate).
- More about summarizing data and finding evidence within data and illustrating your conclusions,
- Or identifying conjectures/hypotheses and exploring with data.

Textbook

- No single text book
  - I'll point you to chapters of different books
  - But much of the material will be online Web sites & resources
- You have to use the Web and different resources to find information you need.
- This is a very important but highly non-trivial skill
  - composing the question/goal
  - finding resources
  - honing queries (Web or human) to get the relevant information
  - knowing when to detour and when not to

Communicating

- Feel free to call me Duncan.
  - My last name is “Temple Lang”
- Ask all questions about the course (content, logistics, …) on Piazza.
  - Make them public, not private.
- Send private/personal emails to me at dtemplelang@ucdavis.edu

Lectures

- I want you to raise questions and discuss problems, questions, concepts in class.
- The beginning of every class, I ask for questions. I expect there to be some. If not, then you are not working on the assignments.
- If I say something you don't understand, but you have tried to follow, ask me to explain it a different way.
- If I speak too quickly, ask me to slow down.

Assignments as Labs

- *Lecture courses offer the opportunity to show whether you can get the right answer. Labs on the other hand offer an essential opportunity for students to learn about the practice of science and this practice includes presenting one's work in a clear and compelling fashion.* – Moskovitz & Kellogg. Science, 29 July, 2011.
- This is a lab class with guidance/instructions in lectures.
- You need to start working on each lab when I post it
  - They take time
  - Don't wait until a day or two before the due date.
  - Way too much stress and you won't learn much.

Assignments/Labs/Mini-Projects

- 5-6 "labs" or short projects
  - Each about 2 weeks

Grading

- 5 assignments - 90%. (16% each, all count)
- 10% participation
  - Piazza, office hours, lecture
  - asking and answering questions

Exams, Quizzes

- Hands-on computing is difficult to assess via written exams & quizzes
- However, if there is significant copying in assignments or cheating, I'll conduct exams.
  - Please don't copy or cheat
  - No benefit to you in medium- and long-term

Copying & Cheating

- Read and understand the Code of Academic Conduct
- You ***can*** use
  - Ideas and code you find on the Web
  - Code snippets posted on Piazza
  - YOU MUST NOTE IN YOUR CODE AND REPORT WHERE YOU GOT THESE!

Piazza

- We'll use Piazza for all questions and answers about assignments, code, lecture, …
- Page: http://piazza.com/uc_davis/spring2022/sta141b
- Make certain to register and login ASAP
- Change your settings to get notifications of posts
- Please post using your login (not anonymously)
  - Helps for participation grade.

Before Posting a Question

- Make certain to read all the posts - regularly
  - You will learn a lot and find suggestions about how to approach aspects of the assignments.
- Don’t repeat a question, i.e., that was asked previously.
- Try to find the answer or some background information before simply expecting others to look it up for you.

Posting Questions

- Much more likely to get a good answer quickly if you pose a question well
- Focus on what information is necessary for a reader who isn't sitting in front of your computer
  - Enough to give all the relevant details
  - Not too much so reader can't see the relevant element
    - And doesn't bother to reply.

Posing a Good Question

- Minimal reproducible example
  - Take the time to create a much simpler version of only the part of your code that exhibits the problem.
  - Doing this will often be enough to solve the problem yourself.
- In the question, state
  - what you expect the code to do and what results you expect it to produce
  - what it actually produces
  - In what ways these are different.
  - Include any error or warning message
  - And the output from sessionInfo()

Bad Question

- “I tried to read the data and it didn’t work”
  - What data - a file, a URL? What format? Does the file actually exist?….
  - What’s “it”?
  - In what way didn’t it “work”?