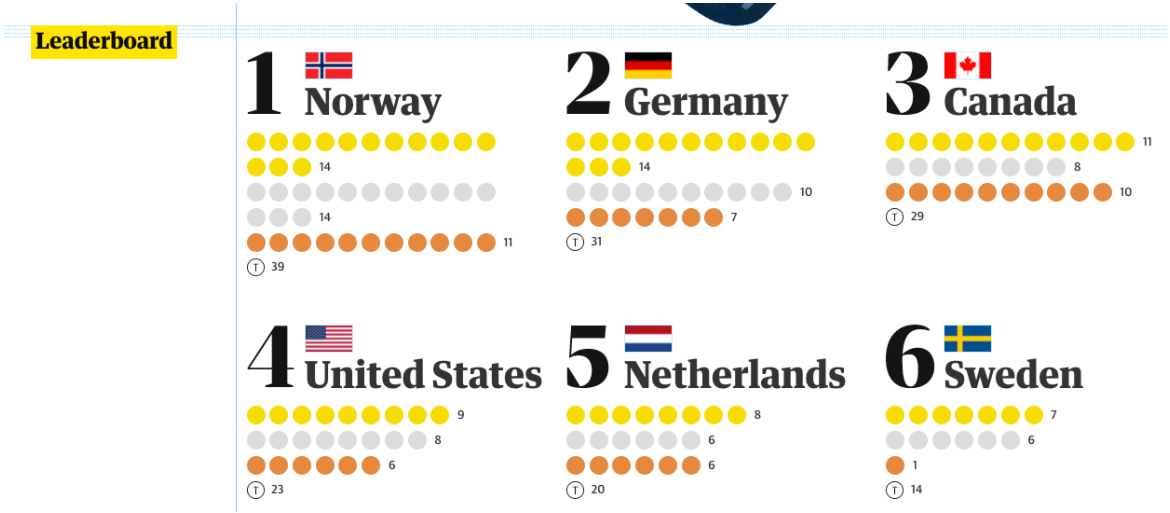
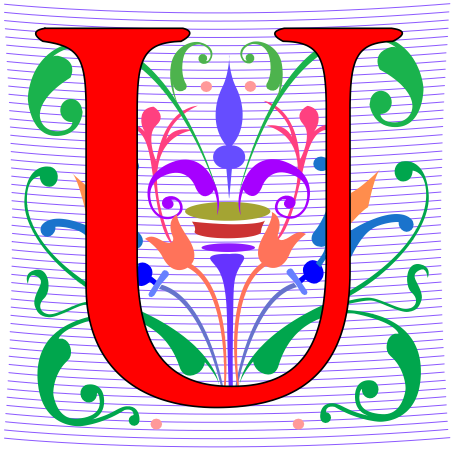
Compsci 101
Stable Sorting, Review

Susan Rodger

April 6, 2023



U is for …

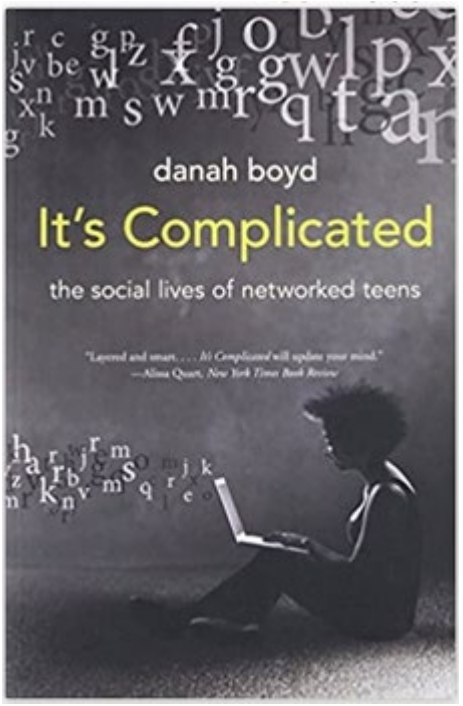


- **URL**
  - https://duke.edu
- **Usenet**
  - Original source of FAQ, Flame, Spam, more
- **UI and UX**
  - User is front and center

danah boyd

Dr. danah boyd is a Principal Researcher at Microsoft Research, … and a Visiting Professor at New York University. Her research is focused on addressing social and cultural inequities by understanding the relationship between technology and society.

"If I have learned one thing from my research, it's this: social media services like Facebook and Twitter are providing teens with new opportunities to participate in public life, and this, more than anything else, is what concerns many anxious adults."



Announcements

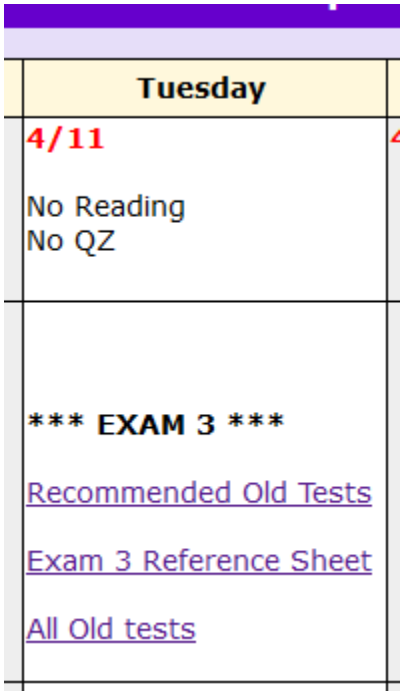
- **APT-6 due Thursday, April 13**
- **Assignment 5 Clever GuessWord due tonight**
- **Assignment 6 Recommender out – due in two weeks**
  - Discuss next time
  - Read through assignment before then

- **Lab 9 Friday**
  - There is a prelab!

- **Exam 3 is Tuesday!**

Exam 3– Tues, April 11

- **Exam is in class on paper – 10:15am**
  - Need pen or pencil
- **See materials under 4/11 date**
  - Exam 3 Reference sheet - part of exam
- **Covers**
  - topics
  - APTs through APT6
  - Labs through Lab 9
  - Assignments through Assignment 5



Exam 3 topics include …

- **List, tuples, list comprehensions**
- **Loops – for loop, while loop, indexing with a loop**
- **Reading from a file**
  - Converting data into a list of things
- **Parallel lists**
- **Sets – solving problems**
- **Dictionaries – solving problems**
- **Sorting – lists, tuples**
- **No turtles, no images - but note we are practicing other concepts with images**

Exam 3

- **Exam 3 is your own work!**
- **No looking at other people's exam**
- **You cannot use any notes, books, computing devices, calculators, or any extra paper**
- **Bring only a pen or pencil**
- **The exam has extra white space and has the Exam 3 reference sheet as part of the exam.**

- **Do not discuss any problems on the exam with others until it is handed back**

Exam 3 – How to Study

- **Practice writing code on paper!**
- **Rewrite an APT**
- **Try to write code from lecture from scratch**
- **Try to write code from lab from scratch**
- **Practice from old exams**
- **Put up old Sakai quizzes, but better to practice writing code**
- **Look at Exam 3 reference sheet when writing code!**

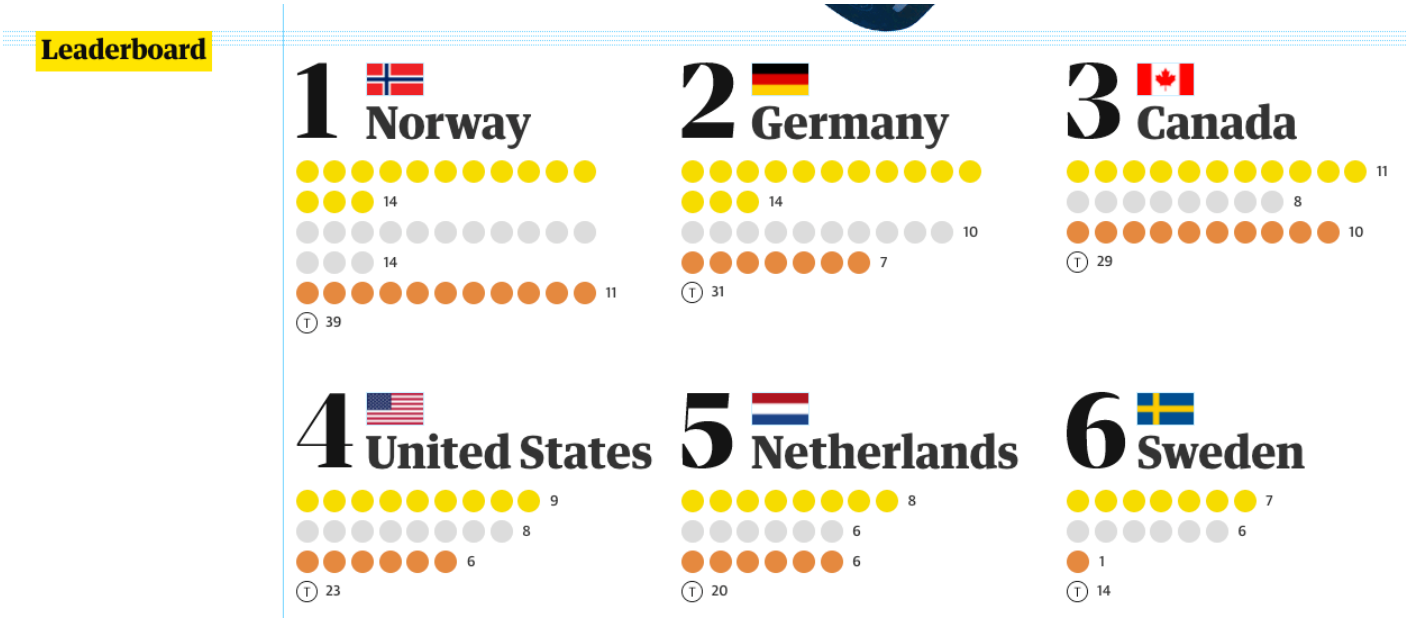
PFTD

- **Review Sorting**
- **An APT MedalTable**
- **Review for Exam 3**

WOTO-1 Review Sorting
http://bit.ly/101s23-0406-1

APT: MedalTable

- http://bit.ly/apt-medal-table



APT: MedalTable

Problem Statement

The Olympic Games will be held, and have been held (and might be being held). Given the results of the olympic disciplines, generate and return the medal table.

The results of the disciplines are given as a `String list` results, where each element is in the format "GGG SSS BBB". GGG, SSS and BBB are the 3-letter country codes (three capital letters from 'A' to 'Z') of the countries winning the gold, silver and bronze medal, respectively.

Specification

```
filename: MedalTable.py

def generate(results):
    """
    return list of strings
    based on data in results, a list of strings
    """

    # you write code here
    return []
```

The medal table is a `String list` with an element for each country appearing in results. Each element has to be in the format "CCO G S B" (quotes for clarity), where G, S and B are the number of gold, silver and bronze medals won by country CCO, e.g. "AUT 1 4 1". The numbers should not have any extra leading zeros.

Sort the elements by the number of gold medals won in decreasing order. If several countries are tied, sort the tied countries by the number of silver medals won in decreasing order. If some countries are still tied, sort the tied countries by the number of bronze medals won in decreasing order. If a tie still remains, sort the tied countries by their 3-letter code in ascending alphabetical order.

1. `["ITA JPN AUS", "KOR TPE UKR", "KOR KOR GBR", "KOR CHN TPE"]`

```
Returns:
[ "KOR 3 1 0",  "ITA 1 0 0",  "TPE 0 1 1",  "CHN 0 1 0",  "JPN 0 1 0",
  "AUS 0 0 1",  "GBR 0 0 1",  "UKR 0 0 1"
]
```

Tracking the Data

- **What do we need to obtain for each country?**
  - What's the data, how do we store it?
  - What's the data, how do we calculate it?

- **Method and code to transform input**
  - What will we store, how do we initialize/update
  - Verifying we've done this properly

Use a dictionary?

- **3 dictionaries**
  - Country to Gold count
  - Country to Silver count
  - Country to Bronze count

Use a dictionary?

- **3 dictionaries**
  - Country to Gold count
  - Country to Silver count
  - Country to Bronze count
- **1 dictionary**
  - Map country to [gld cnt, sil cnt, bro cnt]

Example

- **How would we create a dictionary for:**

[“KOR TPE UKR”, “KOR KOR TPE”, “KOR JPN JPN”]

Example:

- **Process first string: "KOR TPE UKR“**

- **Process second string: "KOR KOR TPE”**

Example: dictionary d

- **Process first string: "KOR TPE UKR“**
  - **d[“KOR”] = [1, 0, 0] # gold**
  - **d[“TPE”] = [0, 1, 0] # silver**
  - **d[“UKR”] = [0, 0, 1] # bronze**
- **Process second string: "KOR KOR TPE”**
  - **d[“KOR”] = [2, 0, 0] # gold**
  - **d[“KOR”] = [2, 1, 0] # silver**
  - **d[“TPE”] = [0, 1, 1] # bronze**

Example: (2)

- **What we have so far:**

- **Process third string: "KOR JPN JPN“**

Example: dictionary d (2)

- **What we have so far:**
  - **d[“KOR”] = [2, 1, 0]**
  - **d[“TPE”] = [0, 1, 1]**
  - **d[“UKR”] = [0, 0, 1]**
- **Process third string: "KOR JPN JPN“**
  - **d[“KOR”] = [3, 1, 0] # gold**
  - **d[“JPN”] = [0, 1, 0] # silver**
  - **d[“JPN”] = [0, 1, 1] # bronze**

Sorting the Data

- **Write a helper function to build the dictionary**
  - d = builddict(results)
  - Where results is string of countries for each event
- **Use dictionary to get list of tuples**

```
[('JPN', [0, 1, 1]), ('KOR', [3, 1, 0]),
('TPE', [0, 1, 1]), ('UKR', [0, 0, 1])]
```

- **Then do passes to sort the data**
  - Will discuss sorting the data in lab

WOTO-2 Building Dictionary
http://bit.ly/101s23-0406-2

Some of the code

```
6   def builddict(data):
7       d = {}
8       for item in data:
9           [gld, sil, bro] = item.split()
10
11
12
```

Use three variables for the three countries

Some of the code

```
6   def builddict(data):
7       d = {}
8       for item in data:
9           [gld, sil, bro] = item.split()
10          if gld not in d:
11              d[gld] = [0, 0, 0]
12
```

If country not in, set to [0, 0, 0] since has no medals counted yet

Some of the code

```
6   def builddict(data):
7       d = {}
8       for item in data:
9           [gld, sil, bro] = item.split()
10          if gld not in d:
11              d[gld] = [0, 0, 0]
12          d[gld][0] += 1
```

Update appropriate index, [0] is the gold count

Review for Exam 3
Problem 4 Fall 2014 Old Tests

- **A programming contest between colleges**
- **There are several problems to solve:**
  - Problem A through Problem J
- **Submit a program for a problem – it is correct or not**
- **Submit it again if it is not correct.**
- **Score is total time for problems solved with 20 minute penalty for each wrong submission that was solved eventually!**
- **Winner solves most problems – Tie breaker (lowest score**

Review for Exam 3
Problem 4 Fall 2014 Old Tests

- **Each entry is: 1) school, 2) name of problem, 3) time to solve in minutes, 4) correct or not**

- **Examples:**

['UNC', 'A', '20', 'reject’]

['Duke', 'A', '26', 'correct’]

Review for Exam 3
Problem 4 Fall 2014 Old Tests

- **Each entry is: 1) school, 2) name of problem, 3) time to solve in minutes, 4) correct or not**

- **Examples:**

['UNC', 'A', '20', 'reject']

UNC submitted problem A in 20 minutes - rejected

['Duke', 'A', '26', 'correct']

Duke submitted Problem A in 26 minutes - correct

Problem 4 Fall 2014 Old tests
Just look at Duke's submissions

[…

['Duke', 'A', '26', 'correct'],

['Duke', 'E', '82', 'reject'],

['Duke', 'D', '200', 'correct'],

['Duke', 'E', '210', 'correct'],

Duke score:

Problem 4 Fall 2014 Old tests
Just look at Duke's submissions

```
[…
 ['Duke', 'A', '26', 'correct'],
 ['Duke', 'E', '82', 'reject'],
 ['Duke', 'D', '200', 'correct'],

['Duke', 'E', '210', 'correct'],
```

Duke score:

26

not correct, no points

plus 200 = 226

plus 210 + 20 (penalty) = 456

penalty since second submission

Duke has 456 points

Problem 4 Fall 2014 Old tests data is list of lists of submissions

```
data = [
  ['UNC', 'A', '20', 'reject’],
  ['Duke', 'A', '26', 'correct’],
  ['UNC', 'A', '33', 'reject’],
  ['ECU', 'A', '34', 'correct’],
  ['Elon', 'A', '34', 'correct’],
  ['USC', 'G', '44', 'reject’],
  ['UNC', 'A', '45', 'correct’],
  ['NCSU', 'B', '60', 'reject’],
  ['USC', 'C', '72', 'reject’],
  ['Duke', 'E', '82', 'reject’],
  ['USC', 'C', '90', 'correct’],
  ['UNC', 'B', '98', 'reject’],
  ['NCSU', 'B', '103’,'correct’],
  ['NCSU', 'A', '115', 'correct’],
  ['USC', 'A', '116', 'correct’],
  ['ECU', 'F', '202', 'reject'],
  ['Duke', 'D', '200', 'correct'],
  ['Duke', 'E', '210', 'correct'],
  ['UNC', 'B', '212', 'reject'],
  ['USC', 'G', '220', 'reject'],
  ['NCSU', 'D', '222', 'correct’],
  ['Elon', 'H', '225', 'correct'],
  ['NCSU', 'H', '230', 'reject’] ]
```

Write function listOfSchools(data)

- **returns sorted unique list of schools that submitted a program whether correct or not**
- **From data should return:**

[’Duke’, ’ECU’, ’Elon’, ’NCSU’, ’UNC’, ’USC’].

Write function listOfSchools(data)

- **returns sorted unique list of schools that submitted a program whether correct or not**
- **From data should return:**

['Duke', 'ECU', 'Elon', 'NCSU', 'UNC', 'USC'].

Note: sorted
Unique schools (use sets)
Returns list (must convert set back to list)

Write function listOfSchools(data)

```
def listOfSchools(data):
```

Write function listOfSchools(data)

```
def listOfSchools(data):
    schools = [ ]
    for item in data:
        schools.append(item[0])
    aset = set(schools)
    return sorted(aset)
```

Problem 4 Fall 2014 Old tests data is list of lists of submissions

```
data = [
  ['UNC', 'A', '20', 'reject’],
  ['Duke', 'A', '26', 'correct’],
  ['UNC', 'A', '33', 'reject’],
  ['ECU', 'A', '34', 'correct’],
  ['Elon', 'A', '34', 'correct’],
  ['USC', 'G', '44', 'reject’],
  ['UNC', 'A', '45', 'correct’],
  ['NCSU', 'B', '60', 'reject’],
  ['USC', 'C', '72', 'reject’],
  ['Duke', 'E', '82', 'reject’],
  ['USC', 'C', '90', 'correct’],
  ['UNC', 'B', '98', 'reject’],
  ['NCSU', 'B', '103’,'correct’],
  ['NCSU', 'A', '115', 'correct’],
  ['USC', 'A', '116', 'correct’],
  ['ECU', 'F', '202', 'reject'],
  ['Duke', 'D', '200', 'correct'],
  ['Duke', 'E', '210', 'correct'],
  ['UNC', 'B', '212', 'reject'],
  ['USC', 'G', '220', 'reject'],
  ['NCSU', 'D', '222', 'correct’],
  ['Elon', 'H', '225', 'correct'],
  ['NCSU', 'H', '230', 'reject’] ]
```

Write function problemsAttempted(data)

- **Returns list of problems attempted**
- **Would return list:**
  - [’A’, ’C’, ’B’, ’E’, ’D’,’G’, ’F’, ’H’]
  - Note doesn’t say anything about the order but implies one of each.

Write function problemsAttempted(data)

- **Returns list of problems attempted**
- **Would return list:**
  - [’A’, ’C’, ’B’, ’E’, ’D’,’G’, ’F’, ’H’]
  - Note doesn’t say anything about the order but implies one of each.

- **Need to loop over the lists in data**
  - Collect the names of problems attempted
  - Get the unique ones

Write function problemsAttempted(data)

```
def problemsAttempted(data):
```

Write function problemsAttempted(data)

```
def problemsAttempted(data):
    problems = set([])
    for item in data:
        problems.add(item[1])
    return list(problems)
```

Problem 4 Fall 2014 Old tests data is list of lists of submissions

```
data = [
  ['UNC', 'A', '20', 'reject’],
  ['Duke', 'A', '26', 'correct’],
  ['UNC', 'A', '33', 'reject’],
  ['ECU', 'A', '34', 'correct’],
  ['Elon', 'A', '34', 'correct’],
  ['USC', 'G', '44', 'reject’],
  ['UNC', 'A', '45', 'correct’],
  ['NCSU', 'B', '60', 'reject’],
  ['USC', 'C', '72', 'reject’],
  ['Duke', 'E', '82', 'reject’],
  ['USC', 'C', '90', 'correct’],
  ['UNC', 'B', '98', 'reject’],
  ['NCSU', 'B', '103’,'correct’],
  ['NCSU', 'A', '115', 'correct’],
  ['USC', 'A', '116', 'correct’],
  ['ECU', 'F', '202', 'reject'],
  ['Duke', 'D', '200', 'correct'],
  ['Duke', 'E', '210', 'correct'],
  ['UNC', 'B', '212', 'reject'],
  ['USC', 'G', '220', 'reject'],
  ['NCSU', 'D', '222', 'correct’],
  ['Elon', 'H', '225', 'correct'],
  ['NCSU', 'H', '230', 'reject’] ]
```

WOTO-3 Solving problems
http://bit.ly/101-s23-0406-3

Write function problemsNotAttempted(problems, data)

- **problems is a list of all possible problems**
  - [’A’, ’B’, ‘C’, ‘D’, ‘E’, ‘F’, ‘G’, ‘H’, ‘I’, ’J’]

- **Returns a list of the problems not attempted**

Write function problemsNotAttempted(problems, data)

- **problems is a list of all possible problems**
  - [’A’, ’B’, ‘C’, ‘D’, ‘E’, ‘F’, ‘G’, ‘H’, ‘I’, ’J’]
- **Returns a list of the problems not attempted**
- **We know how to get all the problems attempted!**
  - Call problemsAttempted!
- **Put both lists in sets and set operation!**

Write function problemsNotAttempted(problems, data)

```
def problemsNotAttempted(problems, data):
```

Write function problemsNotAttempted(problems, data)

```
def problemsNotAttempted(problems, data):
    attempted = problemsAttempted(data)
    setProbs = set(problems)
    setAttempted = set(attempted)
    setNotAttempted = setProbs - setAttempted)
    return sorted(setNotAttempted)
```

Problem 4 Fall 2014 Old tests data is list of lists of submissions

```
data = [
  ['UNC', 'A', '20', 'reject’],
  ['Duke', 'A', '26', 'correct’],
  ['UNC', 'A', '33', 'reject’],
  ['ECU', 'A', '34', 'correct’],
  ['Elon', 'A', '34', 'correct’],
  ['USC', 'G', '44', 'reject’],
  ['UNC', 'A', '45', 'correct’],
  ['NCSU', 'B', '60', 'reject’],
  ['USC', 'C', '72', 'reject’],
  ['Duke', 'E', '82', 'reject’],
  ['USC', 'C', '90', 'correct’],
  ['UNC', 'B', '98', 'reject’],
  ['NCSU', 'B', '103’,'correct’],
  ['NCSU', 'A', '115', 'correct’],
  ['USC', 'A', '116', 'correct’],
  ['ECU', 'F', '202', 'reject'],
  ['Duke', 'D', '200', 'correct'],
  ['Duke', 'E', '210', 'correct'],
  ['UNC', 'B', '212', 'reject'],
  ['USC', 'G', '220', 'reject'],
  ['NCSU', 'D', '222', 'correct’],
  ['Elon', 'H', '225', 'correct'],
  ['NCSU', 'H', '230', 'reject’] ]
```

Write function dictProblemstoSchoolsSolved(data)

- **Returns a dictionary of letters for problems mapped to list of schools that solved that problem**
  - ‘B’ mapped to [‘NCSU’]
  - ‘A’ mapped to
    [‘Duke’, ‘ECU’, ‘Elon’, ‘UNC’, ‘NCSU’, ‘USC’]
  - ‘D’ mapped to [‘Duke’, ‘NCSU’]
  - Etc

Write function dictProblemstoSchoolsSolved(data)

- **Returns a dictionary of letters for problems mapped to list of schools that solved that problem**
  - ‘B’ mapped to [‘NCSU’]
  - ‘A’ mapped to
    [‘Duke’, ‘ECU’, ‘Elon’, ‘UNC’, ‘NCSU’, ‘USC’]
  - ‘D’ mapped to [‘Duke’, ‘NCSU’]
  - Etc
- Each letter - create a list and append schools to it

Write function dictProblemstoSchoolsSolved(data)

```
def dictProblemsToSchoolsSolved(data):
    d = {}
```

Write function dictProblemstoSchoolsSolved(data)

```
def dictProblemsToSchoolsSolved(data):
    d = {}
    for item in data:
        if item[3] == 'correct’:
            if item[1] in d: # already in
                d[item[1]].append(item[0])
            else: # not in yet, add
                d[item[1]] = [item[0]]
    return d
```

Problem 4 Fall 2014 Old tests data is list of lists of submissions

```
data = [
  ['UNC', 'A', '20', 'reject’],
  ['Duke', 'A', '26', 'correct’],
  ['UNC', 'A', '33', 'reject’],
  ['ECU', 'A', '34', 'correct’],
  ['Elon', 'A', '34', 'correct’],
  ['USC', 'G', '44', 'reject’],
  ['UNC', 'A', '45', 'correct’],
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  ['NCSU', 'D', '222', 'correct’],
  ['Elon', 'H', '225', 'correct'],
  ['NCSU', 'H', '230', 'reject’] ]
```

Write function dictSchoolsToNumSubmissions(data)

- **Returns a dictionary of schools mapped to the number of submissions they had (rejected or correct)**
  - ‘Duke’ mapped to 4
  - ‘UNC’ mapped to 5
  - Etc

Write function dictSchoolsToNumSubmissions(data)

- **Returns a dictionary of schools mapped to the number of submissions they had (rejected or correct)**
  - 'Duke' mapped to 4
  - 'UNC' mapped to 5
  - Etc
- Counting dictionary!

Write function dictSchoolsToNumSubmissions(data)

```
def dictSchoolsToNumSubmissions(data):
    d = {}
```

Write function dictSchoolsToNumSubmissions(data)

```
def dictSchoolsToNumSubmissions(data):
    d = {}
    for item in data:
        if item[0] in d:
            d[item[0]] += 1
        else:
            d[item[0]] = 1
    return d
```

WOTO-4 Solving problems
http://bit.ly/101s23-0406-4

Problem 4 Fall 2014 Old tests data is list of lists of submissions

```
data = [
  ['UNC', 'A', '20', 'reject’],
  ['Duke', 'A', '26', 'correct’],
  ['UNC', 'A', '33', 'reject’],
  ['ECU', 'A', '34', 'correct’],
  ['Elon', 'A', '34', 'correct’],
  ['USC', 'G', '44', 'reject’],
  ['UNC', 'A', '45', 'correct’],
  ['NCSU', 'B', '60', 'reject’],
  ['USC', 'C', '72', 'reject’],
  ['Duke', 'E', '82', 'reject’],
  ['USC', 'C', '90', 'correct’],
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  ['USC', 'A', '116', 'correct’],
  ['ECU', 'F', '202', 'reject'],
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  ['Duke', 'E', '210', 'correct'],
  ['UNC', 'B', '212', 'reject'],
  ['USC', 'G', '220', 'reject'],
  ['NCSU', 'D', '222', 'correct’],
  ['Elon', 'H', '225', 'correct'],
  ['NCSU', 'H', '230', 'reject’] ]
```

Write function easiestProblem(data)

- **Returns a tuple of two items**
  - The name of the problem that was solved by the most schools
  - A sorted list of the schools that solved that problem
- **If a tie, then pick any one**
- **Returns:**
  - (’A’, [’Duke’, ’ECU’, ’Elon’, ‘NCSU’, ’UNC’, ’USC’])

Write function easiestProblem(data)

- **Need to calculate the problem that was solved the most**
- **Need to find that problem's list of schools in the dictionary we already built**
  - Will need to call that function
- **Can do both as you walk through the dictionary!**

Write function easiestProblem(data)

```
def easiestProblem(data):
```

Write function easiestProblem(data)

```
def easiestProblem(data):
    d = dictProblemsToSchoolsSolved(data)
    maxProb = (‘’,[ ])
    for (key,value) in d.items():
        if len(value) > len(maxProb[1]):
            maxProb = (key, value)
return maxProb
```