CompSci 101
Introduction to Computer Science

December 5, 2017

Prof. Rodger

Announcements

- Regrades Exam 2 – submit by Thursday, Dec 7
- Regrades for Asg 1-5, APT 1-7 by Dec 8
  - Check your grades! RQ too!
- Assign 8 due today, last late day Dec 8!
- APT 8 due Thursday, Dec 7, last late day, Dec 10!
- Assign 9 – due Dec 11, no late after this date
- Final Exam:
  - Sec 01 Thur, Dec 14, 9am, LSRC B101
  - Sec 02 Sat, Dec 16, 2pm, LSRC B101
  - Get accommodations? Fill out for Final Exam

Calculate Your Grade

- From "About" tab on course web page

Labs	5%
Reading Quizzes	5%
Lecture Group work	5%
Apts	12%
Programming Assignments	12%
APT Quizzes	6%
Two Midterm Exams	30%
final exam	25%

More on Grades

- Lecture – ignore the first two weeks (drop/add period), plus drop 4 points
- Reading Quizzes – will drop 30 points
  - Check your grades to make sure they copied over – fill out duke oit help form if they are wrong
- Lab – drop 6 points (each lab is 4 pts)
  - 44 pts total– 38 pts is 100%
  - Lab 11 covers two new topics!

More Announcements

- Be a UTA for CompSci 101
  - Rewarding and Learning Experience
  - Apply: see link in Sakai announcement

- Today:
  - Finish from last time
  - Why are dictionaries so fast?
  - More on Recursion, Regex
  - More on Sorting and analyzing it

Answer Questions
bit.ly/101f17-1205-1

SortByFreqs APT

Sort items by their frequency, break ties alphabetically

```
data = ["apple", "pear", "cherry", "apple", "pear", "apple", "banana"]

Returns: ["apple", "pear", "banana", "cherry" ]
```


Review Recursion and Regex
bit.ly/101f17-1205-2

Dictionary Comprehension

- List comprehension - builds a new list
- Dictionary comprehension - builds a new dictionary

- Format
  d = { key:value for key in somelist if ....}

:

Example: From Exam 2 Sec 01– dict of clubs to list of tuples

```
def dictClubsToMeetings(data):
    d = {}
    for item in data:
        club = item[0]
        person = item[1]
        meetings = int(item[3])
        if club not in d:
            d[club] = []
        d[club].append((person, meetings))
    return d
```

```
def dictClubsToMeetings(data):
    d = {item[0]:[] for item in data}
    for item in data:
        club = item[0]
        person = item[1]
        meetings = int(item[3])
        d[club].append((person, meetings))
    return d
```


Example: From Exam 2 Sec 02– dict of names to list of tuples

```
def dictNamesToMeetings(data):
    d = {}
    for item in data:
        club = item[0]
        person = item[1]
        meetings = int(item[3])
        if person not in d:
            d[person] = []
        d[person].append((club, meetings))
    return d
```

```
def dictNamesToMeetings(data):
    d = {item[1]:[] for item in data}
    for item in data:
        club = item[0]
        person = item[1]
        meetings = int(item[3])
        d[person].append((club, meetings))
    return d
```


Why are dictionaries so fast?

- They use a technique called hashing
- Each key is converted to hopefully a unique storage location address.
- Then each key's value can be found quickly by indexing to that location

- A dictionary may really be a list underneath, its how you use the list….

Simple Example Hashing

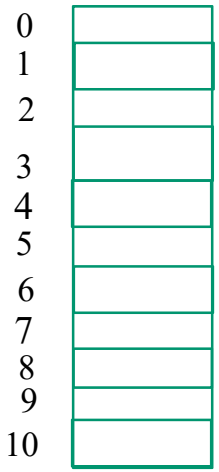
Want a mapping of Soc Sec Num to Names

- Duke's ACM Chapter wants to be able to quickly find out info about its members. Also add, delete and update members. Doesn't need members sorted.

  267-89-5431 John Smith
  703-25-6141 Jack Adams
  319-86-2115 Betty Harris
  476-82-5120 Rose Black
- Hash Table size is 0 to 10
- Possible Hash Function: H(ssn) = last 2 digits mod 11

Have a list of size 11 from 0 to 10

- Insert these into the list
- Insert as (key, value) tuple
  (267-89-5431, John Smith)
  (in example, only showing name)



Hashing, dictionaries
bit.ly/101f17-1205-3

Review:
Sorting with itemgetter

- We can write: import operator
  - Then use key=operator.itemgetter(…)
- We can write: from operator import itemgetter
  - Then use key=itemgetter(…)

Review Example with itemgetter

- Because sort is stable sort first on tie-breaker, then that order is fixed since stable

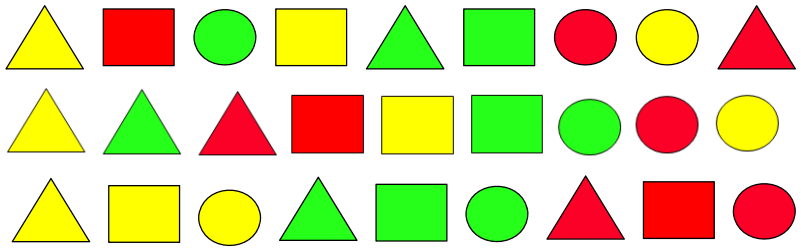
```
a0 = sorted(data,key=operator.itemgetter(0))
a1 = sorted(a0,key=operator.itemgetter(2))
a2 = sorted(a1,key=operator.itemgetter(1))
data
[('f', 2, 0), ('c', 2, 5), ('b', 3, 0),
 ('e', 1, 4), ('a', 2, 0), ('d', 2, 4)]
a0
[('a', 2, 0), ('b', 3, 0), ('c', 2, 5),
 ('d', 2, 4), ('e', 1, 4), ('f', 2, 0)]
```

Two-pass (or more) sorting

```
a0 = sorted(data,key=operator.itemgetter(0))
a1 = sorted(a0,key=operator.itemgetter(2))
a2 = sorted(a1,key=operator.itemgetter(1))
a0
[('a', 2, 0), ('b', 3, 0), ('c', 2, 5),
 ('d', 2, 4), ('e', 1, 4), ('f', 2, 0)]
a1
[('a', 2, 0), ('b', 3, 0), ('f', 2, 0),
 ('d', 2, 4), ('e', 1, 4), ('c', 2, 5)]
a2
[('e', 1, 4), ('a', 2, 0), ('f', 2, 0),
 ('d', 2, 4), ('c', 2, 5), ('b', 3, 0)]
```

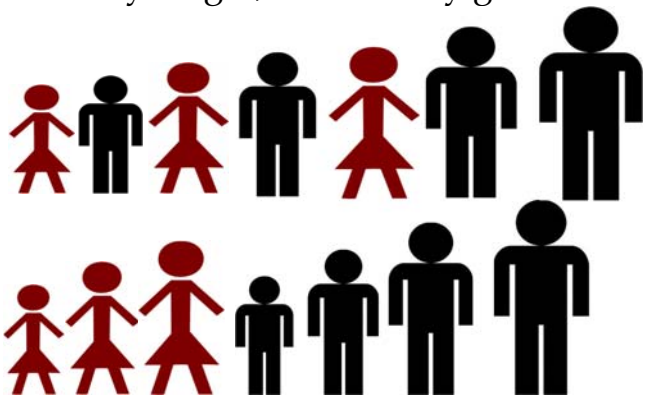

Stable, Stability

- What does the search query 'stable sort' show us?
  - Image search explained
  - First shape, then color: for equal colors?



Stable sorting: respect re-order

- Women before men …
  - First sort by height, then sort by gender



Answer Questions
bit.ly/101f17-1205-4

MedalTable APT

Sort items by their frequency, then sorted in frequencies.

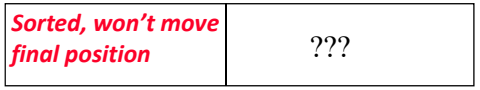
```
["ITA JPN AUS", "KOR TPE UKR", "KOR KOR GBR", "KOR CHN TPE"]

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"
]
```

Sorting

- In python:
  - alist = [8, 5, 2, 3, 1, 6, 4]
  - alist.sort() OR result = sorted(alist)
  - Now alist OR result is [1, 2, 3, 4, 5, 6, 8]
- How does one sort elements in order? How does "sort" work?

Selection Sort

- Sort a list of numbers.
- Idea:
  - Repeat til sorted
    - Find the smallest element in part of list not sorted
    - Put it where it belongs in sorted order.
      - Swap it with the element where it should be
- Sort example



Example: Selection Sort

- Sort the list of numbers using Selection Sort.
- The body of the loop is one pass.
- Show the elements after each pass.
- 9, 5, 4, 1, 3, 6

Selection Sort http://bit.ly/101f17-1205-5

- Sort the list of numbers using Selection Sort.
- The body of the loop is one pass.
- Show the elements after each pass.
- 6, 4, 9, 7, 1, 3

Code for Selection Sort

```
def selectsort(data):
    for i in range(len(data)):
        mindex = minindex(i)
        # swap elements at indexes i and mindex
        tmp = data[i]
        data[i] = data[mindex]
        data[mindex] = tmp
```


Bubble Sort

- Sort a list of numbers.
- Idea:
  - Repeat til sorted
    - Compare all adjacent pairs, one at a time. If out of order then swap them
- Sort example

???	*Sorted, won't move final position*

Bubble Sort
bit.ly/101f17-1205-6

- Sort the list of numbers using BubbleSort.
- The body of the loop is one pass.
- Show the elements after each pass.
- [6, 4, 9, 7, 1, 3]

Bubble Sort – red area sorted