CompSci 101
Introduction to Computer Science

	ABP	BlueEx	McDon	Loop	Panda	Nasher
Sam	0	3	5	0	-3	5
Chris	1	1	0	3	0	-3
Nat	-3	3	3	5	1	-1

Dec 1, 2016

Prof. Rodger

Announcements

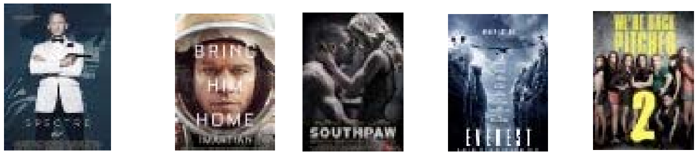
- Reading and RQ due Tuesday
- Assign 8 due Tue., Assign9 due Dec 9
- APT 11 due Dec 9, no penalty til Dec 12!

- Today:
  – Review Recursion
  – Regular Expressions
  – Assignment 8 Recommender

Assignment 9 Due Dec 9
Shhh! No late penalty til Dec 12!

- Write a song, make a video about your experience with CompSci 101

Assignment 8
From User Rating to Recommendations



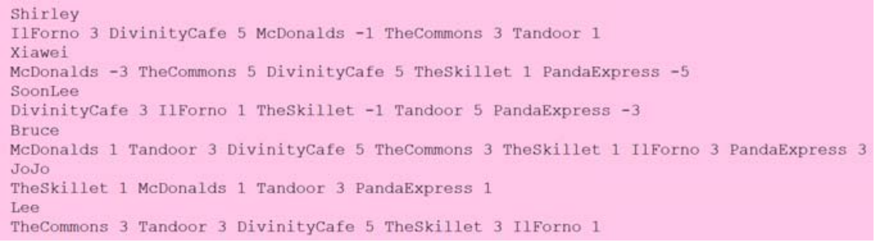
Spectre	Martian	Southpaw	Everest	PitchPerfect 2
3	-3	5	-2	-3
2	2	3	2	3
4	4	-2	1	-1

- **What should I choose to see?**
  - **What does this depend on?**
- **Who is most like me?**
  - **How do we figure this out**

ReadFood modules: Food Format

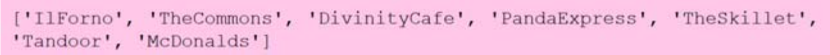
bit.ly/101f16-1201-A

- All Reader modules return a tuple of strings: itemlist and dictratings dictionary

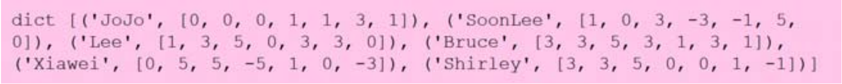


```
Shirley
IlForno 3 DivinityCafe 5 McDonalds -1 TheCommons 3 Tandoor 1
Xiawei
McDonalds -3 TheCommons 5 DivinityCafe 5 TheSkillet 1 PandaExpress -5
SoonLee
DivinityCafe 3 IlForno 1 TheSkillet -1 Tandoor 5 PandaExpress -3
Bruce
McDonalds 1 Tandoor 3 DivinityCafe 5 TheCommons 3 TheSkillet 1 IlForno 3 PandaExpress 3
JoJo
TheSkillet 1 McDonalds 1 Tandoor 3 PandaExpress 1
Lee
TheCommons 3 Tandoor 3 DivinityCafe 5 TheSkillet 3 IlForno 1
```

- Translated to:



```
['IlForno', 'TheCommons', 'DivinityCafe', 'PandaExpress', 'TheSkillet',
'Tandoor', 'McDonalds']
```



```
dict [('JoJo', [0, 0, 0, 1, 1, 3, 1]), ('SoonLee', [1, 0, 3, -3, -1, 5,
0]), ('Lee', [1, 3, 5, 0, 3, 3, 0]), ('Bruce', [3, 3, 5, 3, 1, 3, 1]),
('Xiawei', [0, 5, 5, -5, 1, 0, -3]), ('Shirley', [3, 3, 5, 0, 0, 1, -1])]
```

Data For Recommender

- Users/Raters rate Items
  - We need to know the items
  - We need to know how users rate each item
- Which eatery has highest average rating?
  - Conceptually: average columns in table
  - How is data provided in this assignment?

	ABP	BlueEx	McDon	Loop	Panda	Nasher
Sam	0	3	5	0	-3	5
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Nat	-3	3	3	5	1	-1

Data For Recommender

- itemlist are provided in a list of strings
  - Parsing data provides this list
- dictratings provided in dictionary
  - Key is user ID
  - Value is list of integer ratings

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Data For Recommender

- Given Parameters
  - itemlist: a list of strings
  - dictratings: dictionary of ID to ratings list
- Can you write
  - Average(itemlist, dictratings)

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Drawbacks of Item Averaging

- Are all ratings the same to me?
  - Shouldn't I value ratings of people "near" me as more meaningful than those "far" from me?
- Collaborative Filtering
  - https://en.wikipedia.org/wiki/Collaborative_filtering
  - How do we determine who is "near" me?
- Mathematically: treat ratings as vectors in an N-dimensional space, N = # ratings
  - Informally: assign numbers, higher the number, closer to me

Collaborative Filtering: Recommender

- First determine closeness of all users to me:
  - "Me" is a user-ID, parameter to function
  - Return list of (ID, closeness-#) tuples, sorted
- Use just the ratings of person closest to me
  - Is this a good idea?
  - What about the 10 closest people to me?
- What about weighting ratings
  - Closer to me, more weight given to rating

How do you calculate a similarity?

- Me: [3, 5, -3]
- Joe: [5, 1, -1]
- Sue: [-1, 1, 3]

- Joe to Me

- Sue to Me

How do you calculate a similarity?

- Me: [3, 5, -3]
- Joe: [5, 1, -1]
- Sue: [-1, 1, 3]

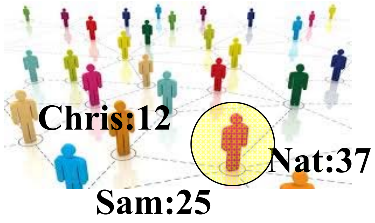
- Joe to Me

  = (3*5 + 5*1 + -3 * -1) = 23
- Sue to Me

  = (3*-1 + 5 * 1 + -3 * 3) = -7

Collaborative Filtering

- For Chris: `12 * [1,1,0,3,0,-3] =`
  - `[12,12,0,36,0,-36]`
- For Sam: `[0,75,125,0,-75,125]`



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Adding lists of numbers

```
[12, 12,   0, 36,  0,-36]
[ 0, 75, 125,  0,-75,125]
[-111,111,111,185,37, -37]
---------------------------
[-99, 198, 236, 221, -38, 52]
```

- Adding columns in lists of numbers
  - Using indexes 0, 1, 2, … sum elements of list
  - `sum([val[i] for val in d.values()])`

Then divide by number of nonzeros

```
[12, 12,   0, 36,  0,-36]
[ 0, 75, 125,  0,-75,125]
[-111,111,111,185,37, -37]
---------------------------
[-99, 198, 236, 221, -38, 52]
  /2    /3    /2    /2    /2    /3
[ -49,   66,   118,  110  -19,    17]
```

Recommend 3rd item

	ABP	BlueEx	McDon	Loop	Panda	Nasher
Sam	0	3	5	0	-3	5
Chris	1	1	0	3	0	-3
Nat	-3	3	3	5	1	-1

Follow 12-step process

- ReadFood first!
  - Read input and save it
  - Get list of restaurants – use that ordering! Set?
  - For each person
    - For each restaurant and its rating
      - Must find location of restaurant in itemlist
      - Then update appropriate counter
  - Print any structure you create to check it

Recursion Review

- Function calls a clone of itself
  - Smaller problem
  - Must be a way out of recursion

Example

```
def Mystery(num):
    if num > 0:
        return 1 + Mystery(num/2)
    else:
        return 2 + num
```

- Mystery(5) is 1 + Mystery(2) = 1 + 4 = 5
- Mystery(2) is 1 + Mystery(1) = 1 + 3 = 4
- Mystery(1) is 1 + Mystery(0) = 1 + 2 = 3
- Mystery(0) is 2

Review: Recursion to find ALL files in a folder

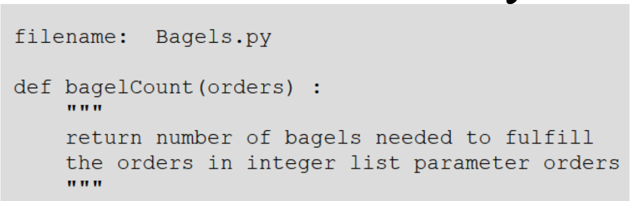
- A folder can have sub folders and files
- A file cannot have sub files

```
def visit(dirname):
  for inner in dirname:
      if isdir(inner):
          visit(inner)
      else:
          print name(inner), size(inner)
```

Is that a directory?

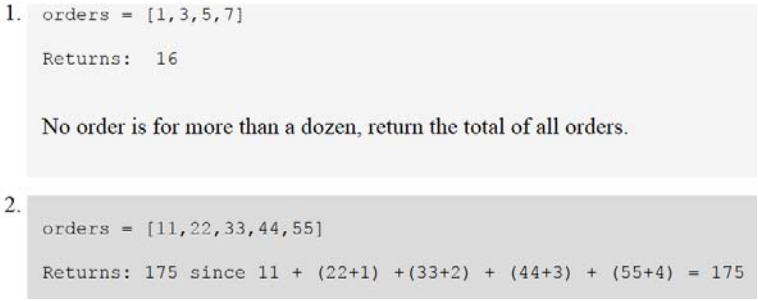
If not a directory, it will be a file

Revisit the APT Bagels Recursively



```
filename:  Bagels.py

def bagelCount(orders) :
    """
    return number of bagels needed to fulfill
    the orders in integer list parameter orders
    """
```



1. `orders = [1,3,5,7]`

   `Returns: 16`

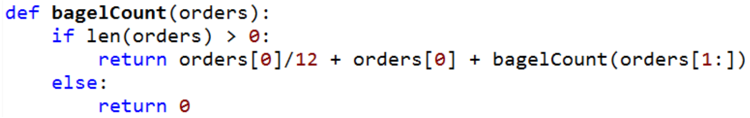
   No order is for more than a dozen, return the total of all orders.

2. `orders = [11,22,33,44,55]`

   `Returns: 175 since 11 + (22+1) +(33+2) + (44+3) + (55+4) = 175`

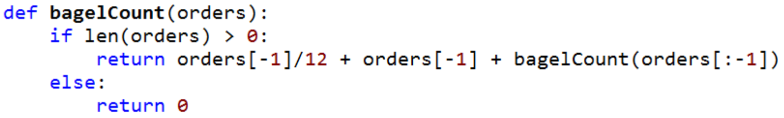
APT Bagels Recursively
bit.ly/101f16-1201-2

A)



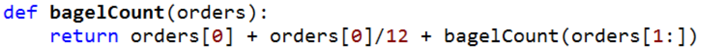
```
def bagelCount(orders):
    if len(orders) > 0:
        return orders[0]/12 + orders[0] + bagelCount(orders[1:])
    else:
        return 0
```

B)



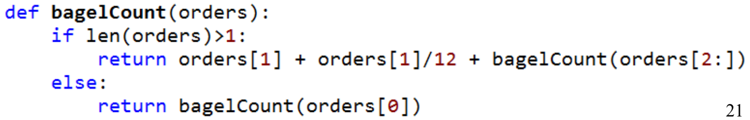
```
def bagelCount(orders):
    if len(orders) > 0:
        return orders[-1]/12 + orders[-1] + bagelCount(orders[:-1])
    else:
        return 0
```

C)



```
def bagelCount(orders):
    return orders[0] + orders[0]/12 + bagelCount(orders[1:])
```

D)

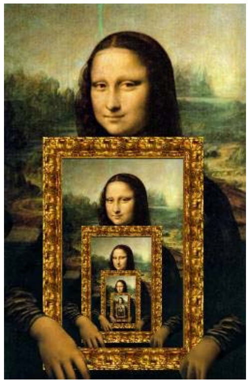


```
def bagelCount(orders):
    if len(orders)>1:
        return orders[1] + orders[1]/12 + bagelCount(orders[2:])
    else:
        return bagelCount(orders[0])
```

Recursion in Pictures

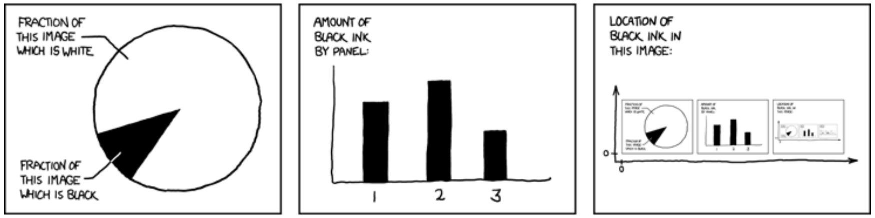
- http://xkcd.com/543/

HAPPY
VALENTINE'S
DAY.
-xkcd



More: Recursion in Pictures

- http://xkcd.com/688/


FRACTION OF THIS IMAGE WHICH IS WHITE
FRACTION OF THIS IMAGE WHICH IS BLACK
AMOUNT OF BLACK INK BY PANEL:
1
2
3
LOCATION OF BLACK INK IN THIS IMAGE:
0
0

What is Computer Science?

- … "it is the study of automating algorithmic processes that scale."
  - https://en.wikipedia.org/wiki/Computer_science
- If you need to find one email address on a webpage, you don't need computer science
  - If you need to scrape every email address, that number in the 10's to 100's, you could use help

How do you solve a problem like …

- How many words end in "aria"?
  - Start with "aria"? Contain "aria"?
  - Why would you care about this?
- Can you find ola@cs.duke.edu, susan.rodger@duke.edu, and andrew.douglas.hilton@gmail.com when searching through a webpage source?
  - What is the format of a "real" email address?

Examples of regex's at work

- What do aria$ and ^aria and aria share?
  - Answers to previous question
- What about the regex .+@.+
  - Turns out that . has special meaning in regex, so does +, so do many characters
- We'll use a module RegexDemo.py to check
  - Uses the re Python library
  - Details won't be tested, regex knowledge will

Regex expressions

- Regex parts combined in powerful ways
  - Each part of a regex "matches" text, can extract matches using programs and regex library
  - ^ is start of word/line, $ is end
- Expressions that match single characters:

`A, a, 9 or …`	Any character matches itself
`.`	Matches any character
`\w`	Matches alphanumeric and _
`\d`	Matches digit
`\s`	Matches whitespace

Regex expressions

- Repeat and combine regex parts
  - * means 0 or more occurrences/repeats
  - + means 1 or more occurrences/repeats
  - ? Means (after * or +) to be *non-greedy*
- Expressions match more than one character

`[a-zAB]`	Brackets create character class
`(regex)`	Tag or group a regex
`\1 or \2`	Matches previously grouped regex
`{1} or {n}`	Repeat regex 1 or n times

Regex examples tried and explained

- Five letter words ending in p? Starts 'd'?
  - `^\w\w\w\wp$` but not `....p$`
- Seven letter words, or seven ending with 'z'
  - Difference between `^\w{7}$` and `^\w{7}`
- Words that start with a consonant:
  - `^[^aeiou]` double meaning of ^

Regex examples tried and explained

- Five letter words ending in p? Starts 'd'?
  - `^\w\w\w\wp$` but not `....p$`
- Seven letter words, or seven ending with 'z'
  - Difference between `^\w{7}$` and `^\w{7}`
- Start and end with the same two letters like sense and metronome, decipher this:
  - `^(\w\w).*\1$`
- Start and end with three letters reversed, like despised and foolproof?

Summary of Regular Expressions

regex	*purpose*	*regex*	*purpose*
`.`	any character	`*`	zero or more of previous regex
`\w`	any alphanumeric character (and _)	`+`	one or more of previous regex
`\s`	any whitespace character	`*? or +?`	non-greedy version of either * or +
`\d`	any digit character	`()`	tag/group a regular expression
`[]`	character class, e.g., [A-Z] or [aeiou]	`\1, \2, ..`	match numbered tagged/grouped regex
`{n}`	n occurrences of preceding regex	`^`	beginning of line/string
`[^...]`	not the characters in the class, e.g., [^aeiou]	`$`	end of line/string

Regex Questions bit.ly/101f16-1201-3

Take Exam questions