CompSci 101
Introduction to Computer Science

<table>
<thead>
<tr>
<th></th>
<th>ABP</th>
<th>BlueEx</th>
<th>McDon</th>
<th>Loop</th>
<th>Panda</th>
<th>Nasher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sam</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td>0</td>
<td>-3</td>
<td>5</td>
</tr>
<tr>
<td>Chris</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>-3</td>
</tr>
<tr>
<td>Nat</td>
<td>-3</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>-1</td>
</tr>
</tbody>
</table>

Dec 1, 2016
Prof. Rodger
Announcements

• Reading and RQ due Tuesday
• Assign 8 due Tue., Assign 9 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

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?

<table>
<thead>
<tr>
<th></th>
<th>ABP</th>
<th>BlueEx</th>
<th>McDon</th>
<th>Loop</th>
<th>Panda</th>
<th>Nasher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sam</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td>0</td>
<td>-3</td>
<td>5</td>
</tr>
<tr>
<td>Chris</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>-3</td>
</tr>
<tr>
<td>Nat</td>
<td>-3</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>-1</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th></th>
<th>ABP</th>
<th>BlueEx</th>
<th>McDon</th>
<th>Loop</th>
<th>Panda</th>
<th>Nasher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sam</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td>0</td>
<td>-3</td>
<td>5</td>
</tr>
<tr>
<td>Chris</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>-3</td>
</tr>
<tr>
<td>Nat</td>
<td>-3</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>-1</td>
</tr>
</tbody>
</table>
Data For Recommender

• Given Parameters
  – itemlist: a list of strings
  – dictratings: dictionary of ID to ratings list

• Can you write
  – Average(itemlist, dictratings)
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
  – How do we determine who is "near" me?

• Mathematically: treat ratings as vectors in an N-dimensional space, \( N = \# \text{ ratings} \)
  – 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
  \[= (3\times5 + 5\times1 + -3 \times -1) = 23\]

• Sue to Me
  \[= (3\times-1 + 5 \times 1 + -3 \times 3) = -7\]
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]
Adding lists of numbers

\[
\begin{align*}
[12, 12, 0, 36, 0, -36] \\
[0, 75, 125, 0, -75, 125] \\
[-111, 111, 111, 185, 37, -37] \\
\hdashline \\
[-99, 198, 236, 221, -38, 52]
\end{align*}
\]

- Adding columns in lists of numbers
  - Using indexes 0, 1, 2, … sum elements of list
  - \texttt{sum([val[i] for val in d.values()])}
Then divide by number of nonzeros

\[
\begin{bmatrix}
12, & 12, & 0, & 36, & 0, & -36 \\
0, & 75, & 125, & 0, & -75, & 125 \\
-111, & 111, & 111, & 185, & 37, & -37 \\
\end{bmatrix}
\]

\[
\begin{bmatrix}
-99, & 198, & 236, & 221, & -38, & 52 \\
\end{bmatrix}
\]

\[
\begin{bmatrix}
-49, & 66, & \mathbf{118}, & 110, & -19, & 17 \\
\end{bmatrix}
\]

<table>
<thead>
<tr>
<th></th>
<th>ABP</th>
<th>BlueEx</th>
<th>McDon</th>
<th>Loop</th>
<th>Panda</th>
<th>Nasher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sam</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td>0</td>
<td>-3</td>
<td>5</td>
</tr>
<tr>
<td>Chris</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>-3</td>
</tr>
<tr>
<td>Nat</td>
<td>-3</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>-1</td>
</tr>
</tbody>
</table>

Recommend 3rd item

compsci 101 fall 2016
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 $1 + \text{Mystery}(2) = 1 + 4 = 5$
• Mystery(2) is $1 + \text{Mystery}(1) = 1 + 3 = 4$
• Mystery(1) is $1 + \text{Mystery}(0) = 1 + 2 = 3$
• 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

```python
def visit(dirname):
    for inner in dirname:
        if isdir(inner):
            visit(inner)
        else:
            print(name(inner), size(inner))
```
Revisit the APT Bagels Recursively

```python
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 $11 + (22+1) + (33+2) + (44+3) + (55+4) = 175$
def bagelCount(orders):
    if len(orders) > 0:
        return orders[0]/12 + orders[0] + bagelCount(orders[1:])
    else:
        return 0

A)

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

B)

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

C)

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

D)
Recursion in Pictures

• http://xkcd.com/543/
More: Recursion in Pictures

- http://xkcd.com/688/
What is Computer Science?

• … "it is the study of automating algorithmic processes that scale."

• 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:

<table>
<thead>
<tr>
<th>Expression</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, a, 9 or ...</td>
<td>Any character matches itself</td>
</tr>
<tr>
<td>.</td>
<td>Matches any character</td>
</tr>
<tr>
<td>\w</td>
<td>Matches alphanumeric and _</td>
</tr>
<tr>
<td>\d</td>
<td>Matches digit</td>
</tr>
<tr>
<td>\s</td>
<td>Matches whitespace</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>[a-zAB]</th>
<th>Brackets create character class</th>
</tr>
</thead>
<tbody>
<tr>
<td>(regex)</td>
<td>Tag or group a regex</td>
</tr>
<tr>
<td>\1 or \2</td>
<td>Matches previously grouped regex</td>
</tr>
<tr>
<td>{1} or {n}</td>
<td>Repeat regex 1 or n times</td>
</tr>
</tbody>
</table>
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

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

compsci 101 fall 2016
Regex Questions
bit.ly/101f16-1201-3
Take Exam questions