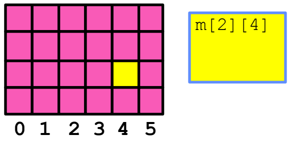
Plan for TBT

- Review APTs
  - Sorting with itemgetter
  - Nested Loops
- Review Recommender Assignment
  - How do you get recommendations
    - Based on Yelp, Amazon, Netflix,
  - What is collaborative filtering
  - How to get assignment done

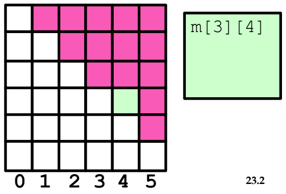
Patterns in some APTs

- PositiveID and FriendScore APT (challenge)
  - Nested loops, look at everything: look at pairs
  - While True: ... break

```
for i in range(4):
   for j in range(6):
      elt = m[i][j]
```



```
for i in range(6):
   for j in range(i+1,6):
      elt = m[i][j]
```



How do we store/use tabular data?

- How can you consider all pairs, e.g., PositiveID?
  - Do suspects 2 and 5 share same characteristics as 5 and 2?
    - Which loop on previous slide captures this?
- What is a matrix?
  - Table of numbers? Entries? Two-Dimensional, m X n
  - Many arithmetic operations available
  - Convenient for representing correlated data
- In Python what is a list of lists?
  - Other languages have arrays, matrixes, ...

Sorting review

- Using operator.itemgetter:
  - Why use reverse=True?
- What does a stable sort get us?
  - Sort by tie-breaking criteria first, then resort

```
sorted([tup,key=operator.itemgetter(1)])
sorted([tup,key=operator.itemgetter(1,0)])
```

Questions

http://bit.ly/101fall15-nov24-1

John Tukey: 1915-2000

- Cooley-Tukey FFT
- Bit: Binary Digit
- Box-plot
- "software" used in print

Far better an approximate answer to the right question, which is often vague, than an exact answer to the wrong question, which can always be made precise.

The combination of some data and an aching desire for an answer does not ensure that a reasonable answer can be extracted from a given body of data.

Math, Engineering, Sociology

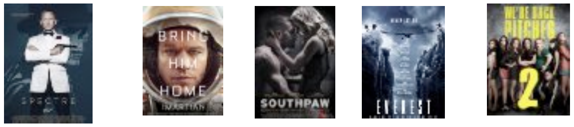
- Netflix prize in 2009
  - Beat the system, win
  - http://nyti.ms/sPvR

NETFLIX

Collaborative Filtering

- How does Amazon know what I want?
  - Lots of customers, lots of purchases
- How does Pandora know music like Kanye's?
  - This isn't really collaborative filtering, more content-based
- How doe Netflix recommend movies?
  - Why did they offer one million $$ to better their method?
- Students at Duke who like Compsci also like …
  - Could this system be built?

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

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
Chris	1	1	0	3	0	-3
Nat	-3	3	3	5	1	-1

Data For Recommender

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

	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

Data For Recommender

- Given Parameters
  - items: a list of strings
  - ratings: dictionary of ID to ratings list
- Can you write
  - getAverage("ABP", items, ratings)

	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

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 closet people to me?
- What about weighting ratings
  - Closer to me, more weight given to rating

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]`

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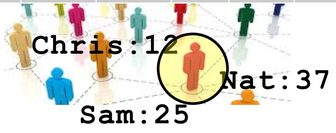
Nat	-3	3	3	5	1	-1



Adding lists of numbers

```
[12, 12,   0, 36,   0,-36]
[ 0, 75, 125,   0,-75,125]
[35, 25, -25, 15,   0, 50]
----------------------------
[47, 112,100, 51,-75,139]
```

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

Processing Data for Recommender

- Data comes in many formats, but all formats must produce:
  - List of items being rated
  - Dictionary of raterID/names to list of ratings
- Read/Parse data files: create list, dictionary
  - Return JSON strings, create list/dict from these

```
[ABP,Blue  Express,Washington  Duke]
```

```
{Chris:  [1,1,0,3,0,-3],
 Nat:  [-3,3,3,5,1,-1]  }
```

JSON format

- Using the json library
  - json.dumps(structure) creates a string st
  - json.loads(st) recreates the structure
- Allows transmission of structured data over the Internet, for example
  - Standard, JavaScript Object Notation (JSON)
  - Python dictionaries are in JSON format!

Reader modules: Food Format

- All Reader modules return a tuple of strings: item list and ratings dictionary
  - Provided!

```
Nasher Cafe
ABP
WaDuke
Loop
Panda
Penn Pavilion
McDonalds
Blue Express
student1001,3,3,-3,5,3,1,0,0
student1002,0,1,5,-3,1,0,5,-3
student1003,5,-3,3,0,3,0,3,-3
student1004,0,1,0,0,1,0,5,0
```

Reader modules: Book Format

- All Reader modules return a tuple of strings: item list and ratings dictionary
  - Alternate form of data, all information on line line of comma-separated values

```
student1001,Nasher,3,ABP,3,WaDuke,-3,Loop,5
student1002,Nasher,0,ABP,1,WaDuke,5,Loop,-3
```

Reader modules: Movie Format

- All Reader modules return a tuple of strings: item list and ratings dictionary
  - Alternate form of data, each rating on one line, lines intermixed, no zeros stored
  - Advantages? Disadvantages?

```
student1001,Nasher,3,
student1002,ABP,1
student1001,ABP,3,
student1002,WaDuke,5
```