Compsci 101
List Comprehensions, Global, Parallel Lists

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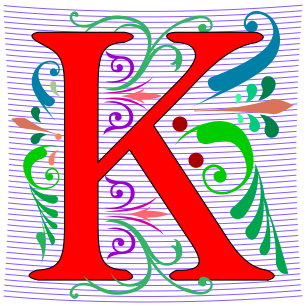
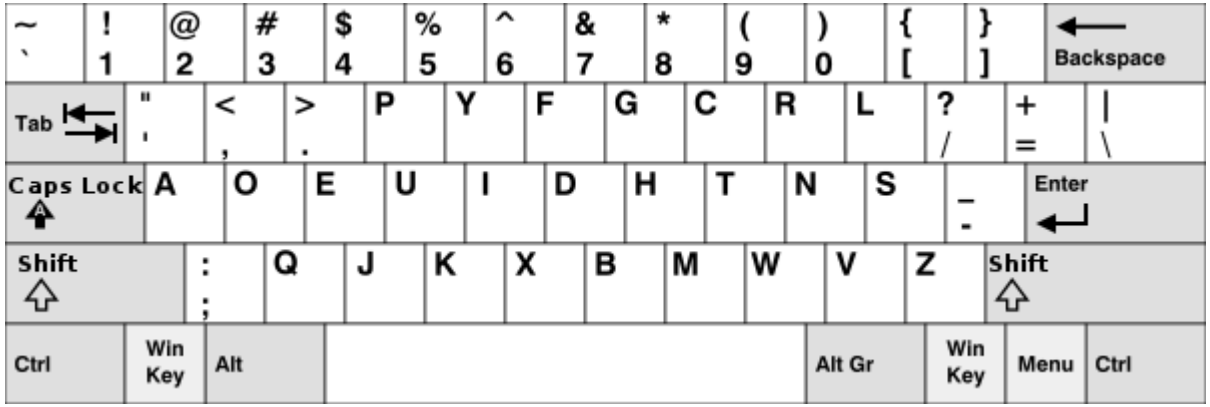
February 15, 2022

`K` is for …



- **Kernel**
  - Core of the OS, Core for Machine Learning
- **Keyboard - QWERTY or DVORAK**
  - DVORAK:



- **Key and (Key,Value) pair**
  - Heart of a dictionary

Tiffany Chen

- Duke BS - IDM CS/Biology
- Stanford PhD Biomedical Informatics (CS and Biomedicine)
- Was Director of Informatics, Cytobank
- Now Group Product Manager at Chan Zuckerberg Inititave

"Part of the advantage of being interdisciplinary is that you can see the big picture when no one else can, and you can communicate to everyone else what that big picture is"

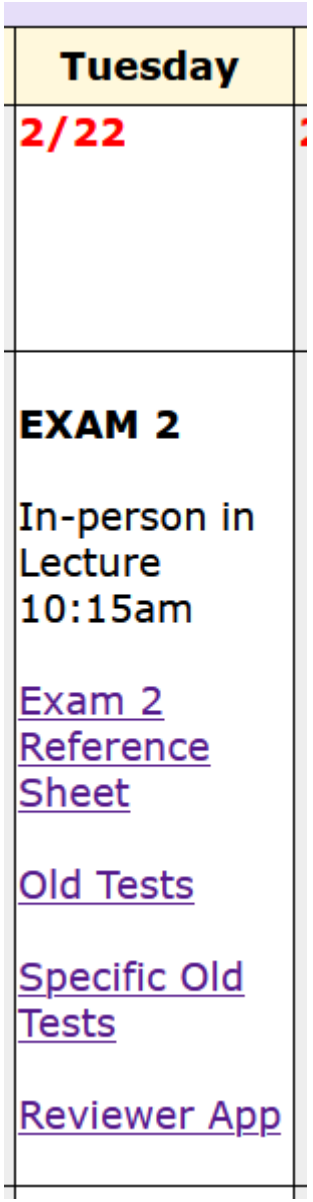
"If you are interested in a PhD, I would suggest doing a summer research experience as an undergraduate, but also an internship in industry. You can see how problems are solved in the real world"

Announcements

- Assign 2 – Turtles due tonight!
- APT-3 due Thursday
- Assign 3-Transform out today, due Tuesday, March 1
  - There is a Sakai quiz on Assign3 – Due Feb 28
- Lab 6 Friday - Do prelab before lab
- Exam 2 – one week – in person
- APT Quiz 1 is Feb 24-Feb 27
  - Take during this time
  - Two parts – each part has two APTs
  - Each part is timed
  - More details Thursday

Exam 2 – in person – Tues, Feb 22

- **Exam is in class on paper – 10:15am**
  - Need pen or pencil
- **See materials under 2/22 date**
  - Exam 2 Reference sheet - part of exam
- **Covers**
  - topics /reading through today
  - APTs through APT3
  - Labs through Lab 5, Lab 6 (Part 1 – list comprehensions)
  - Assignments through Assignment 2
  - Concepts from Assign2, No turtles



PFTD

- Pancakes
- Parallel Lists
- List Comprehensions
- Transform Assignment

Pancakes!

APT Pancake

- How do you solve this (or any) problem?
  - 7 Steps!

- Some APTs are hard problems to solve (step 1-4)
  - Translating to code easy
- Some APTs have easy-to-see algorithms (step 5)
  - Translating to code is hard

APT: Pancakes

Problem Statement

You're a short-order cook in a pancake restaurant, so you need to cook pancakes as fast as possible. You have one pan that can fit `capacity` pancakes at a time. Using this pan you must cook `numCakes` pancakes. Each pancake must be cooked for five minutes on each side, and once a pancake starts cooking on a side it has to cook for five minutes on that side. However, you can take a pancake out of the pan when you're ready to flip it after five minutes and put it back in the pan later to cook it on the other side.

Specification

```
filename: Pancakes.py

def minutesNeeded (numCakes, capacity):
    """
    return integer representing time to cook pancakes
    based on integer parameters as described below
    """
```

Write the method, `minutesNeeded`, that returns the shortest time needed to cook `numCakes` pancakes in a pan that holds `capacity` pancakes at once. See the examples.

Examples

1.
```
numCakes = 0
capacity = 4

Returns: 0
```

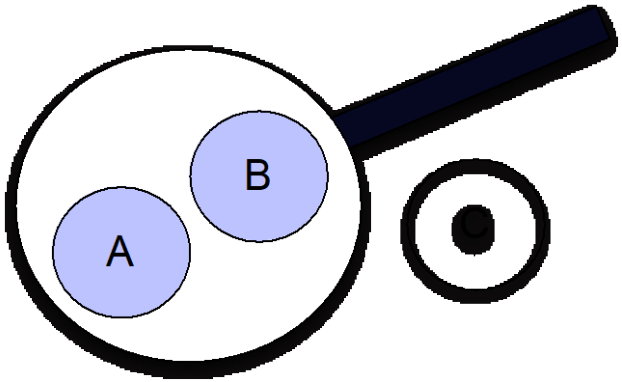
It takes no time to cook 0 pancakes.

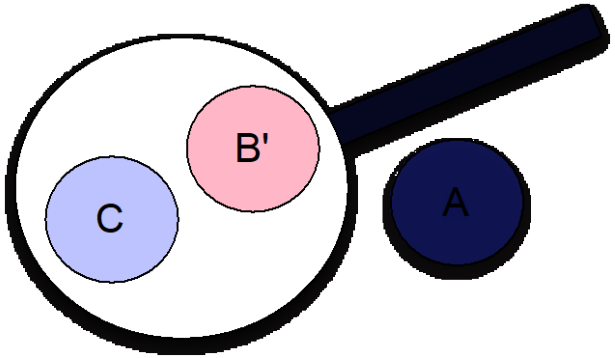
2.
```
numCakes = 2
capacity = 2

Returns: 10
```

You cook both pancakes on one side for five minutes, then flip them over and cook each on the other side for another five minutes.

Step 1: Solve an instance
Three pancakes in a two-cake pan

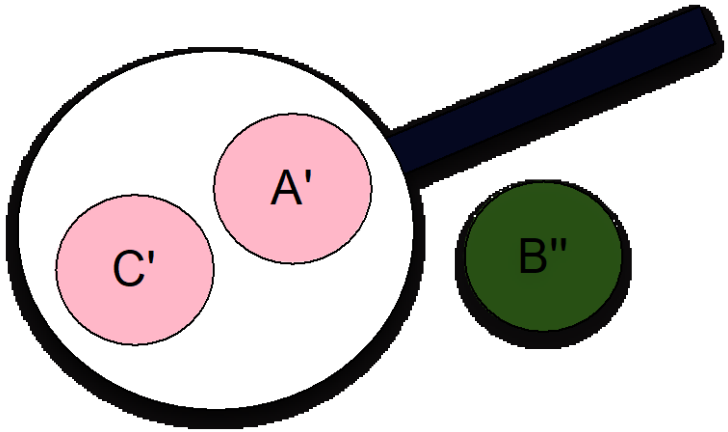
- First 5 minutes
  - 2 half cooking
  - 1 uncooked
- Second 5 minutes
  - 2 half cooking
  - 1 almost cooked





Step 1: Solve an instance
Three pancakes in a two-cake pan

- Third 5 minutes
  - 1 done
  - 2 almost cooked
- How many minutes to cook all three pancakes?



Step 1: Solve an instance

- **What kind of instances? Simple cases that are quickly solved**
  - What are these in Pancake problem?

- **Don't solve for N, solve for 5 (generalize is step 3)**
  - What do when there are two parameters?
    - Fix one, vary the other one
  - Helps identify cases

WOTO-1 Pancakes
http://bit.ly/101s22-0215-1

Pancake flipping Video

How to teach pancake Flipping

- http://www.youtube.com/watch?v=W_gxLKSsSIE
  - For longer, more complex robotic tasks
    - http://www.youtube.com/watch?v=4usoE981e7I

Problem

- Given a file of words, which word occurs the most

- For each word count how many times it occurs
- Determine which word has the highest count

Parallel Lists

- We will use parallel lists to track data
  - Each word is stored in a list named **`words`**
  - Word's count is stored in a list named **`counts`**
  - # occurrences of **`words[k]`** is in **`counts[k]`**

```
["apple", "fox", "vacuum", "lime"]
[   5,      2,       25,      15  ]
```

words

counts

Parallel Lists

- We will use parallel lists to track data
  - Each word is stored in a list named **`words`**
  - Word's count is stored in a list named **`counts`**
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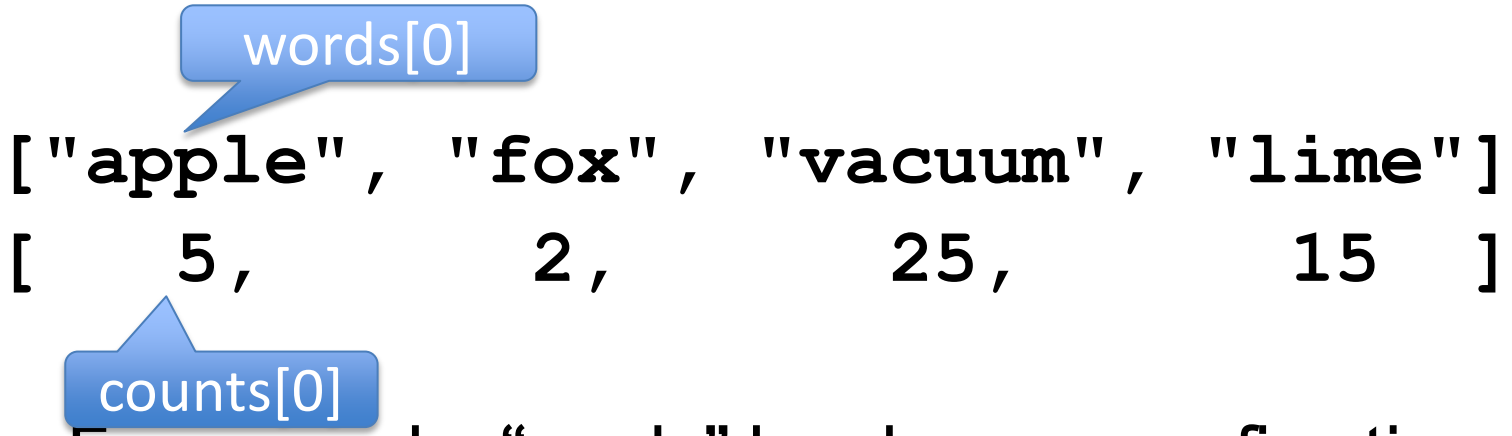

- For example: "apple" has been seen five times

Parallel Lists

- We will use parallel lists to track data
  - Each word is stored in a list named **`words`**
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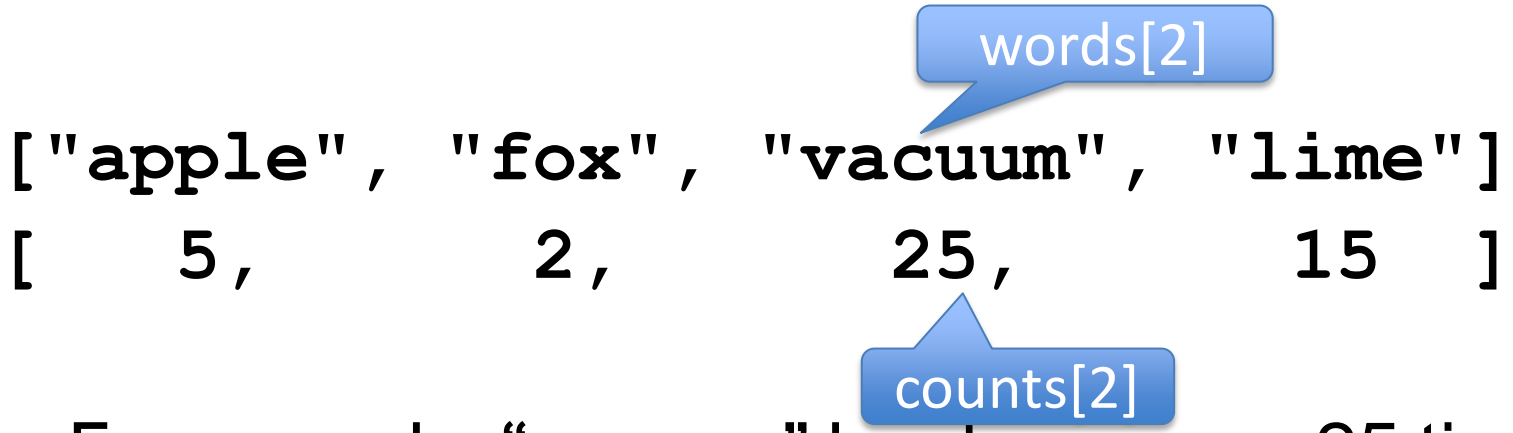


- For example: "vacuum" has been seen 25 times

Parallel Lists

- We will use parallel lists to track data
  - Each word is stored in a list named **`words`**
  - Word's count is stored in a list named **`counts`**
  - # occurrences of **`words[k]`** is in **`counts[k]`**

```
["apple", "fox", "vacuum", "lime"]
[   5,      2,       25,      15  ]
```

- What happens when we read a word?

Read word "vacuum"?

Parallel Lists

- We will use parallel lists to track data
  - Each word is stored in a list named **`words`**
  - Word's count is stored in a list named **`counts`**
  - # occurrences of **`words[k]`** is in **`counts[k]`**

```
["apple", "fox", "vacuum", "lime"]
[   5,      2,       26,      15  ]
```

- What happens when we read a word?

Read word "cat"?

Calculate word most often in file

```
6   def wordOccursTheMost(fname):
7       f = open(fname)
8       words = []
9       counts = []
10      for line in f:
11          line = line.strip()  #remove newline
12          data = line.split()
13          for word in data:
14              if word not in words:
15                  words.append(word)
16                  counts.append(1)
17              else: # update word
18                  pos = words.index(word)
19                  counts[pos] += 1
20      f.close()
```

WOTO-2 Word Most Often
http://bit.ly/101s22-0215-2

List Comprehension Accumulator in one line

```
def onlyPos(nums):
    ret = []
    for n in nums:
        if n > 0:
            ret.append(n)
    return ret

print(onlyPos([1,2,3,-1,-2,-3]))
```

```
return [n for n in nums if n > 0]
```

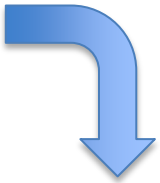
- List Comprehension
  - We will use a complete, but minimal version of list comprehensions, much more is possible

List Comprehension Syntax

```
ret = []
for V in LIST:
    ret.append(V_EXP)
```

```
ret = [V_EXP for V in LIST]
```

```
ret = []
for V in LIST:
    if BOOL_EXP:
        ret.append(V_EXP)
```



```
ret = [V_EXP for V in LIST if BOOL_EXP]
```

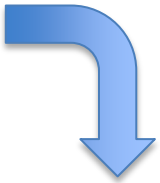
- **V** is any variable: all list elements in order
- **V_EXP** is any expression, often use **V**

List Comprehension Syntax

```
ret = []
for V in LIST:
    ret.append(V_EXP)
```

```
ret = [V_EXP for V in LIST]
```

```
ret = []
for V in LIST:
    if BOOL_EXP:
        ret.append(V_EXP)
```



```
ret = [V_EXP for V in LIST if BOOL_EXP]
```

- **`if`** part optional - **`BOOL_EXP`** is a Boolean expression usually using **`V`**

List Comprehension Examples

```
print( [n*2 for n in range(5)] )
```

```
print( [n for n in range(10) if n % 2 == 1] )
```

List Comprehension Examples

```
print( [n/2 for n in range(10) if n % 2 == 0] )
```

```
lst = [‘banana’, ‘pineapple’, ‘apple’]
print( [c for c in lst if ‘n’ in c] )
```

WOTO-3 List Comprehension Examples
http://bit.ly/101s22-0215-3

Assignment 3: Transform

- **Reading and writing files**
  - We've seen how to read, writing is similar
  - Open, read, and close
  - Open, write, and close - `.write(…)`

- **Apply a function to every word in a file**
  - Encrypt and decrypt
  - Respect lines, so resulting file has same structure

Encrypting and Decrypting

- We give you:
  - Transform.py
  - Vowelizer.py - Removes vowels, then re-vowelize
- You implement
  - Pig Latin
  - Caesar cipher
- Challenge: Shuffleizer

Concepts in Starter Code

- **Global variables**
  - Generally avoided, but very useful
  - Accessible in all module functions

- **FileDialog and tkinter**
  - API and libraries for building UI and UX

- **Docstrings for understanding!**

Look at code

Transform – Remove Vowels

- First line of twain.txt:

```
1    The Notorious Jumping Frog of Calaveras County
```

- Run Transform.py on twain.txt
- Set as:

```
doTransform("-nvw", Vowelizer.encrypt)
#doTransform("-rvw", Vowelizer.decrypt)
```

- Results in new file: twain-nvw.txt
- First line of twain-nvw.txt is:

```
1    Th Ntrs Jmpng Frg f Clvrs Cnty
```

Transform – Get vowels back?

- First line of twain-nvw.txt:

```
1    Th Ntrs Jmpng Frg f Clvrs Cnty
```

- Run Transform.py on twain-nvw.txt
- Set as:

```
#doTransform("-nvw", Vowelizer.encrypt)
doTransform("-rvw", Vowelizer.decrypt)
```

- Results in new file: twain-nvw-rvw.txt
- First line of twain-nvw-rvw.txt is:

```
1    oath antares jumping fargo fe cleavers county
```

Transform – Vowels summary

- First line in twain.txt

```
1    The Notorious Jumping Frog of Calaveras County
```

- After removing vowels – “encrypt”

```
1    Th Ntrs Jmpng Frg f Clvrs Cnty
```

- After trying to re-vowelize – “decrypt”

```
1    oath antares jumping fargo fe cleavers county
```