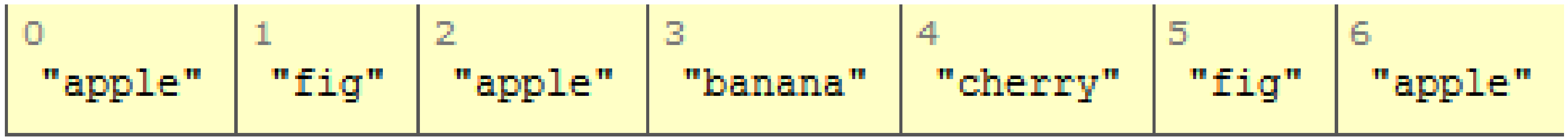
CompSci 101
Introduction to Computer Science

Nov. 7, 2017

Prof. Rodger



0	1	2	3	4	5	6
"apple"	"fig"	"apple"	"banana"	"cherry"	"fig"	"apple"

Announcements

- No RQs until after Exam 2
- Assignment 7 due Thursday
- APT Quiz 2 – must do by Wed midnight
- APT 6 due today, APT 7 out
- Exam 2 is Nov 16
- Lab this week!

- Today:
  – More practice with Dictionaries, finish last time

Announcements

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- Exam 2 is Nov 16
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- Today:
  - More practice with Dictionaries, finish last time

Lab this week! - Odds with poker!

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Denice Denton
Univ. California - Santa Cruz Chancellor, AAAS Fellow, IEEE Fellow.
J
Jennifer Chayes
ACM Fellow, ABI Women of Vision, Microsoft Research Distinguished Scientist.
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Lixia Zhang
Univ. of California - Los Angeles Professor, ACM Fellow, IEEE Fellow.
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Kristina Johnson
CEO of Enduring Hydro, Undersecretary US Dept. of Energy, IEEE Fellow, ABI Women of Vision, SWE Achievement Award.
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Hessa Sultan Al Jaber
Qatar ICT Minister, Chair CS Department - Qatar Univ.
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Barbara Liskov
MIT Professor, Turing Award, ACM Fellow, SWE Achievement Award.
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Frances Allen
IBM Fellow Emerita, Turing Award, Computer History Museum Fellow, IEEE Fel
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Shafrira Goldwasser
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10

Smarty Hangman

- Version of Hangman that is hard to win.
- Program keeps changing secret word to make it hard to guess!
- User never knows!
- Once a letter is chosen and shown in a location, program picks from words that only have that letter in that location
- Program smart to pick from largest group of words available

Smarty Hangman - Dictionary

- Builds a dictionary of categories
- Start with list of words of correct size
- Repeat
  - – User picks a letter
  - – Make dictionary of categories based on letter
  - – New list of words is largest category
    - Category includes already matched letters
    - List shrinks in size each time

Smarty Hangman Example

- Possible scenario after several rounds

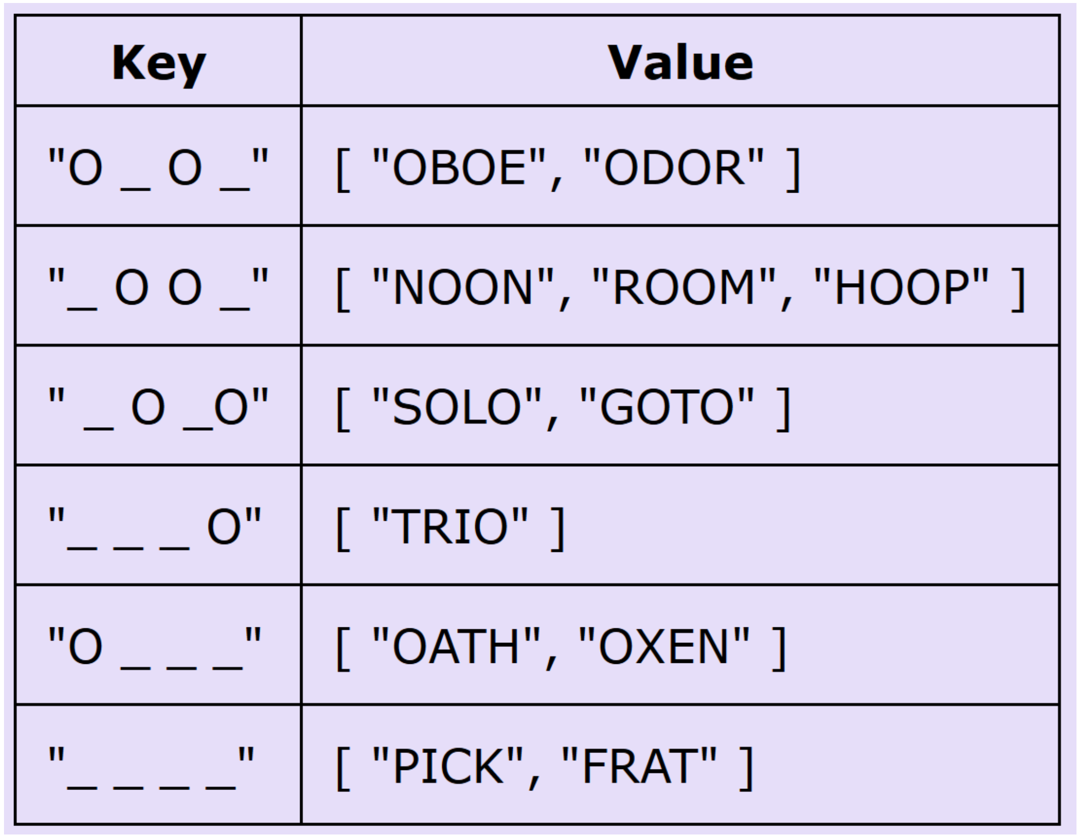
```
(secret word: calls) # words possible 176
You guessed a letter
You have this many guesses left: 4
Letters not guessed: bcdfghjklmnpqrstvwxyz
guessed so far: _ a _ _ _
guess a letter or enter + to guess a word: d
```

- From list of words with **a** the second letter. From that build a dictionary of list of words with **no d** and with **d** in different places:

_a___	147	Choose "no d", most words, 147
add	1	
_a_d_	17	Only 17 words of this type
_ad__	3	
dadd_	1	
da_d_	1	Only 1 word of this type
da___	6	

Everytime guess a letter, build a dictionary based on that letter

- Example: Four letter word, guess o



Key	Value
"O _ O _"	["OBOE", "ODOR"]
"_ O O _"	["NOON", "ROOM", "HOOP"]
" _ O _O"	["SOLO", "GOTO"]
"_ _ _ O"	["TRIO"]
"O _ _ _"	["OATH", "OXEN"]
"_ _ _ _"	["PICK", "FRAT"]

- Key is string, value is list of strings that fit

Keys can’t be lists

- [“O”,”_”,”O”,”_”] need to convert to a string to be the key representing this list:

  “O_O_”

Smarty Hangman

- How to start? How to modify assignment 5?
- What helper function(s) would be useful?
- Helper function to create new list of words, new secret word, new template
  - Pass in current list of words, current template (such as [‘_’, ‘a’, ‘_’, ‘_’, ‘_’]) and the letter guessed
  - Pass back a tuple : new secret word, now list of words, new template

    (x, y, z) = someFunction(a, b, c)

Take another look at the last two problems from last time

Problem 6: Which code is better?

- Problem: Given a string parameter named `phrase` and string named `letter`, the function `findWords` returns a list of all the words from phrase that have letter in them.
- **Example:**
- findWords(*"the circus is coming to town with elephants and clowns", "o")* would return

  [‘coming’, ‘to’, ‘town’, ‘clowns’]

Different questions about these bit.ly/101f17-1107-1

```
def findWords(phrase, letter):
    return [phrase.split()[i] for i in range(len(phrase.split()))
                if letter in phrase.split()[i] ]
```

```
def findWords2(phrase, letter):
    wordlist = phrase.split()
    answer = []
    for i in range(len(wordlist)):
        if letter in wordlist[i]:
            answer.append(wordlist[i])
    return answer
```

How long does phrase.split() take?

“how are you”

How long does phrase.split() take?

“how are you”

words = [‘how’]

words = [‘how’, ‘are’]

words = [‘how’, ‘are’, ‘you’]

For **N chars** in phrase, takes about **N steps**

How long for this solution? Have N chars, M words in phrase

```
def findWords(phrase, letter):
    return [phrase.split()[i] for i in range(len(phrase.split()))
            if letter in phrase.split()[i] ]
```

- range(len(phrase.split()))
- for i in range(…):
  - If letter in phrase.split()[i]
  - phrase.split()[i]

How long for this solution? Have N chars, M words in phrase

```
def findWords(phrase, letter):
    return [phrase.split()[i] for i in range(len(phrase.split()))
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```

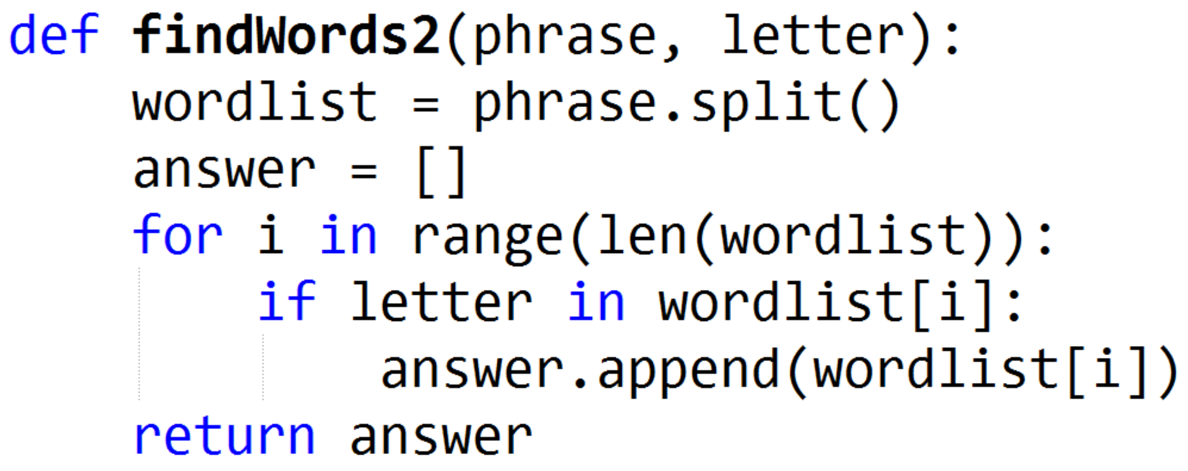
- range(len(phrase.split()))
- for i in range(…):
  - If letter in phrase.split()[i]
  - phrase.split()[i]

- N steps
- For M words
  - N steps
  - N steps

Total: N + M*(2*N)

~ M*N

How long for this solution? Have N chars, M words



```python
def findWords2(phrase, letter):
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```

- phrase.split()
- for each word
  - If letter in word
    - Answer.append

How long for this solution? Have N chars, M words

```
def findWords2(phrase, letter):
    wordlist = phrase.split()
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    for i in range(len(wordlist)):
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    return answer
```

• phrase.split()	• N steps	
• for each word	• For M words	
– If letter in word	– len(word) steps	N steps
• Answer.append	– 1 step	
	• Total: N + N = ~ N	

Problem 7 – Which number appears the most times?

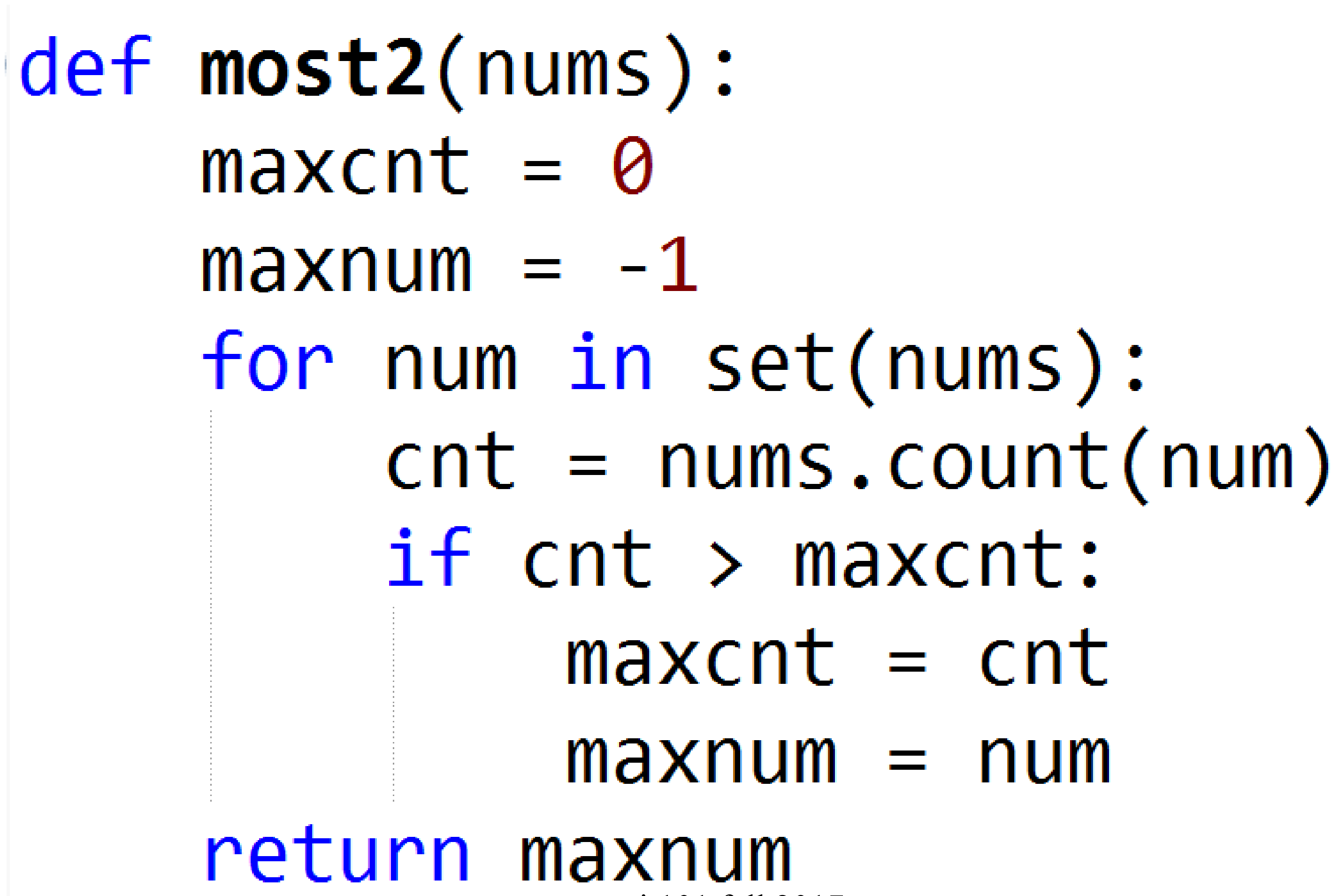
- The function `most` has one parameter `nums`, a list of integers. This function returns the number that appears the most in the list.

- For example, the call most([3,4,2,2,3,2]) returns 2, as 2 appears more than any other number.

How long for Solution 1?

```python
def most(nums):
    maxcnt = 0
    maxnum = -1
    cnts = [0 for n in range(max(nums)+1)]
    for num in nums:
        cnts[num] += 1
        if cnts[num] > maxcnt:
            maxcnt = cnts[num]
            maxnum = num
    return maxnum
```

How long for Solution 2 bit.ly/101f17-1107-2



```python
def most2(nums):
    maxcnt = 0
    maxnum = -1
    for num in set(nums):
        cnt = nums.count(num)
        if cnt > maxcnt:
            maxcnt = cnt
            maxnum = num
    return maxnum
```

How long for Solution 1?
N numbers

```
def most(nums):
    maxcnt = 0
    maxnum = -1
    cnts = [0 for n in range(max(nums)+1)]
    for num in nums:
        cnts[num] += 1
        if cnts[num] > maxcnt:
            maxcnt = cnts[num]
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    return maxnum
```

How long for Solution 1?
N numbers

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def most(nums):
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    for num in nums:
        cnts[num] += 1
        if cnts[num] > maxcnt:
            maxcnt = cnts[num]
            maxnum = num
    return maxnum
```

N steps

Loop N times

1 step

3 steps

Total: N + 4N

~ N

Example: [5, 3, 4, 3, 3, 5]

• [0, 0, 0, 0, 0, 0]	counters from 0 to 5
0 1 2 3 4 5	indexes

Example: [5, 3, 4, 3, 3, 5]

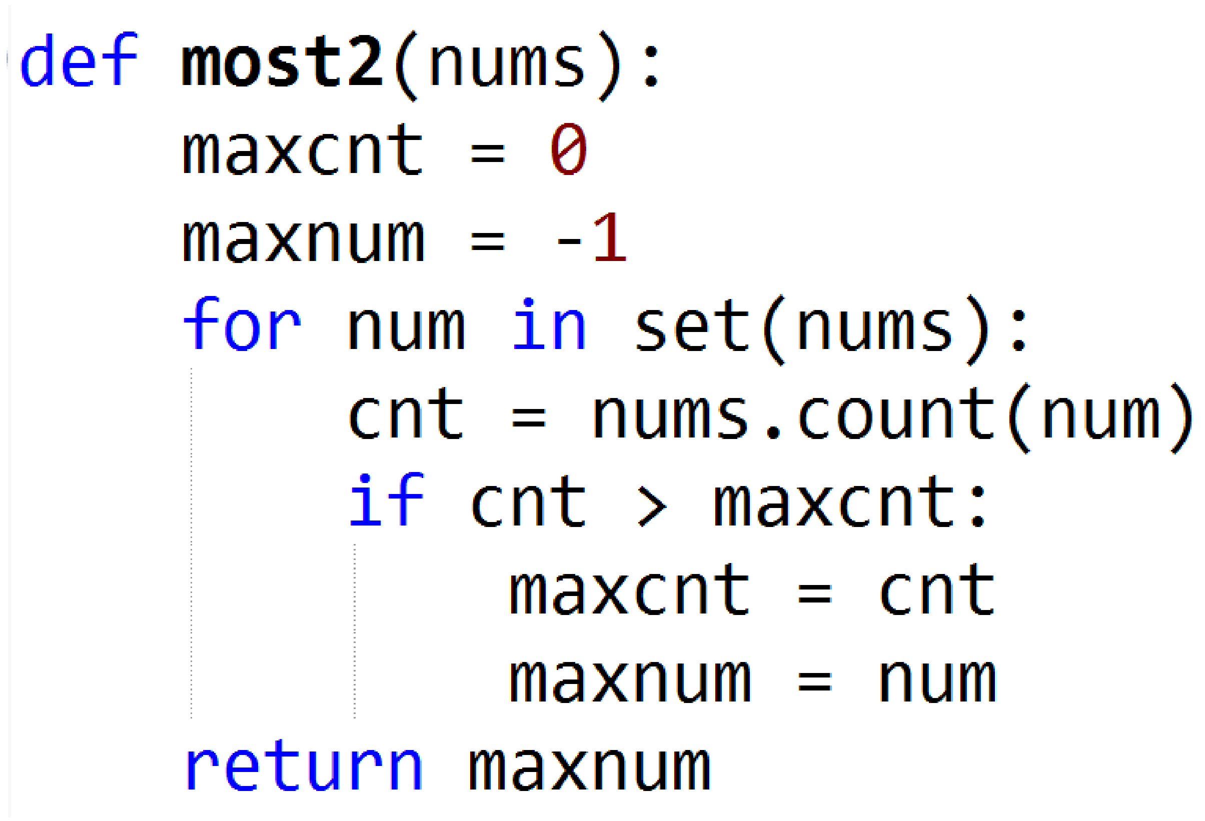
- [0, 0, 0, 0, 0, 0]   counters from 0 to 5

  0 1 2 3 4 5   indexes

- After updating the counts we have:
- [0, 0, 0, 3, 1, 2]   3 3's, 1 4, 2   5's

  0 1 2 3 4 5

How long for Solution 2
N numbers (M unique numbers)



```python
def most2(nums):
    maxcnt = 0
    maxnum = -1
    for num in set(nums):
        cnt = nums.count(num)
        if cnt > maxcnt:
            maxcnt = cnt
            maxnum = num
    return maxnum
```

How long for Solution 2
N numbers (M unique numbers)

```
def most2(nums):
    maxcnt = 0
    maxnum = -1
    for num in set(nums):
        cnt = nums.count(num)
        if cnt > maxcnt:
            maxcnt = cnt
            maxnum = num
    return maxnum
```

Loop M times

N steps

3 steps

Total: M * (N+3)

~ M*N

Python shortcut you can ignore

- The zip function, tuples from two lists
- Does something right if lists have different sizes. Look it up

```
words = ['dog', 'cat', 'fish', 'guava']
counts = [3, 2, 1, 5]
cc = zip(word,counts)

[('dog', 3), ('cat', 2), ('fish', 1), ('guava', 5)]
```

Python functions you CANNOT ignore

- We know how to sort, we call sorted
  - Example: sorting tuples
  - Function sorted returns a new list, original not changed

```
xx = [('dog', 3), ('cat', 2), ('fish', 1),  ('guava', 2)]
yy = sorted(xx)

[('cat', 2), ('dog', 3), ('fish', 1), ('guava', 2)]
```

  - What if sort by numbers instead of words?

Use what you know

- You can re-organize data to sort it as you'd like, list comprehensions are your friend

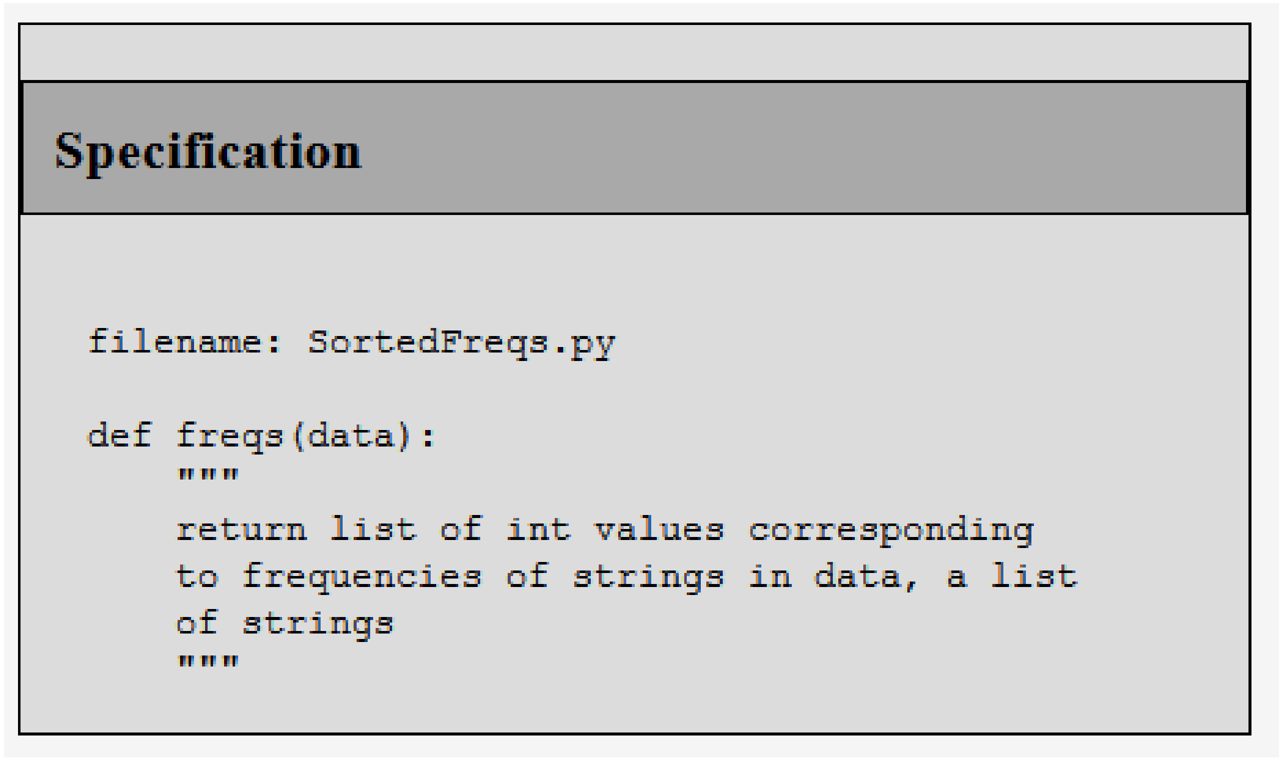
```
xx = [('dog', 3), ('cat', 2), ('fish', 1),  ('guava', 2)]
...
nlist = [(t[1],t[0]) for t in xx]

[(3, 'dog'), (2, 'cat'), (1, 'fish'),  (2, 'guava')]

yy = sorted(nlist)

[(1, 'fish'), (2, 'cat'), (2, 'guava'),  (3, 'dog')]
```

APT – SortedFreqs
bit.ly/101f17-1107-3

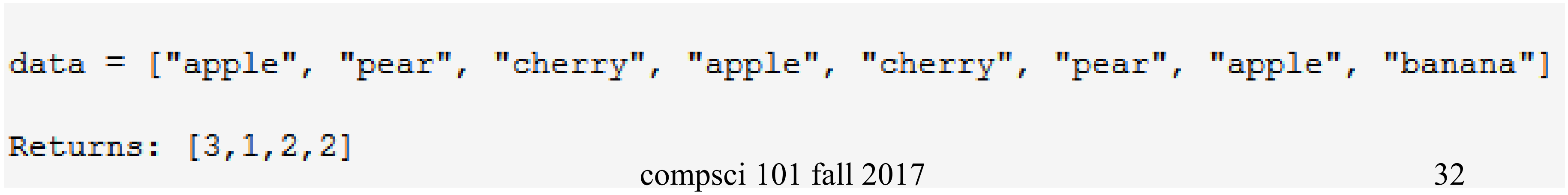


Specification

```
filename: SortedFreqs.py

def freqs(data):
    """
    return list of int values corresponding
    to frequencies of strings in data, a list
    of strings
    """
```

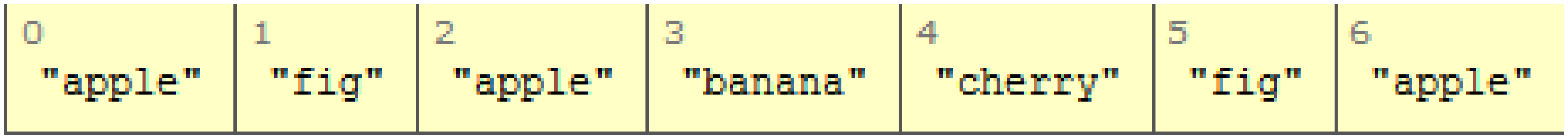
The returned frequencies represent an alphabetic/lexicographic ordering of the unique words, so the first frequency is how many times the alphabetically first word occurs and the last frequency is the number of times the alphabetically last word occurs



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

Returns: [3,1,2,2]
```

Ways to count?
bit.ly/101f17-1107-4



0	1	2	3	4	5	6
"apple"	"fig"	"apple"	"banana"	"cherry"	"fig"	"apple"

- Dictionaries are faster than using lists?
- How fast is list.count(x) for each x?
- For each you are given a list of words…

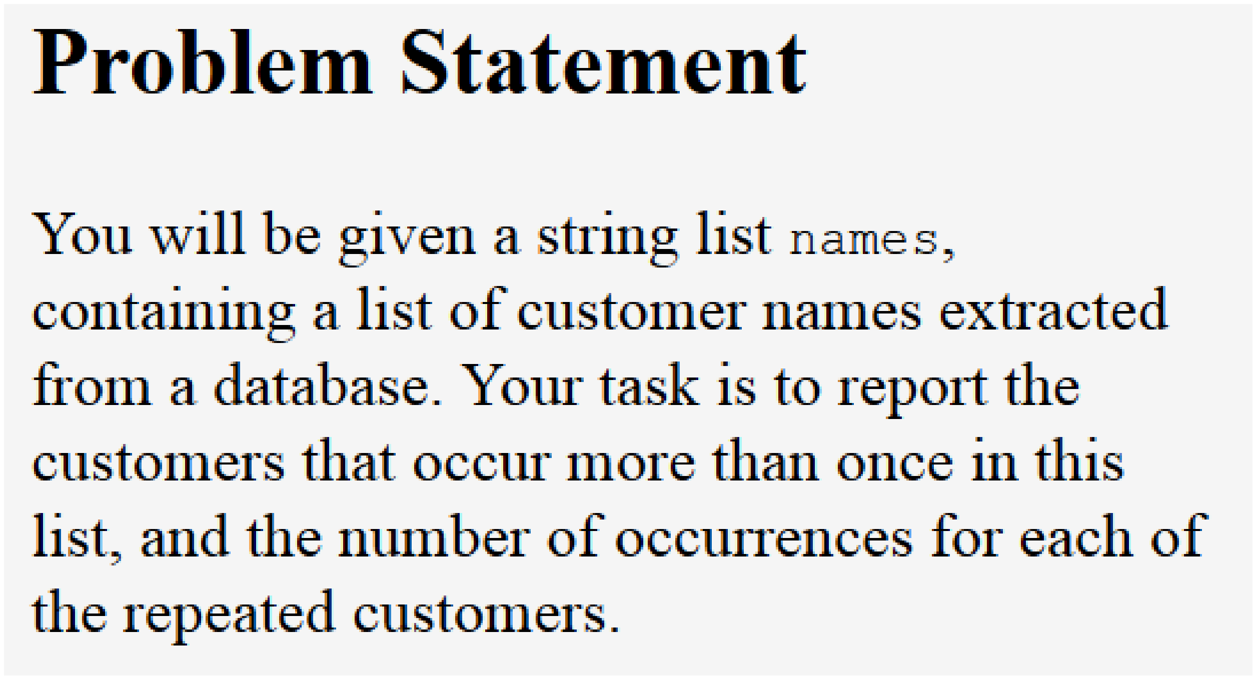
Shafi Goldwasser

- 2012 Turing Award Winner
- RCS professor of computer science at MIT
  - Twice Godel Prize winner
  - Grace Murray Hopper Award
  - National Academy
  - Co-inventor of zero-knowledge proof protocols

  How do you convince someone that you know [a secret] without revealing the knowledge?
- Honesty and Privacy

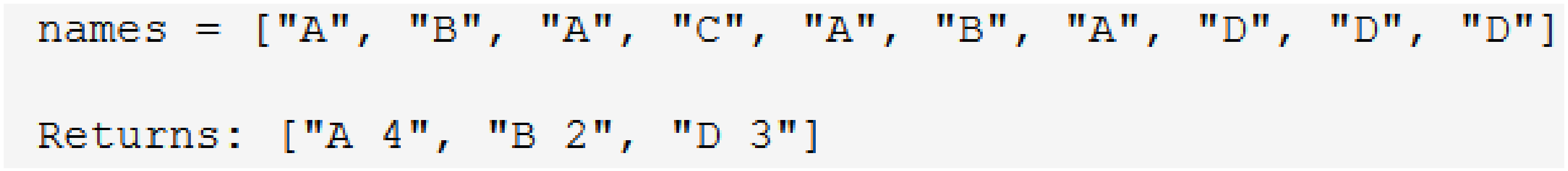
Work on what you like, what feels right, I know of no other way to end up doing creative work

APT Customer Statistics
bit.ly/101f17-1107-5



Problem Statement

You will be given a string list `names`, containing a list of customer names extracted from a database. Your task is to report the customers that occur more than once in this list, and the number of occurrences for each of the repeated customers.



```
names = ["A", "B", "A", "C", "A", "B", "A", "D", "D", "D"]

Returns: ["A 4", "B 2", "D 3"]
```