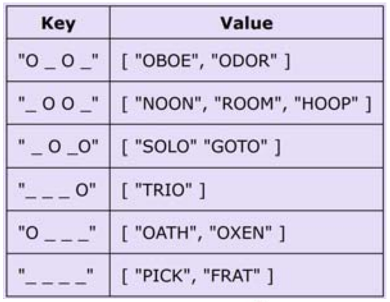
CompSci 101
Introduction to Computer Science



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

Nov 2, 2017

Prof. Rodger

Announcements

- No Reading/RQ until after Exam 2
- Assignment 5 due, Assignment 6 due Nov 8
- APT 6 due Tuesday
- APT Quiz 2 - Sunday-Wednesday

- Today:
  - Debugging
  - Which code is better?

Assignment 7 – Demo
Smarty, Evil, Frustrating Hangman

- Computer changes secret word every time player guesses to make it "hard" to guess
  - Must be consistent with all previous guesses
  - Idea: the more words there are, harder it is
    - Not always true!

- Example of greedy algorithm
  - Locally optimal decision leads to best solution
  - More words to choose from means more likely to be hung

Canonical Greedy Algorithm

- How do you give change with fewest number of coins?
  - Pay $1.00 for something that costs $0.43
  - Pick the largest coin you need, repeat

Greedy not always optimal

- What if you have no nickels?
  - Give $0.31 in change
  - Algorithms exist for this problem too, not greedy!

Smarty Hangman

- When you guess a letter, you're really guessing a category (secret word "salty")

_ _ _ _ _ and user guesses 'a'

  - "gates", "cakes", "false" are all *a the same, in 2cd position*
  - "flats", "aorta", "straw", "spoon" are all *a in different places*
- How can we help ensure player always has many words to distinguish between?

Debugging Output

```
number of misses left: 8
secret so far: _ _ _ _ _ _ _ _
(word is catalyst )
# possible words: 7070
guess a letter: a
a__a___a 1
…
_a______ 587
__aa____ 1
…
__a_____ 498
________ 3475
___a____ 406
…
____a___ 396
# keys = 48
```

```
number of misses left: 7
letters guessed:  a
…
(word is designed )
# possible words: 3475
guess a letter:
```

Debugging Output and Game Play

- Sometimes we want to see debugging output, and sometimes we don't
  - While using microsoft word, don't want to see the programmer's debugging statements
  - Release code and development code
- You'll approximate release/development using a global variable DEBUG
  - Initialize to False, set to True when debugging
  - Ship with DEBUG = False

Look at howto and categorizing words

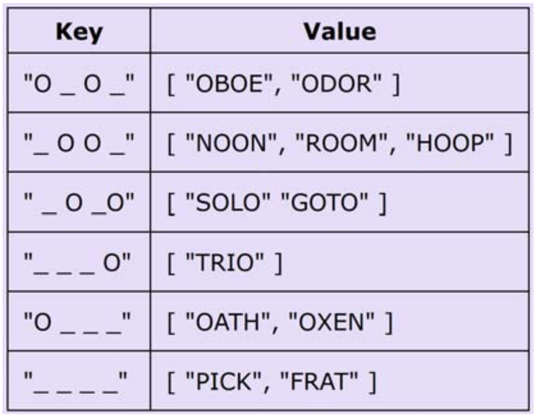
- Play a game with a list of possible words
  - Initially this is all words
  - List of possible words changes after each guess
- Given template "_ _ _ _", list of all words, and a letter, choose a secret word
  - Choose all equivalent secret words, not just one
  - Greedy algorithm, choose largest category

Computing the Categories

- Loop over every string in words, each of which is consistent with guess (template)
  - This is important, also letter *cannot* be in guess
  - Put letter in template according to word
  - _ _ _ a _ t might become _ _ _ a n t
- Build a dictionary of templates with that letter to all words that fit in that template.
- How to create key in dictionary?

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

- Example: Four letter word, guess o



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- 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_”

Bug and Debug

- software 'bug'
- Start small
  - Easier to cope
  - Simplest input?
- Judicious 'print'
  - Debugger too
- Python tutor
  - Visualizes data
  - step through
- Verify the approach being taken, test small, test frequently
  - How do you 'prove' your code works?

9/9

0800 [illegible] started
1000 " stopped - [illegible] ✓ {1.2700 9.037 847 025 / 9.037 846 795 correct
[illegible] ~~[illegible]~~) 4.615925059(-2)
[illegible] 2.130476415
[illegible] 2.130676415
Relays 6-2 in 033 failed special speed test
in relay [illegible] test.
Relays changed
1100 Started Cosine Tape (Sine check)
1525 Started Multi Adder Test.
1545 Relay #70 Panel F
(moth) in relay.
First actual case of bug being found.
[illegible] [illegible] started.
1700 closed down.

Debugging Problems

- Today the main focus is on debugging.
- There are several problems. Trace by hand to see if you can figure out if they are correct or not, or what to do to correct them.

Debug 1 – Does it work?
bit.ly/101f17-1102-1

- The function *sizes* has a parameter named *words* that is a list of strings. This function returns a list of the sizes of each string. For example, sizes(['This', 'is', 'a', 'test']) should return the list [4, 2, 1, 4]

```
def sizes(words):
    nums = [ ]
    for w in words:
        nums = len(w)
    return nums
```

Debug 2 – Does it work?
bit.ly/101f17-1102-2

- The function *buildword* has a parameter *words* that is a list of strings. This function returns a string that is made up of the first character from each word in the list. For example, buildword(['This', 'is', 'a', 'test']) returns 'Tiat'

```
def buildword(words):
    answer = ''
    for w in words:
        answer += w[:1]
        return answer
```

Debug 3 – Does it work?

- The function *middle* has a parameter *names* that is a list of strings, which each string is in the format "firstname:middlename:lastname". This function returns a list of strings of the middlenames.

For example, the call middle("Jo:Mo:Tree", "Mary:Sue:Perez", "Stephen:Lucas:Zhang") returns [‘Mo’, ‘Sue’, ‘Lucas’]

Debug 3 – Does it work? bit.ly/101f17-1102-3

- The function *middle* has a parameter *names* that is a list of strings, which each string is in the format "firstname:middlename:lastname". This function returns a list of strings of the middlenames.

```
def middle(names):
    middlelist = []
    for name in names:
        name.split(":")
        middlelist.append(name[1])
    return middlelist
```

Debug 4 – Does it work? bit.ly/101f17-1102-4

- The function *removeOs* has one string parameter named *names*. This function returns a string equal to names but with all the lowercase o's removed. For example, removeOs(‘Mo Moo Move Over’) returns ‘M M Mve Over’

```
def removeOs(word):
    position = word.find("o")
    while position != -1:
        word = word[:position] +
             word[position+1:]
    return word
```

Problem 5 – Does it work? bit.ly/101f17-1102-5

- The function uniqueDigits has one int parameter number. This function returns the number of unique digits in number. For example, the call uniqueDigits(456655) should return 3.

```
def uniqueDigits(number)
    digits = [ ]
    while number > 0:
        digits.append(number % 10)
        number = number / 10
    return len(digits)
```

Which code is better?

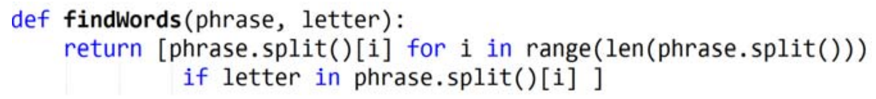
- For the next two problems, we will look at two examples of code that both work in solving the problem, and think about which code is better.

Problem 6: Which code is better?

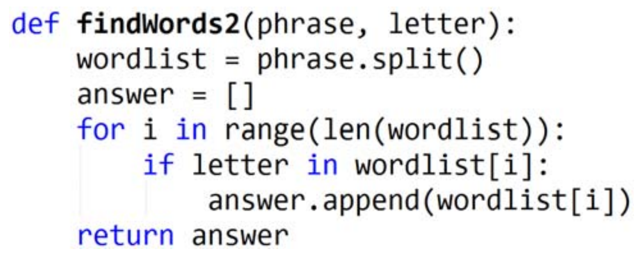
- Problem: Given a string parameter named `phrase` and string named `letter`, the function `findWords` returns a list of all the words from phrase that have letter in them.
- **Example:**
- findWords(*"the circus is coming to town with elephants and clowns", "o")* would return

  [‘coming’, ‘to’, ‘town’, ‘clowns’]

Consider two solutions, which is better? bit.ly/101f17-1102-6



```
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
```

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.

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
```

Compare with Solution 2
bit.ly/101f17-1102-7

```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
```