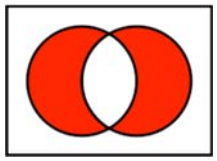
CompSci 101
Introduction to Computer Science



Oct 17, 2017
Prof. Rodger

Exam 1… on Gradescope

- **Use YOURNETID@duke.edu for email**
- Solutions posted – request regrades til Oct 24
  - Ask for regrade on gradescope
- Try working problem you missed first
  - Then look at solution

- Once you think you understand
  - Get blank sheet of paper – try again
- Understand all solutions

Announcements

- Reading and RQ due next time
- Assignment 5 out today
- APT 4 due Thursday, APT 5 out partially
- Lab 6 this week
  - Read APT Anagramfree and Assignment 5 before going to lab!

- Today:
  - list comprehension – shortcut for building a list
  - Sets – new way to organize data

APT MorseLikeCode

1.
```
library = ["O ---",
           "S ..."]
message = "... --- ..."

Returns: "SOS"
```
The example from the problem statement.

2.
```
library = ["O ---"]
message = "... --- ..."

Returns: "?O?"
```
This time we don't have the S, so we replace the three dashes with question marks.

3. library = ["H -", "E .", "L --", "L ..", "O -."] message = "- . -- .. -." Returns: "HELLO"

Solving APT MorseLikeCode

- Put library in a different format?
  - ["H -", "E .", "L -.", "O .."]

MorseLikeCode cont

- Write helper function – for a code, determine the letter for that code using the library
- Send library in new format

def codeToSymbol(library, code)

    return letter

Solving problems – APT MorseLikeCode

- Compare find vs index
  - find with string – returns -1 when not found
  - index with list – CRASHES if not there!
  - You can't say: pos = alist.index("…")
  - Instead: if "…" in alist:
    pos = alist.index("…")

Back to Lists … Build a list from another list

- Given a list of numbers, create a second list of every number squared.

```
nums = [8, 3, 5, 4, 1]
sqnums = []
for v in nums:
    sqnums.append(v*v)
print sqnums
```

[64, 9, 25, 16, 1]

List Comprehension - Short cut way to build a list

- Take advantage of patterns, make a new list based on per element calculations of another list

- Format:

[<expression with variable> for <variable> in <old list>]

- Example:

```
nums = [8, 3, 5, 4, 1]
sqnums =  [v*v  for v in nums]
```


These result in the same list!

```
nums = [8, 3, 5, 4, 1]
```

1)
```
sqnums = []
for v in nums:
    sqnums.append(v*v)
```

2)
```
sqnums =  [v*v  for v in nums]
```


Examples of List Comprehensions bit.ly/101f17-1017-1

```
nums = [4, 3, 8]
x = [v for v in nums]
x = [2 for v in nums]
x = sum([v*2 for v in nums])
x = [v+5 for v in nums][1]
x = [ nums[len(nums)-i -1] for i
       in range(len(nums)) ]
```


Creating a list with just the even numbers

```
nums = [8, 3, 5, 4, 1]
evennums = []
for v in nums:
    if v % 2 == 0:
        evennums.append(v)
print evennums
```

[8, 4]

List Comprehension with Filtering

- Create list and use "if" to filter out elements to the list
- Format:
- [<expression with variable> for <variable> in <old list> if <filter with variable>]

- Example: `nums = [8, 3, 5, 4, 1]`

```
evennums =
    [v for v in nums if v%2==0]
```


More on List Comprehensions www.bit.ly/101f17-1017-2

names = ["Bo", "Moe", "Mary", "Aaron", "Joe"]

- What is the list for the following:

1) [w for w in names if w.endswith("e")]
2) [w for w in names if w.lower()[0] > 'c']
3) [j+1 for j in range(20) if (j%3) == 0]
4) [i*2 for i in [j+1 for j in range(20)
   if (j%3) == 0] if i*i > 19]

More on List Comprehensions bit.ly/101f17-1017-3

- Problem: Given a list of strings, return the longest string. If there are more than one of that length, return the first such one.

fruit = ['kiwi', 'plum', 'orange', 'lemon', 'banana']

Use a list comprehension for this problem

Richard Stallman

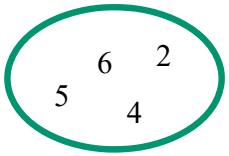
- MacArthur Fellowship (Genious grant)
- ACM Grace Murray Hopper award
- Started GNU – Free Software Foundation (1983)
  - GNU Compiler Collection
  - GNU Emacs

Python Sets

- Set – unordered collection of distinct items
  - Unordered – can look at them one at a time, but cannot count on any order
  - Distinct - one copy of each
- Operations on sets:
  - Modify: add, clear, remove
  - Create a new set: difference(-), intersection(&), union (|), symmetric_difference(^)
  - Boolean: issubset <=, issuperset >=
- Can convert list to set, set to list
  - Great to get rid of duplicates in a list

List vs Set

- List
  - Ordered, 3rd item, can have duplicates
  - Example: `x =[4, 6, 2, 4, 5, 2, 4]`
- Set
  - No duplicates, no ordering
  - Example: `y = set(x)`
- Both
  - Add, remove elements
  - Iterate over all elements



Summary (from wikibooks)

```
set1 = set()                  # A new empty set
set1.add("cat")               # Add a single member
set1.update(["dog", "mouse"]) # Add several members
set1.remove("cat")            # Remove a member - error if not
                                  there

print set1
for item in set1:             # Iteration or "for each element"
  print item
print "Item count:", len(set1) # Length, size, item count
isempty = len(set1) == 0      # Test for emptiness
set1 = set(["cat", "dog"])    # Initialize set from a list
set3 = set1 & set2            # Intersection
set4 = set1 | set2            # Union
set5 = set1 - set3            # Set difference
set6 = set1 ^ set2            # Symmetric difference (elements in
                                  either set but not both)
issubset = set1 <= set2       # Subset test
issuperset = set1 >= set2     # Superset test
set7 = set1.copy()            # A shallow copy (copies the set, not
                                  the elements)
set8.clear()                  # Clear, empty, erase
```


Creating and changing a set

```
colorList = ['red', 'blue', 'red', 'red', 'green']
colorSet = set(colorList)
smallList = list(colorSet)
colorSet.clear()
colorSet.add("yellow")
colorSet.add("red")
colorSet.add("blue")
colorSet.add("yellow")
colorSet.add("purple")
colorSet.remove("yellow")
```

What is the value of smallList and colorSet after this code executes?

Set Operations

```
UScolors = set(['red', 'white', 'blue'])
dukeColors = set(['blue', 'white', 'black'])
print dukeColors.union(UScolors)
print dukeColors | UScolors
print dukeColors.intersection(UScolors)
print dukeColors & UScolors
```


Set Operations

```
UScolors = set(['red', 'white', 'blue'])
dukeColors = set(['blue', 'white', 'black'])
print dukeColors.difference(UScolors)
print dukeColors - UScolors
print UScolors - dukeColors
```


Set Operations

```
UScolors = set(['red', 'white', 'blue'])
dukeColors = set(['blue', 'white', 'black'])
print dukeColors ^ UScolors
print UScolors ^ dukeColors
```


Set Examples
bit.ly/101f17-1017-4

poloClub = set(['Mary', 'Laura', 'Dell'])

rugbyClub = set(['Fred', 'Sue', 'Mary'])

Questions:

print [w for w in poloClub.intersection(rugbyClub)]

print poloClub.intersection(rugbyClub)

print [w for w in poloClub.union(rugbyClub)]

print poloClub.union(rugbyClub)

Set Examples (cont)

```
lista = ['apple', 'pear', 'fig', 'orange', 'strawberry']
listb = ['pear', 'lemon', 'grapefruit', 'orange']
listc = [x for x in lista if x in listb]
listd = list(set(lista)|set(listb))
```


Assignment 5 - Hangman

- Guess a word given the number of letters.
  - Guess a letter
  - see if it is in the word and where.
- Demo
- Will start in lab

APT AnagramFree

words = ["creation","sentence","reaction","sneak","star","rats","snake"]

Returns: 4

"star" "rats" → both have letters: a r t s
"snake" "sneak"
"creation" "reaction"
"sentence"