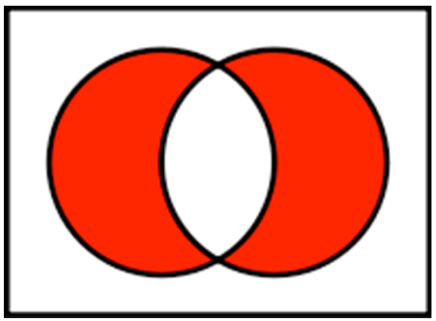
CompSci 101
Introduction to Computer Science



Oct 17, 2017
Prof. Rodger

Enjoy a taste of the NC State Fair!

Fudge

Salt Water Taffy

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

Exam 1 scores

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Exam 1 scores

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Wow

Yes

Ok

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Get Tutor

Exam 1 stats

- Average: 70.9/86
- Median: 74.5/86

- See your email about small group tutoring or private tutors

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 .."]

Solving APT MorseLikeCode

- Put library in a different format?
  - [“H -”, “E .”, “L -.”, “O ..”]
- 1) list of lists?

  lib = [[“H”, “-”], [“E”, “.”], [“L”, “-.”], [“O”,”..”]]
- 2) list of strings?

  lib = [“H”, “-”, “E”, “.”, “L”, “-.”, “O”,”..”]

  code in pos ***i*** corresponds to letter in pos ***i-1***
- 3) 2 parallel lists?
  - letters = [“H”, “E”, “L”, “O”]
  - codes = [“-”, “.”, “-”, “..”]
  - code in pos ***i*** corresponds to letter in pos ***i***

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("…")

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
```

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

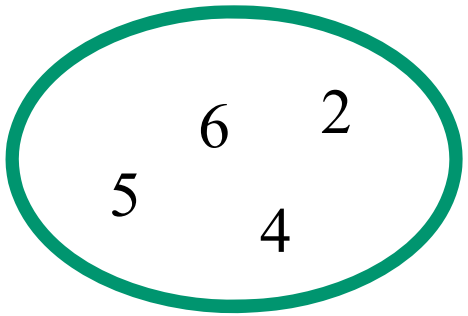
- MacArthur Fellowship (Genious grant)
- ACM Grace Murray Hopper award
- Started GNU – Free Software Foundation (1983)
  - GNU Compiler Collection
  - GNU Emacs

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?

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")
```

smallList = [‘red’, ‘green’, ‘blue’] order?

colorSet = set([“purple”, “red”, “blue”]) order?

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.union(UScolors)
print dukeColors | UScolors
print dukeColors.intersection(UScolors)
print dukeColors & UScolors
```

```
set(['blue', 'black', 'white', 'red'])
set(['blue', 'black', 'white', 'red'])
set(['blue', 'white'])
set(['blue', 'white'])
```

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.difference(UScolors)
print dukeColors - UScolors
print UScolors - dukeColors
```

set(['black'])

set(['black'])

set(['red'])

Set Operations

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

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”