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PYTHON LISTS

Chapter 8 Python for Everybody

www.py4e.com

A Python class for my Mechatronics Engineering @ SVCTE. Last Updated for 2017 – 2018 school year

OVERVIEW & INTRODUCTION

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These slides are an adaption, to better target my SVCTE High School Mechatronics Engineering class, primarily from Dr. Charles R. Severance's Python for Everybody class https://www.py4e.com/ … but from other sources as well. See Appendix A

SEE APPENDIX A, FOR LICENSING & ATTRIBUTION INFORMATION

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Python Lists

Chapter 8

Python for Everybody
www.py4e.com

RESOURCES & MATERIALS NEEDED

- Students should use interactive notebooks to take notes
- Link to PDF presentation for Chapter 8 – Python Lists
- Students should have access to a Raspberry Pi or PC to run and execute Python code

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WHAT YOU WILL KNOW…

- Prior Knowledge
  - How to open and run Python on a Raspberry Pi or other device
  - Familiarity with Python constructs like if, elif, else, while, for loops
  - Debugging skills to break down a python coding challenge

- What You Will Know & Be Able To Do
  - Use your Debugging skill to construct a top down flowchart to describe the python coding challenge
  - Impalement Python code to solve the coding challenge
  - Describe to classmates how you solved the coding challenge

How will you be measured

- Individual Students will submit working code to be graded
- Students teams may present diagram of Top Down design flow chart, and this will be graded
- Students teams may present orally how they solved the coding challenge, and depth of understanding will be graded

NEW WORDS...

- Algorithm
- Data Structure
- Mutable

Programming

- Algorithm
  - A set of rules or steps used to solve a problem

- Data Structure
  - A particular way of organizing data in a computer

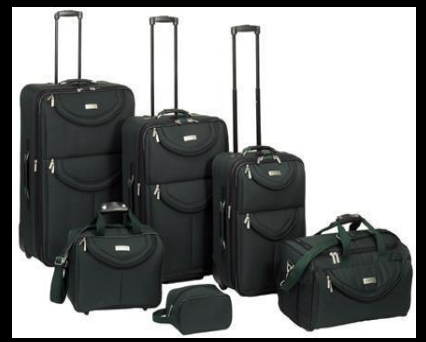
https://en.wikipedia.org/wiki/Algorithm
https://en.wikipedia.org/wiki/Data_structure

What is Not a “Collection”?

Most of our variables have one value in them - when we put a new value in the variable, the old value is overwritten

```
$ python
>>> x = 2
>>> x = 4
>>> print(x)
4
```

A List is a Kind of Collection



- A collection allows us to put many values in a single “variable”
- A collection is nice because we can carry all many values around in one convenient package.

```
friends = [ 'Joseph', 'Glenn', 'Sally' ]

carryon = [ 'socks', 'shirt', 'perfume' ]
```

List Constants

- List constants are surrounded by square brackets and the elements in the list are separated by commas
- A list element can be any Python object - even another list
- A list can be empty

```
>>> print([1, 24, 76])
[1, 24, 76]
>>> print(['red', 'yellow',
'blue'])
['red', 'yellow', 'blue']
>>> print(['red', 24, 98.6])
['red', 24, 98.6]
>>> print([ 1, [5, 6], 7])
[1, [5, 6], 7]
>>> print([])
[]
```

LET'S TRY OUT SOME CODE...

~/myPython

```
STEAM-Clown@STEAM-Clown-PC ~
$ cd myPython

STEAM-Clown@STEAM-Clown-PC ~/myPython
$ python3
Python 3.4.5 (default, Oct 10 2016, 14:41:48)
[GCC 5.4.0] on cygwin
Type "help", "copyright", "credits" or "license" for more
 information.
>>> print([1,2,3,9,8,7])
[1, 2, 3, 9, 8, 7]
>>> print(['zero','one','two','three'])
['zero', 'one', 'two', 'three']
>>> x = ['zero', 1, 'two', 3]
>>> print(x)
['zero', 1, 'two', 3]
>>>
```

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We Already Use Lists!

```
for i in [5, 4, 3, 2, 1] :
    print(i)
print('Blastoff!')
```

```
5
4
3
2
1
Blastoff!
```

Lists and Definite Loops - Best Pals

```
friends = ['Joseph', 'Glenn', 'Sally']
for friend in friends :
    print('Happy New Year:',  friend)
print('Done!')
```

```
Happy New Year: Joseph
Happy New Year: Glenn
Happy New Year: Sally
Done!
```

```
z = ['Joseph', 'Glenn', 'Sally']
for x in z:
    print('Happy New Year:',  x)
print('Done!')
```

Looking Inside Lists

Just like strings, we can get at any single element in a list using an index specified in square brackets

Joseph	Glenn	Sally
0	1	2

```
>>> friends = [ 'Joseph', 'Glenn', 'Sally' ]
>>> print(friends[1])
Glenn
>>>
```

LET'S TRY OUT SOME CODE

~/myPython

```
STEAM-Clown@STEAM-Clown-PC ~/myPython
$ python3
Python 3.4.5 (default, Oct 10 2016, 14:41:48)
[GCC 5.4.0] on cygwin
Type "help", "copyright", "credits" or "license" for more
 information.
>>> z=["Bob","Bob's Brother","Sally","Sue"]
>>> for x in z:
...     print('hello',x)
...
hello Bob
hello Bob's Brother
hello Sally
hello Sue
>>>
```

Lists are Mutable

- Strings are “immutable” - we cannot change the contents of a string - we must make a new string to make any change
- Lists are “mutable” - we can change an element of a list using the index operator

```
>>> fruit = 'Banana'
>>> fruit[0] = 'b'
Traceback
TypeError: 'str' object does not
support item assignment
>>> x = fruit.lower()
>>> print(x)
banana
>>> lotto = [2, 14, 26, 41, 63]
>>> print(lotto)
[2, 14, 26, 41, 63]
>>> lotto[2] = 28
>>> print(lotto)
[2, 14, 28, 41, 63]
```

LET'S TRY OUT SOME CODE

~/myPython

```
>>>
>>>
>>>
>>>
>>>
>>>
>>> fruit='Banana'
>>> print(fruit[2])
n
>>> print(fruit[0])
B
>>> fruit[0] = 'Y'
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: 'str' object does not support item assignment
>>> x=fruit.lower()
>>> print(x)
banana
>>>
```

LET'S TRY OUT SOME CODE

~/myPython

```
STEAM-Clown@STEAM-Clown-PC ~/myPython
$ python3
Python 3.4.5 (default, Oct 10 2016, 14:41:48)
[GCC 5.4.0] on cygwin
Type "help", "copyright", "credits" or "license" for more
 information.
>>> lotto=[17,2,45,21,66]
>>> print(lotto)
[17, 2, 45, 21, 66]
>>> lotto[2]=55
>>> print(lotto)
[17, 2, 55, 21, 66]
>>>
```

Let's try out some code...

How Long is a List?

- The len() function takes a list as a parameter and returns the number of elements in the list
- Actually len() tells us the number of elements of any set or sequence (such as a string...)

```
>>> greet = 'Hello Bob'
>>> print(len(greet))
9
>>> x = [ 1, 2, 'joe', 99]
>>> print(len(x))
4
>>>
```

Using the range Function

- The range function returns a list of numbers that range from zero to one less than the parameter

- We can construct an index loop using for and an integer iterator

```
>>> print(range(4))
[0, 1, 2, 3]
>>> friends = ['Joseph', 'Glenn', 'Sally']
>>> print(len(friends))
3
>>> print(range(len(friends)))
[0, 1, 2]
>>>
```

A Tale of Two Loops...

```
friends = ['Joseph', 'Glenn', 'Sally']

for friend in friends :
    print('Happy New Year:',  friend)

for i in range(len(friends)) :
    friend = friends[i]
    print('Happy New Year:',  friend)
```

```
>>> friends = ['Joseph', 'Glenn', 'Sally']
>>> print(len(friends))
3
>>> print(range(len(friends)))
[0, 1, 2]
>>>
```

Happy New Year: Joseph
Happy New Year: Glenn
Happy New Year: Sally

Concatenating Lists Using +

We can create a new list by adding two existing lists together

```
>>> a = [1, 2, 3]
>>> b = [4, 5, 6]
>>> c = a + b
>>> print(c)
[1, 2, 3, 4, 5, 6]
>>> print(a)
[1, 2, 3]
```

Lists Can Be Sliced Using :

```
>>> t = [9, 41, 12, 3, 74, 15]
>>> t[1:3]
[41,12]
>>> t[:4]
[9, 41, 12, 3]
>>> t[3:]
[3, 74, 15]
>>> t[:]
[9, 41, 12, 3, 74, 15]
```

Remember: Just like in strings, the second number is "up to but not including"

List Methods

```
>>> x = list()
>>> type(x)
<type 'list'>
>>> dir(x)
['append', 'count', 'extend', 'index', 'insert',
'pop', 'remove', 'reverse', 'sort']
>>>
```

http://docs.python.org/tutorial/datastructures.html

Building a List from Scratch

- We can create an empty list and then add elements using the append method
- The list stays in order and new elements are added at the end of the list

```
>>> stuff = list()
>>> stuff.append('book')
>>> stuff.append(99)
>>> print(stuff)
['book', 99]
>>> stuff.append('cookie')
>>> print(stuff)
['book', 99, 'cookie']
```

Is Something in a List?

- Python provides two operators that let you check if an item is in a list
- These are logical operators that return True or False
- They do not modify the list

```
>>> some = [1, 9, 21, 10, 16]
>>> 9 in some
True
>>> 15 in some
False
>>> 20 not in some
True
>>>
```

Lists are in Order

- A list can hold many items and keeps those items in the order until we do something to change the order
- A list can be sorted (i.e., change its order)
- The sort method (unlike in strings) means “sort yourself”

```
>>> friends = [ 'Joseph', 'Glenn', 'Sally' ]
>>> friends.sort()
>>> print(friends)
['Glenn', 'Joseph', 'Sally']
>>> print(friends[1])
Joseph
>>>
```

Built-in Functions and Lists

- There are a number of functions built into Python that take lists as parameters
- Remember the loops we built? These are much simpler.

```
>>> nums = [3, 41, 12, 9, 74, 15]
>>> print(len(nums))
6
>>> print(max(nums))
74
>>> print(min(nums))
3
>>> print(sum(nums))
154
>>> print(sum(nums)/len(nums))
25.6
```

```
total = 0
count = 0
while True :
    inp = input('Enter a number: ')
    if inp == 'done' : break
    value = float(inp)
    total = total + value
    count = count + 1

average = total / count
print('Average:', average)
```

```
Enter a number: 3
Enter a number: 9
Enter a number: 5
Enter a number: done
Average: 5.66666666667
```

```
numlist = list()
while True :
    inp = input('Enter a number: ')
    if inp == 'done' : break
    value = float(inp)
    numlist.append(value)

average = sum(numlist) / len(numlist)
print('Average:', average)
```

Best Friends: Strings and Lists

```
>>> abc = 'With three words'
>>> stuff = abc.split()
>>> print(stuff)
['With', 'three', 'words']
>>> print(len(stuff))
3
>>> print(stuff[0])
With
```

```
>>> print(stuff)
['With', 'three', 'words']
>>> for w in stuff :
...     print(w)
...
With
Three
Words
>>>
```

Split breaks a string into parts and produces a list of strings. We think of these as words. We can access a particular word or loop through all the words.

```
>>> line = 'A lot                    of spaces'
>>> etc = line.split()
>>> print(etc)
['A', 'lot', 'of', 'spaces']
>>>
>>> line = 'first;second;third'
>>> thing = line.split()
>>> print(thing)
['first;second;third']
>>> print(len(thing))
1
>>> thing = line.split(';')
>>> print(thing)
['first', 'second', 'third']
>>> print(len(thing))
3
>>>
```

- When you do not specify a delimiter, multiple spaces are treated like one delimiter
- You can specify what delimiter character to use in the splitting

From stephen.marquard@uct.ac.za Sat Jan 5 09:14:16 2008

```
fhand = open('mbox-short.txt')
for line in fhand:
    line = line.rstrip()
    if not line.startswith('From ') : continue
    words = line.split()
    print(words[2])
```

Sat
Fri
Fri
Fri
...

```
>>> line = 'From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008'
>>> words = line.split()
>>> print(words)
['From', 'stephen.marquard@uct.ac.za', 'Sat', 'Jan', '5', '09:14:16', '2008']
>>>
```

The Double Split Pattern

Sometimes we split a line one way, and then grab one of the pieces of the line and split that piece again

```
From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008
```

```
words = line.split()
email = words[1]
```

The Double Split Pattern

```
From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008

words = line.split()
email = words[1]                    stephen.marquard@uct.ac.za
```

The Double Split Pattern

```
From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008
```

```
words = line.split()
email = words[1]
pieces = email.split('@')
```

```
stephen.marquard@uct.ac.za
['stephen.marquard', 'uct.ac.za']
```

The Double Split Pattern

```
From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008
```

```
words = line.split()
email = words[1]
pieces = email.split('@')
print(pieces[1])
```

```
stephen.marquard@uct.ac.za
['stephen.marquard', 'uct.ac.za']
'uct.ac.za'
```

List Summary

- Concept of a collection
- Lists and definite loops
- Indexing and lookup
- List mutability
- Functions: len, min, max, sum
- Slicing lists
- List methods: append, remove
- Sorting lists
- Splitting strings into lists of words
- Using split to parse strings

Acknowledgements / Contributions

Initial Development: Charles Severance, University of Michigan School of Information

… Insert new Contributors and Translators here

…

ASSESSMENT

- Assessment Type(s):
  - ✓Demonstrations
  - ✓Interviews
  - ✓Journals
  - ✓Observations
  - ✓Labs
  - ✓Projects
  - ✓Portfolios
  - ✓Rubrics
  - ✓Surveys
  - ✓Teacher-Made Test
  - ✓Writing Samples

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REFERENCE SLIDES

Learning Domain, CTE Standards and Stuff Like That…

- Learning Domain

  [ ] cognitive [ ] affective[ ] psychomotor
  - What are some cognitive skills required for success in your pathway?
  - What are some affective skills required for success in your pathway?
  - What are some psychomotor skills required for success in your pathway?
- Time:
  - Lecture
  - Lab
- Standards
  - CTE
  - CCSS
  - NCSS

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APPENDIX

APPENDIX A: LICENSE & ATTRIBUTION

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Appendix B: Attribution for Sources Used