CS35L –

Slide set:	3.2
Slide topics:	Python
Assignment:	3

Python was conceived in the late 1980s by Guido van Rossum at Centrum Wiskunde & Informatica (CWI) in the Netherlands as a successor to the ABC language (itself inspired by SETL), capable of exception handling and interfacing with the Amoeba operating system. Its implementation began in December 1989. Van Rossum's long influence on Python is reflected in the title given to him by the Python community: Benevolent Dictator For Life (BDFL) – a post from which he gave himself permanent vacation on July 12, 2018.

Python

Not just a scripting language

Object-Oriented language

Classes

Member functions

Compiled and interpreted

Python code is compiled to bytecode

Bytecode interpreted by Python interpreter

Not as fast as C but easy to learn, read and use

Very popular at Google and other big companies

Why is it popular?

Uses English keywords frequently where other use different punctuation symbols

Fewer Syntactical Constructions

Automatic Garbage Collection

Easy integration with other programming languages

Different Modes

Interactive:

- Run commands on the python shell without actually writing a script/program.

Script Mode:

- Type a set of commands into a script
- Execute all the commands at once by running the script

Python Variables

- Case sensitive
- Start with _ (underscore) or letters followed by other letters, underscores or digits
- Other special characters are not allowed as part of the variable name
- Certain reserved words may not be used as variable names on their own unless concatenated with other words

Example: Python Variables

Python Script:

```
#!/usr/bin/python
counter = 100    # An integer assignment
miles = 1000.0   # A floating point
name = "John"    # A string
```

Python Lines and Indentation

No braces to indicate blocks of code for class and function definitions or flow control

Blocks of code are denoted by line indentation, which is why it is **strictly enforced**

Number of spaces for indentation may be variable but all the statements within the same block must be equally indented

Hence, *a single space has the ability to change the meaning of the code*

Python Decision Making

```
#!/usr/bin/python
var = 100
if var == 100 :
   print ”Correct”
print "Good bye!"
```

Python List

Common data structure in Python

A python list is like a C array but much more:

- **Dynamic (mutable)**: expands as new items are added
- **Heterogeneous:** can hold objects of different types

How to access elements?

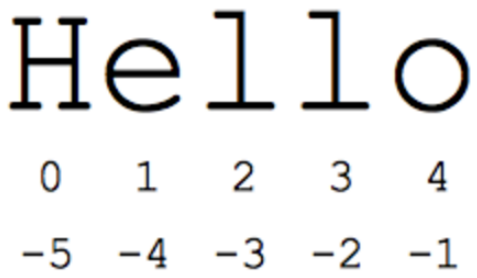
List_name[index]

Example

- >>> t = [123, 3.0, ‘hello!’]
- >>> print t[0]
  - 123
- >>> print t[1]
  - 3.0
- >>> print t[2]
  - hello!

String Slices

The "slice" syntax is a handy way to refer to sub-parts of sequences -- typically strings and lists. The slice s[start:end] is the elements beginning at start and extending up to but not including end. Suppose we have s = "Hello"



- s[1:4] is 'ell' -- chars starting at index 1 and extending up to but not including index 4
- s[1:] is 'ello' -- omitting either index defaults to the start or end of the string
- s[:] is 'Hello' -- omitting both always gives us a copy of the whole thing (this is the pythonic way to copy a sequence like a string or list)
- s[1:100] is 'ello' -- an index that is too big is truncated down to the string length

The standard zero-based index numbers give easy access to chars near the start of the string. As an alternative, Python uses negative numbers to give easy access to the chars at the end of the string: s[-1] is the last char 'o', s[-2] is 'l' the next-to-last char, and so on. Negative index numbers count back from the end of the string:

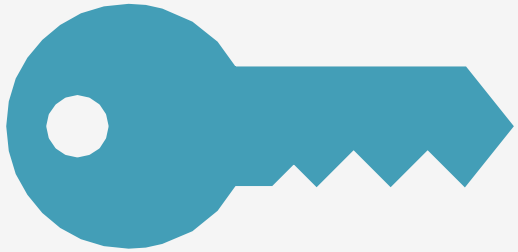
- s[-1] is 'o' -- last char (1st from the end)
- s[-4] is 'e' -- 4th from the end
- s[:-3] is 'He' -- going up to but not including the last 3 chars.
- s[-3:] is 'llo' -- starting with the 3rd char from the end and extending to the end of the string.

Example – Merging Lists

- `>>> list1 = [1, 2, 3, 4]`
- `>>> list2 = [5, 6, 7, 8]`
- `>>> merged_list = list1 + list2`
- `>>> print merged_list`
  - **Output: [1, 2, 3, 4, 5, 6, 7, 8]**

Python Dictionary

- Essentially a hash table
  - Provides key-value (pair) storage capability
- Instantiation:
  - `dict = {}`
  - This creates an EMPTY dictionary
- Keys are unique, values are not!
  - Keys must be immutable (strings, numbers, tuples)



Example

```
dict = {}
dict[‘france’] = “paris”
dict[‘japan’] = “tokyo”
print dict[‘france’]

dict[‘germany’] = “berlin”
if (dict[‘france’] == ”paris”):
     print “Correct!”
else:
     print “Wrong!”

del dict[‘france’]
del dict
```

for loops

```
list1 = [‘Mary’, ‘had’, ‘a’, ‘little’, ‘lamb’]
```

```
for i in list1:
    print i
```

Result:

```
Mary
had
a
little
lamb
```

```
for i in range(len(list1)):
    print i
```

Result:

```
0
1
2
3
4
```

Classes

```
class MyClass:
        """A simple example class"""
        age = 0
        def create(self):
                return “I’m alive!”

obj = MyClass()
print(obj.create())
print(obj.age)
```

Constructors

```
import math

class Complex:
      def __init__(self, realpart, imagpart):
         self.r = realpart
         self.i = imagpart
       def mod(self):
          return math.sqrt(self.r*self.r + self.i*self.i)

carbs = Complex(5.0, 12.0)
print(carbs.mod())
```

Classes – another example

```
class Rectangle:
	def __init__(self, x, y):
		self.l = x
		self.b = y

	def getArea(self):
		return self.l * self.b

	def getPerimeter(self):
		return 2 * (self.l + self.b)

def main():
	rect = Rectangle(3, 4)
	print("Area of Rectangle:", rect.getArea())
	print("Perimeter of Rectangle:", rect.getPerimeter())

main()
```

I/O Basics

The *raw_input([prompt])* function reads one line from standard input and returns it as a string (removing the trailing newline)

```
s = raw_input("Enter your input: ");
print("Received input is : ", s)
```

The *input([prompt])* function is equivalent to raw_input, except that it assumes the input is a valid Python expression and returns the evaluated result to you.

```
str = input("Enter your input: ");
print("Received input is : ", str)
```

Functions

A function is a block of organized, reusable code that is used to perform a single, related action. They provide better modularity for your application and a high degree of code reusing.

Syntax:

```
def function_name( parameters ):

    #code inside the function
```

Functions - examples

Example 1:

```
def printme(new_string): #string is a parameter
      #This prints a string passed into this function
      print new_string
      return
```

Example 2: To print sum of numbers in a list

```
def find_sum(new_list):
      sum=0  #initialize variable*
      for element in new_list:
            sum = sum + element
    return sum #returns the computed sum

result=find_sum([2,3,4,5]) #function call
print(result)
```

Note:

#this is a single-line comment

```this is a multi-line Comment```
```

Python 2 vs Python 3

- Powerful library for parsing command-line options
  - **Argument:**
    - String entered on the command line and passed in to the script
    - Elements of sys.argv[1:] (sys.argv[0] is the name of the program being executed)
  - **Option:**
    - An argument that supplies extra information to customize the execution of a program
  - **Option Argument:**
    - An argument that follows an option and is closely associated with it. It is consumed from the argument list when the option is

Optparse Library - to be replaced by Argparse Library

Python Walk-Through

```
#!/usr/bin/python

import random, sys
from optparse import OptionParser

class randline:
    def __init__(self, filename):
        f = open (filename, 'r')
        self.lines = f.readlines()
        f.close ()

    def chooseline(self):
        return random.choice(self.lines)


def main():
    version_msg = "%prog 2.0"
    usage_msg = """%prog [OPTION]...
FILE Output randomly selected lines
from FILE."""
```

Tells the shell which interpreter to use

Import statements, similar to include statements
Import OptionParser class from optparse module

The beginning of the class statement: randline
The constructor
Creates a file handle
Reads the file into a list of strings called lines
Close the file

The beginning of a function belonging to randline
Randomly select a number between 0 and the size of lines and returns the line corresponding to the randomly selected number

The beginning of main function

version message

usage message

```
parser = OptionParser(version=version_msg,
                      usage=usage_msg)
parser.add_option("-n", "--numlines",
          action="store", dest="numlines",
          default=1, help="output NUMLINES    lines
(default 1)")

options, args = parser.parse_args(sys.argv[1:])

try:
    numlines = int(options.numlines)
except:
    parser.error("invalid NUMLINES: {0}".
                 format(options.numlines))
if numlines < 0:
    parser.error("negative count: {0}".
                format(numlines))
if len(args) != 1:
    parser.error("wrong number of operands")
input_file = args[0]
try:
    generator = randline(input_file)
    for index in range(numlines):
        sys.stdout.write(generator.chooseline())
except IOError as (errno, strerror):
    parser.error("I/O error({0}): {1}".
format(errno, strerror))

if __name__ == "__main__":
    main()
```

Creates OptionParser instance

Start defining options, action "store" tells optparse to take next argument and store to the right destination which is "numlines". Set the default value of "numlines" to 1 and help message.

options: an object containing all option args

args: list of positional args leftover after parsing options

Try block

get numline from options and convert to integer

Exception handling

error message if numlines is not integer type, replace {o} w/ input

If numlines is negative

error message

If length of args is not 1 (no file name or more than one file name)

error message

Assign the first and only argument to variable input_file

Try block

instantiate randline object with parameter input_file

for loop, iterate from 0 to numlines – 1

print the randomly chosen line

Exception handling

error message in the format of "I/O error (errno):strerror

In order to make the Python file a standalone program