Introduction to Python
Modules, Conditionals, Looping

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Review of Previous Class

- Values and Types
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Lightning Talks

Lightning talks by Cliff and Myke today

(in that order)

Homework review

Homework Questions?

Functions as Objects

Passing a function as an argument

```
def simple():
    print "I'm simple"

def run_twice(fun):
    fun()
    fun()

run_twice( simple )
vs.
run_twice( simple() )
```

Note about lectures

Hopefully, you are reading the book(s)

I'm not going to be comprehensive–

I'll focus on overview and "gotchas"

Notes on reading

Checking for type – factorial example

tuple unpacking in function arguments – Pythagoras example

Code Structure

Python is all about namespaces – the "dots"

`name.another_name`

the "dot" indicates looking for a name in the namespace of the given object.
could be:

- name in a module
- module in a package
- attribute of an object
- method of an object

indenting and blocks

Indenting determines blocks of code

```
something:
    some code
    some more code
    another block:
        code in
        that block
```

But you need the colon too...

indenting and blocks

You can put a one-liner after the colon:

```
In [167]: x = 12

In [168]: if x > 4: print x
12
```

Only do this if it makes it more readable...

spaces and tabs

An indent can be:

- Any number of spaces
- A tab
- tabs and spaces:
  - A tab is eight spaces (always!)
  - Are they eight in your editor?

Use four spaces – really!

(PEP 8)

Various Brackets

Bracket types:

- parentheses `( )`
  - tuple literal: `(1,2,3)`
  - function call: `fun( arg1, arg2 )`
  - grouping: `(a + b) * c`
- square brackets `[ ]`
  - list literal: `[1,2,3]`
  - sequence indexing: `a_string[4]`
- curly brackets `{ }`
  - dictionary literal: `{"this":3, "that":6}`
  - (we'll get to those...)

tuples and commas..

Tuples don't NEED parentheses...

```
In [161]: t = (1,2,3)
In [162]: t
Out[162]: (1, 2, 3)

In [163]: t = 1,2,3
In [164]: t
Out[164]: (1, 2, 3)

In [165]: type(t)
Out[165]: tuple
```

tuples and commas..

Tuples do need commas...

```
In [156]: t = ( 3 )

In [157]: type(t)
Out[157]: int

In [158]: t = (3,)
In [159]: t
Out[159]: (3,)

In [160]: type(t)
Out[160]: tuple
```

modules and packages

A module is simply a namespace

A package is a module with other modules in it

The code in the module is run when it is imported

importing modules

```
import modulename

from modulename import this, that

import modulename as a_new_name
```

(demo)

importing from packages

```
import packagename.modulename

from packagename.modulename import this, that

from package import modulename
```

(demo)

http://effbot.org/zone/import-confusion.htm

importing from packages

```
from modulename import *
```

Don't do this!

("Namespaces are one honking great idea...")

(wxPython and numpy example...)

Except *maybe* math module

(demo)

import

If you dont know the module name before execution.

```
__import__(module)
```

where `module` is a Python string.

modules and packages

The code in a module is NOT re-run when imported again – it must be explicitly reloaded to be re-run

```
import modulename
```

```
reload(modulename)
```

(demo)

```
import sys
print sys.modules
```

(demo)

LAB

Experiment with importing different ways:

```
import math
dir(math) # or, in ipython -- math.<tab>
math.sqrt(4)

import math as m
m.sqrt(4)

from math import *
sqrt(4)
```

LAB

Experiment with importing different ways:

```
import sys
print sys.path

import os
print os.path
```

You wouldn't want to import * those – check out

```
os.path.split()
os.path.join()
```

Lightning Talk

Lightning Talk: Cliff

Truthiness

What is true or false in Python?

- The Booleans: `True` and `False`
- "Something or Nothing"

`http://mail.python.org/pipermail/python-dev/2002-April/022107.html`

Truthiness

determining Truthiness:

`bool(something)`

Boolean Expressions

False

- None
- False
- zero of any numeric type, for example, 0, 0L, 0.0, 0j.
- any empty sequence, for example, '', (), [] .
- any empty mapping, for example, {}.
- instances of user-defined classes, if the class defines a __nonzero__() or __len__() method, when that method returns the integer zero or bool value False.

http://docs.python.org/library/stdtypes.html

Boolean Expressions

avoid

```
if xx == True:
```

use

```
if xx:
```

Boolean Expressions

"Shortcutting"

```
                    if x is false,
x or y                 return y,
                       else return x

                    if x is false,
x and y                 return  x
                        else return y

                    if x is false,
not x                 return True,
                      else return False
```

Boolean Expressions

Stringing them together

```
a or b or c or d
```

```
a and b and c and d
```

The first value that defines the result is returned

(demo)

Boolean returns

From CodingBat

```
def sleep_in(weekday, vacation):
    if weekday == True and vacation == False:
        return False
    else:
        return True
```

Boolean returns

From CodingBat

```
def sleep_in(weekday, vacation):
    return not (weekday == True and vacation == False)
```

or

```
def sleep_in(weekday, vacation):
    return (not weekday) or vacation
```

bools are ints?

bool types are subclasses of integer

```
In [1]: True == 1
Out[1]: True

In [2]: False == 0
Out[2]: True
```

It gets weirder!

```
In [6]: 3 + True
Out[6]: 4
```

(demo)

LAB

re-write a couple CodingBat exercises, returning the direct boolean results

if

Making Decisions...

```
if a:
    print 'a'
elif b:
    print 'b'
elif c:
    print 'c'
else:
    print 'that was unexpected'
```

if

Making Decisions...

```
if a:
    print 'a'
elif b:
    print 'b'

## versus...

if a:
    print 'a'
if b:
    print 'b'
```

switch?

No switch/case in Python

use use `if..elif..elif..else`

(or a dictionary, or subclassing....)

Sequences

Sequences are ordered collections

They can be indexed, sliced, iterated over,...

They have a length: `len(sequence)`

Common sequences (Duck Typing)

- strings
- tuples
- lists

Indexing

square brackets for indexing: []

Indexing starts at zero

```
In [98]: s = "this is a string"

In [99]: s[0]
Out[99]: 't'

In [100]: s[5]
Out[100]: 'i'
```

Indexing

Negative indexes count from the end

```
In [105]: s = "this is a string"

In [106]: s[-1]
Out[106]: 'g'

In [107]: s[-6]
Out[107]: 's'
```

Slices

Slicing: Pulling a range out of a sequence

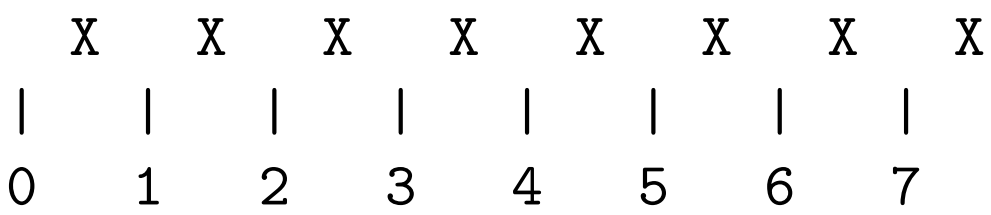
```
sequence[start:finish]

indexes for which:

start <= i < finish
```

Slices

```
In [121]: s = "a bunch of words"
In [122]: s[2]
Out[122]: 'b'

In [123]: s[6]
Out[123]: 'h'

In [124]: s[2:6]
Out[124]: 'bunc'

In [125]: s[2:7]
Out[125]: 'bunch'
```

Slices

the indexes point to the spaces between the items



Slices

Slicing satisfies nifty properties:

```
len( seq[a:b] ) == b - a
```

```
seq[a:b] + seq [b:c] == seq
```

Slicing vs. Indexing

Indexing returns a single element

```
In [86]: l
Out[86]: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]

In [87]: type(l)
Out[87]: list

In [88]: l[3]
Out[88]: 3

In [89]: type( l[3] )
Out[89]: int
```

Slicing vs. Indexing

Unless it's a string:

```
In [75]: s = "a string"

In [76]: s[3]
Out[76]: 't'

In [77]: type(s[3])
Out[77]: str
```

there is no single character type

Slicing vs. Indexing

Slicing returns a sequence:

```
In [68]: l
Out[68]: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]

In [69]: l[2:4]
Out[69]: [2, 3]
```

Even if it's one element long

```
In [70]: l[2:3]
Out[70]: [2]

In [71]: type(l[2:3])
Out[71]: list
```

Slicing vs. Indexing

Indexing out of range produces an error

```
In [129]: s = "a bunch of words"
In [130]: s[17]
----> 1 s[17]
IndexError: string index out of range
```

Slicing just gives you what's there

```
In [131]: s[10:20]
Out[131]: ' words'

In [132]: s[20:30]
Out[132]: ''
```

(demo)

Multiplying and slicing

from CodingBat: Warmup-1 – front3

```
def front3(str):
  if len(str) < 3:
    return str+str+str
  else:
    return str[:3]+str[:3]+str[:3]
```

or

```
def front3(str):
    return str[:3] * 3
```

Slicing

from CodingBat: Warmup-1 – missing_char

```
def missing_char(str, n):
  front = str[0:n]
  l = len(str)-1
  back = str[n+1:l+1]
  return front + back

def missing_char(str, n):
    return str[:n] + str[n+1:]
```

Slicing

you can skip items, too

```
In [289]: string = "a fairly long string"

In [290]: string[0:15]
Out[290]: 'a fairly long s'

In [291]: string[0:15:2]
Out[291]: 'afil ogs'

In [292]: string[0:15:3]
Out[292]: 'aallg'
```

LAB

Write some functions that:

- return a string with the first and last characters exchanged.
- return a string with every other character removed
- return a string with the first and last 4 characters removed, and every other char in between
- return a string reversed (just with slicing)
- return a string with the middle, then last, then first third in a new order

Lightning Talk

Lightning Talk: Myke

for loops

looping through sequences

```
for x in sequence:
    do_something_with_x
```

for loops

```
In [170]: for x in "a string":
    .....:         print x
    .....:
a

s
t
r
i
n
g
```

range

looping a known number of times..

```
In [171]: for i in range(5):
   .....:     print i
   .....:
0
1
2
3
4
```

(you don't need to do anything with i...

range

`range` defined similarly to indexing

```
In [183]: range(4)
Out[183]: [0, 1, 2, 3]

In [184]: range(2,4)
Out[184]: [2, 3]

In [185]: range(2,10,2)
Out[185]: [2, 4, 6, 8]
```

indexing?

Python only loops through a sequence – not like C, Javascript, etc...

```
for(var i=0; i<arr.length; i++) {
    var value = arr[i];
    alert(i =") "+value);
}
```

indexing?

Use range?

```
In [193]: letters = "Python"

In [194]: for i in range(len(letters)):
   .....:     print letters[i]
   .....:
P
y
t
h
o
n
```

indexing?

More Pythonic – for loops through sequences

```
In [196]: for l in letters:
    .....:     print l
    .....:
P
y
t
h
o
n
```

Never index in normal cases

enumerate

If you need an index – enumerate

```
In [197]: for i, l in enumerate(letters):
    .....:     print i, l
    .....:
0 P
1 y
2 t
3 h
4 o
5 n
```

multiple sequences – zip

If you need to loop though parallel sequences – `zip`

```
In [200]: first_names = ['Fred', 'Mary', 'Jane']

In [201]: last_names = ['Baker', 'Jones', 'Miller']

In [203]: for first, last in zip(first_names, last_names):
   .....:     print first, last
   .....:
Fred Baker
Mary Jones
Jane Miller
```

xrange

`range` creates the whole list

`xrange` is a generator – creates it as it's needed –

a good idea for large numbers

```
In [207]: for i in xrange(3):
   .....:     print i
0
1
2
```

(Python 3 – `range == xrange`)

for

`for` does NOT create a name space:

```
In [172]: x = 10

In [173]: for x in range(3):
   .....:     pass
   .....:

In [174]: x
Out[174]: 2
```

LAB

- Look up the % operator. What do these do?

```
10 % 7 == 3
14 % 7 == 0
```

- Write a program that prints the numbers from 1 to 100 inclusive. But for multiples of three print “Fizz” instead of the number and for the multiples of five print “Buzz”. For numbers which are multiples of both three and five print “FizzBuzz” instead.

while

`while` is for when you don't know how many loops you need

Continues to execute the body until condition is not `True`

```
while a_condition:
    some_code
    in_the_body
```

while

`while` is more general than `for` – you can always express for as while, but not always vice-versa.

`while` is more error-prone – requires some care to terminate

loop body must make progress, so condition can become `False`

potential error: infinite loops

while vs. for

```
letters = 'Python'
i=0
while i < len(letters):
    print letters[i]
    i += 1
```

vs.

```
letters = 'Python'
for c in letters:
    print c
```

while

Shortcut: recall – 0 or empty sequence is `False`

break

break ends a loop early

```
x = 0
while True:
    print x
    if x > 3:
        break
    x = x + 1
In [216]: run for_while.py
0
1
2
3
4
```

break

same way with a `for` loop

```
name = "Chris Barker"
for c in name:
    print c,
    if c == "B":
        break
print "I'm done"
```

```
C h r i s   B
I'm done
```

continue

`continue` skips to the start of the loop again

```
print "continue in a for loop"
name = "Chris Barker"
for c in name:
    if c == "B":
        continue
    print c,
print "\nI'm done"
```

```
continue in a for loop
C h r i s   a r k e r
I'm done
```

continue

`continue` works for a `while` loop too.

```
print "continue in a while loop"
x = 6
while x > 0:
    x = x-1
    if x%2:
        continue
    print x,
print "\nI'm done"

continue in a while loop
4 2 0
I'm done
```

else again

`else` block run if the loop finished naturally – no `break`

```
print "else in a for loop"
x = 5
for i in range(5):
    print i
    if i == x:
        break
else:
    print "else block run"
```

Command Line Input

input and raw_input

input evaluates the input

```
In [265]: val = input("a message> ")
a message> 4.5

In [266]: type(val)
Out[266]: float
```

raw_input gives you the plain string

```
In [265]: val = input("a message> ")
a message> 4.5

In [266]: type(val)
Out[266]: float
```

LAB

`def count_them(letter):`

- prompts the user to input a letter
- counts the number of times the given letter is input
- prompts the user for another letter
- continues until the user inputs "x"
- returns the count of the letter input

`def count_letter_in_string(string, letter):`

- counts the number of instances of the letter in the string
- ends when a period is encountered
- if no period is encountered – prints "hey, there was no period!"

example

Example: `re-run-latex.py` script

Homework

Read:

- Read TP: 9, 14
- extra: string methods: `http://docs.python.org/library/stdtypes.html#string-methods`
- extra: unicode: `http://www.joelonsoftware.com/articles/Unicode.html`

Do:

- Six more CodingBat exercises.
- LPTHW: for extra practice with the concepts – some of:

  strings: ex5, ex6, ex7, ex8, ex9, ex10

  raw_input(), sys.argv: ex12, ex13, ex14 (needed for files)

  files: ex15, ex16, ex17