

Fundamentals of Programming

Python short course

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Outline

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- 2 Getting started
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Programming

I'm the boss now, computer.

- *Programs*: a set of computer instructions
- *Programming*: defining the instructions
- *Algorithm*: set of instructions for some task

Why learn to program?

- Automation
 - **Productivity!**
 - Reduces human error
- Flexibility and Control
 - Custom experiments
 - Custom analysis

Requirements

- 1 Text editor: for writing code
 - Lets you type out instructions for the computer to follow
- 2 Programming language (Python)
 - Syntax and rules for writing instructions
- 3 interpreter/compiler (Python)
 - Converts our code to code the computer can understand

Text Editor

Not a word processor

Text editor: a program that lets you edit text

- notepad (notepad++)
- VI (VIM)

Some text editors are made for writing code

- syntax highlighting
- auto-completion

Example text file

Created with a text editor

```
This is an example text file.  The writing
inside is plain
text.  Whatever text is saved in the text
file is the only thing saved
in the text file, including return keys,
tabs, and spaces.
No extra characters are added.
```


Programming language

Python (From Monty Python)

Programming language: Formal language specifying rules for communicating instructions to the computer

- store a value
- do something multiple times
- save something in a text file
- show something on the display

Interpreter/Compiler

Python

Interpreter: A program that takes the instructions you wrote in the python language, and converts it to computer code

- Python interpreter runs code line by line (like MATLAB)
- Compiled languages (like C++) must be processed (compiled) in their entirety before being run by computer

Get Python

It's Free

Anaconda: A free Python distribution for scientific computing

- <https://www.continuum.io/downloads>

Hello World

helloWorld.py

```
print('hello world')
```

Hello World 2.0

helloWorld2.py

```
# S Rivera  
# Oct 2015  
# Simple hello world program for lecture 1.  
# <- means comment to ignore  
print('hello world')
```

Simple Example

Store, manipulate, retrieve

```
x = 5 # Create a variable called x
      # That variable has memory storage
      # Store the value 5 there
x = x + 2 # add 2 to value in x, store it in x
print( x ) # show the value of x on screen
```

What you will learn

All about the algorithms

Any program is built from only 3 control structures

- 1 Do something
- 2 Do something multiple times
- 3 Do something if something else is True

Be clever and combine them to perform any task

Do Something

Computer, store some value.

```
x = 'something' # a string
xx = 4.0 # a float value
y = [1, 2, 3] # a list of integers
z = True # (or False) a boolean value
zz = None # a None data type
```


Do Something

Computer, do math.

```
x = 5*1 # multiply
y = 3/2 # divide and truncate
z = 3/2.0 # divide properly
zz = 2**10 # exponential
xyz = 5 % 2 # modulus
```

```
from math import sqrt # load sqrt code
x = sqrt(2) # store result of squareroot 2 in x
```

Do Something

Computer, compare values.

```
x = ( 5 > 2 )  
y = ( 5 <= 2 )  
z = ( 5 == 2 )  
zz = ( 5 != 2 )
```

Do Something

Computer, use predefined *functions*.

```
x = range( 5 ) # Call the 'range' function.  
               # Pass it the value 5, which  
               # returns the list [0,1,2,3,4].  
               # Store it in x.  
  
help( range ) # Explain the range function.  
              # Call from command prompt  
  
print( 'print is also a function' )  
  
len( x ) # Return number of items in x.  
         # Don't save result
```

Conditional

Do something if something else.

```
x = True
if x :
    print( 'x is true' )
else:
    print( 'x is not true' )
```

For loop

Do something a specific number of times.

```
for x in [1,2,3,4,5]:  
    print( x ) # show x every time in loop
```

For Loop

Do something 5 times.

```
for x in range(5): # range function trick  
    print( x )
```

While Loop

Do something while some condition is true.

```
x = 0
while x < 10:  # Always true, infinite loop
    print( x )
```

```
x = 0
while x < 10:
    print( x )
    x = x+1  # ensures loop ends
```

Exercise 1

Show the values from 1 to 10 on the screen

Pseudocode

```
Loop through a list of numbers from 1 to 10  
show the number
```


Exercise 1

Show the integers from 1 to 10 on the screen.

```
for x in range(10):  
    print( x+1)
```

Exercise 2

Show the *EVEN* values from 1 to 10 on the screen

Pseudocode

```
Loop through a list of numbers from 1 to 10  
if it is even, show the number
```

Exercise 2

Show the *EVEN* values from 1 to 10 on the screen.

```
for x in range(1,11):  
    if (x % 2) == 0: # modulus trick  
        print( x)
```

Additional resources

You are not alone.

- Google
- Free book: <http://www.greenteapress.com/thinkpython/>
- Online course: <https://www.codecademy.com/>
- Other students