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## What is Python

- Python is a free, open-source, object-oriented programming language
  - Strong community support
  - 1000s packages you may download and reference (language processing, facial recognition etc.)
- Examples:
  - scipy, numpy, pandas, mpi4py for science
  - PyQt for GUI interface development
  - APIs - LinkedIn, Craigslist, Google, BeautifulSoup
  - TensorFlow for Machine Learning
  - nltk for Natural Language Processing and Analysis
  - py2FaceR for Facial Recognition
- Objects can have properties and methods:
  - Properties – Name, Spatial Reference, Extent, etc.
  - Method – Something the object can do
- Scripting allows you to automate time-consuming and complex process so you can work more efficiently.

# How do I get it

## Python

Python of "free" but is curated by several organizations (some for profit)

<https://anaconda.org/> (<https://anaconda.org/>)

<https://www.enthought.com/product/canopy/> (<https://www.enthought.com/product/canopy/>)

<https://www.python.org/> (<https://www.python.org/>)

## PyPI - the Python Package Index

The Python Package Index is a repository of software for the Python programming language. Currently the repository contains over 130,000 packages.

<https://pypi.python.org/pypi> (<https://pypi.python.org/pypi>)

## Make No Commitments

<http://pythonfiddle.com/> (<http://pythonfiddle.com/>)

## Some Python Miscellany

- Python is interpreted
- Python is case-sensitive
- Python uses indentation to define code blocks
- '#' is used to designate comment code (and '"""' ...'"""' for multi-line comments)
- '\*' is a wildcard character in strings (useful for finding or identifying specific files:  
"I:\plays\\*henry\*.doc")
- = vs ==
  - = is used for assignment.
  - == is used to test for equivalency

# Data Types

- Numbers
  - Integer/Long Integer, Float
- Strings
  - Text
- Lists
  - Ordered list of numbers, strings, other lists, or combinations of data types.
- Dictionaries
  - Keyed collection of numbers, strings, other lists, or combinations of data types.
- Tuples
  - Similar to list above but immutable (useful for indexing)

## Numbers

- Assign number values to variables using =
- Convert between integer and floating point using `int()` and `float()` functions.
- Numbers can be converted into strings using the `str()` function
- Python cannot concatenate numbers and strings

```
In [1]: number = 14  
        print(number)
```

14

```
In [2]: float(number)
```

Out[2]: 14.0

```
In [3]: int(number)
```

Out[3]: 14

```
In [4]: str(number)
```

Out[4]: '14'

```
In [5]: year = 2018
s = "number = {0}".format(year)
print(s)
```

```
number = 2018
```

Op	Arithmetic Operators	Op	Comparison Operators
+	Addition	==	Is Equal To
-	Subtraction	!=	Does Not Equal
*	Multiplication	<>	Does Not Equal
/	Division	>	Greater Than
%	Modulus	<	Less Than
**	Exponent	>=	Greater Than or Equal To
//	Floor Division	<=	Less Than or Equal To

## Strings

- Strings are defined by single or double quotes ("Hello World")
- Strings are a collection of characters
- Individual characters may be accessed via and index
- Backslashes are escape characters in Python. Use 'r' (raw) to define strings that contain backslashes
- Strings are concatenated using the '+' operator

```
In [6]: example = "Hi"
example = 'Hello world'
print(example)
```

```
Hello world
```

```
In [7]: print(example[0])
        print(example[1])
        print(example[2])
        print(example[3])
        print(example[4])
```

```
H
e
l
l
o
```

```
In [8]: filePath = "C:\\users\\chuck\\Tools"
        print(filePath)
        filePath = r"C:\users\chuck\Tools"
        print(filePath)
```

```
C:\users\chuck\Tools
C:\users\chuck\Tools
```

```
In [9]: example = "Hi " + "everyone"
        print(example)
```

```
Hi everyone
```

String Method	Description	Examples:
.startswith(prefix)	Returns True if string starts with prefix.	>>> txt = r"I:\GIS\clayton.shp"  >>> txt.startswith("I:\GIS") True
.endswith(suffix)	Returns True if string ends with suffix. *Useful for finding filetypes!	>>> txt.endswith(".shp") True
.isalnum(string)	Returns True if all characters in string are alphanumeric.	>>> txt.isalnum() False
.replace(old, new)	Returns a copy of the string with all occurrences of old replaced by new.	>>> txt.replace("GIS", "GDB") "I:\GDB\clayton.shp"
.split(sep)	Returns a list of the words in a string, using sep as the delimiter.	>>> txt.split("\\") ["I:", "GIS", "clayton.shp"]
.strip(chars)	Returns a copy of the string with the leading/ trailing chars removed. If no chars given, whitespace is removed.	>>> txt.strip(".shp") "I:\GIS\clayton"

# Lists

- Lists are ordered sets of data elements enclosed in square brackets
- Items in lists are ordered 0, 1, 2, 3, etc.
- Items in the list may be of different types
- To retrieve a specific item, give the list name followed by the item's index (i.e., order) number enclosed in square brackets
- List comprehensions are a special construct for the creation of lists

```
In [10]: emptyList = []  
Cities = ["Houston" , "Austin" , "Dallas"]  
print(Cities)  
print(Cities[0])  
print(Cities[1])  
print(Cities[2])
```

```
['Houston', 'Austin', 'Dallas']  
Houston  
Austin  
Dallas
```

```
In [11]: list = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]  
print(list)  
list = [x for x in list if (x % 2) == 0 ]  
print(list)
```

```
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]  
[0, 2, 4, 6, 8]
```

List Method	Description	Examples:
		<code>&gt;&gt;&gt; list = ['a', 'd', 'c', 'b']</code>
<code>.append(item)</code>	Add item to the list.	<code>&gt;&gt;&gt; list.append('e')</code> <code>['a', 'd', 'c', 'b', 'e']</code>
<code>.sort()</code>	Sort the items of a list.	<code>&gt;&gt;&gt; print list.sort()</code> <code>['a', 'd', 'c', 'b']</code>
<code>.reverse()</code>	Reverse the item order.	<code>&gt;&gt;&gt; print list.reverse()</code> <code>['b', 'c', 'd', 'a']</code>
<code>.remove(x)</code>	Remove the first item from the list whose value is x.	<code>&gt;&gt;&gt; print list.remove('a')</code> <code>['d', 'c', 'b']</code>
<code>.insert(#, item)</code>	Insert item into the list at the list position #.	<code>&gt;&gt;&gt; print list.insert(0, 'z')</code> <code>['z', 'a', 'd', 'c', 'b']</code>
<code>.count(x)</code>	Count the number of times x appears in the list.	<code>&gt;&gt;&gt; print list.count('c')</code> <code>1</code>

## Dictionaries

- Dictionaries are unordered sets of key value pairs enclosed in curly brackets
- Items in the dictionary may be of different types
- To retrieve a specific item, give the dictionary name followed by the item's key enclosed in square brackets
- Dictionary comprehensions are a special construct for the creation of dictionaries

```
In [12]: emptyDictionary = {}
emptyDictionary["cat"] = 1
emptyDictionary["dog"] = "happy"
print("emptyDictionary[\"cat\"] = {}".format(emptyDictionary["cat"]))
print("emptyDictionary[\"dog\"] = {}".format(emptyDictionary["dog"]))

emptyDictionary["cat"] = 1
emptyDictionary["dog"] = happy
```

```
In [13]: CityPopulations = { "Houston":2000000 , "Austin":1500001 , "Dallas":3000
print(CityPopulations)
print(CityPopulations["Austin"])

{'Houston': 2000000, 'Austin': 1500001, 'Dallas': 3000000}
1500001
```

```
In [14]: CityPopulations = {k:v for (k,v) in CityPopulations.items() if (v % 2) == 0}
print(CityPopulations)

{'Houston': 2000000, 'Dallas': 3000000}
```

```
In [15]: CityPopulations.items()
```

```
Out[15]: dict_items([('Houston', 2000000), ('Dallas', 3000000)])
```

Dictionary Method	Description	Examples:
.items()	Returns a view of the dictionary's (key,value) pairs.	>>> dict = {'a':0, 'd':1}  >>> dict.items('e') dict_items([('a':0), ('d':1)])
.keys()	Returns a view object of all keys.	>>> print dict.keys() dict_keys(['a', 'd'])
.values()	Returns a view object of all values.	>>> print dict.values() dict_values([0, 1])
.pop(key)	Returns an item and deletes it from the dictionary.	>>> print dict.pop('a') {'d':1}
.clear()	Removes all items from the dictionary.	>>> print dict.clear() {}

## Tuples

- Tuples are ordered sets of data elements enclosed in parenthesis
- Tuples are very similar to lists
- Tuples are immutable and therefore are useful as indexers

```
In [16]: person = ("Chuck", "Knight")
print(person[0])
```

Chuck

```
In [17]: people = {}
people[("Chuck", "Knight")] = 10
people[("Kody", "Knight")] = 11
people[("William", "Tell")] = 0
print(people)
```

```
{('Chuck', 'Knight'): 10, ('Kody', 'Knight'): 11, ('William', 'Tell'): 0}
```



```
In [18]: person = ("Chuck", "Knight")
         person[0] = "not chuck"
```

```
-----
-----
TypeError                                 Traceback (most recent call
last)
<ipython-input-18-cf59a9b45c74> in <module>
      1 person = ("Chuck", "Knight")
----> 2 person[0] = "not chuck"

TypeError: 'tuple' object does not support item assignment
```

## Conditions and Loops

- All conditional and loop statements end with a ':'
- Code within a conditional or loop is nested using spaces

## if - elif - else Statements

- Perform some operation if a statement is true otherwise (else) do something else
- Boolean operators were listed previously (under Numbers)

```
In [19]: pi = 1.14
         if pi >= 4:
             print("pi is greater than or equal to 4")
         elif pi > 3:
             print("pi is greater than or equal to 3 but less than 4")
         else:
             print("pi is not greater than or equal to 3")
```

pi is not greater than or equal to 3

```
In [20]: pi = 3.14
         if pi >= 4:
             print("pi is greater than or equal to 4")
         else:
             if pi > 3:
                 print("pi is greater than or equal to 3 but less than 4")
             else:
                 print("pi is not greater than or equal to 3")
```

pi is greater than or equal to 3 but less than 4

## for - else Statements

- Loops are used to iterate over a collection/range of elements
- Like other languages Python has the concept of break and continue for loops
- Unlike other languages a for loop may have an else clause
- Introducing range() - used to create iteration indices

```
In [21]: list = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
         for x in list:
             print(x)
```

0  
1  
2  
3  
4  
5  
6  
7  
8  
9

```
In [22]: for x in range(0, 10):  
         print(x)
```

```
0  
1  
2  
3  
4  
5  
6  
7  
8  
9
```

```
In [23]: list = []  
         for x in list:  
             print(x)  
         else:  
             print("There were no elements")
```

There were no elements

## while - else Statements

- Loops are used to iterate some criteria are met (some statement is true)
- Again
  - Like other languages Python has the concept of break and continue for loops
  - Unlike other languages a while loop may have an else clause
- Introducing pass - The no op command

```
In [24]: count = 0  
         while (count < 9):  
             print("The count is: {}".format(count))  
             count = count + 1
```

```
The count is: 0  
The count is: 1  
The count is: 2  
The count is: 3  
The count is: 4  
The count is: 5  
The count is: 6  
The count is: 7  
The count is: 8
```

```
In [25]: count = 10
while (count < 9):
    print("The count is: {}".format(count))
    count = count + 1
else:
    print("count was never less than 9")
```

count was never less than 9

```
In [26]: count = 10
while (count < 9):
    pass
```

## Modules

- At some point you will want to use other peoples Python code (OPPC)
- Importing allows your Python code to see installed Python packages
- You can use OPPC either from it's native namespace or merge it into yours

Some core modules

- os – Operating system functions
- sys – System-specific parameters and functions
- glob – Unix-style pathname patterns
- csv – CSV file reading and writing

```
In [27]: import sys
print(sys.version)
```

3.6.7 |Anaconda, Inc.| (default, Oct 23 2018, 14:01:38)  
[GCC 4.2.1 Compatible Clang 4.0.1 (tags/RELEASE\_401/final)]

```
In [28]: import os as o
print(o.getcwd())
```

/Users/chuck/Desktop/Trenton-Computer-Festival

```
In [29]: # Merge import into our namespace (no qualifier needed)  
from time import sleep  
print("Sleeping...")  
sleep(1)  
print("done!")
```

Sleeping...

done!

```
In [30]: # Merge all imports into our namespace (no qualifier needed)  
# Other than those prefixed by "_" which implements a crude form of enca  
from random import *  
print("randint = {0}".format(randint(0, 10)))
```

randint = 4