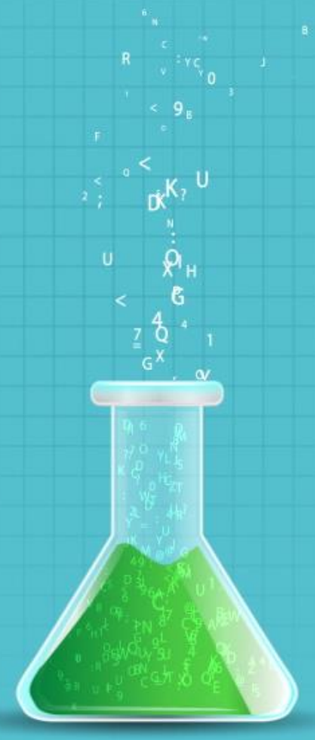
Data Science with Python

Lesson 04—Python: Environment Setup and Essentials

DATA SCIENCE

What You'll Learn

- How to install Anaconda and Jupyter notebook
- Some of the important data types supported by Python
- Data structures such as lists, tuples, sets, and dicts
- Slicing and accessing the four data structures
- Few basic operators and functions
- Some important control flow statements



Python: Environment Setup and Essentials

Python Environment Setup

DATA SCIENCE

Quick Recap: Python for Data Science

You have seen how Python and its different libraries are useful in various aspects of Data Science.

Data Science

Acquire

Wrangle

pandas

Explore

matplotlib

Model

scikit learn

NumPy

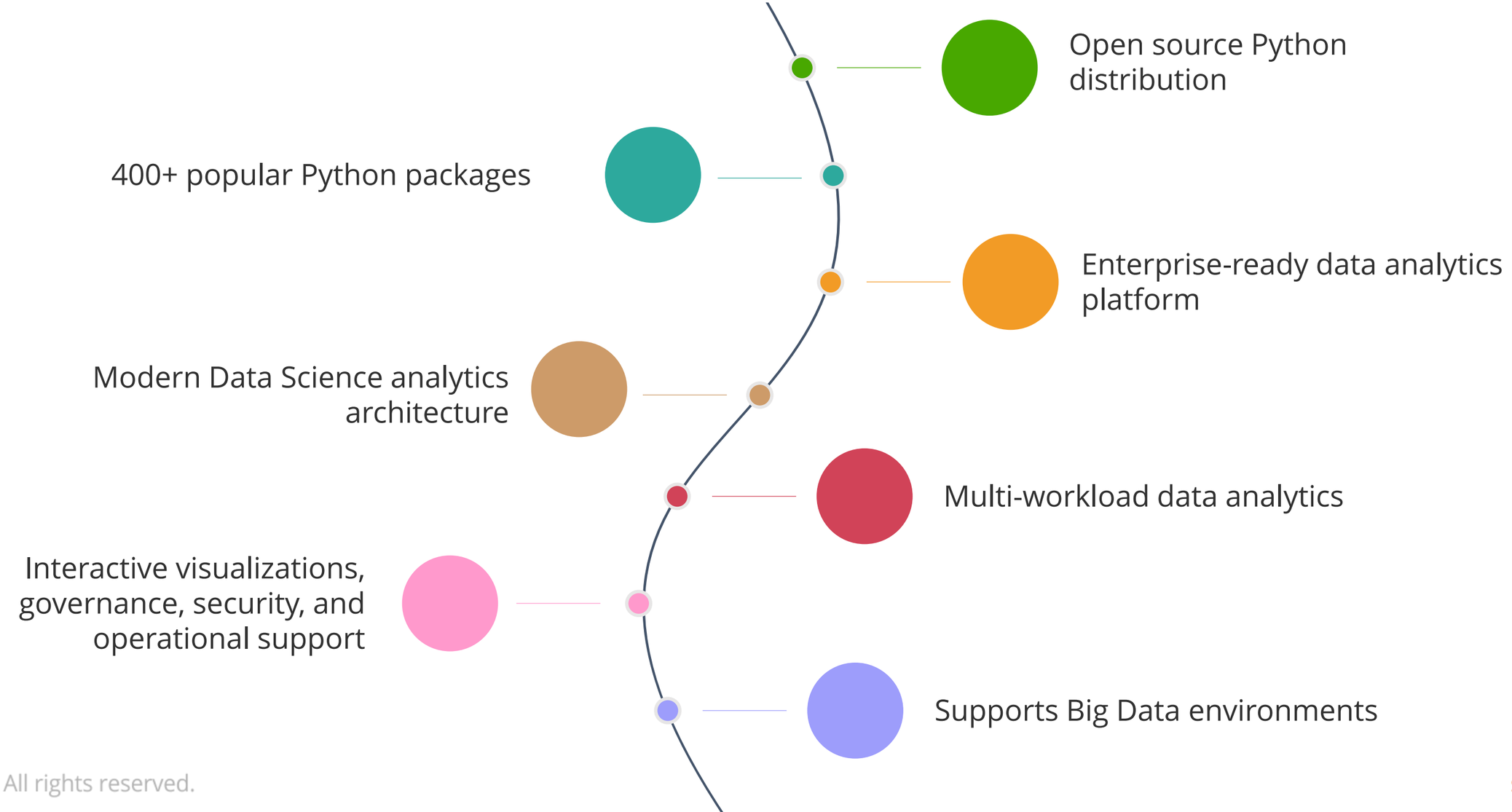
Visualize

Bokeh

SciPy

Why Anaconda

To use Python, we recommend that you download Anaconda. Following are some of the reasons why Anaconda is one of the best Data Science platforms:



Installation of Anaconda Python Distribution

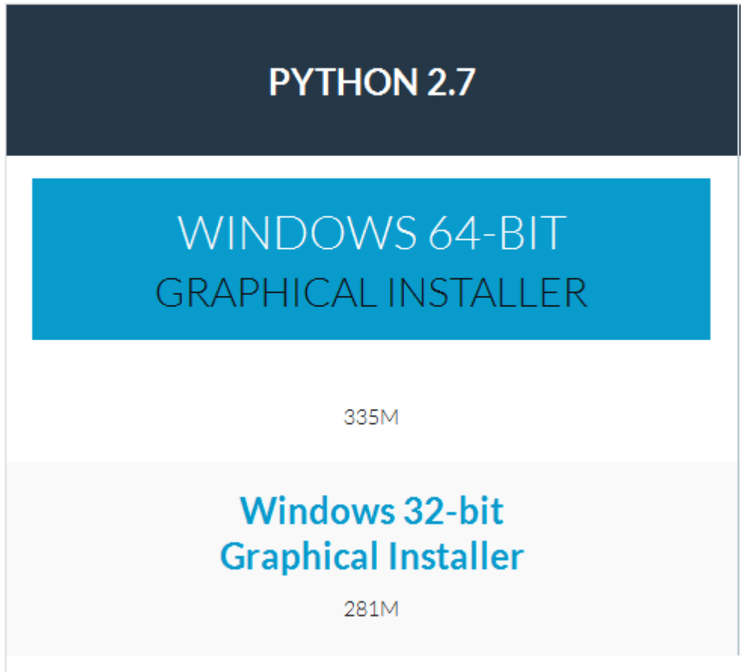
Currently, there are two versions of Python. You can download and use either of them although the 2.7 version is preferable.

PYTHON 2.7	PYTHON 3.5
WINDOWS 64-BIT GRAPHICAL INSTALLER	WINDOWS 64-BIT GRAPHICAL INSTALLER
335M	345M
Windows 32-bit Graphical Installer	Windows 32-bit Graphical Installer
281M	283M

Installation of Anaconda Python Distribution (contd.)

You can install and run the Anaconda Python distribution on different platforms.

Windows | Mac OS | Linux



Website URL:
https://www.continuum.io/downloads

Graphical Installer

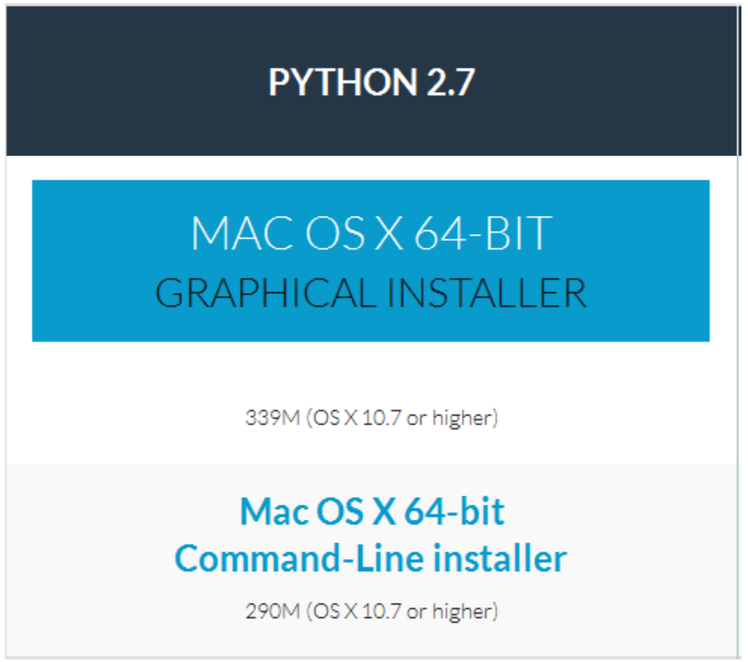
- Download the graphical installer.
- Double-click the .exe file to install Anaconda and follow the instructions on the screen.

Click each tab to know how to install Python on those operating systems.

Installation of Anaconda Python Distribution (contd.)

You can install and run the Anaconda Python distribution on different platforms.

Windows | Mac OS | Linux



Website URL:
https://www.continuum.io/downloads

Graphical Installer

- Download the graphical installer.
- Double-click the downloaded .pkg file and follow the instructions.

Command Line Installer

- Download the command line installer.
- In your terminal window, type the command listed below and follow the given instructions:

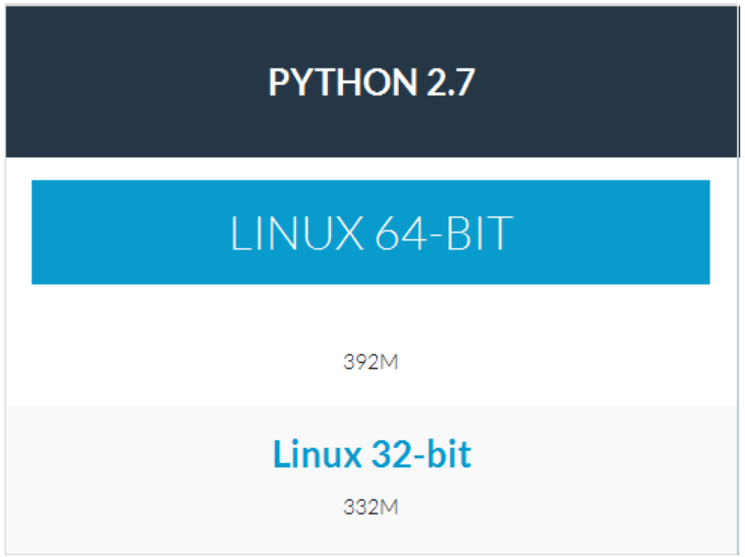
  Python 2.7:
  bash Anaconda2-4.0.0-MacOSX-x86_64.sh

Click each tab to know how to install Python on those operating systems.

Installation of Anaconda Python Distribution (contd.)

You can install and run the Anaconda Python distribution on different platforms.

Windows | Mac OS | Linux



Website URL:
https://www.continuum.io/downloads

Command Line Installer

- Download the installer.
- In your terminal window, type the command line shown below and follow the instructions:

Python 2.7:
bash Anaconda2-4.0.0-Linux-x86_64.sh

Click each tab to know how to install Python on those operating systems.

Jupyter Notebook

Jupyter is an open source and interactive web-based Python interface for Data Science and scientific computing. Some of its advantages are:

Python language support

Content sharing and contribution

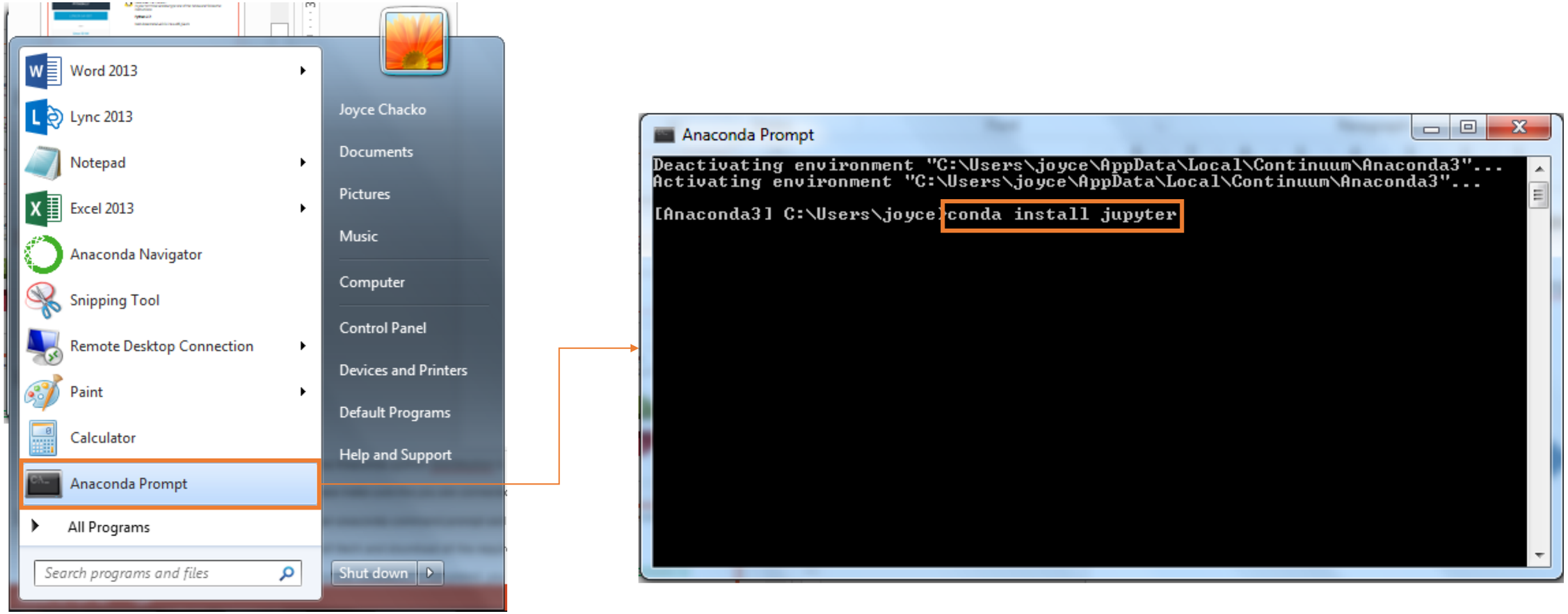
jupyter

Big Data platform integration

Built-in interactive widgets

Jupyter Notebook: Installation

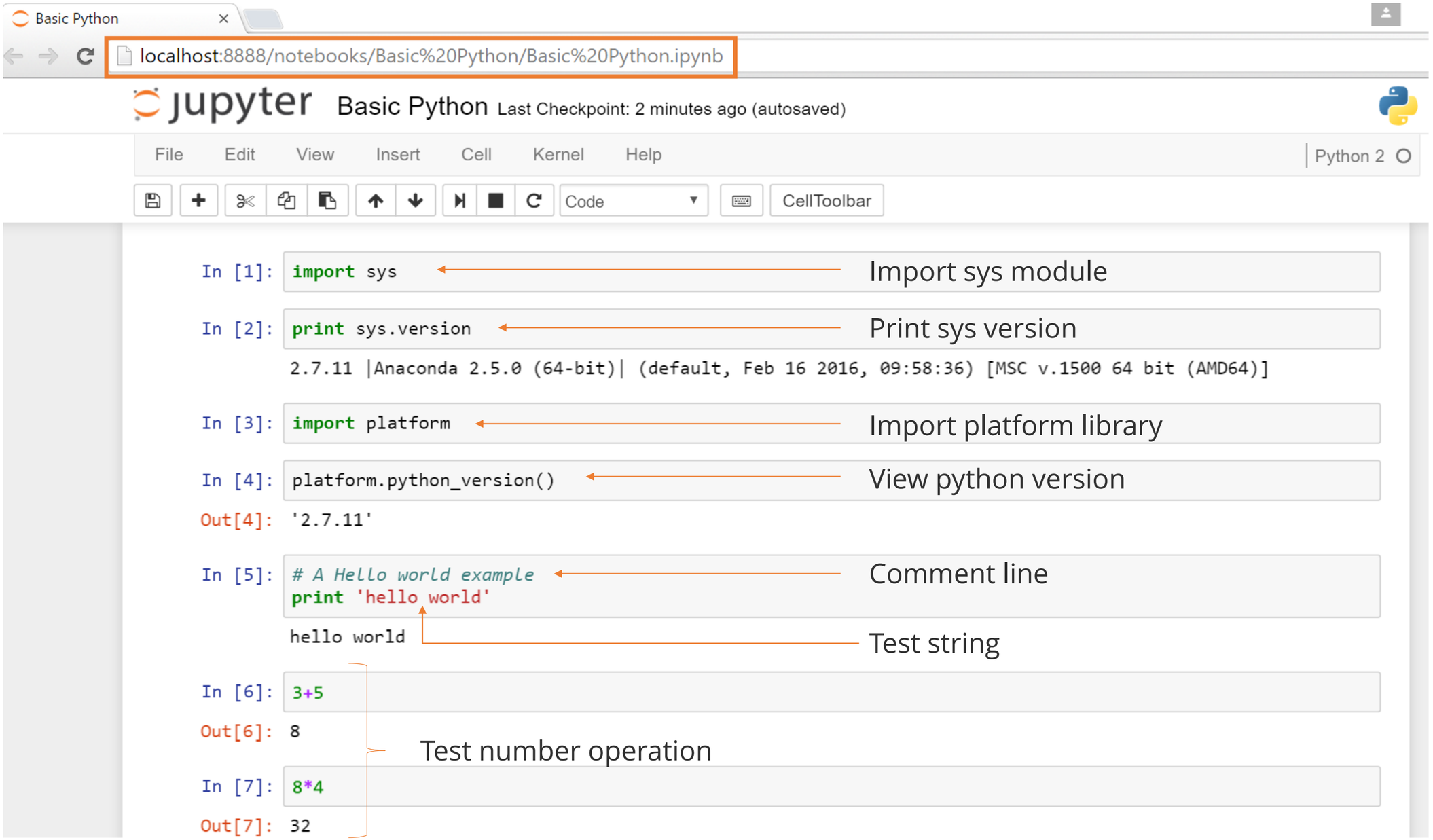
To install Jupyter notebook on your system, type the command shown here on Anaconda prompt and press Enter to execute it.



Python: Environment Setup and Essentials

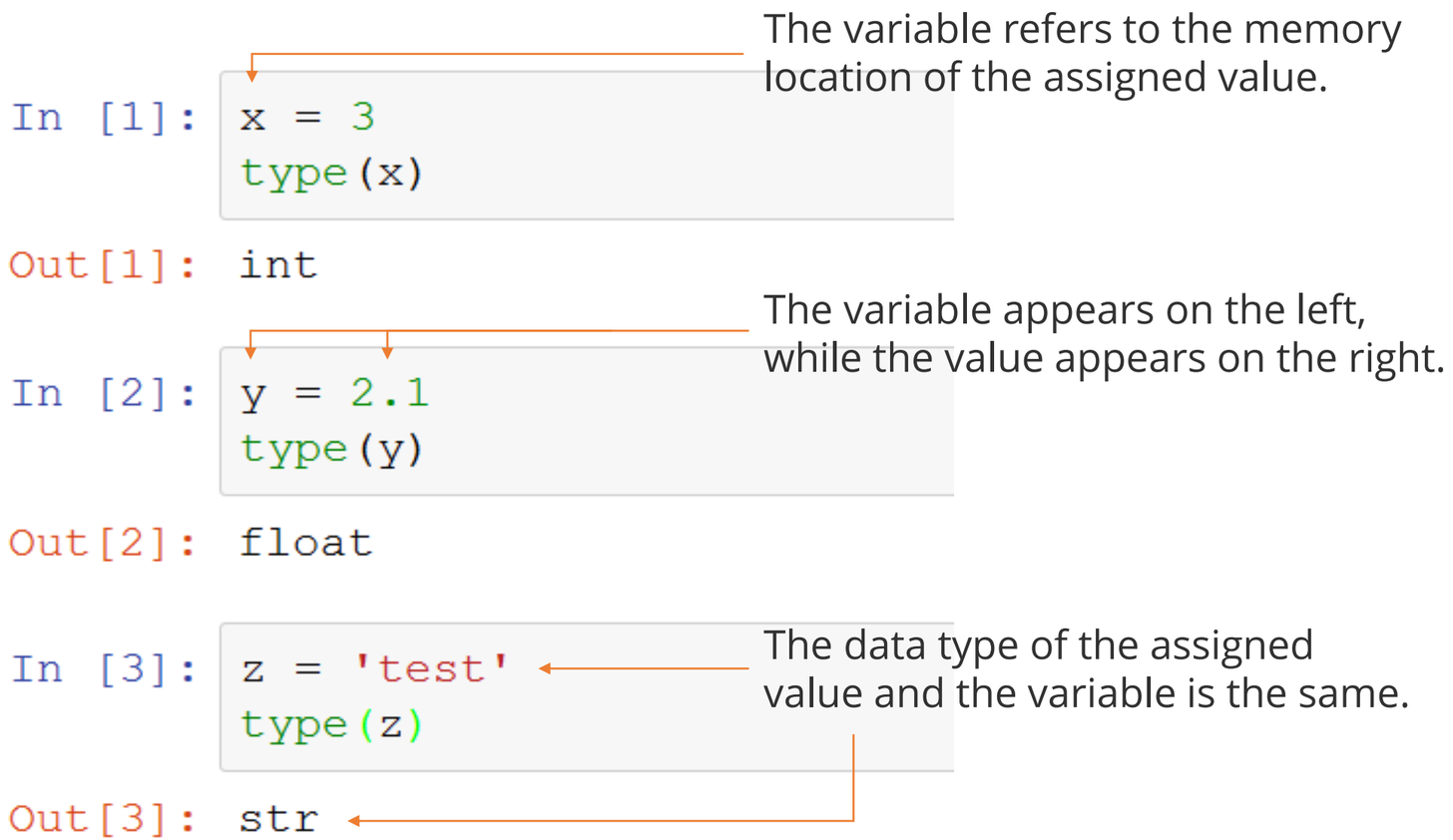
Python Primer

Getting Started



Variables and Assignment

A variable can be assigned or bound to any value. Some of the characteristics of binding a variable in Python are listed here:



Example—Variables and Assignment

Let us look at an example of how you can assign a value to a variable, and print it and its data type.

```
In [44]: first_string_variable = 'test'
         first_integer_variable = 123
```

Assignment

```
In [45]: print first_string_variable
         print first_integer_variable

         test
         123
```

Variable data value

```
In [47]: print type(first_string_variable)
         print type(first_integer_variable)

         <type 'str'>
         <type 'int'>
```

Data type of the object

Multiple Assignments

You can access a variable only if it is defined. You can define multiple variables simultaneously.

```
In [48]: number_example
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
<ipython-input-48-a856f233ae98> in <module>()
----> 1 number_example

NameError: name 'number_example' is not defined
```

Access variable without assignment

```
In [49]: number_example = 2
         number_example
Out[49]: 2
```

Access variable after assignment

```
In [54]: integer_x, integer_y = 5,22
In [55]: integer_x
Out[55]: 5
In [56]: integer_y
Out[56]: 22
```

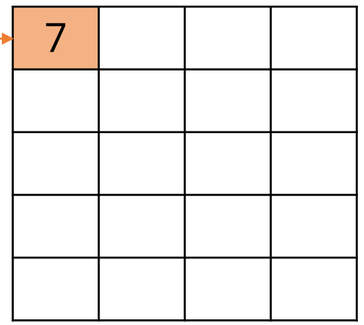
Multiple assignments

Assignment and Reference

When a variable is assigned a value, it refers to the value's memory location or address. It does not equal the value itself.

```
x = 7
```

Ref: <address 1>



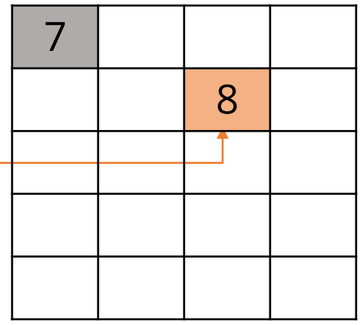
Memory location

```
x = 7
x = x + 1

print(x)
```

```
8
```

Ref: <address 12>

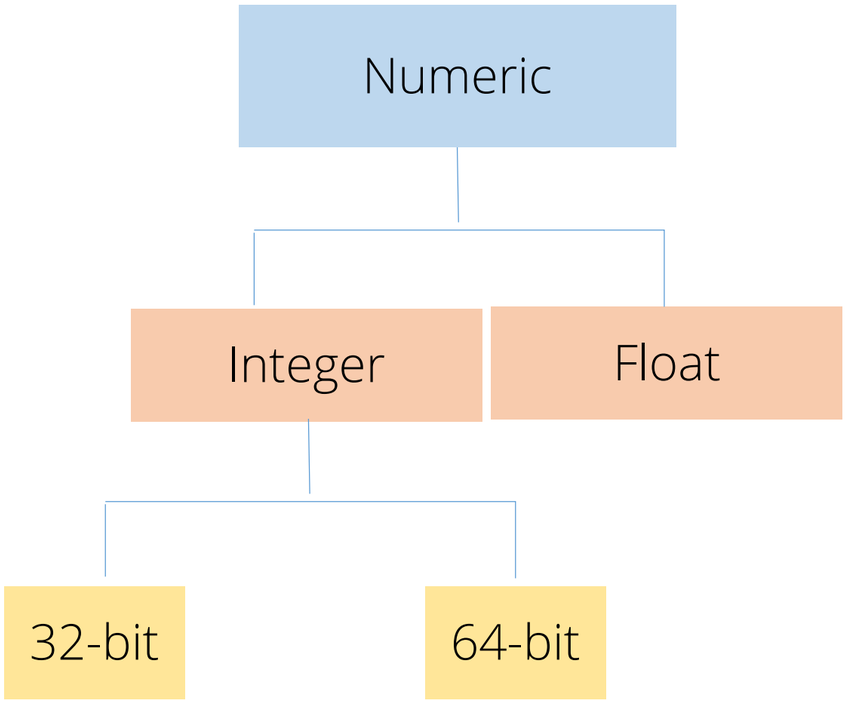
Garbage collected



Memory location

Basic Data Types: Integer and Float

Python supports various data types. There are two main numeric data types:




```
In [9]: int_number = 7/2
        int_number

Out[9]: 3
```

Integer value

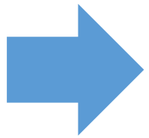
```
In [10]: float_number = 5.2/2
         float_number

Out[10]: 2.6
```

Float value

Basic Data Types: String

Python has extremely powerful and flexible built-in string processing capabilities.

String



```
In [14]: string_one = 'first string'
         string_two = "second string"
         string_three = """third string"""

In [15]: print string_one
         print string_two
         print string_three

first string
second string
third string
```

With single quote

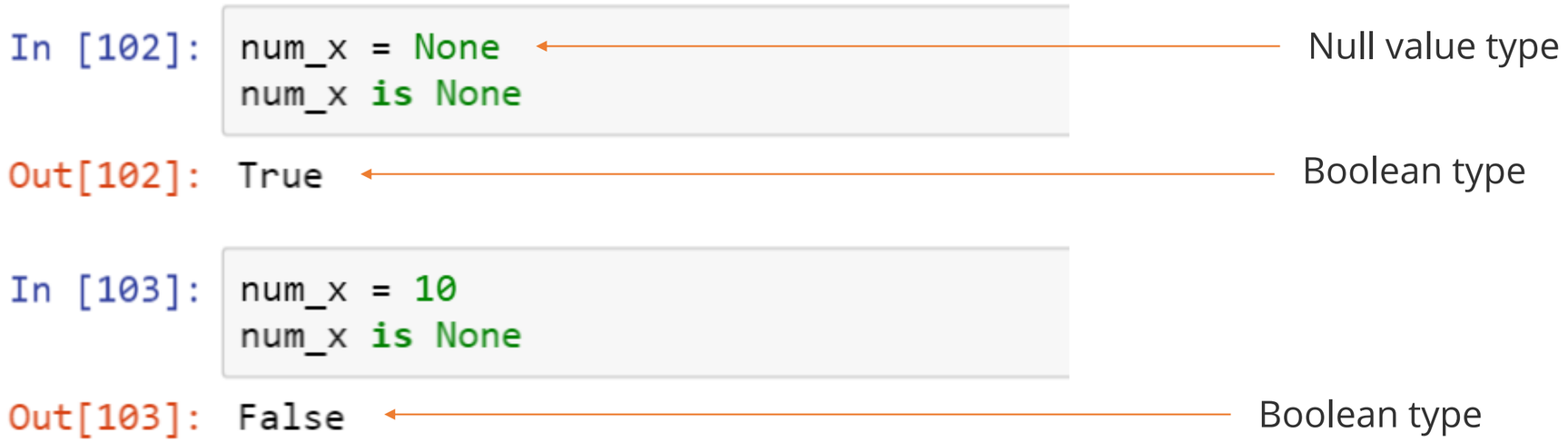
With double quote

Three double quotes

Print string values

Basic Data Types: None and Boolean

Python also supports the Null and Boolean data types.



Type Casting

You can change the data type of a number using type casting.

```
In [58]: float_number = 3.6467
```

Float number

```
In [59]: float_number

Out[59]: 3.6467
```

```
In [60]: int(float_number)
```

Type cast to integer

```
Out[60]: 3
```

```
In [61]: str(float_number)
```

Type cast to string value

```
Out[61]: '3.6467'
```

Data Structure: Tuple

A tuple is a one-dimensional, immutable ordered sequence of items which can be of mixed data types.

```
In [145]: first_tuple = (12,'Jack',45.6,'new',(3,2),'test')
```

Create a tuple

```
In [146]: first_tuple
Out[146]: (12, 'Jack', 45.6, 'new', (3, 2), 'test')
```

View tuple

```
In [147]: first_tuple[1]
Out[147]: 'Jack'
```

Access the data at index value 1

```
In [148]: first_tuple[1] = 'Mark'
```

Try to modify the tuple

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
<ipython-input-148-38afcbb40e37> in <module>()
----> 1 first_tuple[1] = 'Mark'

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

Error: A tuple is immutable and can't be modified

Data Structure: Accessing Tuples

You can access a tuple using indices.

```
In [1]: first_tuple = (12, 'Jack', 45.6, 'new', (3,2), 'test')
```

Tuple

```
In [2]: #Accessing elements using a positive index
        #The index count starts from the left, with the first index being 0
        first_tuple[2]
```

```
Out[2]: 45.6
```

Access with positive index

```
In [3]: #Accessing elements using a negative index
        #The index count starts from the right, with the first index being -1
        first_tuple[-3]
```

```
Out[3]: 'new'
```

Access with negative index

Data Structure: Slicing Tuples

You can also slice a range of elements by specifying the start and end indices of the desired range.

```
In [1]: first_tuple = (12, 'Jack', 45.6, 'new', (3,2), 'test')
```

Tuple

```
In [4]: #Creating a subset/slice of the tuple
        #Specify the indices of the elements, separated by a colon
        #The first index is inclusive; the second index is exclusive
        first_tuple[1:4]

Out[4]: ('Jack', 45.6, 'new')
```

Count starts with the first index but stops before the second index

```
In [5]: #You can use negative indices as well to slice a tuple
        #Count from the right, starting from -1, to specify the correct index
        first_tuple[1: -1]

Out[5]: ('Jack', 45.6, 'new', (3, 2))
```

Even for negative indices, the count stops before the second index

Data Structure: List

A list is a one-dimensional, mutable ordered sequence of items which can be of mixed data types.

```
In [161]: first_list = ['Mark',101,23.6,'test',None,11]
```
Create a list

```
In [162]: first_list
Out[162]: ['Mark', 101, 23.6, 'test', None, 11]
```
View a list

```
In [163]: first_list.append('Jack')
          first_list
Out[163]: ['Mark', 101, 23.6, 'test', None, 11, 'Jack']
```
Modify a list: Add new items

```
In [164]: first_list.remove('Mark')
          first_list
Out[164]: [101, 23.6, 'test', None, 11, 'Jack']
```
Modify a list: Remove items

```
In [165]: first_list.pop(2)
Out[165]: 'test'
```
Access and remove list data using element indices

```
In [166]: first_list.insert(1,'Smith')
          first_list
Out[166]: [101, 'Smith', 23.6, None, 11, 'Jack']
```
Modify a list: Insert a new item at a certain index

Data Structure: Accessing Lists

Just like tuples, you can access elements in a list through indices.

```
In [5]: first_list

Out[5]: [101, 'Smith', 'Smith', 23.6, None, 11, 'Jack']
```

New modified list

```
In [6]: #Accessing elements using a positive index
        #The index count starts from the left, with the first index being 0
        first_list[2]

Out[6]: 'Smith'
```

Access with positive index

```
In [7]: #Accessing elements using a negative index
        #The index count starts from the right, with the first index being -1
        first_list[-2]

Out[7]: 11
```

Access with negative index

Data Structure: Slicing Lists

Just like tuples, you can access elements in a list through indices.

```
In [5]: first_list

Out[5]: [101, 'Smith', 'Smith', 23.6, None, 11, 'Jack']
```

New modified list

```
In [8]: #Creating a subset/slice of the tuple
        #Specify the indices of the elements, separated by a colon
        #The first index is inclusive; the second index is exclusive
        first_list[1:4]

Out[8]: ['Smith', 'Smith', 23.6]
```

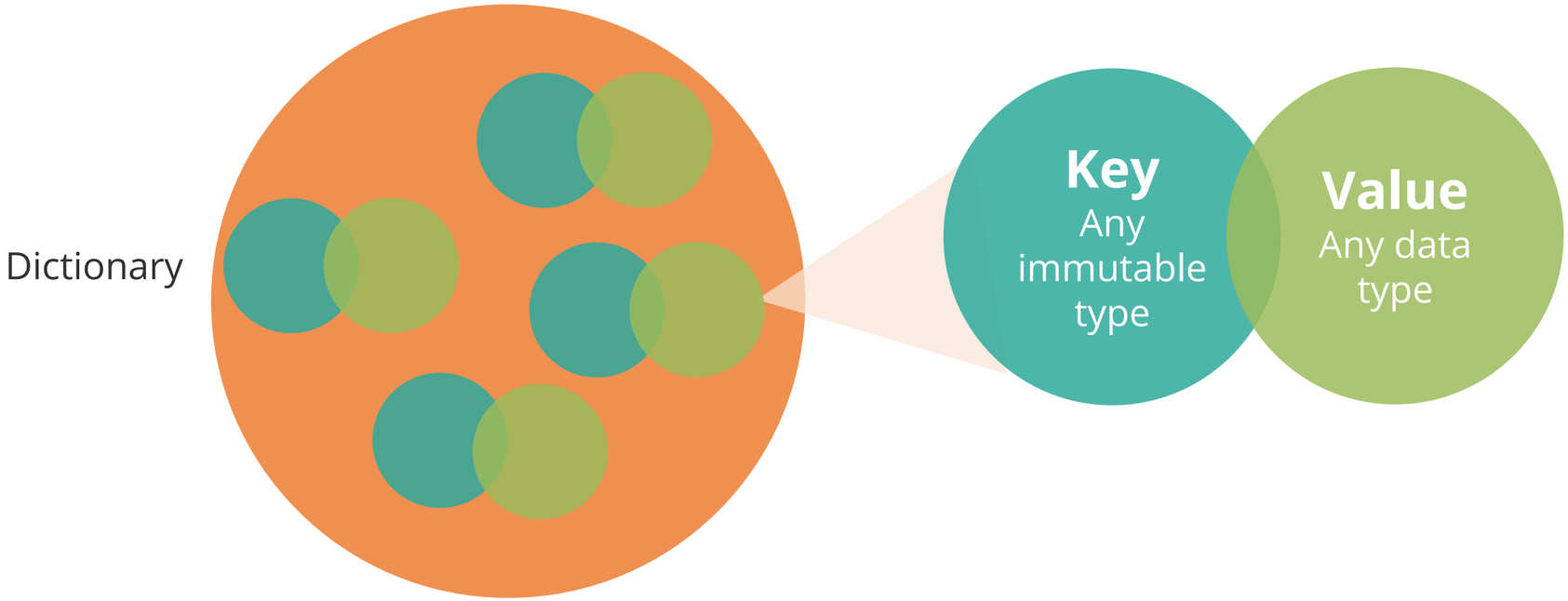
Count starts with the first index but stops before the second index

```
In [9]: #You can use negative indices as well to slice a tuple
        #Count from the right, starting from -1, to specify the correct index
        first_list[1:-1]

Out[9]: ['Smith', 'Smith', 23.6, None, 11]
```

Even for negative indices, the count stops before the second index

Data Structure: Dictionary (dict)

Dictionaries store a mapping between a set of keys and a set of values.



Define

Modify

View

Lookup

Data Structure: View Dictionaries

You can view the keys and values in a dict, either separately or together, using the syntax shown here.

```
In [215]: first_dict = {'John':'john@abc.com','Kelly':'kelly@xyz.org','id':[23,81]}
In [216]: first_dict
Out[216]: {'John': 'john@abc.com', 'Kelly': 'kelly@xyz.org', 'id': [23, 81]}
In [217]: first_dict.keys()
Out[217]: ['Kelly', 'John', 'id']
In [218]: first_dict.values()
Out[218]: ['kelly@xyz.org', 'john@abc.com', [23, 81]]
```

Create a dictionary

View entire dictionary

View only keys

View only values

Data Structure: Access and Modify dict Elements

You can also access and modify individual elements in a dict.

```
In [219]: first_dict['Kelly']
Out[219]: 'kelly@xyz.org'

In [220]: first_dict['id']
Out[220]: [23, 81]

In [221]: first_dict.update({'id':[32,55]})

In [222]: first_dict
Out[222]: {'John': 'john@abc.com', 'Kelly': 'kelly@xyz.org', 'id': [32, 55]}

In [223]: del first_dict['id']

In [224]: first_dict
Out[224]: {'John': 'john@abc.com', 'Kelly': 'kelly@xyz.org'}
```

Access with key

Modify dictionary: update

Modify dictionary: delete

Data Structure: Set

A set is an unordered collection of unique elements.

```
In [327]: auto_survey = set(['Audi','BMW','BMW','Ferrari','GM','Mercedes','Cheverolet','GM'])
```
Create a set

```
In [328]: auto_survey
Out[328]: {'Audi', 'BMW', 'Cheverolet', 'Ferrari', 'GM', 'Mercedes'}
```
View the set

```
In [329]: auto_survey_set = {'Audi','BMW','BMW','Ferrari','GM','Mercedes','Cheverolet','GM'}
```
Create a set

```
In [330]: type(auto_survey_set)
Out[330]: set
```
View the object type

```
In [331]: auto_survery_set
Out[331]: {'Audi', 'BMW', 'Cheverolet', 'Ferrari', 'GM', 'Mercedes'}
```
View the set

Data Structure: Set Operations

Let us look at some basic set operations.

```
In [334]: auto_survery_1 = set(['Audi','BMW','BMW','Ferrari','GM','Mercedes','Cheverolet','GM','Toyota'])
          auto_survery_2 = set(['BMW','Ferrari','GM','Hyundai','Kia','Cheverolet','GM','Ford','Toyota','Zen'])
```

Create sets

```
In [335]: combined_survery_report = auto_survery_1 | auto_survery_2
```

OR – Union set operation

```
In [336]: combined_survery_report
```

```
Out[336]: {'Audi',
           'BMW',
           'Cheverolet',
           'Ferrari',
           'Ford',
           'GM',
           'Hyundai',
           'Kia',
           'Mercedes',
           'Toyota',
           'Zen'}
```

View the output of the OR operation

```
In [337]: common_survey_report = auto_survery_1 & auto_survery_2
```

AND – Intersection set operation

```
In [338]: common_survey_report
```

```
Out[338]: {'BMW', 'Cheverolet', 'Ferrari', 'GM', 'Toyota'}
```

View the output of the NOT operation

Basic Operator: “in”

The “in” operator is used to generate a Boolean value to indicate whether a given value is present in the container or not.

```
In [225]: student_list = ['Tom','Jack','Nick','Sarah','Nicole']
```

Create a list

```
In [226]: 'Nick' in student_list
Out[226]: True

In [227]: 'Mark' in student_list
Out[227]: False
```

Test presence of string with ‘in’ operator

```
In [228]: word = 'encyclopedia'
```

Create a string

```
In [229]: 't' in word
Out[229]: False

In [230]: 'i' in word
Out[230]: True
```

Test presence of substrings with ‘in’ operator

Basic Operator: “+”

The “plus” operator produces a new tuple, list, or string whose value is the concatenation of its arguments.

```
In [239]: test_score_1 = (68,96,71)
          test_score_2 = (92,87,83)
```

Create tuples

```
In [240]: test_score = test_score_1+test_score_2
          test_score
Out[240]: (68, 96, 71, 92, 87, 83)
```

Add tuples

```
In [241]: country_list_1 = ['USA','UK','China','Brazil','Mexico']
          country_list_2 = ['Australia','Spain','Italy']
```

Create lists

```
In [242]: country_list_final = country_list_1+country_list_2
          country_list_final
Out[242]: ['USA', 'UK', 'China', 'Brazil', 'Mexico', 'Australia', 'Spain', 'Italy']
```

Add lists

```
In [243]: first_name = 'George'
          last_name = 'Washington'
```

Create strings

```
In [244]: full_name = first_name+' '+ last_name
          full_name
Out[244]: 'George Washington'
```

Concatenate strings

Basic Operator: "*"

The "multiplication" operator produces a new tuple, list, or string that "repeats" the original content.

```
In [249]: age = (12,17,9) * 3
          age

Out[249]: (12, 17, 9, 12, 17, 9, 12, 17, 9)
```

* operator with tuple

```
In [250]: ID = [101,23,77,45] * 2
          ID

Out[250]: [101, 23, 77, 45, 101, 23, 77, 45]
```

* operator with list

```
In [251]: name = 'friend'*3
          name

Out[251]: 'friendfriendfriend'
```

* operator with string

The '*" operator does not actually multiply the values; it only repeats the values for the specified number of times.

Functions

Functions are the primary method of code organization and reuse in Python.

Syntax
def <name>(arg1, arg2, ..., argN): <statements> return <value>

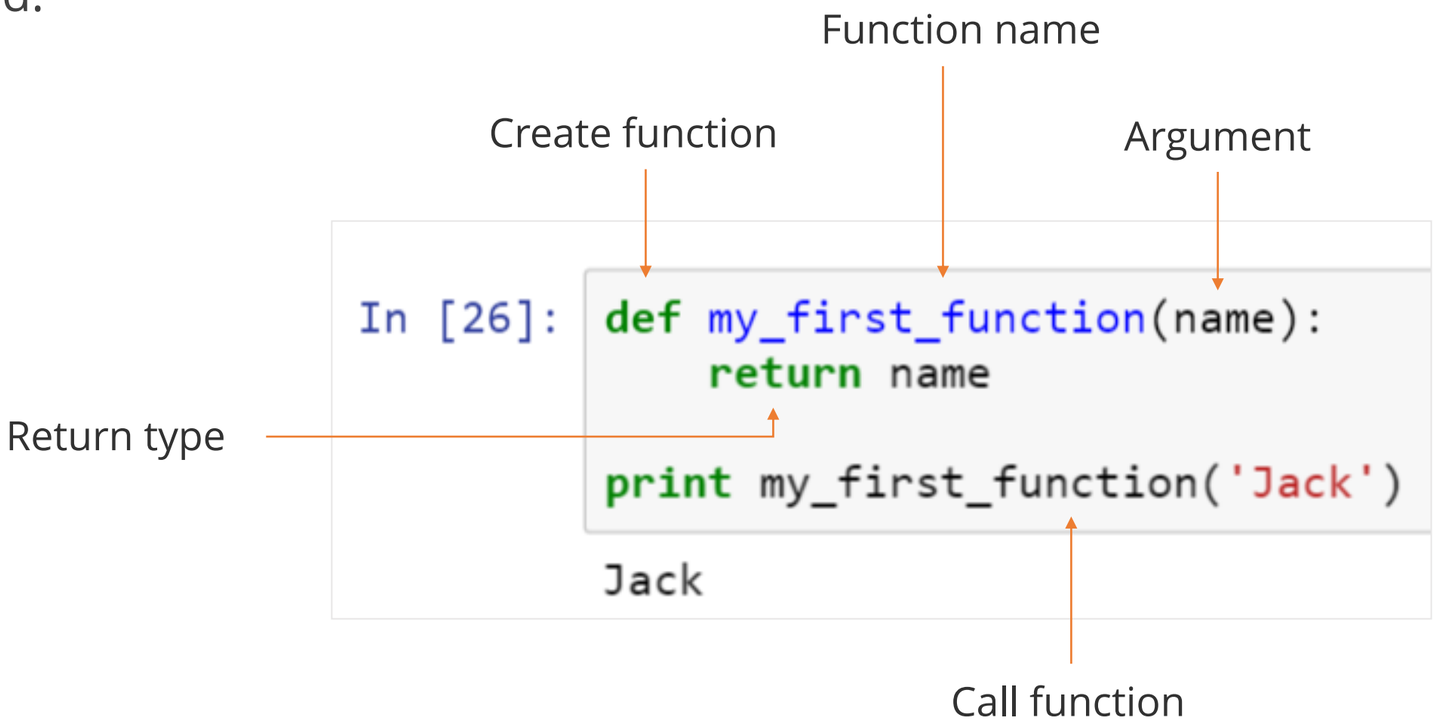
Properties
• Outcome of the function is communicated by return statement • Arguments in parenthesis are basically assignments

Use **def** to create a function and assign it a name.

Functions: Considerations

Some important points to consider while defining functions:

- A function should always have a “return” value.
- If “return” is not defined, then it returns “None.”
- Function overloading is not permitted.



Functions: Returning Values

You can use a function to return a single value or multiple values.

```
In [256]: def add_two_numbers(num1, num2):
              return num1+num2

          number1 = 23
          number2  = 47.5
          result = add_two_numbers(number1,number2)
          result
```

Create function

Call function

```
Out[256]: 70.5
```

```
In [257]: def profile():
              age = 21
              height = 5.5
              weight = 130
              return age, height, weight

          age, height, weight = profile()
```

Create function

Multiple return

Call function

```
In [258]: print age, height, weight

          21 5.5 130
```

Built-in Sequence Functions

The built-in sequence functions of Python are as follows:

enumerate
Indexes data to keep track of indices and corresponding data mapping

sorted
Returns the new sorted list for the given sequence

reversed
Iterates the data in reverse order

Zip
Creates lists of tuples by pairing up elements of lists, tuples, or other sequence

Built-in Sequence Functions: enumerate

```
In [20]: store_list = ['McDonnald','Taco Bell', 'Dunkin','Wendys','Chipotle' ]
```

List of food stores

```
In [21]: for position,name in enumerate(store_list):
             print position, name

0 McDonnald
1 Taco Bell
2 Dunkin
3 Wendys
4 Chipotle
```

Print data element and index using enumerate method

```
In [22]: store_map = dict((name,position) for  position,name in enumerate(store_list))
```

Create a data element and index map using dict

```
In [23]: store_map

Out[23]: {'Chipotle': 4, 'Dunkin': 2, 'McDonnald': 0, 'Taco Bell': 1, 'Wendys': 3}
```

View the store map in the form of key-value pair

Built-in Sequence Functions: sorted

This screen explains the **sorted** function

```
In [27]: sorted([91,43,65,56,7,33,21])
Out[27]: [7, 21, 33, 43, 56, 65, 91]
```

Sort numbers

```
In [28]: sorted('the data science')
Out[28]: [' ',
          ' ',
          ' ',
          'a',
          'a',
          'c',
          'c',
          'd',
          'e',
          'e',
          'e',
          'e',
          'h',
          'i',
          'n',
          's',
          't',
          't']
```

Sort a string value

Built-in Sequence Functions: reversed and zip

Let us see how to use reversed and zip functions

```
In [50]: num_list = range(15)
```

Create a list of numbers for range 15

```
In [51]: list(reversed(num_list))
```

Use reversed function to reverse the order

```
Out[51]: [14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, 0]
```

```
In [52]: subjects = ['math','statistics','algebra']
         subject_count = ['one','two','three']
```

Define list of subjects and count

```
In [53]: total_subject = zip(subjects,subject_count)
         total_subject
```

Zip function to pair the data elements of lists

```
Out[53]: [('math', 'one'), ('statistics', 'two'), ('algebra', 'three')]
```

Returns list of tuples

```
In [54]: type(total_subject)
```

View type

```
Out[54]: list
```

Control Flow: if, elif, else

The “if”, “elif,” and “else” statements are the most commonly used control flow statements.

```
In [341]: age = 21

In [342]: if age<18:
              print 'minor'
          else:
              print 'adult'

adult

In [343]: marks = 81

In [344]: if marks>90:
              print 'grade A'
          elif 80<=marks<=90:
              print 'grade B'
          elif 70<=marks<=80:
              print 'grade c'
          elif 60<=marks<=70:
              print 'grade d'
          else:
              print 'grade f'

grade B
```

If condition

Else block

Nested if, elif and else

Control Flow: “for” Loops

A “for” loop is used to iterate over a collection (like a list or tuple) or an iterator.

```
In [278]: stock_tickers =['AAPL','MSFT','GOOGL',None,'AMZN','CSCO','ORCL']
```

```
In [279]: for tickers in (stock_tickers):
              if(tickers is None):
                  continue
              print tickers
```

For loop iterator

The ‘continue’ statement

```
AAPL
MSFT
GOOGL
AMZN
CSCO
ORCL
```

```
In [280]: for tickers in (stock_tickers):
              if(tickers is None):
                  break
              print tickers
```

The ‘break’ statement

```
AAPL
MSFT
GOOGL
```

Control Flow: “while” Loops

A while loop specifies a condition and a block of code that is to be executed until the condition evaluates to False or the loop is explicitly ended with break.

```
In [283]: temperature =   100
          while temperature > 95:
              print(temperature)
              temperature = temperature - 1
```

While condition

```
100
99
98
97
96
```

Control Flow: Exception Handling

Handling Python errors or exceptions gracefully is an important part of building robust programs and algorithms.

```
In [307]: def test_float(number):
              return float(number)
```

Create function

```
In [308]: test_float(7.32453)

Out[308]: 7.32453
```

```
In [309]: test_float('test float')
```

Pass wrong argument type

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
<ipython-input-309-d3d4bead5bfb> in <module>()
----> 1 test_float('test float')

<ipython-input-307-c9efb2931c9f> in test_float(number)
      1 def test_float(number):
----> 2     return float(number)

ValueError: could not convert string to float: test float
```

Error

```
In [310]: def test_float(number):
              try:
                  return float(number)
              except ValueError:
                  return 'not a number, the input value is',number
```

Exception handling with try –except block

```
In [311]: test_float('test')

Out[311]: ('not a number, the input value is', 'test')
```

Quiz

QUIZ

1

What is the data type of the object x = 3 * 7.5?

a. Int

b. Float

c. String

d. None of the above

QUIZ

1

What is the data type of the object x = 3 * 7.5?

a. Int

b. Float

c. String

d. None of the above

The correct answer is **b** .

Explanation: Since one of the operands is float, the *x* variable will also be of the float data type.

QUIZ 2

Which of the data structures can be modified? *Select all that apply.*

a. tuple

b. list

c. dict

d. set

QUIZ 2

Which of the data structures can be modified? *Select all that apply.*

a. tuple

b. list

c. dict

d. set

The correct answer is **b, c, d**

Explanation: Only a tuple is immutable and cannot be modified. All the other data structures can be modified.

QUIZ

3

What will be the output of the following code?

```
In [350]: summit_venue = ['NYC','LA','Miami','London','Madrid','Paris']
          summit_venue[3:-1]
```

a. ['NYC', 'Madrid']

b. ['London', 'Madrid']

c. ['Miami', 'Madrid']

d. ['Miami', 'Paris']

QUIZ

3

What will be the output of the following code?

```
In [350]: summit_venue = ['NYC','LA','Miami','London','Madrid','Paris']
          summit_venue[3:-1]
```

a. ['NYC', 'Madrid']

b. ['London', 'Madrid']

c. ['Miami', 'Madrid']

d. ['Miami', 'Paris']

The correct answer is **b** .

Explanation: Slicing starts at the first index and stops before the second index. Here, the element at index 3 is "London" and the element before index -1 is "Madrid."

QUIZ

4

Which of the following data structures is preferred to contain a unique collection of values?

a. dict

b. list

c. set

d. tuple

QUIZ

4

Which of the following data structures is preferred to contain a unique collection of values?

a. dict

b. list

c. set

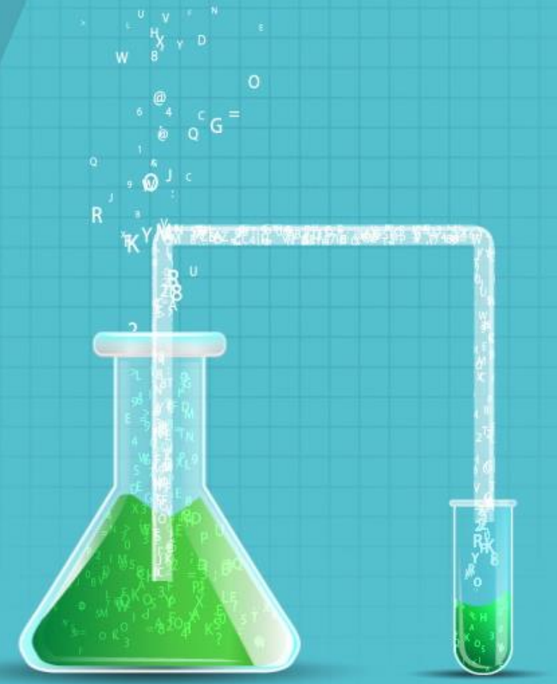
d. tuple

The correct answer is **c** .

Explanation: A set is used when a unique collection of values is desired.

Key Takeaways

- Download Python 2.7 version from Anaconda and install Jupyter notebook.
- When you assign values to variables, you create references and not duplicates.
- Integers, floats, strings, None, and Boolean are some of the data types supported by Python.
- Tuples, lists, dicts, and sets are some of the data structures of Python.
- You can use indices to access individual or a range of elements in a data structure.
- The “in”, “+”, and “*” are some of the basic operators.
- Functions are the primary and the most important methods of code organization and reuse in Python.
- The conditional “if”, “elif” statements, “while” and “for” loops, and exception handling are some important control flow statements.



This concludes “Python: Environment Setup and Essentials.”

The next lesson is “Mathematical Computing with Python (NumPy).”