CHEAT SHEET'S

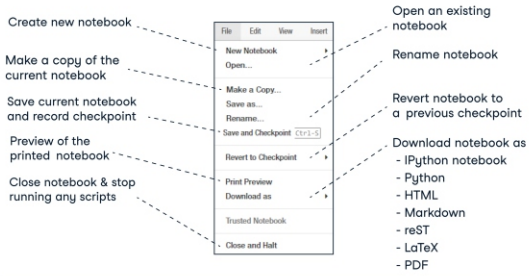
DATA SCIENCE, MACHINE LEARNING & NEURAL NETWORKS.

1. **Jupyter Notebook**
2. **Python** (high-level, general-purpose programming language)
3. **Sql** (Structured Query Language)
4. **Numpy** (N-dimentionsal arrays)
5. **Pandas** (Seires, DataFrames)
6. **Matplotlib** (Visualization)
7. **Seaborn** (Visualization)
8. **Scipy** (Visualization)
9. **Bokeh** (Visualization)
10. **Folium** (Map-Visualization)
11. **Scikit-Learn** (Model Building)
12. **Keras** (Creating deep models)
13. **spaCy** (pre-process text for deep learning)
14. **Pyspark SQL** (API)
15. **Pyspark RDD** (Parallel processing on a cluster)
16. **BeautifulSoup** (Web Scraping)
17. **Selenium** (Web Scraping)
18. **Data Wrangling**
19. **Importing Data**
20. **Project Steps** (Data Extraction, Data Cleaning, Data Wrangling, Analysis, Action)

~ By G PREMSAGAR

Python For Data Science
Jupyter Cheat Sheet

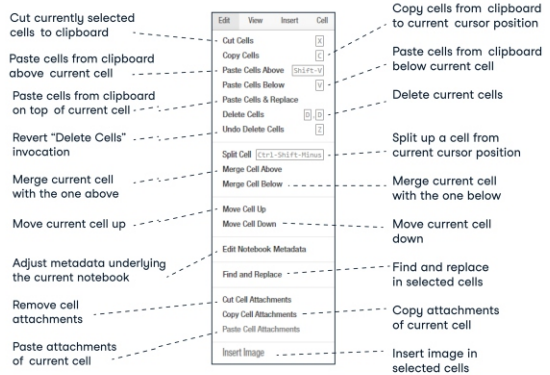
> Saving/Loading Notebooks



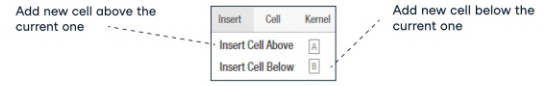
> Writing Code And Text

Code and text are encapsulated by 3 basic cell types: markdown cells, code cells, and raw NBConvert cells

Edit Cells



Insert Cells

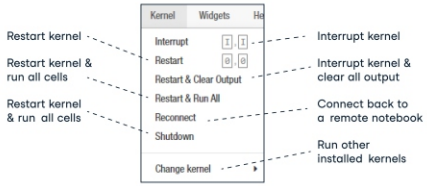


> Working with Different Programming Languages

Kernels provide computation and communication with front-end interfaces like the notebooks. There are three main kernels:

IPython IRkernel IJulia

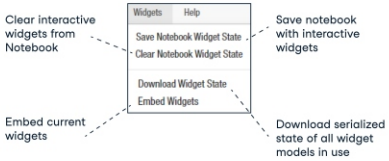
Installing Jupyter Notebook will automatically install the IPython kernel.



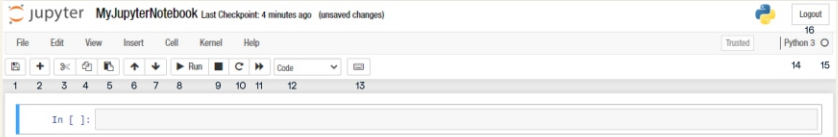
> Widgets

Notebook widgets provide the ability to visualize and control changes in your data, often as a control like a slider, textbox, etc.

You can use them to build interactive GUIs for your notebooks or to synchronize stateful and stateless information between Python and JavaScript.

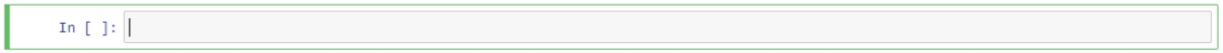


Command Mode:

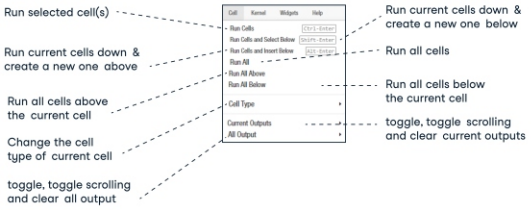


1. Save and checkpoint
2. Insert cell below
3. Cut cell
4. Copy cell(s)
5. Paste cell(s) below
6. Move cell up
7. Move cell down
8. Run current cell
9. Interrupt kernel
10. Restart kernel
11. Restart kernel and re-run notebook
12. Display characteristics
13. Open command palette
14. Current kernel
15. Kernel status
16. Log out from notebook server

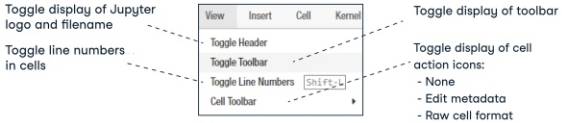
Edit Mode:



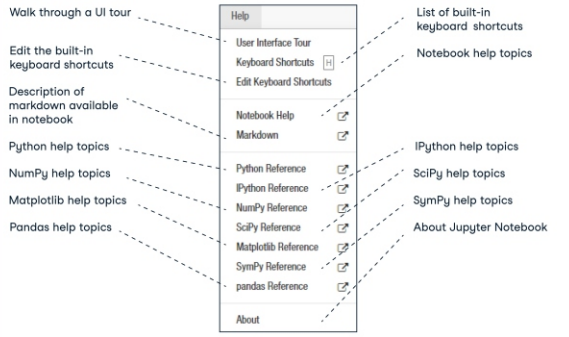
Executing Cells



View Cells



Asking For Help



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Python For Data Science

python™ Basics Cheat Sheet

> Variables and Data Types

Variable Assignment

```
>>> x=5
>>> x
 5
```

Calculations With Variables

```
>>> x+2 #Sum of two variables
 7
>>> x-2 #Subtraction of two variables
 3
>>> x*2 #Multiplication of two variables
 10
```

```
>>> x**2 #Exponentiation of a variable
 25
>>> x%2 #Remainder of a variable
 1
>>> x/float(2) #Division of a variable
 2.5
```

Types and Type Conversion

```
str()
'5', '3.45', 'True' #Variables to strings
int()
5, 3, 1 #Variables to integers
```

```
float()
5.0, 1.0 #Variables to floats
bool()
True, True, True #Variables to booleans
```

> Libraries

Import Libraries

```
>>> import numpy
>>> import numpy as np
```

Selective import

```
>>> from math import pi
```

> Strings

```
>>> my_string = 'thisStringIsAwesome'
>>> my_string
 'thisStringIsAwesome'
```

String Operations

```
>>> my_string * 2
 'thisStringIsAwesomethisStringIsAwesome'
>>> my_string + 'Innit'
 'thisStringIsAwesomeInnit'
>>> 'm' in my_string
 True
```

String Indexing — Index starts at 0

```
>>> my_string[3]
>>> my_string[4:9]
```

String Methods

```
>>> my_string.upper() #String to uppercase
>>> my_string.lower() #String to lowercase
>>> my_string.count('w') #Count String elements
>>> my_string.replace('e', 'i') #Replace String elements
>>> my_string.strip() #Strip whitespaces
```

> NumPy Arrays — Also see Lists

```
>>> my_list = [1, 2, 3, 4]
>>> my_array = np.array(my_list)
>>> my_2darray = np.array([[1,2,3],[4,5,6]])
```

Selecting Numpy Array Elements — Index starts at 0

Subset

```
>>> my_array[1] #Select item at index 1
 2
```

Slice

```
>>> my_array[0:2] #Select items at index 0 and 1
 array([1, 2])
```

Subset 2D Numpy arrays

```
>>> my_2darray[:,0] #my_2darray[rows, columns]
 array([1, 4])
```

Numpy Array Operations

```
>>> my_array > 3
 array([False, False, False, True], dtype=bool)
>>> my_array * 2
 array([2, 4, 6, 8])
>>> my_array + np.array([5, 6, 7, 8])
 array([6, 8, 10, 12])
```

Numpy Array Functions

```
>>> my_array.shape #Get the dimensions of the array
>>> np.append(other_array) #Append items to an array
>>> np.insert(my_array, 1, 5) #Insert items in an array
>>> np.delete(my_array,[1]) #Delete items in an array
>>> np.mean(my_array) #Mean of the array
>>> np.median(my_array) #Median of the array
>>> my_array.corrcoef() #Correlation coefficient
>>> np.std(my_array) #Standard deviation
```

> Lists — Also see NumPy Arrays

```
>>> a = 'is'
>>> b = 'nice'
>>> my_list = ['my', 'list', a, b]
>>> my_list2 = [[4,5,6,7], [3,4,5,6]]
```

Selecting List Elements — Index starts at 0

Subset

```
>>> my_list[1] #Select item at index 1
>>> my_list[-3] #Select 3rd last item
```

Slice

```
>>> my_list[1:3] #Select items at index 1 and 2
>>> my_list[1:] #Select items after index 0
>>> my_list[:3] #Select items before index 3
>>> my_list[:] #Copy my_list
```

Subset Lists of Lists

```
>>> my_list2[1][0] #my_list[list][itemOflist]
>>> my_list2[1][:2]
```

List Operations

```
>>> my_list + my_list
['my', 'list', 'is', 'nice', 'my', 'list', 'is', 'nice']
>>> my_list * 2
['my', 'list', 'is', 'nice', 'my', 'list', 'is', 'nice']
>>> my_list2 > 4
True
```

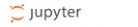
List Methods

```
>>> my_list.index(a) #Get the index of an item
>>> my_list.count(a) #Count an item
>>> my_list.append('!') #Append an item at a time
>>> my_list.remove('!') #Remove an item
>>> del(my_list[0:1]) #Remove an item
>>> my_list.reverse() #Reverse the list
>>> my_list.extend('!') #Append an item
>>> my_list.pop(-1) #Remove an item
>>> my_list.insert(0,'!') #Insert an item
>>> my_list.sort() #Sort the list
```

> Python IDEs (Integrated Development Environment)

Leading open data science platform powered by Python

Free IDE that is included with Anaconda



Create and share documents with live code

> Asking For Help

```
>>> help(str)
```

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SQL COMMANDS
CHEAT SHEET

SQL Commands

The commands in SQL are called Queries and they are of two types:

- Data Definition Query: The statements which defines the structure of a database, create tables, specify their keys, indexes and so on
- Data manipulation queries: These are the queries which can be edited.

  E.g.: Select, update and insert operation

Command	Syntax	Description
ALTER table	ALTER TABLE table_name ADD column_name datatype;	It is used to add columns to a table in a database
AND	SELECT column_name(s) FROM table_name WHERE column_1 = value_1 AND column_2 = value_2;	It is an operator that is used to combine two conditions
AS	SELECT column_name AS 'Alias' FROM table_name;	It is an keyword in SQL that is used to rename a column or table using an alias name
BETWEEN	SELECT column_name(s) FROM table_name WHERE column_name BETWEEN value_1 AND value_2;	It is an operator used to filter the result within a certain range
CASE	SELECT column_name, CASE WHEN condition THEN 'Result_1' WHEN condition THEN 'Result_2' ELSE 'Result_3' END FROM table_name;	It is a statement used to create different outputs inside a SELECT statement
COUNT	SELECT COUNT(column_name) FROM table_name;	It is a function that takes the name of a column as argument and counts the number of rows when the column is not NULL
Create TABLE	CREATE TABLE table_name (column_1 datatype, column_2 datatype, column_3 datatype);	It is used to create a new table in a database and specify the name of the table and columns inside it

Command	Syntax	Description
GROUP BY	SELECT column_name, COUNT(*) FROM table_name GROUP BY column_name;	It is an clause in SQL used for aggregate functions in collaboration with the SELECT statement
HAVING	SELECT column_name, COUNT(*) FROM table_name GROUP BY column_name HAVING COUNT(*) > value;	It is used in SQL because the WHERE keyword cannot be used in aggregating functions
INNER JOIN	SELECT column_name(s) FROM table_1 JOIN table_2 ON table_1.column_name = table_2.column_name;	It is used to combine rows from different tables if the Join condition goes TRUE
INSERT	INSERT INTO table_name (column_1, column_2, column_3) VALUES (value_1, 'value_2', value_3);	It is used to add new rows to a table
IS NULL/ IS NOT NULL	SELECT column_name(s) FROM table_name WHERE column_name IS NULL;	It is a operator used with the WHERE clause to check for the empty values
LIKE	SELECT column_name(s) FROM table_name WHERE column_name LIKE pattern;	It is an special operator used with the WHERE clause to search for a specific pattern in a column
LIMIT	SELECT column_name(s) FROM table_name LIMIT number;	It is a clause to specify the maximum number of rows the result set must have
MAX	SELECT MAX(column_name) FROM table_name;	It is a function that takes number of columns as an argument and return the largest value among them
MIN	SELECT MIN(column_name) FROM table_name;	It is a function that takes number of columns as an argument and return the smallest value among them
OR	SELECT column_name FROM table_name WHERE column_name = value_1 OR column_name = value_2;	It is an operator that is used to filter the result set to contain only the rows where either condition is TRUE
ORDER BY	SELECT column_name FROM table_name ORDER BY column_name ASC | DESC;	It is a clause used to sort the result set by a particular column either numerically or alphabetically

Command	Syntax	Description
OUTER JOIN	SELECT column_name(s) FROM table_1 LEFT JOIN table_2 ON table_1.column_name = table_2.column_name;	It is sued to combine rows from different tables even if the condition is NOT TRUE
ROUND	SELECT ROUND(column_name, integer) FROM table_name;	It is a function that takes the column name and a integer as an argument, and rounds the values in a column to the number of decimal places specified by an integer
SELECT	SELECT column_name FROM table_name;	It is a statement that is used to fetch data from a database
SELECT DISTINCT	SELECT DISTINCT column_name FROM table_name;	It is used to specify that the statement is a query which returns unique values in specified columns
SUM	SELECT SUM(column_name) FROM table_name;	It is function used to return sum of values from a particular column
UPDATE	UPDATE table_name SET some_column = some_value WHERE some_column = some_value;	It is used to edit rows in a table
WHERE	SELECT column_name(s) FROM table_name WHERE column_name operator value;	It is a clause used to filter the result set to include the rows where the condition is TRUE
WITH	WITH temporary_name AS (SELECT * FROM table_name) SELECT * FROM temporary_name WHERE column_name operator value;	It is used to store the result of a particular query in a temporary table using an alias
DELETE	DELETE FROM table_name WHERE some_column = some_value;	It is used to remove the rows from a table
AVG	SELECT AVG(column_name) FROM table_name;	It is used to aggregate a numeric column and return its average

Commands and syntax for querying data from Single Table	Commands and syntax for querying data from Multiple Table
SELECT c1 FROM t To select the data in Column c1 from table t	SELECT c1, c2 FROM t1 INNER JOIN t2 on condition Select column c1 and c2 from table t1 and perform an inner join between t1 and t2
SELECT * FROM t To select all rows and columns from table t	SELECT c1, c2 FROM t1 LEFT JOIN t2 on condition Select column c1 and c2 from table t1 and perform a left join between t1 and t2
SELECT c1 FROM t WHERE c1 = 'test' To select data in column c1 from table t, where c1=test	SELECT c1, c2 FROM t1 RIGHT JOIN t2 on condition Select column c1 and c2 from table t1 and perform a right join between t1 and t2
SELECT c1 FROM t ORDER BY c1 ASC (DESC) To select data in column c1 from table t either in ascending or descending order	SELECT c1, c2 FROM t1 FULL OUTER JOIN t2 on condition Select column c1 and c2 from table t1 and perform a full outer join between t1 and t2
SELECT c1 FROM t ORDER BY c1LIMIT n OFFSET offset To skip the offset of rows and return the next n rows	SELECT c1, c2 FROM t1 CROSS JOIN t2 Select column c1 and c2 from table t1 and produce a Cartesian product of rows in a table
SELECT c1, aggregate(c2) FROM t GROUP BY c1 To group rows using an aggregate function	SELECT c1, c2 FROM t1, t2 Select column c1 and c2 from table t1 and produce a Cartesian product of rows in a table
SELECT c1, aggregate(c2) FROM t GROUP BY c1HAVING condition Group rows using an aggregate function and filter these groups using 'HAVING' clause	SELECT c1, c2 FROM t1 A INNER JOIN t2 B on condition Select column c1 and c2 from table t1 and join it to itself using INNER JOIN clause

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SQL JOINs Cheat Sheet

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COLUMN AND TABLE ALIASES

Aliases give a temporary name to a **table** or a **column** in a table.

CAT AS c

cat_id	cat_name	mom_id	owner_id
1	Kitty	5	1
2	Hugo	1	2
3	Sam	2	2
4	Misty	1	NULL

OWNER AS o

id	name
1	John Smith
2	Danielle Davis

A **column alias** renames a column in the result. A **table alias** renames a table within the query. If you define a table alias, you must use it instead of the table name everywhere in the query. The AS keyword is optional in defining aliases.

```
SELECT
  o.name AS owner_name,
  c.cat_name
FROM cat   AS c
JOIN owner AS o
  ON c.owner_id = o.id;
```

cat_name	owner_name
Kitty	John Smith
Sam	Danielle Davis
Hugo	Danielle Davis

SELF JOIN

You can join a table to itself, for example, to show a parent-child relationship.

CAT AS child

cat_id	cat_name	owner_id	mom_id
1	Kitty	1	5
2	Hugo	2	1
3	Sam	2	2
4	Misty	NULL	1

CAT AS mom

cat_id	cat_name	owner_id	mom_id
1	Kitty	1	5
2	Hugo	2	1
3	Sam	2	2
4	Misty	NULL	1

Each occurrence of the table must be given a **different alias**. Each column reference must be preceded with an **appropriate table alias**.

```
SELECT
  child.cat_name AS child_name,
  mom.cat_name   AS mom_name
FROM cat AS child
JOIN cat AS mom
  ON child.mom_id = mom.cat_id;
```

child_name	mom_name
Hugo	Kitty
Sam	Hugo
Misty	Kitty

NON-EQUI SELF JOIN

You can use a **non-equality** in the ON condition, for example, to show **all different pairs** of rows.

TOY AS a

toy_id	toy_name	cat_id
3	mouse	1
5	ball	1
1	ball	3
4	mouse	4
2	spring	NULL

TOY AS b

cat_id	toy_id	toy_name
1	3	mouse
1	5	ball
3	1	ball
4	4	mouse
NULL	2	spring

```
SELECT
  a.toy_name AS toy_a,
  b.toy_name AS toy_b
FROM toy a
JOIN toy b
  ON a.cat_id < b.cat_id;
```

cat_a_id	toy_a	cat_b_id	toy_b
1	mouse	3	ball
1	ball	3	ball
1	mouse	4	mouse
1	ball	4	mouse
3	ball	4	mouse

MULTIPLE JOINS

You can join more than two tables together. First, two tables are joined, then the third table is joined to the result of the previous joining.

TOY AS t

toy_id	toy_name	cat_id
1	ball	3
2	spring	NULL
3	mouse	1
4	mouse	4
5	ball	1

CAT AS c

cat_id	cat_name	mom_id	owner_id
1	Kitty	5	1
2	Hugo	1	2
3	Sam	2	2
4	Misty	1	NULL

OWNER AS o

id	name
1	John Smith
2	Danielle Davis

JOIN & JOIN

```
SELECT
  t.toy_name,
  c.cat_name,
  o.name AS owner_name
FROM toy t
JOIN cat c
  ON t.cat_id = c.cat_id
JOIN owner o
  ON c.owner_id = o.id;
```

toy_name	cat_name	owner_name
ball	Kitty	John Smith
mouse	Kitty	John Smith
ball	Sam	Danielle Davis

JOIN & LEFT JOIN

```
SELECT
  t.toy_name,
  c.cat_name,
  o.name AS owner_name
FROM toy t
JOIN cat c
  ON t.cat_id = c.cat_id
LEFT JOIN owner o
  ON c.owner_id = o.id;
```

toy_name	cat_name	owner_name
ball	Kitty	John Smith
mouse	Kitty	John Smith
ball	Sam	Danielle Davis
mouse	Misty	NULL

LEFT JOIN & LEFT JOIN

```
SELECT
  t.toy_name,
  c.cat_name,
  o.name AS owner_name
FROM toy t
LEFT JOIN cat c
  ON t.cat_id = c.cat_id
LEFT JOIN owner o
  ON c.owner_id = o.id;
```

toy_name	cat_name	owner_name
ball	Kitty	John Smith
mouse	Kitty	John Smith
ball	Sam	Danielle Davis
mouse	Misty	NULL
spring	NULL	NULL

JOIN WITH MULTIPLE CONDITIONS

You can use multiple JOIN conditions using the **ON** keyword once and the **AND** keywords as many times as you need.

CAT AS c

cat_id	cat_name	mom_id	owner_id	age
1	Kitty	5	1	17
2	Hugo	1	2	10
3	Sam	2	2	5
4	Misty	1	NULL	11

OWNER AS o

id	name	age
1	John Smith	18
2	Danielle Davis	10

```
SELECT
  cat_name,
  o.name AS owner_name,
  c.age  AS cat_age,
  o.age  AS owner_age
FROM cat c
JOIN owner o
  ON c.owner_id = o.id
 AND c.age < o.age;
```

cat_name	owner_name	age	age
Kitty	John Smith	17	18
Sam	Danielle Davis	5	10

Python For Data Science
NumPy Cheat Sheet

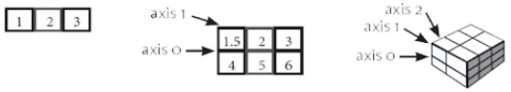
Numpy

The NumPy library is the core library for scientific computing in Python. It provides a high-performance multidimensional array object, and tools for working with these arrays

Use the following import convention:

```
>>> import numpy as np
```

NumPy Arrays



> Creating Arrays

```
>>> a = np.array([1,2,3])
>>> b = np.array([(1.5,2,3), (4,5,6)], dtype = float)
>>> c = np.array([[(1.5,2,3), (4,5,6)],[(3,2,1), (4,5,6)]], dtype = float)
```

Initial Placeholders

```
>>> np.zeros((3,4)) #Create an array of zeros
>>> np.ones((2,3,4),dtype=np.int16) #Create an array of ones
>>> d = np.arange(10,25,5) #Create an array of evenly spaced values (step value)
>>> np.linspace(0,2,9) #Create an array of evenly spaced values (number of samples)
>>> e = np.full((2,2),7) #Create a constant array
>>> f = np.eye(2) #Create a 2X2 identity matrix
>>> np.random.random((2,2)) #Create an array with random values
>>> np.empty((3,2)) #Create an empty array
```

> I/O

Saving & Loading On Disk

```
>>> np.save('my_array', a)
>>> np.savez('array.npz', a, b)
>>> np.load('my_array.npy')
```

Saving & Loading Text Files

```
>>> np.loadtxt("myfile.txt")
>>> np.genfromtxt("my_file.csv", delimiter=',')
>>> np.savetxt("myarray.txt", a, delimiter=" ")
```

> Asking For Help

```
>>> np.info(np.ndarray.dtype)
```

> Inspecting Your Array

```
>>> a.shape #Array dimensions
>>> len(a) #Length of array
>>> b.ndim #Number of array dimensions
>>> e.size #Number of array elements
>>> b.dtype #Data type of array elements
>>> b.dtype.name #Name of data type
>>> b.astype(int) #Convert an array to a different type
```

> Data Types

```
>>> np.int64 #Signed 64-bit integer types
>>> np.float32 #Standard double-precision floating point
>>> np.complex #Complex numbers represented by 128 floats
>>> np.bool #Boolean type storing TRUE and FALSE values
>>> np.object #Python object type
>>> np.string_ #Fixed-length string type
>>> np.unicode_ #Fixed-length unicode type
```

> Array Mathematics

Arithmetic Operations

```
>>> g = a - b #Subtraction
 array([[-0.5, 0. , 0. ],
        [-3. , -3. , -3. ]])
>>> np.subtract(a,b) #Subtraction
>>> b + a #Addition
 array([[ 2.5, 4. , 6. ],
        [ 5. , 7. , 9. ]])
>>> np.add(b,a) #Addition
>>> a / b #Division
 array([[ 0.66666667, 1. , 1. ],
        [ 0.25 , 0.4 , 0.5 ]])
>>> np.divide(a,b) #Division
>>> a * b #Multiplication
 array([[ 1.5, 4. , 9. ],
        [ 4. , 10. , 18. ]])
>>> np.multiply(a,b) #Multiplication
>>> np.exp(b) #Exponentiation
>>> np.sqrt(b) #Square root
>>> np.sin(a) #Print sines of an array
>>> np.cos(b) #Element-wise cosine
>>> np.log(a) #Element-wise natural logarithm
>>> e.dot(f) #Dot product
 array([[ 7., 7.],
        [ 7., 7.]])
```

Comparison

```
>>> a == b #Element-wise comparison
 array([[False, True, True],
        [False, False, False]], dtype=bool)
>>> a < 2 #Element-wise comparison
 array([True, False, False], dtype=bool)
>>> np.array_equal(a, b) #Array-wise comparison
```

Aggregate Functions

```
>>> a.sum() #Array-wise sum
>>> a.min() #Array-wise minimum value
>>> b.max(axis=0) #Maximum value of an array row
>>> b.cumsum(axis=1) #Cumulative sum of the elements
>>> a.mean() #Mean
>>> np.median(b) #Median
>>> np.corrcoef(a) #Correlation coefficient
>>> np.std(b) #Standard deviation
```

> Copying Arrays

```
>>> h = a.view() #Create a view of the array with the same data
>>> np.copy(a) #Create a copy of the array
>>> h = a.copy() #Create a deep copy of the array
```

> Sorting Arrays

```
>>> a.sort() #Sort an array
>>> c.sort(axis=0) #Sort the elements of an array's axis
```

> Subsetting, Slicing, Indexing

Subsetting

```
>>> a[2] #Select the element at the 2nd index
3
>>> b[1,2] #Select the element at row 1 column 2 (equivalent to b[1][2])
 6.0
```

Slicing

```
>>> a[0:2] #Select items at index 0 and 1
 array([1, 2])
>>> b[0:2,1] #Select items at rows 0 and 1 in column 1
 array([ 2., 5.])
>>> b[:1] #Select all items at row 0 (equivalent to b[0:1, :])
 array([[1.5, 2., 3.]])
>>> c[1,...] #Same as [1,:,:]
 array([[[ 3., 2., 1.],
         [ 4., 5., 6.]]])
>>> a[ : :-1] #Reversed array a array([3, 2, 1])
```

Boolean Indexing

```
>>> a[a<2] #Select elements from a less than 2
 array([1])
```

Fancy Indexing

```
>>> b[[1, 0, 1, 0],[0, 1, 2, 0]] #Select elements (1,0),(0,1),(1,2) and (0,0)
 array([ 4. , 2. , 6. , 1.5])
>>> b[[1, 0, 1, 0]][:,[0,1,2,0]] #Select a subset of the matrix's rows and columns
 array([[ 4. ,5. , 6. , 4. ],
        [ 1.5, 2. , 3. , 1.5],
        [ 4. , 5. , 6. , 4. ],
        [ 1.5, 2. , 3. , 1.5]])
```

> Array Manipulation

Transposing Array

```
>>> i = np.transpose(b) #Permute array dimensions
>>> i.T #Permute array dimensions
```

Changing Array Shape

```
>>> b.ravel() #Flatten the array
>>> g.reshape(3,-2) #Reshape, but don't change data
```

Adding/Removing Elements

```
>>> h.resize((2,6)) #Return a new array with shape (2,6)
>>> np.append(h,g) #Append items to an array
>>> np.insert(a, 1, 5) #Insert items in an array
>>> np.delete(a,[1]) #Delete items from an array
```

Combining Arrays

```
>>> np.concatenate((a,d),axis=0) #Concatenate arrays
 array([ 1, 2, 3, 10, 15, 20])
>>> np.vstack((a,b)) #Stack arrays vertically (row-wise)
 array([[ 1. , 2. , 3. ],
        [ 1.5, 2. , 3. ],
        [ 4. , 5. , 6. ]])
>>> np.r_[e,f] #Stack arrays vertically (row-wise)
>>> np.hstack((e,f)) #Stack arrays horizontally (column-wise)
 array([[ 7., 7., 1., 0.],
        [ 7., 7., 0., 1.]])
>>> np.column_stack((a,d)) #Create stacked column-wise arrays
 array([[ 1, 10],
        [ 2, 15],
        [ 3, 20]])
>>> np.c_[a,d] #Create stacked column-wise arrays
```

Splitting Arrays

```
>>> np.hsplit(a,3) #Split the array horizontally at the 3rd index
 [array([1]),array([2]),array([3])]
>>> np.vsplit(c,2) #Split the array vertically at the 2nd index
 [array([[[ 1.5, 2. , 1. ],
          [ 4. , 5. , 6. ]]]),
 array([[[ 3., 2., 3.],
         [ 4., 5., 6.]]])]
```

~SagaR

Python For Data Science
Pandas Basics Cheat Sheet

Pandas

The **Pandas** library is built on NumPy and provides easy-to-use **data structures** and **data analysis** tools for the Python programming language.

Use the following import convention:

```
>>> import pandas as pd
```

> Pandas Data Structures

Series

A **one-dimensional** labeled array capable of holding any data type

Index →

a	3
b	-5
c	7
d	4

```
>>> s = pd.Series([3, -5, 7, 4], index=['a', 'b', 'c', 'd'])
```

Dataframe

A **two-dimensional** labeled data structure with columns of potentially different types

Columns →

Index →	Country	Capital	Population
0	Belgium	Brussels	11190846
1	India	New Delhi	1303171035
2	Brazil	Brasilia	207847528

```
>>> data = {'Country': ['Belgium', 'India', 'Brazil'],
            'Capital': ['Brussels', 'New Delhi', 'Brasilia'],
            'Population': [11190846, 1303171035, 207847528]}
>>> df = pd.DataFrame(data,
                      columns=['Country', 'Capital', 'Population'])
```

> Dropping

```
>>> s.drop(['a', 'c']) #Drop values from rows (axis=0)
>>> df.drop('Country', axis=1) #Drop values from columns(axis=1)
```

> Asking For Help

```
>>> help(pd.Series.loc)
```

> Sort & Rank

```
>>> df.sort_index() #Sort by labels along an axis
>>> df.sort_values(by='Country') #Sort by the values along an axis
>>> df.rank() #Assign ranks to entries
```

> I/O

Read and Write to CSV

```
>>> pd.read_csv('file.csv', header=None, nrows=5)
>>> df.to_csv('myDataFrame.csv')
```

Read and Write to Excel

```
>>> pd.read_excel('file.xlsx')
>>> df.to_excel('dir/myDataFrame.xlsx', sheet_name='Sheet1')
```

Read multiple sheets from the same file

```
>>> xlsx = pd.ExcelFile('file.xls')
>>> df = pd.read_excel(xlsx, 'Sheet1')
```

Read and Write to SQL Query or Database Table

```
>>> from sqlalchemy import create_engine
>>> engine = create_engine('sqlite:///:memory:')
>>> pd.read_sql("SELECT * FROM my_table;", engine)
>>> pd.read_sql_table('my_table', engine)
>>> pd.read_sql_query("SELECT * FROM my_table;", engine)
```

read_sql() **is a convenience wrapper around** read_sql_table() **and** read_sql_query()

```
>>> df.to_sql('myDf', engine)
```

> Selection

Also see NumPy Arrays

Getting

```
>>> s['b'] #Get one element
-5
>>> df[1:] #Get subset of a DataFrame
  Country Capital Population
1 India New Delhi 1303171035
2 Brazil Brasilia 207847528
```

Selecting, Boolean Indexing & Setting

By Position

```
>>> df.iloc[[0],[0]] #Select single value by row & column
'Belgium'
>>> df.iat([0],[0])
'Belgium'
```

By Label

```
>>> df.loc[[0], ['Country']] #Select single value by row & column labels
'Belgium'
>>> df.at([0], ['Country'])
'Belgium'
```

By Label/Position

```
>>> df.ix[2] #Select single row of subset of rows
Country Brazil
Capital Brasilia
Population 207847528
>>> df.ix[:,'Capital'] #Select a single column of subset of columns
0 Brussels
1 New Delhi
2 Brasilia
>>> df.ix[1,'Capital'] #Select rows and columns
'New Delhi'
```

Boolean Indexing

```
>>> s[~(s > 1)] #Series s where value is not >1
>>> s[(s < -1) | (s > 2)] #s where value is <-1 or >2
>>> df[df['Population']>1200000000] #Use filter to adjust DataFrame
```

Setting

```
>>> s['a'] = 6 #Set index a of Series s to 6
```

> Retrieving Series/DataFrame Information

Basic Information

```
>>> df.shape #(rows,columns)
>>> df.index #Describe index
>>> df.columns #Describe DataFrame columns
>>> df.info() #Info on DataFrame
>>> df.count() #Number of non-NA values
```

Summary

```
>>> df.sum() #Sum of values
>>> df.cumsum() #Cummulative sum of values
>>> df.min()/df.max() #Minimum/maximum values
>>> df.idxmin()/df.idxmax() #Minimum/Maximum index value
>>> df.describe() #Summary statistics
>>> df.mean() #Mean of values
>>> df.median() #Median of values
```

> Applying Functions

```
>>> f = lambda x: x*2
>>> df.apply(f) #Apply function
>>> df.applymap(f) #Apply function element-wise
```

> Data Alignment

Internal Data Alignment

NA values are introduced in the indices that don't overlap:

```
>>> s3 = pd.Series([7, -2, 3], index=['a', 'c', 'd'])
>>> s + s3
a 10.0
b NaN
c 5.0
d 7.0
```

Arithmetic Operations with Fill Methods

You can also do the internal data alignment yourself with the help of the fill methods:

```
>>> s.add(s3, fill_values=0)
a 10.0
b -5.0
c 5.0
d 7.0
>>> s.sub(s3, fill_value=2)
>>> s.div(s3, fill_value=4)
>>> s.mul(s3, fill_value=3)
```

~SagaR

Python For Data Science
Matplotlib Cheat Sheet

Matplotlib

Matplotlib is a Python 2D plotting library which produces publication-quality figures in a variety of hardcopy formats and interactive environments across platforms.

> Prepare The Data

1D Data

```
>>> import numpy as np
>>> x = np.linspace(0, 10, 100)
>>> y = np.cos(x)
>>> z = np.sin(x)
```

2D Data or Images

```
>>> data = 2 * np.random.random((10, 10))
>>> data2 = 3 * np.random.random((10, 10))
>>> Y, X = np.mgrid[-3:3:100j, -3:3:100j]
>>> U = -1 - X**2 + Y
>>> V = 1 + X - Y**2
>>> from matplotlib.cbook import get_sample_data
>>> img = np.load(get_sample_data('axes_grid/bivariate_normal.npy'))
```

> Create Plot

```
>>> import matplotlib.pyplot as plt
```

Figure

```
>>> fig = plt.figure()
>>> fig2 = plt.figure(figsize=plt.figaspect(2.0))
```

Axes

All plotting is done with respect to an Axes. In most cases, a subplot will fit your needs.
A subplot is an axes on a grid system.

```
>>> fig.add_axes()
>>> ax1 = fig.add_subplot(221) #row-col-num
>>> ax3 = fig.add_subplot(212)
>>> fig3, axes = plt.subplots(nrows=2,ncols=2)
>>> fig4, axes2 = plt.subplots(ncols=3)
```

> Save Plot

```
>>> plt.savefig('foo.png')  #Save figures
>>> plt.savefig('foo.png', transparent=True)  #Save transparent figures
```

> Show Plot

```
>>> plt.show()
```

> Plotting Routines

1D Data

```
>>> fig, ax = plt.subplots()
>>> lines = ax.plot(x,y) #Draw points with lines or markers connecting them
>>> ax.scatter(x,y) #Draw unconnected points, scaled or colored
>>> axes[0,0].bar([1,2,3],[3,4,5]) #Plot vertical rectangles (constant width)
>>> axes[1,0].barh([0.5,1,2.5],[0,1,2]) #Plot horiontal rectangles (constant height)
>>> axes[1,1].axhline(0.45) #Draw a horizontal line across axes
>>> axes[0,1].axvline(0.65) #Draw a vertical line across axes
>>> ax.fill(x,y,color='blue') #Draw filled polygons
>>> ax.fill_between(x,y,color='yellow') #Fill between y-values and 0
```

2D Data

```
>>> fig, ax = plt.subplots()
>>> im = ax.imshow(img, #Colormapped or RGB arrays
                   cmap='gist_earth',
                   interpolation='nearest',
                   vmin=-2,
                   vmax=2)
>>> axes2[0].pcolor(data2) #Pseudocolor plot of 2D array
>>> axes2[0].pcolormesh(data) #Pseudocolor plot of 2D array
>>> CS = plt.contour(Y,X,U) #Plot contours
>>> axes2[2].contourf(data1) #Plot filled contours
>>> axes2[2]= ax.clabel(CS) #Label a contour plot
```

Vector Fields

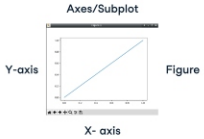
```
>>> axes[0,1].arrow(0,0,0.5,0.5) #Add an arrow to the axes
>>> axes[1,1].quiver(y,z) #Plot a 2D field of arrows
>>> axes[0,1].streamplot(X,Y,U,V) #Plot a 2D field of arrows
```

Data Distributions

```
>>> ax1.hist(y) #Plot a histogram
>>> ax3.boxplot(y) #Make a box and whisker plot
>>> ax3.violinplot(z) #Make a violin plot
```

> Plot Anatomy & Workflow

Plot Anatomy



Workflow

The basic steps to creating plots with matplotlib are:

1 Prepare Data 2 Create Plot 3 Plot 4 Customized Plot 5 Save Plot 6 Show Plot

```
>>> import matplotlib.pyplot as plt
>>> x = [1,2,3,4] #Step 1
>>> y = [10,20,25,30]
>>> fig = plt.figure() #Step 2
>>> ax = fig.add_subplot(111) #Step 3
>>> ax.plot(x, y, color='lightblue', linewidth=3) #Step 3, 4
>>> ax.scatter([2,4,6],
               [5,15,25],
               color='darkgreen',
               marker='^')
>>> ax.set_xlim(1, 6.5)
>>> plt.savefig('foo.png') #Step 5
>>> plt.show() #Step 6
```

> Close and Clear

```
>>> plt.cla() #Clear an axis
>>> plt.clf() #Clear the entire figure
>>> plt.close() #Close a window
```

> Plotting Cutomize Plot

Colors, Color Bars & Color Maps

```
>>> plt.plot(x, x, x, x**2, x, x**3)
>>> ax.plot(x, y, alpha = 0.4)
>>> ax.plot(x, y, c='k')
>>> fig.colorbar(im, orientation='horizontal')
>>> im = ax.imshow(img,
                   cmap='seismic')
```

Markers

```
>>> fig, ax = plt.subplots()
>>> ax.scatter(x,y,marker=".")
>>> ax.plot(x,y,marker="o")
```

Linestyles

```
>>> plt.plot(x,y,linewidth=4.0)
>>> plt.plot(x,y,ls='solid')
>>> plt.plot(x,y,ls='--')
>>> plt.plot(x,y,'--',x**2,y**2,'-.')
>>> plt.setp(lines,color='r',linewidth=4.0)
```

Text & Annotations

```
>>> ax.text(1,
            -2.1,
            'Example Graph',
            style='italic')
>>> ax.annotate("Sine",
                xy=(8, 0),
                xycoords='data',
                xytext=(10.5, 0),
                textcoords='data',
                arrowprops=dict(arrowstyle="->",
                connectionstyle="arc3"),)
```

Mathtext

```
>>> plt.title(r'$sigma_i=15$', fontsize=20)
```

Limits, Legends and Layouts

Limits & Autoscaling

```
>>> ax.margins(x=0.0,y=0.1) #Add padding to a plot
>>> ax.axis('equal') #Set the aspect ratio of the plot to 1
>>> ax.set(xlim=[0,10.5],ylim=[-1.5,1.5]) #Set limits for x-and y-axis
>>> ax.set_xlim(0,10.5) #Set limits for x-axis
```

Legends

```
>>> ax.set(title='An Example Axes', #Set a title and x-and y-axis labels
           ylabel='Y-Axis',
           xlabel='X-Axis')
>>> ax.legend(loc='best') #No overlapping plot elements
```

Ticks

```
>>> ax.xaxis.set(ticks=range(1,5), #Manually set x-ticks
                 ticklabels=[3,100,-12,"foo"])
>>> ax.tick_params(axis='y', #Make y-ticks longer and go in and out
                   direction='inout',
                   length=10)
```

Subplot Spacing

```
>>> fig3.subplots_adjust(wspace=0.5, #Adjust the spacing between subplots
                         hspace=0.3,
                         left=0.125,
                         right=0.9,
                         top=0.9,
                         bottom=0.1)
>>> fig.tight_layout() #Fit subplot(s) in to the figure area
```

Axis Spines

```
>>> ax1.spines['top'].set_visible(False)  #Make the top axis line for a plot invisible
>>> ax1.spines['bottom'].set_position(('outward',10)) #Move the bottom axis line outward
```

~SagaR

Python For Data Science
SciPy Cheat Sheet

SciPy

The **SciPy** library is one of the core packages for scientific computing that provides mathematical algorithms and convenience functions built on the NumPy extension of Python.

> Interacting With NumPy

Also see NumPy

```
>>> import numpy as np
>>> a = np.array([1,2,3])
>>> b = np.array([(1+5j,2j,3j), (4j,5j,6j)])
>>> c = np.array([[(1.5,2,3), (4,5,6)], [(3,2,1), (4,5,6)]])
```

Index Tricks

```
>>> np.mgrid[0:5,0:5] #Create a dense meshgrid
>>> np.ogrid[0:2,0:2] #Create an open meshgrid
>>> np.r_[[3,[0]*5,-1:1:10j] #Stack arrays vertically (row-wise)
>>> np.c_[b,c] #Create stacked column-wise arrays
```

Shape Manipulation

```
>>> np.transpose(b) #Permute array dimensions
>>> b.flatten() #Flatten the array
>>> np.hstack((b,c)) #Stack arrays horizontally (column-wise)
>>> np.vstack((a,b)) #Stack arrays vertically (row-wise)
>>> np.hsplit(c,2) #Split the array horizontally at the 2nd index
>>> np.vpslit(d,2) #Split the array vertically at the 2nd index
```

Polynomials

```
>>> from numpy import poly1d
>>> p = poly1d([3,4,5]) #Create a polynomial object
```

Vectorizing Functions

```
>>> def myfunc(a): if a < 0:
        return a*2
        else:
        return a/2
>>> np.vectorize(myfunc) #Vectorize functions
```

Type Handling

```
>>> np.real(c) #Return the real part of the array elements
>>> np.imag(c) #Return the imaginary part of the array elements
>>> np.real_if_close(c,tol=1000) #Return a real array if complex parts close to 0
>>> np.cast['f'](np.pi) #Cast object to a data type
```

Other Useful Functions

```
>>> np.angle(b,deg=True) #Return the angle of the complex argument
>>> g = np.linspace(0,np.pi,num=5) #Create an array of evenly spaced values(number of samples)
>>> g [3:] += np.pi
>>> np.unwrap(g) #Unwrap
>>> np.logspace(0,10,3) #Create an array of evenly spaced values (log scale)
>>> np.select([c<4],[c*2]) #Return values from a list of arrays depending on conditions
>>> misc.factorial(a) #Factorial
>>> misc.comb(10,3,exact=True) #Combine N things taken at k time
>>> misc.central_diff_weights(3) #Weights for Np-point central derivative
>>> misc.derivative(myfunc,1.0) #Find the n-th derivative of a function at a point
```

> Linear Algebra

Also see NumPy

You'll use the `linalg` and `sparse` modules.
Note that `scipy.linalg` contains and expands on `numpy.linalg`.

```
>>> from scipy import linalg, sparse
```

Creating Matrices

```
>>> A = np.matrix(np.random.random((2,2)))
>>> B = np.asmatrix(b)
>>> C = np.mat(np.random.random((10,5)))
>>> D = np.mat([[3,4], [5,6]])
```

Basic Matrix Routines

Inverse

```
>>> A.I #Inverse
>>> linalg.inv(A) #Inverse
>>> A.T #Tranpose matrix
>>> A.H #Conjugate transposition
>>> np.trace(A) #Trace
```

Norm

```
>>> linalg.norm(A) #Frobenius norm
>>> linalg.norm(A,1) #L1 norm (max column sum)
>>> linalg.norm(A,np.inf) #L inf norm (max row sum)
```

Rank

```
>>> np.linalg.matrix_rank(C) #Matrix rank
```

Determinant

```
>>> linalg.det(A) #Determinant
```

Solving linear problems

```
>>> linalg.solve(A,b) #Solver for dense matrices
>>> E = np.mat(a).T #Solver for dense matrices
>>> linalg.lstsq(D,E) #Least-squares solution to linear matrix equation
```

Generalized inverse

```
>>> linalg.pinv(C) #Compute the pseudo-inverse of a matrix (least-squares solver)
>>> linalg.pinv2(C) #Compute the pseudo-inverse of a matrix  (SVD)
```

Creating Sparse Matrices

```
>>> F = np.eye(3, k=1) #Create a 2X2 identity matrix
>>> G = np.mat(np.identity(2)) #Create a 2x2 identity matrix
>>> C[C > 0.5] = 0
>>> H = sparse.csr_matrix(C) #Compressed Sparse Row matrix
>>> I = sparse.csc_matrix(D) #Compressed Sparse Column matrix
>>> J = sparse.dok_matrix(A) #Dictionary Of Keys matrix
>>> E.todense() #Sparse matrix to full matrix
>>> sparse.issparse_csc(A) #Identify sparse matrix
```

Sparse Matrix Routines

Inverse

```
>>> sparse.linalg.inv(I) #Inverse
```

Norm

```
>>> sparse.linalg.norm(I) #Norm
```

Solving linear problems

```
>>> sparse.linalg.spsolve(H,I) #Solver for sparse matrices
```

Sparse Matrix Functions

```
>>> sparse.linalg.expm(I) #Sparse matrix exponential
```

Sparse Matrix Decompositions

```
>>> la, v = sparse.linalg.eigs(F,1) #Eigenvalues and eigenvectors
>>> sparse.linalg.svds(H, 2) #SVD
```

> Asking For Help

```
>>> help(scipy.linalg.diagsvd)
>>> np.info(np.matrix)
```

Matrix Functions

Addition

```
>>> np.add(A,D) #Addition
```

Subtraction

```
>>> np.subtract(A,D) #Subtraction
```

Division

```
>>> np.divide(A,D) #Division
```

Multiplication

```
>>> np.multiply(D,A) #Multiplication
>>> np.dot(A,D) #Dot product
>>> np.vdot(A,D) #Vector dot product
>>> np.inner(A,D) #Inner product
>>> np.outer(A,D) #Outer product
>>> np.tensordot(A,D) #Tensor dot product
>>> np.kron(A,D) #Kronecker product
```

Exponential Functions

```
>>> linalg.expm(A) #Matrix exponential
>>> linalg.expm2(A) #Matrix exponential (Taylor Series)
>>> linalg.expm3(D) #Matrix exponential (eigenvalue decomposition)
```

Logarithm Function

```
>>> linalg.logm(A) #Matrix logarithm
```

Trigonometric Functions

```
>>> linalg.sinm(D) Matrix sine
>>> linalg.cosm(D) Matrix cosine
>>> linalg.tanm(A) Matrix tangent
```

Hyperbolic Trigonometric Functions

```
>>> linalg.sinhm(D) #Hyperbolic matrix sine
>>> linalg.coshm(D) #Hyperbolic matrix cosine
>>> linalg.tanhm(A) #Hyperbolic matrix tangent
```

Matrix Sign Function

```
>>> np.sigm(A) #Matrix sign function
```

Matrix Square Root

```
>>> linalg.sqrtm(A) #Matrix square root
```

Arbitrary Functions

```
>>> linalg.funm(A, lambda x: x*x) #Evaluate matrix function
```

Decompositions

Eigenvalues and Eigenvectors

```
>>> la, v = linalg.eig(A) #Solve ordinary or generalized eigenvalue problem for square matrix
>>> l1, l2 = la #Unpack eigenvalues
>>> v[:,0] #First eigenvector
>>> v[:,1] #Second eigenvector
>>> linalg.eigvals(A) #Unpack eigenvalues
```

Singular Value Decomposition

```
>>> U,s,Vh = linalg.svd(B) #Singular Value Decomposition (SVD)
>>> M,N = B.shape
>>> Sig = linalg.diagsvd(s,M,N) #Construct sigma matrix in SVD
```

LU Decomposition

```
>>> P,L,U = linalg.lu(C) #LU Decomposition
```

~SagaR

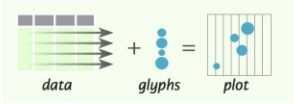
Python For Data Science

Bokeh Cheat Sheet

Plotting With Bokeh

The Python interactive visualization library **Bokeh** enables high-performance visual presentation of large datasets in modern web browsers.

Bokeh's mid-level general purpose `bokeh.plotting` interface is centered around two main components: data and glyphs.



The basic steps to creating plots with the `bokeh.plotting` interface are:

1. Prepare some data (Python lists, NumPy arrays, Pandas DataFrames and other sequences of values)
2. Create a new plot
3. Add renderers for your data, with visual customizations
4. Specify where to generate the output
5. Show or save the results

```
>>> from bokeh.plotting import figure
>>> from bokeh.io import output_file, show
>>> x = [1, 2, 3, 4, 5] #Step 1
>>> y = [6, 7, 2, 4, 5]
>>> p = figure(title="simple line example", #Step 2
 x_axis_label='x',
 y_axis_label='y')
>>> p.line(x, y, legend="Temp.", line_width=2) #Step 3
>>> output_file("lines.html") #Step 4
>>> show(p) #Step 5
```

1 Data

Also see Lists, NumPy & Pandas

Under the hood, your data is converted to Column Data Sources.
You can also do this manually:

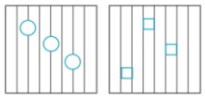
```
>>> import numpy as np
>>> import pandas as pd
>>> df = pd.DataFrame(np.array([[33.9,4,65, 'US'],
                                [32.4, 4, 66, 'Asia'],
                                [21.4, 4, 109, 'Europe']]),
                      columns=['mpg','cyl', 'hp', 'origin'],
                      index=['Toyota', 'Fiat', 'Volvo'])

>>> from bokeh.models import ColumnDataSource
>>> cds_df = ColumnDataSource(df)
```

2 Plotting

```
>>> from bokeh.plotting import figure
>>> p1 = figure(plot_width=300, tools='pan,box_zoom')
>>> p2 = figure(plot_width=300, plot_height=300,
                x_range=(0, 8), y_range=(0, 8))
>>> p3 = figure()
```

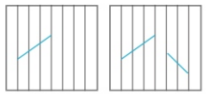
3 Renderers & Visual Customizations

Glyphs



Scatter Markers

```
>>> p1.circle(np.array([1,2,3]), np.array([3,2,1]),
              fill_color='white')
>>> p2.square(np.array([1.5,3.5,5.5]), [1,4,3],
              color='blue', size=1)
```



Line Glyphs

```
>>> p1.line([1,2,3,4], [3,4,5,6], line_width=2)
>>> p2.multi_line(pd.DataFrame([[1,2,3],[5,6,7]]),
                  pd.DataFrame([[3,4,5],[3,2,1]]),
                  color="blue")
```

Customized Glyphs

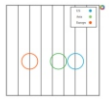
Also see Data

Selection and Non-Selection Glyphs

```
>>> p = figure(tools='box_select')
>>> p.circle('mpg', 'cyl', source=cds_df,
             selection_color='red',
             nonselection_alpha=0.1)
```

Hover Glyphs

```
>>> from bokeh.models import HoverTool
>>> hover = HoverTool(tooltips=None, mode='vline')
>>> p3.add_tools(hover)
```



Colormapping

```
>>> from bokeh.models import CategoricalColorMapper
>>> color_mapper = CategoricalColorMapper(
                   factors=['US', 'Asia', 'Europe'],
                   palette=['blue', 'red', 'green'])
>>> p3.circle('mpg', 'cyl', source=cds_df,
              color=dict(field='origin',
                         transform=color_mapper),
              legend='Origin')
```

4 Output & Export

Notebook

```
>>> from bokeh.io import output_notebook, show
>>> output_notebook()
```

HTML

Standalone HTML

```
>>> from bokeh.embed import file_html
>>> from bokeh.resources import CDN
>>> html = file_html(p, CDN, "my_plot")

>>> from bokeh.io import output_file, show
>>> output_file('my_bar_chart.html', mode='cdn')
```

Components

```
>>> from bokeh.embed import components
>>> script, div = components(p)
```

PNG

```
>>> from bokeh.io import export_png
>>> export_png(p, filename="plot.png")
```

SVG

```
>>> from bokeh.io import export_svgs
>>> p.output_backend = "svg"
>>> export_svgs(p, filename="plot.svg")
```

Legend Location

Inside Plot Area

```
>>> p.legend.location = 'bottom_left'
```

Outside Plot Area

```
>>> from bokeh.models import Legend
>>> r1 = p2.asterisk(np.array([1,2,3]), np.array([3,2,1])
>>> r2 = p2.line([1,2,3,4], [3,4,5,6])
>>> legend = Legend(items=[("One" ,[p1, r1]),("Two",[r2])],
                    location=(0, -30))
>>> p.add_layout(legend, 'right')
```

Legend Orientation

```
>>> p.legend.orientation = "horizontal"
>>> p.legend.orientation = "vertical"
```

Legend Background & Border

```
>>> p.legend.border_line_color = "navy"
>>> p.legend.background_fill_color = "white"
```

Rows & Columns Layout

Rows

```
>>> from bokeh.layouts import row
>>> layout = row(p1,p2,p3)
```

Columns

```
>>> from bokeh.layouts import columns
>>> layout = column(p1,p2,p3)
```

Nesting Rows & Columns

```
>>>layout = row(column(p1,p2), p3)
```

Grid Layout

```
>>> from bokeh.layouts import gridplot
>>> row1 = [p1,p2]
>>> row2 = [p3]
>>> layout = gridplot([[p1,p2],[p3]])
```

Tabbed Layout

```
>>> from bokeh.models.widgets import Panel, Tabs
>>> tab1 = Panel(child=p1, title="tab1")
>>> tab2 = Panel(child=p2, title="tab2")
>>> layout = Tabs(tabs=[tab1, tab2])
```

Linked Plots

Linked Axes

```
>>> p2.x_range = p1.x_range
>>> p2.y_range = p1.y_range
```

Linked Brushing

```
>>> p4 = figure(plot_width = 100, tools='box_select,lasso_select')
>>> p4.circle('mpg', 'cyl', source=cds_df)
>>> p5 = figure(plot_width = 200, tools='box_select,lasso_select')
>>> p5.circle('mpg', 'hp', source=cds_df)
>>> layout = row(p4,p5)
```

5 Show or Save Your Plots

```
>>> show(p1)
>>> show(layout)
>>> save(p1)
>>> save(layout)
```

~SagaR

Folium – a Leaflet wrapper for

an open-source JavaScript library for mobile-friendly interactive maps

Quick Start

Installation

Use: **pip install folium**
or **pip install git+git+goo.gl/kmkGd3** - *to install directly from GitHub*

Basic Map

```
> import folium
> from folium import plugins
> m = folium.Map(location = [45.372, -121.6972])
> folium.Marker([45.3288, -121.6625],
                popup='<i>Mt. Hood Meadows</i>',
                tooltip='click me').add_to(m)
> m
```

Markers

Icon Markers

> folium.Marker([lat, lon], popup, tooltip) - *add basic icon markers*
> folium.Icon(color, icon) - *customize marker icons*

Circle Markers

> folium.Circle(location, fill_color, fill_opacity, color, color,_opacity, radius, popup, ...) - Customize the color, radius, stroke, opacity

Vincent/Vega and Altair/VegaLite Markers

```
> m = folium.Map(location)
> VegaPop = folium.Popup(max_width).add_child(folium.Vega(json,
width, height)) - built-in support for vincent and altair visualizations
> folium.Marker(location, popup=VegaPop).add_to(m)
```

MarkerClusters

```
> m = folium.Map(location)
> marker_cluster = MarkerCluster().add_to(m)
> folium.Marker([lat, lon], popup, tooltip).add_to(marker_cluster)
```

ClickForMarker and PopOvers

```
> m = folium.Map(location)
> m.add_child(folium.LatLngPopup()) - conveniently add lat/lng
popovers
> m.add_child(folium.ClickForMarker(popup)) - on-the-fly placement of
markers
```

BoatMarker

> plugins.BoatMarker(location, heading, wind_heading, wind_speed) - *also: color, popup, icon, **kws*

Lines and Shapes

Lines & PolyLineTextPath

> folium.PolyLine(locations, tooltip, popup).add_to(m) - *also: color, opacity, weight, smoothing_factor, line_cap, **kws*
> plugins.PolyLineTextPath(folium.PolyLine(locations), text, repeat, offset, attributes) - *also: orientation, below, center,**kws*

Polygons

> folium.Polygon(locations, tooltip, popup).add_to(m) - *also: color, opacity, weight, fill_color, fill_opacity, smooth_factor, no_clip, **kws*

Circles

> folium.Circle(location, tooltip, popup).add_to(m) - *also: color, opacity, weight, fill_color, fill_opacity, radius, **kws*
> folium.CircleMarker(location, tooltip, popup).add_to(m) - *also: color, opacity, weight, fill_color, fill_opacity, radius, **kws*

Rectangles

> folium.Rectangle(bounds=[[lat,lon],[lat,lon]], tooltip, popup).add_to(m) - *also: color, fill_color, dash_array, weight, line_join, line_cap, opacity, fill_opacity, **kws*

GeoJson and TopoJson

GeoJson and GeoJsonCSS

> folium.GeoJson(GeoJson_path) - *add name then use folium.LayerControl().add_to(m)*
> folium.GeoJsonCss(GeoJsonCss) - *add styling, and popups into the data*

TopoJson

> folium.TopoJson(TopoJson_path) - *add name then use folium.LayerControl().add_to(m)*

Choropleth

> folium.choropleth(geo_data, data, columns, key_on, fill_color) - *also: name, threshold_scale, line_color, line_weight, line_opacity, legend_name, topojson, **kws*

Basemaps

> folium.Map(location, tiles = 'Stamen Toner') - *use a variety of tiles*

Default

'Stamen Toner'

'Mapbox Control Room'

'Cartodb Positron'

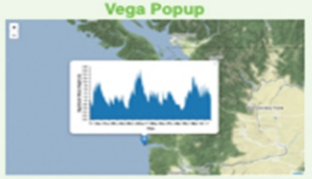
'Stamen Terrain'

Custom

Popups and Labels

> folium.Popup(html, parse_html, max_width)

Vega Popup



Fancy HTML Popup

Plugins

ScrollZoomToggler, Terminator and Fullscreen

```
> plugins.ScrollZoomToggler().add_to(m)
> plugins.Terminator().add_to(m)
> plugins.Fullscreen(position) - also: title, title_cancel, force_separation, button
```

Search, Draw and MeasureControl

> plugins.Search(GeoJson, search_zoom, geom_type).add_to(m) - *also: search_label, position, popup_on_found*
> plugins.Draw().add_to(m) - *also: export*
> m.add_child(plugins.MeasureControl()) - *also: position, primary_length_unit, primary_area_unit, secondary_length_unit, secondary_area_unit*

FloatImage

> plugins.FloatImage(url, bottom, left).add_to(m)

TimestampedGeoJson

> plugins.TimestampedGeoJson(GeoJson, period) - *also: add_last_point, dateOptions, auto_play…*

HeatMap and HeatMapWithTime

> plugins.HeatMap(data).add_to(m) - *also: name, radius, min_opacity, max_val, blur, gradient, overlay, max_zoom*
> plugins.HeatMapWithTime(data).add_to(m) - *also: index, name, radius, min_opacity, max_opacity, auto_play, position, …*

Python For Data Science
Scikit-Learn Cheat Sheet

Scikit-learn

Scikit-learn is an open source Python library that implements a range of machine learning, preprocessing, cross-validation and visualization algorithms using a unified interface.

A Basic Example

```
>>> from sklearn import neighbors, datasets, preprocessing
>>> from sklearn.model_selection import train_test_split
>>> from sklearn.metrics import accuracy_score
>>> iris = datasets.load_iris()
>>> X, y = iris.data[:, :2], iris.target
>>> X_train, X_test, y_train, y_test = train_test_split(X, y, random_state=33)
>>> scaler = preprocessing.StandardScaler().fit(X_train)
>>> X_train = scaler.transform(X_train)
>>> X_test = scaler.transform(X_test)
>>> knn = neighbors.KNeighborsClassifier(n_neighbors=5)
>>> knn.fit(X_train, y_train)
>>> y_pred = knn.predict(X_test)
>>> accuracy_score(y_test, y_pred)
```

> Loading The Data

Also see NumPy & Pandas

Your data needs to be numeric and stored as NumPy arrays or SciPy sparse matrices. Other types that are convertible to numeric arrays, such as Pandas DataFrame, are also acceptable.

```
>>> import numpy as np
>>> X = np.random.random((10,5))
>>> y = np.array(['M','M','F','F','M','F','M','M','F','F','F'])
>>> X[X < 0.7] = 0
```

> Training And Test Data

```
>>> from sklearn.model_selection import train_test_split
>>> X_train, X_test, y_train, y_test = train_test_split(X,
                                                        y,
                                                        random_state=0)
```

> Model Fitting

Supervised learning

```
>>> lr.fit(X, y) #Fit the model to the data
>>> knn.fit(X_train, y_train)
>>> svc.fit(X_train, y_train)
```

Unsupervised Learning

```
>>> k_means.fit(X_train) #Fit the model to the data
>>> pca_model = pca.fit_transform(X_train) #Fit to data, then transform it
```

> Prediction

Supervised Estimators

```
>>> y_pred = svc.predict(np.random.random((2,5))) #Predict labels
>>> y_pred = lr.predict(X_test) #Predict labels
>>> y_pred = knn.predict_proba(X_test) #Estimate probability of a label
```

Unsupervised Estimators

```
>>> y_pred = k_means.predict(X_test) #Predict labels in clustering algos
```

> Preprocessing The Data

Standardization

```
>>> from sklearn.preprocessing import StandardScaler
>>> scaler = StandardScaler().fit(X_train)
>>> standardized_X = scaler.transform(X_train)
>>> standardized_X_test = scaler.transform(X_test)
```

Normalization

```
>>> from sklearn.preprocessing import Normalizer
>>> scaler = Normalizer().fit(X_train)
>>> normalized_X = scaler.transform(X_train)
>>> normalized_X_test = scaler.transform(X_test)
```

Binarization

```
>>> from sklearn.preprocessing import Binarizer
>>> binarizer = Binarizer(threshold=0.0).fit(X)
>>> binary_X = binarizer.transform(X)
```

Encoding Categorical Features

```
>>> from sklearn.preprocessing import LabelEncoder
>>> enc = LabelEncoder()
>>> y = enc.fit_transform(y)
```

Imputing Missing Values

```
>>> from sklearn.preprocessing import Imputer
>>> imp = Imputer(missing_values=0, strategy='mean', axis=0)
>>> imp.fit_transform(X_train)
```

Generating Polynomial Features

```
>>> from sklearn.preprocessing import PolynomialFeatures
>>> poly = PolynomialFeatures(5)
>>> poly.fit_transform(X)
```

> Create Your Model

Supervised Learning Estimators

Linear Regression

```
>>> from sklearn.linear_model import LinearRegression
>>> lr = LinearRegression(normalize=True)
```

Support Vector Machines (SVM)

```
>>> from sklearn.svm import SVC
>>> svc = SVC(kernel='linear')
```

Naive Bayes

```
>>> from sklearn.naive_bayes import GaussianNB
>>> gnb = GaussianNB()
```

KNN

```
>>> from sklearn import neighbors
>>> knn = neighbors.KNeighborsClassifier(n_neighbors=5)
```

Unsupervised Learning Estimators

Principal Component Analysis (PCA)

```
>>> from sklearn.decomposition import PCA
>>> pca = PCA(n_components=0.95)
```

K Means

```
>>> from sklearn.cluster import KMeans
>>> k_means = KMeans(n_clusters=3, random_state=0)
```

> Evaluate Your Model's Performance

Classification Metrics

Accuracy Score

```
>>> knn.score(X_test, y_test) #Estimator score method
>>> from sklearn.metrics import accuracy_score #Metric scoring functions
>>> accuracy_score(y_test, y_pred)
```

Classification Report

```
>>> from sklearn.metrics import classification_report #Precision, recall, f1-score and support
>>> print(classification_report(y_test, y_pred))
```

Confusion Matrix

```
>>> from sklearn.metrics import confusion_matrix
>>> print(confusion_matrix(y_test, y_pred))
```

Regression Metrics

Mean Absolute Error

```
>>> from sklearn.metrics import mean_absolute_error
>>> y_true = [3, -0.5, 2]
>>> mean_absolute_error(y_true, y_pred)
```

Mean Squared Error

```
>>> from sklearn.metrics import mean_squared_error
>>> mean_squared_error(y_test, y_pred)
```

R^2 Score

```
>>> from sklearn.metrics import r2_score
>>> r2_score(y_true, y_pred)
```

Clustering Metrics

Adjusted Rand Index

```
>>> from sklearn.metrics import adjusted_rand_score
>>> adjusted_rand_score(y_true, y_pred)
```

Homogeneity

```
>>> from sklearn.metrics import homogeneity_score
>>> homogeneity_score(y_true, y_pred)
```

V-measure

```
>>> from sklearn.metrics import v_measure_score
>>> metrics.v_measure_score(y_true, y_pred)
```

Cross-Validation

```
>>> from sklearn.cross_validation import cross_val_score
>>> print(cross_val_score(knn, X_train, y_train, cv=4))
>>> print(cross_val_score(lr, X, y, cv=2))
```

> Tune Your Model

Grid Search

```
>>> from sklearn.grid_search import GridSearchCV
>>> params = {"n_neighbors": np.arange(1,3),
              "metric": ["euclidean", "cityblock"]}
>>> grid = GridSearchCV(estimator=knn,
                        param_grid=params)
>>> grid.fit(X_train, y_train)
>>> print(grid.best_score_)
>>> print(grid.best_estimator_.n_neighbors)
```

Randomized Parameter Optimization

```
>>> from sklearn.grid_search import RandomizedSearchCV
>>> params = {"n_neighbors": range(1,5), "weights": ["uniform", "distance"]}
>>> rsearch = RandomizedSearchCV(estimator=knn, param_distributions=params,
                                 cv=4, n_iter=8, random_state=5)
>>> rsearch.fit(X_train, y_train)
>>> print(rsearch.best_score_)
```

~SagaR

Python For Data Science
Keras Cheat Sheet

Keras

Keras is a powerful and easy-to-use deep learning library forTheano and TensorFlow that provides a high-level neural networks API to develop and evaluate deep learning models.

A Basic Example

```
>>> import numpy as np
>>> from keras.models import Sequential
>>> from keras.layers import Dense
>>> data = np.random.random((1000,100))
>>> labels = np.random.randint(2,size=(1000,1))
>>> model = Sequential()
>>> model.add(Dense(32,
                    activation='relu',
                    input_dim=100))
>>> model.add(Dense(1, activation='sigmoid'))
>>> model.compile(optimizer='rmsprop',
                  loss='binary_crossentropy',
                  metrics=['accuracy'])
>>> model.fit(data,labels,epochs=10,batch_size=32)
>>> predictions = model.predict(data)
```

> Data

Your data needs to be stored as NumPy arrays or as a list of NumPy arrays. Ideally, you split the data in training and test sets, for which you can also resort to the `train_test_split` module of `sklearn.cross_validation`.

Keras Data Sets

```
>>> from keras.datasets import boston_housing, mnist, cifar10, imdb
>>> (x_train,y_train),(x_test,y_test) = mnist.load_data()
>>> (x_train2,y_train2),(x_test2,y_test2) = boston_housing.load_data()
>>> (x_train3,y_train3),(x_test3,y_test3) = cifar10.load_data()
>>> (x_train4,y_train4),(x_test4,y_test4) = imdb.load_data(num_words=20000)
>>> num_classes = 10
```

Other

```
>>> from urllib.request import urlopen
>>> data =
np.loadtxt(urlopen("http://archive.ics.uci.edu/ml/machine-learning-databases/pima-indians-diabetes/pima-indians-diabetes.data"),delimiter=",")
>>> X = data[:,0:8]
>>> y = data [:,8]
```

> Preprocessing

Also see NumPy & Scikit-Learn

Sequence Padding

```
>>> from keras.preprocessing import sequence
>>> x_train4 = sequence.pad_sequences(x_train4,maxlen=80)
>>> x_test4 = sequence.pad_sequences(x_test4,maxlen=80)
```

One-Hot Encoding

```
>>> from keras.utils import to_categorical
>>> Y_train = to_categorical(y_train, num_classes)
>>> Y_test = to_categorical(y_test, num_classes)
>>> Y_train3 = to_categorical(y_train3, num_classes)
>>> Y_test3 = to_categorical(y_test3, num_classes)
```

> Model Architecture

Sequential Model

```
>>> from keras.models import Sequential
>>> model = Sequential()
>>> model2 = Sequential()
>>> model3 = Sequential()
```

Multilayer Perceptron (MLP)

Binary Classification

```
>>> from keras.layers import Dense
>>> model.add(Dense(12,
                    input_dim=8,
                    kernel_initializer='uniform',
                    activation='relu'))
>>> model.add(Dense(8,kernel_initializer='uniform',activation='relu'))
>>> model.add(Dense(1,kernel_initializer='uniform',activation='sigmoid'))
```

Multi-Class Classification

```
>>> from keras.layers import Dropout
>>> model.add(Dense(512,activation='relu',input_shape=(784,)))
>>> model.add(Dropout(0.2))
>>> model.add(Dense(512,activation='relu'))
>>> model.add(Dropout(0.2))
>>> model.add(Dense(10,activation='softmax'))
```

Regression

```
>>> model.add(Dense(64,activation='relu',input_dim=train_data.shape[1]))
>>> model.add(Dense(1))
```

Convolutional Neural Network (CNN)

```
>>> from keras.layers import Activation,Conv2D,MaxPooling2D,Flatten
>>> model2.add(Conv2D(32,(3,3),padding='same',input_shape=x_train.shape[1:]))
>>> model2.add(Activation('relu'))
>>> model2.add(Conv2D(32,(3,3)))
>>> model2.add(Activation('relu'))
>>> model2.add(MaxPooling2D(pool_size=(2,2)))
>>> model2.add(Dropout(0.25))
>>> model2.add(Conv2D(64,(3,3), padding='same'))
>>> model2.add(Activation('relu'))
>>> model2.add(Conv2D(64,(3, 3)))
>>> model2.add(Activation('relu'))
>>> model2.add(MaxPooling2D(pool_size=(2,2)))
>>> model2.add(Dropout(0.25))
>>> model2.add(Flatten())
>>> model2.add(Dense(512))
>>> model2.add(Activation('relu'))
>>> model2.add(Dropout(0.5))
>>> model2.add(Dense(num_classes))
>>> model2.add(Activation('softmax'))
```

Recurrent Neural Network (RNN)

```
>>> from keras.klayers import Embedding,LSTM
>>> model3.add(Embedding(20000,128))
>>> model3.add(LSTM(128,dropout=0.2,recurrent_dropout=0.2))
>>> model3.add(Dense(1,activation='sigmoid'))
```

> Prediction

```
>>> model3.predict(x_test4, batch_size=32)
>>> model3.predict_classes(x_test4,batch_size=32)
```

Train and Test Sets

```
>>> from sklearn.model_selection import train_test_split
>>> X_train5,X_test5,y_train5,y_test5 = train_test_split(X, y,
                                                         test_size=0.33,
                                                         random_state=42)
```

Standardization/Normalization

```
>>> from sklearn.preprocessing import StandardScaler
>>> scaler = StandardScaler().fit(x_train2)
>>> standardized_X = scaler.transform(x_train2)
>>> standardized_X_test = scaler.transform(x_test2)
```

> Inspect Model

```
>>> model.output_shape #Model output shape
>>> model.summary() #Model summary representation
>>> model.get_config() #Model configuration
>>> model.get_weights() #List all weight tensors in the model
```

> Compile Model

MLP: Binary Classification

```
>>> model.compile(optimizer='adam',
                  loss='binary_crossentropy',
                  metrics=['accuracy'])
```

MLP: Multi-Class Classification

```
>>> model.compile(optimizer='rmsprop',
                  loss='categorical_crossentropy',
                  metrics=['accuracy'])
```

MLP: Regression

```
>>> model.compile(optimizer='rmsprop',
                  loss='mse',
                  metrics=['mae'])
```

Recurrent Neural Network

```
>>> model3.compile(loss='binary_crossentropy',
                   optimizer='adam',
                   metrics=['accuracy'])
```

> Model Training

```
>>> model3.fit(x_train4,
               y_train4,
               batch_size=32,
               epochs=15,
               verbose=1,
               validation_data=(x_test4,y_test4))
```

> Evaluate Your Model's Performance

```
>>> score = model3.evaluate(x_test,
                            y_test,
                            batch_size=32)
```

> Save/ Reload Models

```
>>> from keras.models import load_model
>>> model3.save('model_file.h5')
>>> my_model = load_model('my_model.h5')
```

> Model Fine-tuning

Optimization Parameters

```
>>> from keras.optimizers import RMSprop
>>> opt = RMSprop(lr=0.0001, decay=1e-6)
>>> model2.compile(loss='categorical_crossentropy',
                   optimizer=opt,
                   metrics=['accuracy'])
```

Early Stopping

```
>>> from keras.callbacks import EarlyStopping
>>> early_stopping_monitor = EarlyStopping(patience=2)
>>> model3.fit(x_train4,
               y_train4,
               batch_size=32,
               epochs=15,
               validation_data=(x_test4,y_test4),
               callbacks=[early_stopping_monitor])
```

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Python For Data Science
spaCy Cheat Sheet

spaCy

spaCy is a free, open-source library for advanced Natural Language processing (NLP) in Python. It's designed specifically for production use and helps you build applications that process and "understand" large volumes of text. Documentation: spacy.io

```
>>> $ pip install spacy
>>> import spacy
```

> Statistical models

Download statistical models

Predict part-of-speech tags, dependency labels, named entities and more. See here for available models: spacy.io/models

```
>>> $ python -m spacy download en_core_web_sm
```

Check that your installed models are up to date

```
>>> $ python -m spacy validate
```

Loading statistical models

```
>>> import spacy
>>> nlp = spacy.load("en_core_web_sm") # Load the installed model "en_core_web_sm"
```

> Documents and tokens

Processing text

Processing text with the `nlp` object returns a `Doc` object that holds all information about the tokens, their linguistic features and their relationships

```
>>> doc = nlp("This is a text")
```

Accessing token attributes

```
>>> doc = nlp("This is a text")
>>>[token.text for token in doc] #Token texts
['This', 'is', 'a', 'text']
```

> Label explanations

```
>>> spacy.explain("RB")
'adverb'
>>> spacy.explain("GPE")
'Countries, cities, states'
```

> Spans

Accessing spans

Span indices are exclusive. So `doc[2:4]` is a span starting at token 2, up to – but not including! – token 4.

```
>>> doc = nlp("This is a text")
>>> span = doc[2:4]
>>> span.text
'a text'
```

Creating a span manually

```
>>> from spacy.tokens import Span #Import the Span object
>>> doc = nlp("I live in New York") #Create a Doc object
>>> span = Span(doc, 3, 5, label="GPE") #Span for "New York" with label GPE (geopolitical)
>>> span.text
'New York'
```

> Linguistic features

Attributes return label IDs. For string labels, use the attributes with an underscore. For example, `token.pos_` .

Part-of-speech tags — Predicted by Statistical model

```
>>> doc = nlp("This is a text.")
>>> [token.pos_ for token in doc] #Coarse-grained part-of-speech tags
['DET', 'VERB', 'DET', 'NOUN', 'PUNCT']
>>> [token.tag_ for token in doc] #Fine-grained part-of-speech tags
['DT', 'VBZ', 'DT', 'NN', '.']
```

Syntactic dependencies — Predicted by Statistical model

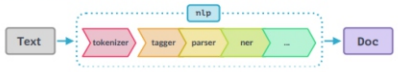
```
>>> doc = nlp("This is a text.")
>>> [token.dep_ for token in doc] #Dependency labels
['nsubj', 'ROOT', 'det', 'attr', 'punct']
>>> [token.head.text for token in doc] #Syntactic head token (governor)
['is', 'is', 'text', 'is', 'is']
```

Named entities — Predicted by Statistical model

```
>>> doc = nlp("Larry Page founded Google")
>>> [(ent.text, ent.label_) for ent in doc.ents] #Text and label of named entity span
[('Larry Page', 'PERSON'), ('Google', 'ORG')]
```

> Pipeline components

Functions that take a `Doc` object, modify it and return it.



Pipeline information

```
>>> nlp = spacy.load("en_core_web_sm")
>>> nlp.pipe_names
['tagger', 'parser', 'ner']
>>> nlp.pipeline
[('tagger', <spacy.pipeline.Tagger>),
 ('parser', <spacy.pipeline.DependencyParser>),
 ('ner', <spacy.pipeline.EntityRecognizer>)]
```

Custom components

```
def custom_component(doc): #Function that modifies the doc and returns it
    print("Do something to the doc here!")
    return doc
nlp.add_pipe(custom_component, first=True) #Add the component first in the pipeline
```

Components can be added `first` , `last` (default), or `before` or `after` an `existing` component.

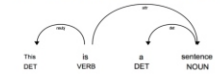
> Visualizing

If you're in a Jupyter notebook, use `displacy.render` otherwise, use `displacy.serve` to start a web server and show the visualization in your browser.

```
>>> from spacy import displacy
```

Visualize dependencies

```
>>> doc = nlp("This is a sentence")
>>> displacy.render(doc, style="dep")
```



Visualize named entities

```
>>> doc = nlp("Larry Page founded Google")
>>> displacy.render(doc, style="ent")
```

Larry Page PERSON founded Google ORG

> Word vectors and similarity

To use word vectors, you need to install the larger models ending in `md` or `lg` , for example `en_core_web_lg` .

Comparing similarity

```
>>> doc1 = nlp("I like cats")
>>> doc2 = nlp("I like dogs")
>>> doc1.similarity(doc2) #Compare 2 documents
>>> doc1[2].similarity(doc2[2]) #Compare 2 tokens
>>> doc1[0].similarity(doc2[1:3]) # Comparetokens and spans
```

Accessing word vectors

```
>>> doc = nlp("I like cats") #Vector as a numpy array
>>> doc[2].vector #The L2 norm of the token's vector
>>> doc[2].vector_norm
```

> Syntax iterators

Sentences — Ususally needs the dependency parser

```
>>> doc = nlp("This a sentence. This is another one.")
>>> [sent.text for sent in doc.sents] #doc.sents is a generator that yields sentence spans
['This is a sentence.', 'This is another one.']
```

Base noun phrases — Needs the tagger and parser

```
>>> doc = nlp("I have a red car")
#doc.noun_chunks is a generator that yields spans
>>> [chunk.text for chunk in doc.noun_chunks]
['I', 'a red car']
```

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Python For Data Science
PySpark SQL Basics Cheat Sheet

PySpark & Spark SQL

Spark SQL is Apache Spark's module for working with structured data.

> Initializing SparkSession

A SparkSession can be used create DataFrame, register DataFrame as tables, execute SQL over tables, cache tables, and read parquet files.

```
>>> from pyspark.sql import SparkSession
>>> spark = SparkSession \
        .builder \
        .appName("Python Spark SQL basic example") \
        .config("spark.some.config.option", "some-value") \
        .getOrCreate()
```

> Creating DataFrames

From RDDs

```
>>> from pyspark.sql.types import *
```

Infer Schema

```
>>> sc = spark.sparkContext
>>> lines = sc.textFile("people.txt")
>>> parts = lines.map(lambda l: l.split(","))
>>> people = parts.map(lambda p: Row(name=p[0],age=int(p[1])))
>>> peopledf = spark.createDataFrame(people)
```

Specify Schema

```
>>> people = parts.map(lambda p: Row(name=p[0],
                                     age=int(p[1].strip())))
>>> schemaString = "name age"
>>> fields = [StructField(field_name, StringType(), True) for
field_name in schemaString.split()]
>>> schema = StructType(fields)
>>> spark.createDataFrame(people, schema).show()
```

```
+---------+---+
|     name|age|
+---------+---+
|     Mine| 28|
|    Filip| 29|
|Jonathan| 30|
+---------+---+
```

From Spark Data Sources

JSON

```
>>> df = spark.read.json("customer.json")
>>> df.show()
```

```
+--------------------+---+---------+--------+--------------------+
|             address|age|firstName|lastName|         phoneNumber|
+--------------------+---+---------+--------+--------------------+
|[New York,10021,N...| 25|     John|   Smith|[{212 555-1234,ho...|
|[New York,10021,N...| 21|     Jane|     Doe|[{322 888-1234,ho...|
+--------------------+---+---------+--------+--------------------+
```

```
>>> df2 = spark.read.load("people.json", format="json")
```

Parquet files

```
>>> df3 = spark.read.load("users.parquet")
```

TXT files

```
>>> df4 = spark.read.text("people.txt")
```

> Filter

```
#Filter entries of age, only keep those records of which the values are >24
>>> df.filter(df["age"]>24).show()
```

> Duplicate Values

```
>>> df = df.dropDuplicates()
```

> Queries

```
>>> from pyspark.sql import functions as F
```

Select

```
>>> df.select("firstName").show() #Show all entries in firstName column
>>> df.select("firstName","lastName") \
      .show()
>>> df.select("firstName", #Show all entries in firstName, age and type
              "age",
              explode("phoneNumber") \
              .alias("contactInfo")) \
      .select("contactInfo.type",
              "firstName",
              "age") \
      .show()
>>> df.select(df["firstName"],df["age"]+ 1)  #Show all entries in firstName and age,
      .show()                                  add 1 to the entries of age
>>> df.select(df['age'] > 24).show() #Show all entries where age >24
```

When

```
>>> df.select("firstName", #Show firstName and 0 or 1 depending on age >30
              F.when(df.age > 30, 1) \
              .otherwise(0)) \
      .show()
>>> df[df.firstName.isin("Jane","Boris")] #Show firstName if in the given options
                .collect()
```

Like

```
>>> df.select("firstName", #Show firstName, and lastName is TRUE if lastName is like Smith
              df.lastName.like("Smith")) \
      .show()
```

Startswith - Endswith

```
>>> df.select("firstName", #Show firstName, and TRUE if lastName starts with Sm
              df.lastName \
                .startswith("Sm")) \
      .show()
>>> df.select(df.lastName.endswith("th"))\ #Show last names ending in th
      .show()
```

Substring

```
>>> df.select(df.firstName.substr(1, 3) \ #Return substrings of firstName
                       .alias("name")) \
      .collect()
```

Between

```
>>> df.select(df.age.between(22, 24)) \ #Show age: values are TRUE if between 22 and 24
      .show()
```

> Add, Update & Remove Columns

Adding Columns

```
>>> df = df.withColumn('city',df.address.city) \
           .withColumn('postalCode',df.address.postalCode) \
           .withColumn('state',df.address.state) \
           .withColumn('streetAddress',df.address.streetAddress) \
           .withColumn('telePhoneNumber', explode(df.phoneNumber.number)) \
           .withColumn('telePhoneType', explode(df.phoneNumber.type))
```

Updating Columns

```
>>> df = df.withColumnRenamed('telePhoneNumber', 'phoneNumber')
```

Removing Columns

```
>>> df = df.drop("address", "phoneNumber")
>>> df = df.drop(df.address).drop(df.phoneNumber)
```

> Missing & Replacing Values

```
>>> df.na.fill(50).show() #Replace null values
>>> df.na.drop().show() #Return new df omitting rows with null values
>>> df.na \ #Return new df replacing one value with another
      .replace(10, 20) \
      .show()
```

> GroupBy

```
>>> df.groupBy("age")\ #Group by age, count the members in the groups
      .count() \
      .show()
```

> Sort

```
>>> peopledf.sort(peopledf.age.desc()).collect()
>>> df.sort("age", ascending=False).collect()
>>> df.orderBy(["age","city"],ascending=[0,1])\
      .collect()
```

> Repartitioning

```
>>> df.repartition(10)\ #df with 10 partitions
      .rdd \
      .getNumPartitions()
>>> df.coalesce(1).rdd.getNumPartitions() #df with 1 partition
```

> Running Queries Programmatically

Registering DataFrames as Views

```
>>> peopledf.createGlobalTempView("people")
>>> df.createTempView("customer")
>>> df.createOrReplaceTempView("customer")
```

Query Views

```
>>> df5 = spark.sql("SELECT * FROM customer").show()
>>> peopledf2 = spark.sql("SELECT * FROM global_temp.people")\
                 .show()
```

> Inspect Data

```
>>> df.dtypes #Return df column names and data types
>>> df.show() #Display the content of df
>>> df.head() #Return first n rows
>>> df.first() #Return first row
>>> df.take(2) #Return the first n rows >>> df.schema Return the schema of df
>>> df.describe().show() #Compute summary statistics >>> df.columns Return the columns of df
>>> df.count() #Count the number of rows in df
>>> df.distinct().count() #Count the number of distinct rows in df
>>> df.printSchema() #Print the schema of df
>>> df.explain() #Print the (logical and physical) plans
```

> Output

Data Structures

```
>>> rdd1 = df.rdd #Convert df into an RDD
>>> df.toJSON().first() #Convert df into a RDD of string
>>> df.toPandas() #Return the contents of df as Pandas DataFrame
```

Write & Save to Files

```
>>> df.select("firstName", "city")\
      .write \
      .save("nameAndCity.parquet")
>>> df.select("firstName", "age") \
      .write \
      .save("namesAndAges.json",format="json")
```

> Stopping SparkSession

```
>>> spark.stop()
```

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Python For Data Science
PySpark RDD Cheat Sheet

Spark

PySpark is the Spark Python API that exposes the Spark programming model to Python.

> Initializing Spark

SparkContext

```
>>> from pyspark import SparkContext
>>> sc = SparkContext(master = 'local[2]')
```

Inspect SparkContext

```
>>> sc.version #Retrieve SparkContext version
>>> sc.pythonVer #Retrieve Python version
>>> sc.master #Master URL to connect to
>>> str(sc.sparkHome) #Path where Spark is installed on worker nodes
>>> str(sc.sparkUser()) #Retrieve name of the Spark User running SparkContext
>>> sc.appName #Return application name
>>> sc.applicationId #Retrieve application ID
>>> sc.defaultParallelism #Return default level of parallelism
>>> sc.defaultMinPartitions #Default minimum number of partitions for RDDs
```

Configuration

```
>>> from pyspark import SparkConf, SparkContext
>>> conf = (SparkConf()
            .setMaster("local")
            .setAppName("My app")
            .set("spark.executor.memory", "1g"))
>>> sc = SparkContext(conf = conf)
```

Using The Shell

In the PySpark shell, a special interpreter-aware SparkContext is already created in the variable called `sc`.

```
$ ./bin/spark-shell --master local[2]
$ ./bin/pyspark --master local[4] --py-files code.py
```

Set which master the context connects to with the `--master` argument, and add Python .zip, .egg or .py files to the runtime path by passing a comma-separated list to `--py-files`.

> Loading Data

Parallelized Collections

```
>>> rdd = sc.parallelize([('a',7),('a',2),('b',2)])
>>> rdd2 = sc.parallelize([('a',2),('d',1),('b',1)])
>>> rdd3 = sc.parallelize(range(100))
>>> rdd4 = sc.parallelize([("a",["x","y","z"]),
                           ("b",["p", "r"])])
```

External Data

Read either one text file from HDFS, a local file system or or any Hadoop-supported file system URI with `textFile()`, or read in a directory of text files with `wholeTextFiles()`

```
>>> textFile = sc.textFile("/my/directory/*.txt")
>>> textFile2 = sc.wholeTextFiles("/my/directory/")
```

> Retrieving RDD Information

Basic Information

```
>>> rdd.getNumPartitions() #List the number of partitions
>>> rdd.count() #Count RDD instances 3
>>> rdd.countByKey() #Count RDD instances by key
 defaultdict(<type 'int'>,{'a':2,'b':1})
>>> rdd.countByValue() #Count RDD instances by value
 defaultdict(<type 'int'>,{('b',2):1,('a',2):1,('a',7):1})
>>> rdd.collectAsMap() #Return (key,value) pairs as a dictionary
 {'a': 2,'b': 2}
>>> rdd3.sum() #Sum of RDD elements 4950
>>> sc.parallelize([]).isEmpty() #Check whether RDD is empty
 True
```

Summary

```
>>> rdd3.max() #Maximum value of RDD elements
 99
>>> rdd3.min() #Minimum value of RDD elements
 0
>>> rdd3.mean() #Mean value of RDD elements
 49.5
>>> rdd3.stdev() #Standard deviation of RDD elements
 28.866070047722118
>>> rdd3.variance() #Compute variance of RDD elements
 833.25
>>> rdd3.histogram(3) #Compute histogram by bins
 ([0,33,66,99],[33,33,34])
>>> rdd3.stats() #Summary statistics (count, mean, stdev, max & min)
```

> Applying Functions

```
#Apply a function to each RDD element
 >>> rdd.map(lambda x: x+(x[1],x[0])).collect()
 [('a',7,7,'a'),('a',2,2,'a'),('b',2,2,'b')]
#Apply a function to each RDD element and flatten the result
 >>> rdd5 = rdd.flatMap(lambda x: x+(x[1],x[0]))
 >>> rdd5.collect()
 ['a',7,7,'a','a',2,2,'a','b',2,2,'b']
#Apply a flatMap function to each (key,value) pair of rdd4 without changing the keys
 >>> rdd4.flatMapValues(lambda x: x).collect()
 [('a','x'),('a','y'),('a','z'),('b','p'),('b','r')]
```

> Selecting Data

Getting

```
>>> rdd.collect() #Return a list with all RDD elements
 [('a', 7), ('a', 2), ('b', 2)]
>>> rdd.take(2) #Take first 2 RDD elements
 [('a', 7), ('a', 2)]
>>> rdd.first() #Take first RDD element
 ('a', 7)
>>> rdd.top(2) #Take top 2 RDD elements
 [('b', 2), ('a', 7)]
```

Sampling

```
>>> rdd3.sample(False, 0.15, 81).collect() #Return sampled subset of rdd3
 [3,4,27,31,40,41,42,43,60,76,79,80,86,97]
```

Filtering

```
>>> rdd.filter(lambda x: "a" in x).collect()  #Filter the RDD
 [('a',7),('a',2)]
>>> rdd5.distinct().collect() #Return distinct RDD values
 ['a',2,'b',7]
>>> rdd.keys().collect() #Return (key,value) RDD's keys
 ['a', 'a', 'b']
```

> Iterating

```
>>> def g(x): print(x)
>>> rdd.foreach(g) #Apply a function to all RDD elements
 ('a', 7)
 ('b', 2)
 ('a', 2)
```

> Reshaping Data

Reducing

```
>>> rdd.reduceByKey(lambda x,y : x+y).collect() #Merge the rdd values for each key
 [('a',9),('b',2)]
>>> rdd.reduce(lambda a, b: a + b) #Merge the rdd values
 ('a',7,'a',2,'b',2)
```

Grouping by

```
>>> rdd3.groupBy(lambda x: x % 2) #Return RDD of grouped values
        .mapValues(list)
        .collect()
>>> rdd.groupByKey() #Group rdd by key
       .mapValues(list)
        .collect()
 [('a',[7,2]),('b',[2])]
```

Aggregating

```
>>> seqOp = (lambda x,y: (x[0]+y,x[1]+1))
>>> combOp = (lambda x,y:(x[0]+y[0],x[1]+y[1]))
#Aggregate RDD elements of each partition and then the results
>>> rdd3.aggregate((0,0),seqOp,combOp)
 (4950,100)
 #Aggregate values of each RDD key
>>> rdd.aggregateByKey((0,0),seqop,combop).collect()
 [('a',(9,2)), ('b',(2,1))]
#Aggregate the elements of each partition, and then the results
>>> rdd3.fold(0,add)
 4950
#Merge the values for each key
>>> rdd.foldByKey(0, add).collect()
 [('a',9),('b',2)]
#Create tuples of RDD elements by applying a function
>>> rdd3.keyBy(lambda x: x+x).collect()
```

> Mathematical Operations

```
>>> rdd.subtract(rdd2).collect() #Return each rdd value not contained in rdd2
 [('b',2),('a',7)]
#Return each (key,value) pair of rdd2  with no matching key in rdd
>>> rdd2.subtractByKey(rdd).collect()
 [('d', 1)]
>>> rdd.cartesian(rdd2).collect() #Return the Cartesian product of rdd and rdd2
```

> Sort

```
>>> rdd2.sortBy(lambda x: x[1]).collect() #Sort RDD by given function
 [('d',1),('b',1),('a',2)]
>>> rdd2.sortByKey().collect() #Sort (key, value) RDD by key
 [('a',2),('b',1),('d',1)]
```

> Repartitioning

```
>>> rdd.repartition(4) #New RDD with 4 partitions
>>> rdd.coalesce(1) #Decrease the number of partitions in the RDD to 1
```

> Saving

```
>>> rdd.saveAsTextFile("rdd.txt")
>>> rdd.saveAsHadoopFile("hdfs://namenodehost/parent/child",
                         'org.apache.hadoop.mapred.TextOutputFormat')
```

> Stopping SparkContext

```
>>> sc.stop()
```

> Execution

```
$ ./bin/spark-submit examples/src/main/python/pi.py
```

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Import Resources

import requests

from bs4 **import** BeautifulSoup

Make a soup object out of a website

```
// 1. The HTTP request
webpage = request.get('URL', 'html.parser');

// 2. Turn the website into a soup object
soup = BeautifulSoup(webpage.content);
```

"html.parser" is one option for parsers we could use. There are other options, like "lxml" and "html5lib" that have different advantages and disadvantages.

Object types

```
//1. Tags correspond to HTML tags
Example Code:
soup = BeautifulSoup('<div id="example">An example div</div><p>An example p tag</p>');

print(soup.div);
--> <div id="example">An example div</div>
--> gets the first tag of that type on the page

print(soup.div.name)
print(soup.div.attrs)
--> div
--> {'id': 'example'}

//2. Navigable Strings: Piece of text inside of HTML Tags
print(soup.div.string)
--> An example div
```

Navigating by Tasks

```
Example Code:
<h1>World's Best Chocolate Chip Cookies</h1>
<div class="banner">
  <h1>Ingredients</h1>
</div>
<ul>
  <li> 1 cup flour </li>
  <li> 1/2 cup sugar </li>
  <li> 2 tbsp oil </li>
  <li> 1/2 tsp baking soda </li>
  <li> ½ cup chocolate chips </li>
  <li> 1/2 tsp vanilla <li>
  <li> 2 tbsp milk </li>
</ul>

//1. Get the children of a tag:
for child in soup.ul.children:
    print(child)
--> <li> 1 cup flour </li>
--> <li> 1/2 cup sugar </li>
...

//2. Get the parent of a tag:
for parent in soup.li.parents:
    print(parent)
```

Finding All

```
//1. find_all()
print(soup.find_all("h1"))
--> Outputs all <h1>...</h1> on the website

//1.1. find_all()  with regex
import re
soup.find_all(re.compile("[ou]l"))
--> Outputs all <ul>...</ul> and <ol>...</ol>
soup.find_all(re.compile("h[1-9]"))
--> Outputs all headings

//1.2. find_all() with lists
soup.find_all(['h1', 'a', 'p'])

//1.3 find_all() with attributes
soup.find_all(attrs={'class':'banner', 'id':'jumbotron'});

//1.4 find_all() with functions
def has_banner_class_and_hello_world(tag):
    return tag.attr('class') == "banner" and tag.string == "Hello
world"

soup.find_all(has_banner_class_and_hello_world)
```

CSS Selectors

```
//1. grab CSS classes with .select("class_name")
soup.select(".recipeLink")

//*2. grab CSS IDs with .select("#id_name")
soup.select("#selected")

//3. using a loop
for link in soup.select(".recipeLink > a"):
  webpage = requests.get(link)
  new_soup = BeautifulSoup(webpage)
```

BeautifulSoup
~SagaR

Selenium Python Cheat Sheet

1. Import the Selenium library

```
from selenium import webdriver
```

2. Driver Initialization with Python

```
# Initialize Chrome WebDriver
driver = webdriver.Chrome()
```

3. Path to uses the download file

```
driver =
webdriver.Chrome(executable_path="/usr/bin/chromedriver/",
options=chrome_options )
```

3. Setting Options in Selenium WebDriver

```
from selenium import webdriver

from
selenium.webdriver.chrome.options
import Options
```

4. Finding an element

```
from selenium import webdriver

driver = webdriver.Chrome()
driver.get("https://www.lambdatest.com")
email_form =
driver.find_element_by_id("testing_form")
```

5. Locate Element by CSS Class

```
from selenium import webdriver

driver = webdriver.Chrome()
driver.get("https://www.lambdatest.com")
first_form_input = driver.find_element_by_class_name(" form-control
")
```

6. Locate Elements by Name

```
Ex: <input name="name" type="text" value="user name"
/>
---------------------------------------------------------------------------
from selenium import webdriver

driver = webdriver.Chrome()
driver.get("https://www.lambdatest.com")

# for selection input with name attribute "name"
name_input = driver.find_element_by_name("name")
```

7. Locate Elements by XPath

```
from selenium import webdriver

driver = webdriver.Chrome()

driver.get("https://www.lambdatest.com")

email_input =
driver.find_element_by_xpath("//input[@name='email']")
```

8. Locating element by tag name

```
driver = webdriver.Chrome()

driver.get("https://www.lambdatest.com")

email_input =
driver.find_element_by_tag_name("input")
```

9. Locate Element by Link text or Partial Link Text

```
from selenium import webdriver

driver = webdriver.Chrome()
driver.get("https://www.lambdatest.com")

email_input = driver.find_element_by_link_text('Start
Free Testing')
```

10. Misc methods for finding elements

- ID = “id”
- XPATH = “xpath”
- NAME = “name”
- TAG_NAME = “tag name”
- CLASS_NAME = “class name”
- LINK_TEXT = “link text”
- PARTIAL_LINK_TEXT = “partial link text”

11. Opening a URL (or document)

```
driver.get('url')
```

Refresh Page
driver.refresh()

12. Clear in text box

```
# get element
element =
driver.find_element_by_id("useremail")

# send keys
element.clear()
```

13. Click on object

```
# get element
button_element =
driver.find_element_by_link_text("Start Free
Testing")

# click the element
button_element.click()
```

14. Dragging and Dropping a WebElement

```
element = driver.find_element_by_name("source")
target = driver.find_element_by_name("target")

from selenium.webdriver import ActionChains
action_chains = ActionChains(driver)
action_chains.drag_and_drop(element,
target).perform()
```

15. Selecting an option

```
from selenium.webdriver.support.ui import
Select
select =
Select(driver.find_element_by_id('city'))
select.select_by_index(index)
select.select_by_visible_text("text")
select.select_by_value(value)
```

16. Navigating between windows

```
driver.switch_to_window("window_handle")
```

17. driver.window_handles

```
for handle in driver.window_handles:
    driver.switch_to_window(handle)
```

18. driver.current_window_handle

```
handler = driver.current_window_handle
```

19. Switching to iFrames

```
driver.switch_to_frame("frame_name.0.child")
```

20. driver.switch_to_default_content()

```
driver.switch_to_default_content()
```

21. Handling pop-ups and alerts

- Simple Alert
- Confirmation Alert
- Prompt Alert

➔ **driver.switch_to.alert**

```
alert_obj = driver.switch_to.alert
```

➔ **alert_obj.accept()**

```
alert_obj = driver.switch_to.alert
alert_obj.accept()
```

➔ alert_obj.dismiss()

```
alert_obj = driver.switch_to.alert
alert_obj.accept()
```

➔ alert_obj.text()

```
alert_obj = driver.switch_to.alert
msg = alert_obj.text()
print(msg)
```

22. Getting Page Source

```
page_source = driver.page_source
```

23. Navigating browser history

```
driver.forward()
```

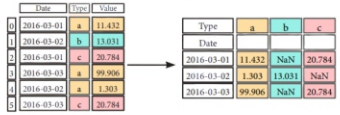
Python For Data Science

Data Wrangling in Pandas Cheat Sheet

> Reshaping Data

Pivot

```
>>> df3= df2.pivot(index='Date', #Spread rows into columns
                   columns='Type',
                   values='Value')
```

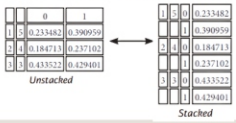


Pivot Table

```
>>> df4 = pd.pivot_table(df2, #Spread rows into
                         columns values='Value',
                         index='Date',
                         columns='Type'])
```

Stack / Unstack

```
>>> stacked = df5.stack() #Pivot a level of column labels
>>> stacked.unstack() #Pivot a level of index labels
```

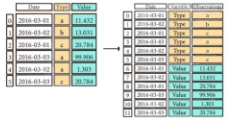


Unstacked

Stacked

Melt

```
>>> pd.melt(df2, #Gather columns into rows
            id_vars=["Date"],
            value_vars=["Type", "Value"],
            value_name="Observations")
```



> Iteration

```
>>> df.iteritems() #(Column-index, Series) pairs
>>> df.iterrows() #(Row-index, Series) pairs
```

> Missing Data

```
>>> df.dropna() #Drop NaN values
>>> df3.fillna(df3.mean()) #Fill NaN values with a predetermined value
>>> df2.replace("a", "f") #Replace values with others
```

> Advanced Indexing

Also see NumPy Arrays

Selecting

```
>>> df3.loc[:,(df3>1).any()] #Select cols with any vals >1
>>> df3.loc[:,(df3>1).all()] #Select cols with vals > 1
>>> df3.loc[:,df3.isnull().any()] #Select cols with NaN
>>> df3.loc[:,df3.notnull().all()] #Select cols without NaN
```

Indexing With `isin()`

```
>>> df[(df.Country.isin(df2.Type))] #Find same elements
>>> df3.filter(items="a","b"]) #Filter on values
>>> df.select(lambda x: not x%5) #Select specific elements
```

Where

```
>>> s.where(s > 0) #Subset the data
```

Query

```
>>> df6.query('second > first') #Query DataFrame
```

Setting/Resetting Index

```
>>> df.set_index('Country') #Set the index
>>> df4 = df.reset_index() #Reset the index
>>> df = df.rename(index=str, #Rename
                   DataFrame columns={"Country":"cntry",
                                      "Capital":"cptl",
                                      "Population":"ppltn"})
```

Reindexing

```
>>> s2 = s.reindex(['a','c','d','e','b'])
```

Forward Filling

```
>>> df.reindex(range(4),
               method='ffill')
```

	Country	Capital	Population
0	Belgium	Brussels	11190846
1	India	New Delhi	1303171035
2	Brazil	Brasilia	207847528
3	Brazil	Brasilia	207847528

Backward Filling

```
>>> s3 = s.reindex(range(5),
                   method='bfill')
```

0	3
1	3
2	3
3	3
4	3

MultiIndexing

```
>>> arrays = [np.array([1,2,3]),
              np.array([5,4,3])]
>>> df5 = pd.DataFrame(np.random.rand(3, 2), index=arrays)
>>> tuples = list(zip(*arrays))
>>> index = pd.MultiIndex.from_tuples(tuples,
                                      names=['first', 'second'])
>>> df6 = pd.DataFrame(np.random.rand(3, 2), index=index)
>>> df2.set_index(["Date", "Type"])
```

> Duplicate Data

```
>>> s3.unique() #Return unique values
>>> df2.duplicated('Type') #Check duplicates
>>> df2.drop_duplicates('Type', keep='last') #Drop duplicates
>>> df.index.duplicated() #Check index duplicates
```

> Grouping Data

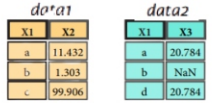
Aggregation

```
>>> df2.groupby(by=['Date','Type']).mean()
>>> df4.groupby(level=0).sum()
>>> df4.groupby(level=0).agg({'a':lambda x:sum(x)/len(x), 'b': np.sum})
```

Transformation

```
>>> customSum = lambda x: (x+x%2)
>>> df4.groupby(level=0).transform(customSum)
```

> Combining Data



data1

data2

Merge

```
>>> pd.merge(data1,
             data2,
             how='left',
             on='X1')
```

X1	X2	X3
a	11.432	20.784
b	1.303	NaN
c	99.906	NaN

```
>>> pd.merge(data1,
             data2,
             how='right',
             on='X1')
```

X1	X2	X3
a	11.432	20.784
b	1.303	NaN
d	NaN	20.784

```
>>> pd.merge(data1,
             data2,
             how='inner',
             on='X1')
```

X1	X2	X3
a	11.432	20.784
b	1.303	NaN

```
>>> pd.merge(data1,
             data2,
             how='outer',
             on='X1')
```

X1	X2	X3
a	11.432	20.784
b	1.303	NaN
c	99.906	NaN
d	NaN	20.784

Join

```
>>> data1.join(data2, how='right')
```

Concatenate

Vertical

```
>>> s.append(s2)
```

Horizontal/Vertical

```
>>> pd.concat([s,s2],axis=1, keys=['One','Two'])
>>> pd.concat([data1, data2], axis=1, join='inner')
```

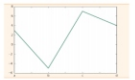
> Dates

```
>>> df2['Date']= pd.to_datetime(df2['Date'])
>>> df2['Date']= pd.date_range('2000-1-1',
                               periods=6,
                               freq='M')
>>> dates = [datetime(2012,5,1), datetime(2012,5,2)]
>>> index = pd.DatetimeIndex(dates)
>>> index = pd.date_range(datetime(2012,2,1), end, freq='BM')
```

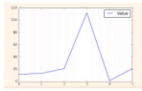
> Visualization

Also see Matplotlib

```
>>> import matplotlib.pyplot as plt
>>> s.plot()
>>> plt.show()
```



```
>>> df2.plot()
>>> plt.show()
```



~SagaR

Python For Data Science
Importing Data Cheat Sheet

> Importing Data in Python

Most of the time, you'll use either NumPy or pandas to import your data:

```
>>> import numpy as np
>>> import pandas as pd
```

> Help

```
>>> np.info(np.ndarray.dtype)
>>> help(pd.read_csv)
```

> Text Files

Plain Text Files

```
>>> filename = 'huck_finn.txt'
>>> file = open(filename, mode='r') #Open the file for reading
>>> text = file.read() #Read a file's contents
>>> print(file.closed) #Check whether file is closed
>>> file.close() #Close file
>>> print(text)
```

Using the context manager with

```
>>> with open('huck_finn.txt', 'r') as file:
        print(file.readline()) #Read a single line
        print(file.readline())
        print(file.readline())
```

Table Data: Flat Files

Importing Flat Files with NumPy

```
>>> filename = 'huck_finn.txt'
>>> file = open(filename, mode='r') #Open the file for reading
>>> text = file.read() #Read a file's contents
>>> print(file.closed) #Check whether file is closed
>>> file.close() #Close file
>>> print(text)
```

Files with one data type

```
>>> filename = 'mnist.txt'
>>> data = np.loadtxt(filename,
                      delimiter=',', #String used to separate values
                      skiprows=2, #Skip the first 2 lines
                      usecols=[0,2], #Read the 1st and 3rd column
                      dtype=str) #The type of the resulting array
```

Files with mixed data type

```
>>> filename = 'titanic.csv'
>>> data = np.genfromtxt(filename,
                         delimiter=',',
                         names=True, #Look for column header
                         dtype=None)
>>> data_array = np.recfromcsv(filename)
#The default dtype of the np.recfromcsv() function is None
```

Importing Flat Files with Pandas

```
>>> filename = 'winequality-red.csv'
>>> data = pd.read_csv(filename,
                       nrows=5, #Number of rows of file to read
                       header=None, #Row number to use as col names
                       sep='\t', #Delimiter to use
                       comment='#', #Character to split comments
                       na_values=[""]) #String to recognize as NA/NaN
```

> Exploring Your Data

NumPy Arrays

```
>>> data_array.dtype #Data type of array elements
>>> data_array.shape #Array dimensions
>>> len(data_array) #Length of array
```

Pandas DataFrames

```
>>> df.head() #Return first DataFrame rows
>>> df.tail() #Return last DataFrame rows
>>> df.index #Describe index
>>> df.columns #Describe DataFrame columns
>>> df.info() #Info on DataFrame
>>> data_array = data.values #Convert a DataFrame to an a NumPy array
```

> SAS File

```
>>> from sas7bdat import SAS7BDAT
>>> with SAS7BDAT('urbanpop.sas7bdat') as file:
        df_sas = file.to_data_frame()
```

> Stata File

```
>>> data = pd.read_stata('urbanpop.dta')
```

> Excel Spreadsheets

```
>>> file = 'urbanpop.xlsx'
>>> data = pd.ExcelFile(file)
>>> df_sheet2 = data.parse('1960-1966',
                           skiprows=[0],
                           names=['Country',
                           'AAM: War(2002)'])
>>> df_sheet1 = data.parse(0,
                           parse_cols=[0],
                           skiprows=[0],
                           names=['Country'])
```

To access the sheet names, use the `sheet_names` **attribute:**

```
>>> data.sheet_names
```

> Relational Databases

```
>>> from sqlalchemy import create_engine
>>> engine = create_engine('sqlite://Northwind.sqlite')
```

Use the `table_names()` **method to fetch a list of table names:**

```
>>> table_names = engine.table_names()
```

Querying Relational Databases

```
>>> con = engine.connect()
>>> rs = con.execute("SELECT * FROM Orders")
>>> df = pd.DataFrame(rs.fetchall())
>>> df.columns = rs.keys()
>>> con.close()
```

Using the context manager with

```
>>> with engine.connect() as con:
        rs = con.execute("SELECT OrderID FROM Orders")
        df = pd.DataFrame(rs.fetchmany(size=5))
        df.columns = rs.keys()
```

Querying relational databases with pandas

```
>>> df = pd.read_sql_query("SELECT * FROM Orders", engine)
```

> Pickled Files

```
>>> import pickle
>>> with open('pickled_fruit.pkl', 'rb') as file:
        pickled_data = pickle.load(file)
```

> Matlab Files

```
>>> import scipy.io
>>> filename = 'workspace.mat'
>>> mat = scipy.io.loadmat(filename)
```

> HDF5 Files

```
>>> import h5py
>>> filename = 'H-H1_LOSC_4_v1-815411200-4096.hdf5'
>>> data = h5py.File(filename, 'r')
```

> Exploring Dictionaries

Querying relational databases with pandas

```
>>> print(mat.keys()) #Print dictionary keys
>>> for key in data.keys(): #Print dictionary keys
        print(key)
meta
quality
strain
>>> pickled_data.values() #Return dictionary values
>>> print(mat.items()) #Returns items in list format of (key, value) tuple pairs
```

Accessing Data Items with Keys

```
>>> for key in data ['meta'].keys() #Explore the HDF5 structure
        print(key)
Description
DescriptionURL
Detector
Duration
GPSstart
Observatory
Type
UTCstart
#Retrieve the value for a key
>>> print(data['meta']['Description'].value)
```

> Navigating Your FileSystem

Magic Commands

```
!ls  #List directory contents of files and directories
%cd .. #Change current working directory
%pwd #Return the current working directory path
```

OS Library

```
>>> import os
>>> path = "/usr/tmp"
>>> wd = os.getcwd() #Store the name of current directory in a string
>>> os.listdir(wd) #Output contents of the directory in a list
>>> os.chdir(path) #Change current working directory
>>> os.rename("test1.txt", #Rename a file
              "test2.txt")
>>> os.remove("test1.txt") #Delete an existing file
>>> os.mkdir("newdir") #Create a new directory
```

~SagaR

!pip install pandas

13. Read SQL Table

import pandas as pd

We can extract table from SQL database (SQL Server / Teradata). See the program below -

SQL Server

You can read data from tables stored in SQL Server by building a connection. You need to have server, User ID (UID), database details to establish connection.

```
import pandas as pd
import pyodbc
conn = pyodbc.connect("Driver={SQL Server};Server=serverName;UID=UserName;PWD=Password;Database=RCO_DW;")
df = pd.read_sql_query('select * from dbo.Table WHERE ID > 10', conn)
df.head()
```

Teradata

You need to import **Teradata module** which makes python easily integrated with Teradata Database. an **install this package** using the command below -

```
import pandas as pd
import teradata
udaExec = teradata.UdaExec(appName="HelloWorld", version="1.0",
                    logConsole=False)
session = udaExec.connect(method="odbc",
                    USEREGIONALSETTINGS="N",
                    system="tdprod",
                    username="xxx",
                    password="xxx");

query = "SELECT * FROM flight"
df = pd.read_sql(query , session)
```

Explanation

- UdaExec provides DevOps support features such as configuration and logging.
- You can assign any name and version in appName and version
- logConsole=False tells Python not to log to the console.
- system="tdprod" refers to name of the system we are connecting using ODBC as the connection method
- USEREGIONALSETTINGS="N" is used to ensure that float values can be loaded and make decimal separator be '.'

4. Read Excel F

mydata = pd.re
skiprows=2)
If you do not sp

We can load Stata data file via read_stata() function.

mydata41 = pd.read_stata('cars.dta')

5. Read delimit

Suppose you have .db extension file which is a database file and you want to extract data from it.

11. Specify values as missing values

```
import sqlite3
from pandas.io import sql
conn = sqlite3.connect('C:/Users/Deepanshu/Downloads/flight.db')
query = "SELECT * FROM flight"
results = pd.read_sql(query, con=conn)
print results.head()
```

6. Read SAS File

We can import SAS data file by using read_sas() function.

mydata4 = pd.read_sas('cars.sas7bdat')

12. Skip rows while importing

Suppose you want to skip first 5 rows and wants to read data from 6th row (6th row would be a header row)

*mydata8 = pd.read_csv("http://winterolympicsmedals.com/medals.csv",**skiprows**=5)*

Projects Steps

~SagaR

Data Extraction

- [ ] SQL
- [ ] Scrapping
- [ ] File Formats
  - CSV
  - Json
  - Xml
- [ ] Consulting APIs
- [ ] Buying Data
- [ ] Distributed Databases

Data Cleaning

- [ ] Missing values & empty data
- [ ] Data imputation
- [ ] Incorrect types
- [ ] Incorrect or invalid values
- [ ] Outliers & non relevant data
- [ ] Statistical sanitization

Data Wrangling

- [ ] Hierarchical Data
- [ ] Handling categorical data
- [ ] Reshaping & transforming structures
- [ ] Indexing data for quick access
- [ ] Merging, combining & joining data

Analysis

- [ ] Exploration
- [ ] Building statistical models
- [ ] Visualization & representations
- [ ] Correlation vs Causation analysis
- [ ] Hypothesis testing
- [ ] Statistical analysis
- [ ] Reporting

Action

- [ ] Building Machine Learning Models
- [ ] Feature Engineering
- [ ] Moving ML into production
- [ ] Building ETL pipelines
- [ ] Live dashboard & reporting
- [ ] Decision marking & real-life tests