

SciPy Training for Beginners



What is SciPy?

- Free and open-source Python library
- Used for scientific computing and technical computing
- Contains modules for optimization, linear algebra, integration, interpolation, special functions, FFT, signal and image processing



What are the characteristics of SciPy?



Characteristics of SciPy

01

Contains toolboxes dedicated to common issues in Scientific Computing

02

Different submodules corresponds to different applications

03

Operates on NumPy array, NumPy and SciPy work hand in hand

04

Adds significant power to the interactive Python session

05

Routines are tested and optimized

What are the
different SciPy
packages you're
talking about?

SciPy Sub-packages



Sub-packages in SciPy

`scipy.cluster`

`scipy.stats`

`scipy.optimize`

`scipy.integrate`

`scipy.linalg`

`scipy.fftpack`

`scipy.signal`

Working with SciPy Sub-packages



Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

Why do we use `scipy.cluster()`?

- Provides `kmeans()` function
- Useful while dividing data into clusters of related attributes
- Divide n observations into k clusters

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

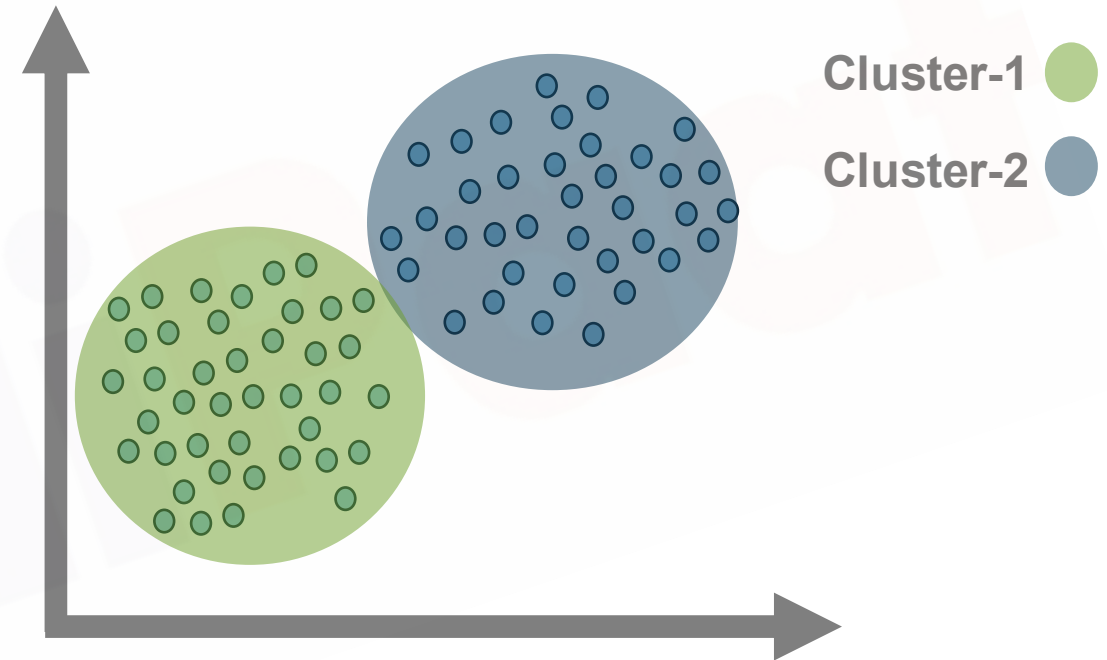
scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

What is clustering?



Dividing data into groups

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

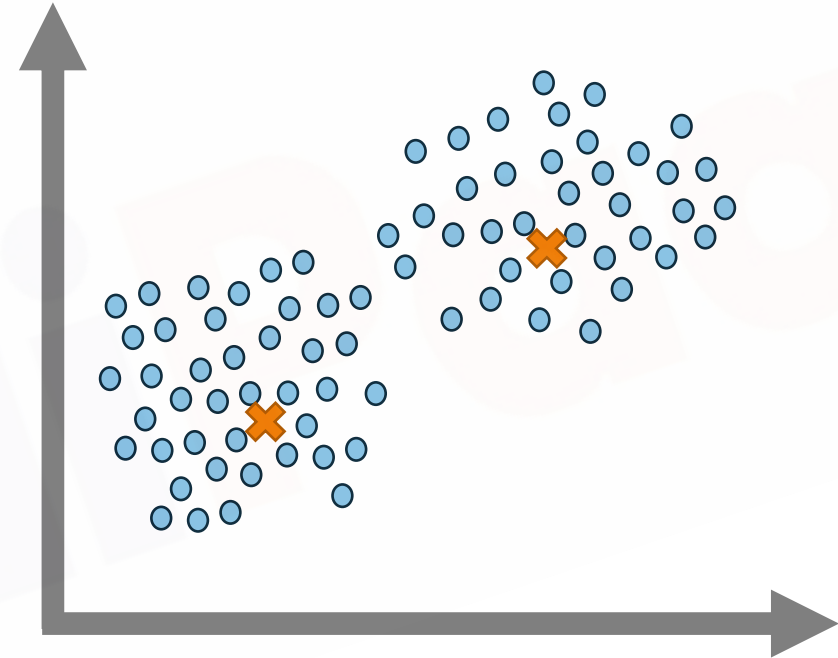
scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we find clusters?



Step:1 Randomly select two cluster centers

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

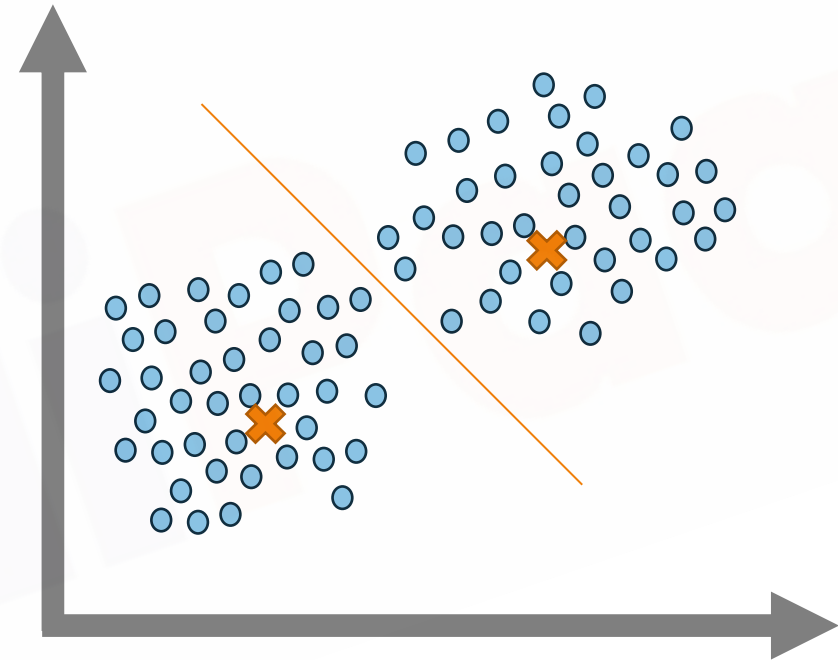
scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we find clusters?



Step:2 Assign members to the cluster

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

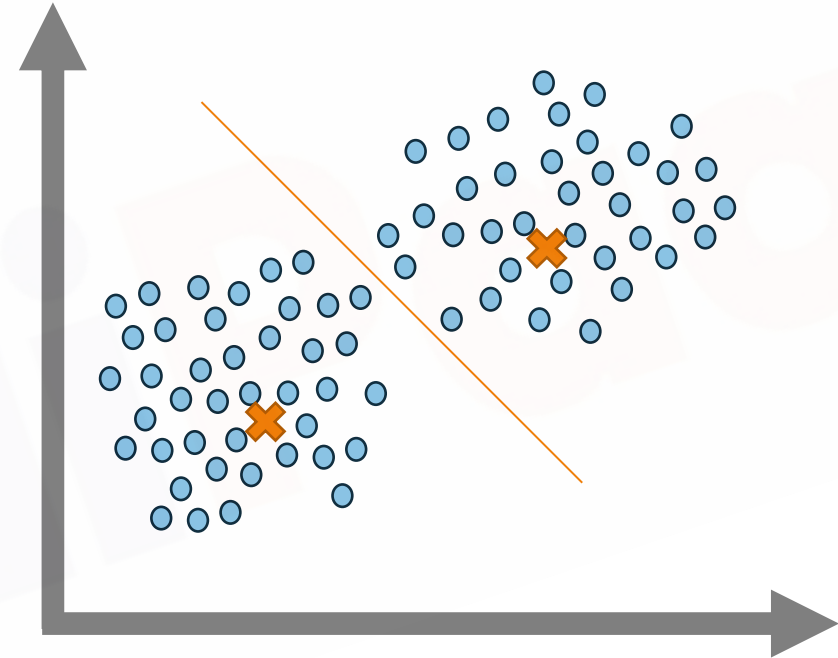
scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we find clusters?



Step:3 Calculate the mean distance of each member

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

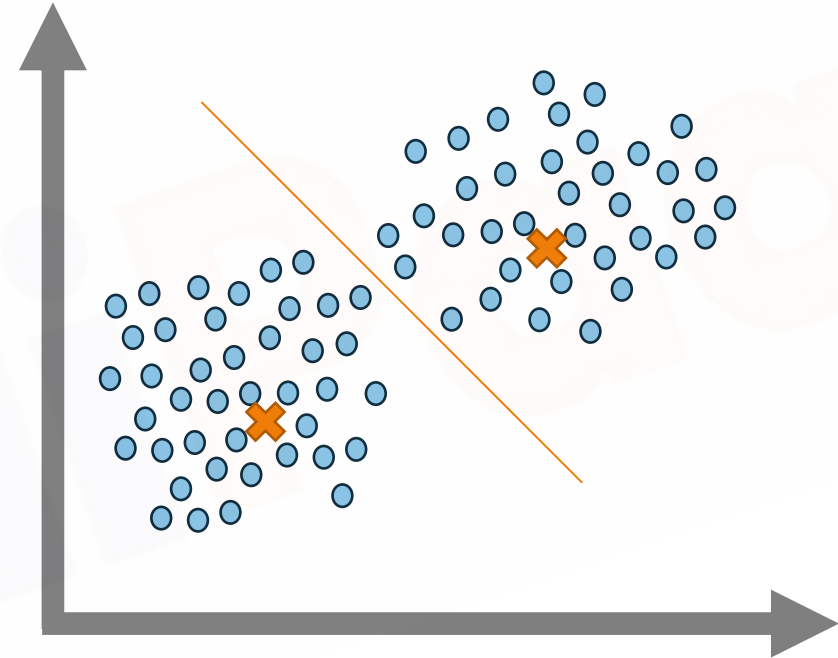
scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we find clusters?



Step:4 Shift the cluster center towards mean

Repeat **Step:2** and **Step:3** until no member changes the group

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we find cluster?

Example:

X	Y	Dist-k1	Dist-k2	Min	Cluster
1	1	8	33.62	8	1
2	2	2	19.22	2	1
4	4	2	2.42	2	1
5	5	8	0.02	0.02	2
6	6	18	1.62	1.62	2

K1(Centroid1)	3	3
K2(Centroid2)	5.1	5.1

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we find cluster?

Example:

X	Y	Cluster-1		Cluster-2	
1	1	1	1		
2	2	2	2		
4	4	4	4		
5	5			5	5
6	6			6	6
	Mean	2.333	2.333	5.5	5.5

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we find cluster?

Example:

X	Y	Cluster-1		Cluster-2	
1	1	1	1		
2	2	2	2		
4	4	4	4		
5	5			5	5
6	6			6	6
	Mean	2.333	2.333	5.5	5.5

- Now, consider (2.33, 2.33) and (5.5, 5.5) as K1 and K2
- Again, find distance of each point from K1 and K2
- Based on minimum distance put them in clusters
- Repeat until no member changes the cluster

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we find cluster using SciPy?

```
In [24]: import pandas as pd  
#importing data  
data=pd.read_excel('somecars1.xlsx')  
data
```

Out[24]:

	mpg	cyl	displacement	hp	drat	wt	qsec	vs	am	gear	carb
0	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
1	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
2	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
3	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
4	18.7	8	360.0	175	3.15	3.440	17.02	0	0	3	2
5	18.1	6	225.0	105	2.76	3.460	20.22	1	0	3	1
6	14.3	8	360.0	245	3.21	3.570	15.84	0	0	3	4
7	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
8	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	2
9	19.2	6	167.6	123	3.92	3.440	18.30	1	0	4	4
10	17.8	6	167.6	123	3.92	3.440	18.90	1	0	4	4
11	16.4	8	275.8	180	3.07	4.070	17.40	0	0	3	3
12	17.3	8	275.8	180	3.07	3.730	17.60	0	0	3	3
13	15.2	8	275.8	180	3.07	3.780	18.00	0	0	3	3

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we find cluster using SciPy?

```
In [25]: import pandas as pd
          from scipy.cluster.vq import kmeans,vq
          #data importing
          data=pd.read_excel('somecars1.xlsx')
          #Find out centroid with the help of kmeans function, here k=3
          centroid,_ = kmeans(data,3)
          #Find out cluster index for each record with vector quantization function(i.e. vq(data,centroid))
          idx, _ = vq(data,centroid)
          #print cluster index
          idx
```

```
Out[25]: array([0, 0, 0, 2, 1, 2, 1, 0, 0, 0, 0, 2, 2, 2, 1, 1, 1, 0, 0, 0, 0, 2,
                2, 1, 1, 0, 0, 0, 1, 0, 1, 0])
```

k-means without data whitening

```
In [32]: print(centroid)
```

```
[[2.45000000e+01 4.62500000e+00 1.22293750e+02 9.68750000e+01
 4.00250000e+00 2.51800000e+00 1.85431250e+01 7.50000000e-01
 6.87500000e-01 4.12500000e+00 2.43750000e+00]
 [1.70142857e+01 7.42857143e+00 2.76057143e+02 1.50714286e+02
 2.99428571e+00 3.60142857e+00 1.81185714e+01 2.85714286e-01
 0.00000000e+00 3.00000000e+00 2.14285714e+00]
 [1.46444444e+01 8.00000000e+00 3.88222222e+02 2.32111111e+02
 3.34333333e+00 4.16155556e+00 1.64044444e+01 0.00000000e+00
 2.22222222e-01 3.44444444e+00 4.00000000e+00]]
```

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we find cluster using SciPy?

```
In [27]: import pandas as pd
          from scipy.cluster.vq import kmeans,vq,whiten
          #data importing
          data=pd.read_excel('somecars1.xlsx')
          #whitening data
          data = whiten(data)
          #Find out centroid with the help of kmeans function, here k=3
          centroid,_ = kmeans(data,3)
          #Find out cluster index for each record with vector quintization function(i.e. vq(data,centroid),
          idx,_ = vq(data,centroid)
          #print clusetr index
          idx
```

```
Out[27]: array([0, 0, 1, 2, 2, 2, 2, 1, 1, 0, 0, 2, 2, 2, 2, 2, 1, 1, 1, 1, 2,
                2, 2, 2, 1, 1, 1, 0, 0, 0, 1])
```

k-means with data whitening

```
In [32]: print(centroid)
```

```
[[ 2.65026134  4.38861477  2.79561906  2.69379731  5.87571578  4.14784379
   9.96498874  0.28797293  0.         4.13118224  1.75228367]
 [ 4.49485899  2.27557803  0.86186686  1.22454955  7.73557558  2.373431
  10.88086523  1.83255502  1.48080818  5.63343032  0.9721294 ]
 [ 3.11866282  3.73844962  1.70065265  2.62499698  7.33480435  3.24639015
   9.36352368  0.57594586  1.45436517  6.09841187  3.05526383]]
```

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

Why do we use `scipy.stats()`?

- All of the statistical functions are located in the sub-package `scipy.stats`.
- Contains a large number of probability distributions
- Use `info(stats)` to see all the functions

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we use `scipy.stats()`?

Example:

Nutritionists measured the sugar content (in grams) for 13 drinks at Jake's Java coffee shop. The collected data looks like this

Sugar
15
18
20
26
32
38
32
24
21
16
12
11
14

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we use scipy.stats()?

Example:

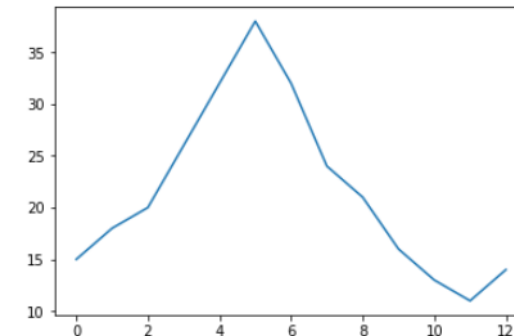
The drinks had a mean of 21.5g and a standard deviation of 8g, and the distribution was roughly symmetric.

Sugar
15
18
20
26
32
38
32
24
21
16
12
11
14

```
In [52]: #import numpy
import numpy as np
#create the marks array
coffee = np.array([15,18,20,26,32,38,32,24,21,16,13,11,14])
print(coffee.mean(), coffee.std())
#let us see the data distribution by plotting it
import matplotlib.pyplot as pyplot
plt.plot(range(13),coffee)
```

21.53846153846154 8.063358573156098

Out[52]: [<matplotlib.lines.Line2D at 0x295efe4a668>]



Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we use `scipy.stats()`?

Example:

Now, a Grande Mocha Cappuccino at Jake's Java contains 14g of sugar. Calculate the standardized score (z-score) for the Grande Mocha Cappuccino.

Sugar
15
18
20
26
32
38
32
24
21
16
12
11
14

```
In [47]: #import numpy
import numpy as np
#create the marks array
coffee = np.array([15,18,20,26,32,38,32,24,21,16,13,11,14])
from scipy import stats
#find the zscore
print(stats.zscore(coffee))
```

```
[-0.81088562 -0.43883222 -0.19079662  0.55331019  1.297417    2.0415238
 1.297417    0.30527459 -0.06677882 -0.68686782 -1.05892123 -1.30695683
-0.93490342]
```


Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we use `scipy.stats()`?

Example:

Now, a Grande Mocha Cappuccino at Jake's Java contains 14g of sugar. Calculate the standardized score (z-score) for the Grande Mocha Cappuccino.

Sugar
15
18
20
26
32
38
32
24
21
16
12
11
14

```
In [47]: #import numpy
import numpy as np
#create the marks array
coffee = np.array([15,18,20,26,32,38,32,24,21,16,13,11,14])
from scipy import stats
#find the zscore
print(stats.zscore(coffee))
```

```
[-0.81088562 -0.43883222 -0.19079662  0.55331019  1.297417    2.0415238
 1.297417    0.30527459 -0.06677882 -0.68686782 -1.05892123 -1.30695683
-0.93490342]
```

z-score of the Mocha Cappuccino is **-0.9**

What does this mean?

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we use `scipy.stats()`?

Example:

Now, a Grande Mocha Cappuccino at Jake's Java contains 14g of sugar. Calculate the standardized score (z-score) for the Grande Mocha Cappuccino.

Sugar
15
18
20
26
32
38
32
24
21
16
12
11
14

What does this mean?

- A. This drink has 0.9g of sugar less than the mean of the 13 drinks.
- B. This drink is 0.9 standard deviations below the mean of the 13 drinks.
- C. About 90% of drinks have a lower sugar content than this drink.
- D. About 90% of drinks have a higher sugar content than this drink.

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we use `scipy.stats()`?

Example:

Now, a Grande Mocha Cappuccino at Jake's Java contains 14g of sugar. Calculate the standardized score (z-score) for the Grande Mocha Cappuccino.

Sugar
15
18
20
26
32
38
32
24
21
16
12
11
14

What does this mean?

- A. This drink has 0.9g of sugar less than the mean of the 13 drinks.
- B. This drink is 0.9 standard deviations below the mean of the 13 drinks.
- C. About 90% of drinks have a lower sugar content than this drink.
- D. About 90% of drinks have a higher sugar content than this drink.**

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we use `scipy.stats()`?

Example:

Dataset consists of frequency of people going to gym and frequency of smoking

Gym going Smoking	Always	Never	Sometimes
Heavy	7	1	3
Never	87	18	84
Occasional	12	3	4
Regular	9	1	7

Test if the relation is significant or not..

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we use `scipy.stats()`?

Example:

Dataset consists of frequency of people going to gym and frequency of smoking

Gym going Smoking	Always	Never	Sometimes
Heavy	7	1	3
Never	87	18	84
Occasional	12	3	4
Regular	9	1	7

Test if the relation is significant or not..

Find the **p value**..

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we use scipy.stats()?

Example:

Dataset consists of frequency of people going to gym and frequency of smoking

Gym going Smoking	Always	Never	Sometimes
Heavy	7	1	3
Never	87	18	84
Occasional	12	3	4
Regular	9	1	7

Test if the relation is significant or not..

If **p value** is less than **0.05** than there is a dependency otherwise not

← Dependent				Independent →				
0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we use `scipy.stats()`?

```
In [46]: import numpy as np
          from scipy import stats
          obs= np.array([[7,1,3],[87,18,84],[12,3,4],[9,1,7]])
          chi2,p,dof,expected=stats.chi2_contingency(obs)
          p
```

```
Out[46]: 0.48284216946545633
```

P value is greater than 0.05

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we use scipy.stats()?

```
In [46]: import numpy as np
          from scipy import stats
          obs= np.array([[7,1,3],[87,18,84],[12,3,4],[9,1,7]])
          chi2,p,dof,expected=stats.chi2_contingency(obs)
          p
```

```
Out[46]: 0.48284216946545633
```

P value is greater than 0.05

No dependency between frequency of smoking and frequency of going to gym for our observed data.

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

Why do we use `scipy.optimize()`?

- Provides algorithms for function minimization (scalar or multi-dimensional)
- Can also be used for curve fitting and root finding

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

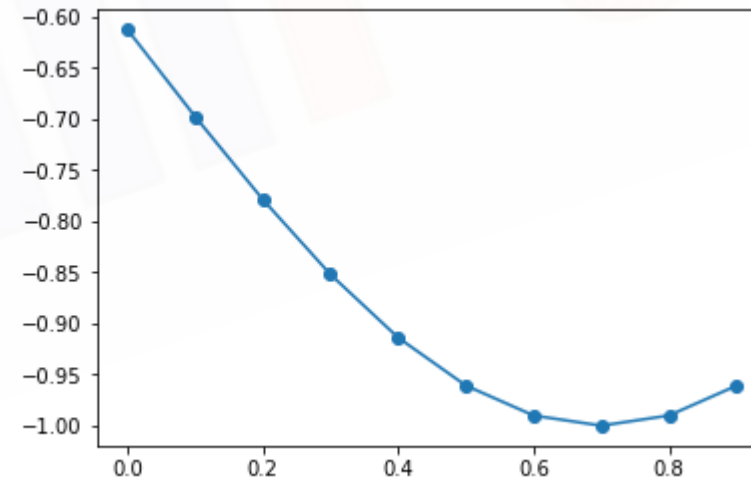
scipy.linalg

scipy.fftpack

scipy.signal

Why do we use `scipy.optimize()`?

```
In [80]: import matplotlib.pyplot as plt
import numpy as np
x = np.arange(0.0, 1.0, 0.1)
def f(x):
    return -np.exp(-(x-0.7)**2)
plt.plot(x, f(x), 'o-')
```



Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

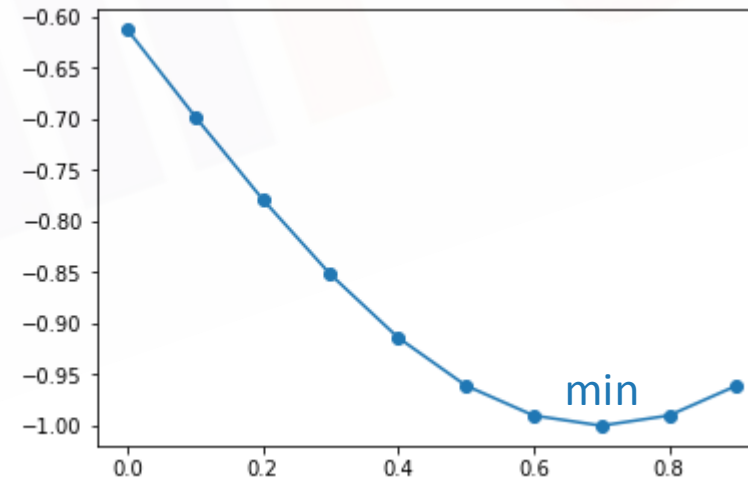
scipy.linalg

scipy.fftpack

scipy.signal

Why do we use `scipy.optimize()`?

```
In [80]: import matplotlib.pyplot as plt
import numpy as np
x = np.arange(0.0, 1.0, 0.1)
def f(x):
    return -np.exp(-(x-0.7)**2)
plt.plot(x, f(x), 'o-')
```



Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

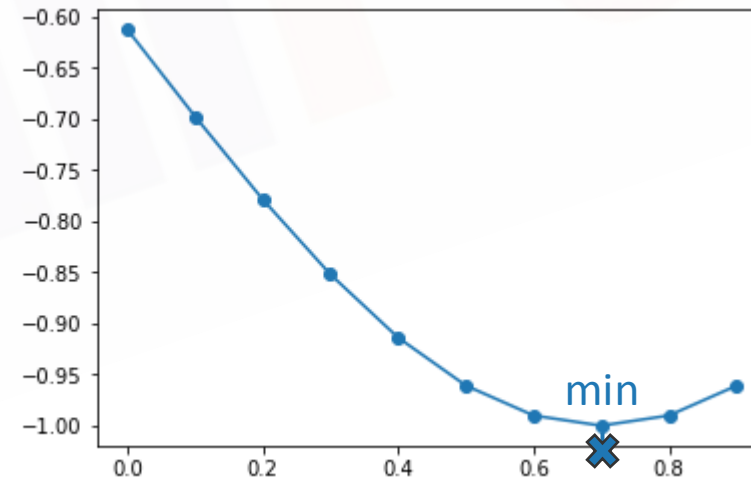
scipy.linalg

scipy.fftpack

scipy.signal

Why do we use `scipy.optimize()`?

```
In [80]: import matplotlib.pyplot as plt
import numpy as np
x = np.arange(0.0, 1.0, 0.1)
def f(x):
    return -np.exp(-(x-0.7)**2)
plt.plot(x, f(x), 'o-')
```



Manually: $f(0.1)$, $f(0.2)$, ..., $f(1)$. But when data is more??

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

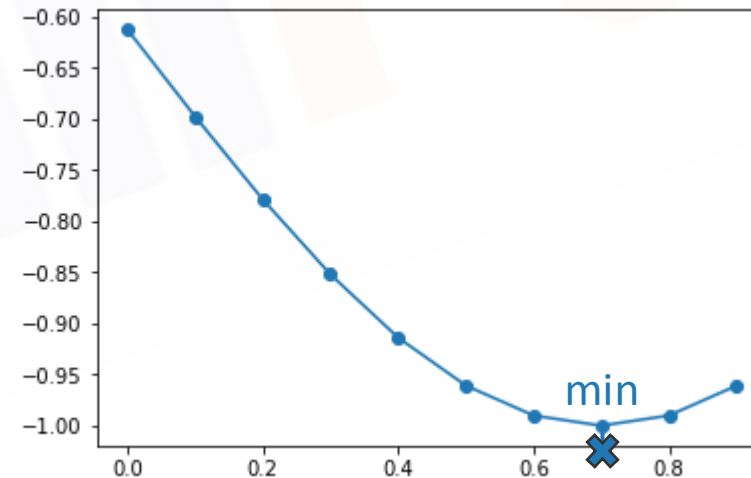
scipy.linalg

scipy.fftpack

scipy.signal

Why do we use `scipy.optimize()`?

```
In [80]: import matplotlib.pyplot as plt
import numpy as np
x = np.arange(0.0, 1.0, 0.1)
def f(x):
    return -np.exp(-(x-0.7)**2)
plt.plot(x, f(x), 'o-')
```



That is when `scipy.optimize()` comes in handy.

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we use `scipy.optimize()`?

```
In [55]: from scipy import optimize
import numpy as np
def f(x):
    return -np.exp(-(x-0.7)**2)
result = optimize.minimize_scalar(f)
x_min = result.x
x_min
```

```
Out[55]: 0.6999999997839409
```

This means that at $x=0.699$ we get a minimum out of our function.

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

Why do we use `scipy.integrate()`?

- When analytical integration becomes difficult, numerical integration comes handy.
- Offers number of routines for performing numerical integration.
- Offers **quad** for single integration, **dblquad** for double integration, **tplquad** for triple integration, **nquad** for n-fold multiple integration.

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

Why do we use `scipy.integrate()`?

Example:

If $f(x) = x^2$, $y = f(x)$ then find the value of $\int_a^b y \, dx$

where $a = 0$ and $b = 1$

Mathematically,

$$y = x^n = x^2$$

$$\int_a^b x^n dx = \frac{a^{(n+1)}}{(n+1)} - \frac{b^{(n+1)}}{(n+1)}$$

Here, $n=2$,

$$\int_0^1 x^2 dx = \frac{1^{(2+1)}}{(2+1)} - 0 = 0.333$$

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we use `scipy.integrate()`?

```
In [82]: import scipy.integrate as intg  
  
def integrad(x):  
    return x**2  
ans, _ = intg.quad(integrad,0,1)  
ans
```

```
Out[82]: 0.33333333333333337
```

Similarly,

For double integration use `dblquad`

For triple integration use `tplquad`

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

Why do we use `scipy.linalg()`?

- Provides standard linear algebra operation
- Compute determinant of a square matrix
- Compute inverse of a square matrix
- Compute eigen values of the matrix
- Can find out singular-value decomposition, commonly used in statistics and signal processing

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we use `scipy.linalg()`?

Determinant of a square matrix

```
In [84]: from scipy import linalg
import numpy as np
data = np.array([[1,2,3],[3,4,5],[5,6,7]])
linalg.det(data)
```

```
Out[84]: -1.1842378929335004e-15
```

Inverse of a square matrix

```
In [85]: from scipy import linalg
import numpy as np
data = np.array([[1,2,3],[3,4,5],[5,6,7]])
linalg.inv(data)
```

```
Out[85]: array([[ -1.18515780e+15,  2.37031559e+15, -1.18515780e+15],
 [ 2.37031559e+15, -4.74063119e+15,  2.37031559e+15],
 [-1.18515780e+15,  2.37031559e+15, -1.18515780e+15]])
```

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

How do we use `scipy.linalg()`?

Eigen values of a square matrix

```
In [86]: from scipy import linalg  
import numpy as np  
data = np.array([[1,2,3],[3,4,5],[5,6,7]])  
linalg.eigvals(data)
```

```
Out[86]: array([ 1.29282032e+01+0.j, -9.28203230e-01+0.j,  6.16237757e-16+0.j])
```

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

Why do we use `scipy.fftpack()`?

- Computes fast Fourier transforms (FFTs)
- An efficient implementation of the discrete Fourier Transform (DFT)

It provides functions such as:

- `scipy.fftpack.fft()` to compute the FFT
- `scipy.fftpack.fftfreq()` to generate the sampling frequencies
- `scipy.fftpack.ifft()` to compute the inverse FFT, from frequency space to signal space

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

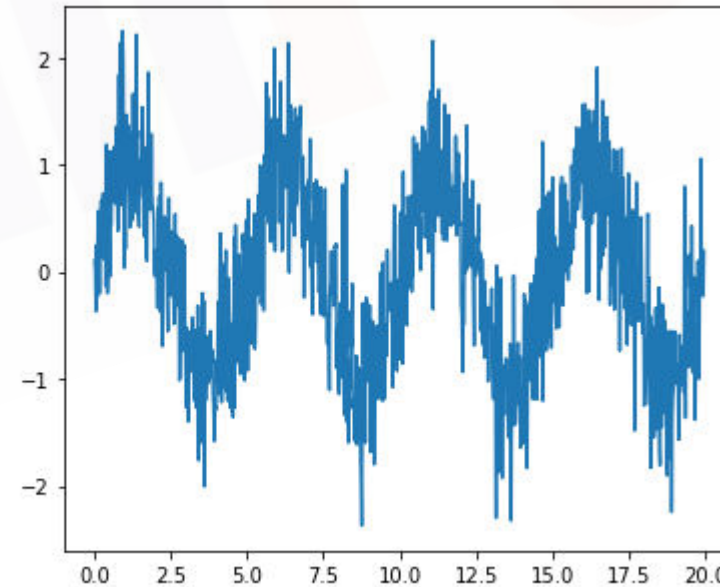
scipy.fftpack

scipy.signal

How do we use scipy.fftpack()?

Generate a noisy signal:

```
In [90]: import numpy as np
time_step = 0.02
period = 5.
time_vec = np.arange(0, 20, time_step)
sig = np.sin(2 * np.pi / period * time_vec) + 0.5 * np.random.randn(time_vec.size)
plt.figure(figsize=(6, 5))
plt.plot(time_vec, sig)
plt.show()
```



Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

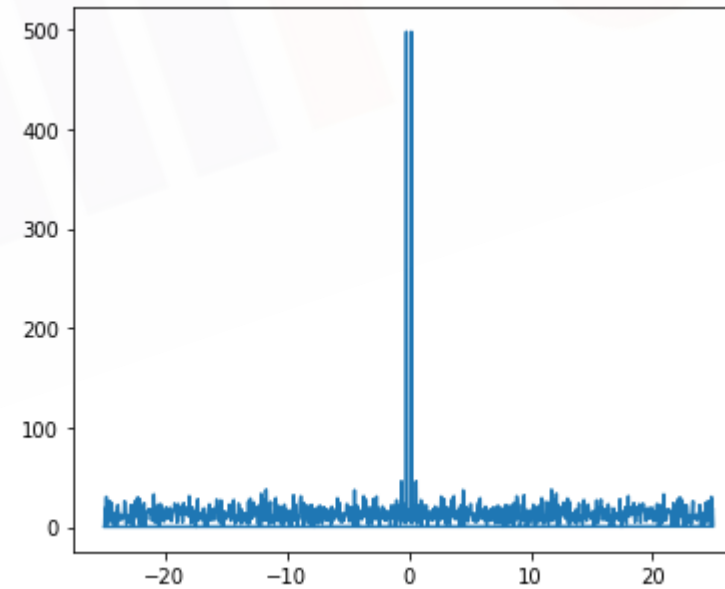
scipy.fftpack

scipy.signal

How do we use scipy.fftpack()?

Applying fft:

```
In [92]: from scipy import fftpack
sample_freq = fftpack.fftfreq(sig.size, d = time_step)
sig_fft = fftpack.fft(sig)
power = np.abs(sig_fft)
sample_freq = fftpack.fftfreq(sig.size, d=time_step)
plt.figure(figsize=(6, 5))
plt.plot(sample_freq, power)
plt.show()
```



Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

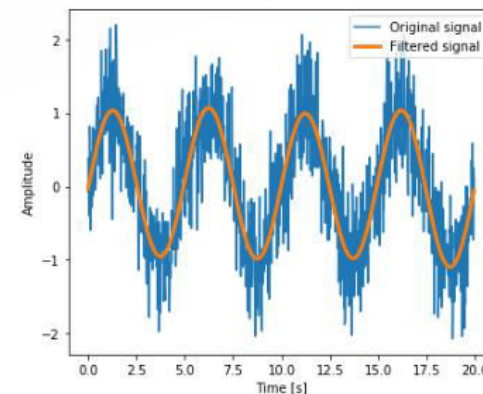
How do we use scipy.fftpack()?

Applying ifft to get the noiseless signal:

```
In [10]: #Filter out the sample frequencies that are greater than 0 with numpy.where(condition)
pos_mask = np.where(sample_freq > 0)
#Apply the filter on sample_freq and store the +ve sample_freq on freqs
freqs = sample_freq[pos_mask]

#print(power[pos_mask].argmax())
#Find the peak frequency, here we focus on only the positive frequencies
peak_freq = freqs[power[pos_mask].argmax()]
#now get an array copy of the signal where we already applied fft.
high_freq_fft = sig_fft.copy()
#assign the ones greater than peak_freq as 0 in order to remove the noise
high_freq_fft[np.abs(sample_freq) > peak_freq] = 0

#print(high_freq_fft)
#Now apply inverse fft on the new high_freq_fft this will be the filtered signal
filtered_sig = fftpack.ifft(high_freq_fft)
#plot
plt.figure(figsize=(6, 5))
#now plot the original signal for reference
plt.plot(time_vec, sig, label='Original signal')
#now plot the filtered signal
plt.plot(time_vec, filtered_sig, linewidth=3, label='Filtered signal')
#add label, legend
plt.xlabel('Time [s]')
plt.ylabel('Amplitude')
plt.legend(loc='best')
#show
plt.show()
```



Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

scipy.fftpack

scipy.signal

Why do we use `scipy.signal()`?

- Used for typical signal processing(1D Dimensional and periodic signals)
- Say, you need to resample a signal with n data points to x data points, `scipy.signal` is used. Scipy resamples data points by using FFT.

Sub-packages in SciPy

scipy.cluster

scipy.stats

scipy.optimize

scipy.integrate

scipy.linalg

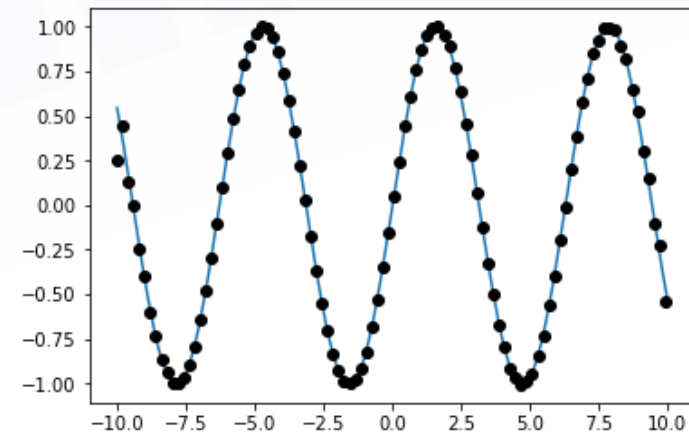
scipy.fftpack

scipy.signal

How do we use scipy.signal()?

Resampling:

```
In [33]: #scipy.signal uses FFT to resample a 1D signal.
import matplotlib.pyplot as plt
import numpy as np
from scipy import signal
#Now let us create a signal with 200 data point
t = np.linspace(-10, 10, 200) #Defining Time Interval
y = np.sin(t)
x_resampled = signal.resample(y, 100) #Number of required samples is 100
plt.plot(t, y)
#for x axis slice t into 2 step size
plt.plot(t[::2], x_resampled, 'o')
plt.show()
```



QUIZ

Quiz 1

Which of the following will be used to find out the zscore of the given numpy array?

A

`np.stats.zscore(numarr)`

B

`stats.zscore(numarr)`

C

`stats.zcores(numarr)`

D

`np.stats.zscores(numarr)`

```
from scipy import stats
import numpy as np
numarr=np.array([9,8,7,6,5,4,3,2,1,0])
```



Answer 1

Which of the following will be used to find out the zscore of the given numpy array?

A

`np.stats.zscore(numarr)`

B

`stats.zscore(numarr)`

C

`stats.zcores(numarr)`

D

`np.stats.zscores(numarr)`

```
from scipy import stats
import numpy as np
numarr=np.array([9,8,7,6,5,4,3,2,1,0])
```



Quiz 2

Find out the correct output:

A

0.2464

B

1.0929

C

2.3111

D

None of the above

```
import numpy as np
from scipy import stats
new=np.array([[0.1,1,2],[3,0.2,1],[
1,0.5,4]])
_,p,_,_
=stats.chi2_contingency(new)
```



Answer 2

Find out the correct output:

A

0.2464

B

1.0929

C

2.3111

D

None of the above

```
import numpy as np
from scipy import stats
new=np.array([[0.1,1,2],[3,0.2,1],[
1,0.5,4]])
_,p,_,_
=stats.chi2_contingency(new)
```



Quiz 3

Find out the correct output:

A

8.37

B

-8.37

C

1

D

None of the above

```
from scipy import linalg
import numpy as np
new=np.array([[0.1,1,2],[3,0.2,1],[
1,0.5,4]])
linalg.det(new)
```



Answer 3

Find out the correct output:

A

8.37

B

-8.37

C

1

D

None of the above

```
from scipy import linalg
import numpy as np
new=np.array([[0.1,1,2],[3,0.2,1],[
1,0.5,4]])
linalg.det(new)
```



Quiz 4

Find out the correct cluster index array for the following:

A

array([1, 1, 1, 1, 1, 1, 0, 1, 0, 0, 1, 1, 1, 1])

B

array([1, 1, 1, 1, 1, 1, 0, 1, 0, 0, 1, 1, 1, 1])

C

array([1, 1, 1, 1, 1, 0, 1, 1, 0, 0, 1, 1, 1, 1])

D

array([1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 0, 1, 1, 1])

```
from scipy.cluster.vq import  
kmeans,vq,whiten  
import matplotlib.pyplot as plt  
new=[0.1,1,3,0.2,1,0.5,12,0.2,10,  
0.5,10,2,5,0.8]  
plt.scatter(range(len(new)),new)  
centroid,_ = kmeans(new,2)  
idx,_ = vq(new,centroid)  
idx
```



Answer 4

Find out the correct cluster index array for the following:

A

array([1, 1, 1, 1, 1, 1, 0, 1, 0, 0, 1, 1, 1, 1])

B

array([1, 1, 1, 1, 1, 1, 0, 1, 0, 0, 1, 1, 1, 1])

C

array([1, 1, 1, 1, 1, 0, 1, 1, 0, 0, 1, 1, 1, 1])

D

array([1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 0, 1, 1, 1])

```
from scipy.cluster.vq import  
kmeans,vq,whiten  
import matplotlib.pyplot as plt  
new=[0.1,1,3,0.2,1,0.5,12,0.2,10,  
0.5,10,2,5,0.8]  
plt.scatter(range(len(new)),new)  
centroid,_ = kmeans(new,2)  
idx,_ = vq(new,centroid)  
idx
```



Quiz 5

Which of the following is used to find double integration?

A

doublequad

B

dblquad

C

quadquad

D

None



Answer 5

Which of the following is used to find double integration?

A

doublequad

B

dblquad

C

quadquad

D

None



Quiz 6

What is the output of the following?

A

[[1 2 3 0 0 0 0 0 7 8 9]]

B

[[1 2 3 0 0 0]]

C

[[1 2 3]
[7 8 9]]

D

None

```
import numpy
array_1 =
numpy.array([[1,2,3],[0,0,0]])
array_2 =
numpy.array([[0,0,0],[7,8,9]])
print(numpy.concatenate((array_1
, array_2), axis = 1))
```



Answer 6

What is the output of the following?

A

[[1 2 3 0 0 0 0 0 7 8 9]]

B

[[1 2 3 0 0 0]]

C

[[1 2 3]
[7 8 9]]

D

None

```
import numpy
array_1 =
numpy.array([[1,2,3],[0,0,0]])
array_2 =
numpy.array([[0,0,0],[7,8,9]])
print(numpy.concatenate((array_1
, array_2), axis = 1))
```



Quiz 7

What is the output?

A

[1. 2. 3. 4. 5. 6. 7. 8. 9.]

B

[2. 3. 4. 5. 6. 7. 8. 9. 10.]

C

[.1 .2 .3 .4 .5 .6 .7 .8 .9]

D

[.2 .3 .4 .5 .6 .7 .8 .9 .10]

```
import numpy
my_array = numpy.array([1.1, 2.2,
3.3, 4.4, 5.5, 6.6, 7.7, 8.8, 9.9])
print(numpy.ceil(my_array))
```



Answer 7

What is the output?

A

[1. 2. 3. 4. 5. 6. 7. 8. 9.]

B

[2. 3. 4. 5. 6. 7. 8. 9. 10.]

C

[.1 .2 .3 .4 .5 .6 .7 .8 .9]

D

[.2 .3 .4 .5 .6 .7 .8 .9 .10]

```
import numpy
my_array = numpy.array([1.1, 2.2,
3.3, 4.4, 5.5, 6.6, 7.7, 8.8, 9.9])
print(numpy.ceil(my_array))
```



Thank
You



www.intellipaat.com



India : +91-7847955955

US : 1-800-216-8930 (TOLL FREE)

sales@intellipaat.com