2 LAB 4: Data Pre-Processing

2.0.1 Feature Engineering in DataScience

- Data Visualization
- Data Pre-processing
- Dimension Reduction
- Feature Extraction
- Feature Selection

```
! pip install matplotlib
```

```
Requirement already satisfied: matplotlib in /usr/local/lib/python3.6/dist-packages (3.2.2)
Requirement already satisfied: kiwisolver>=1.0.1 in /usr/local/lib/python3.6/dist-packages (from matplotlib) (1.3.1)
Requirement already satisfied: python-dateutil>=2.1 in /usr/local/lib/python3.6/dist-packages (from matplotlib) (2.8.1)
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.1 in /usr/local/lib/python3.6/dist-packages (from matplot
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.6/dist-packages (from matplotlib) (0.10.0)
Requirement already satisfied: numpy>=1.11 in /usr/local/lib/python3.6/dist-packages (from matplotlib) (1.19.5)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.6/dist-packages (from python-dateutil>=2.1->matplotlib) (1.15
```

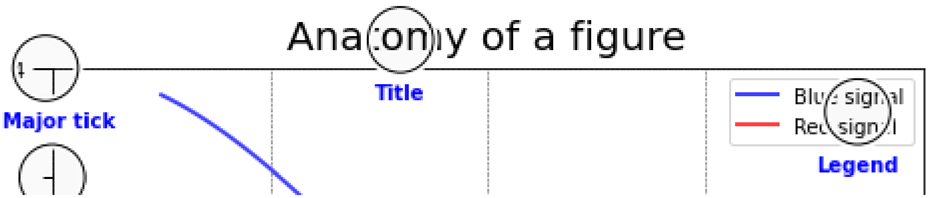
```
import numpy as np
import matplotlib.pyplot as plt
from matplotlib.ticker import AutoMinorLocator, MultipleLocator, FuncFormatter

np.random.seed(19680801)

X = np.linspace(0.5, 3.5, 100)
Y1 = 3+np.cos(X)
Y2 = 1+np.cos(1+X/0.75)/2
Y3 = np.random.uniform(Y1, Y2, len(X))
```

```
fig = plt.figure(figsize=(8, 8))
ax = fig.add_subplot(1, 1, 1, aspect=1)


def minor_tick(x, pos):
    if not x % 1.0:
        return ""
    return "%.2f" % x

ax.xaxis.set_major_locator(MultipleLocator(1.000))
ax.xaxis.set_minor_locator(AutoMinorLocator(4))
ax.yaxis.set_major_locator(MultipleLocator(1.000))
ax.yaxis.set_minor_locator(AutoMinorLocator(4))
ax.xaxis.set_minor_formatter(FuncFormatter(minor_tick))

ax.set_xlim(0, 4)
ax.set_ylim(0, 4)

ax.tick_params(which='major', width=1.0)
ax.tick_params(which='major', length=10)
ax.tick_params(which='minor', width=1.0, labelsize=10)
ax.tick_params(which='minor', length=5, labelsize=10, labelcolor='0.25')

ax.grid(linestyle="--", linewidth=0.5, color='.25', zorder=-10)

ax.plot(X, Y1, c=(0.25, 0.25, 1.00), lw=2, label="Blue signal", zorder=10)
ax.plot(X, Y2, c=(1.00, 0.25, 0.25), lw=2, label="Red signal")
ax.plot(X, Y3, linewidth=0,
        marker='o', markerfacecolor='w', markeredgecolor='k')

ax.set_title("Anatomy of a figure", fontsize=20, verticalalignment='bottom')
ax.set_xlabel("X axis label")
ax.set_ylabel("Y axis label")

ax.legend()


def circle(x, y, radius=0.15):
```

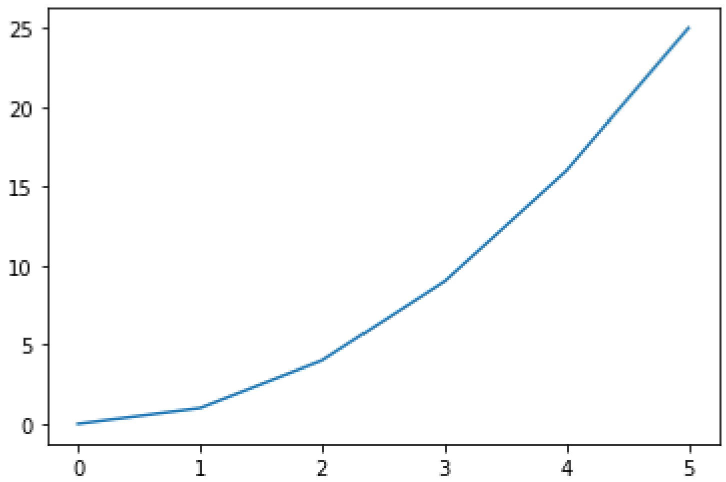
```
        from matplotlib.patches import Circle
        from matplotlib.patheffects import withStroke
        circle = Circle((x, y), radius, clip_on=False, zorder=10, linewidth=1,
                        edgecolor='black', facecolor=(0, 0, 0, .0125),
                        path_effects=[withStroke(linewidth=5, foreground='w')])
        ax.add_artist(circle)


    def text(x, y, text):
        ax.text(x, y, text, backgroundcolor="white",
                ha='center', va='top', weight='bold', color='blue')


    # Minor tick
    circle(0.50, -0.10)
    text(0.50, -0.32, "Minor tick label")

    # Major tick
    circle(-0.03, 4.00)
    text(0.03, 3.80, "Major tick")

    # Minor tick
    circle(0.00, 3.50)
    text(0.00, 3.30, "Minor tick")

    # Major tick label
    circle(-0.15, 3.00)
    text(-0.15, 2.80, "Major tick label")

    # X Label
    circle(1.80, -0.27)
    text(1.80, -0.45, "X axis label")

    # Y Label
    circle(-0.27, 1.80)
    text(-0.27, 1.6, "Y axis label")

    # Title
```

```
# Title
circle(1.60, 4.13)
text(1.60, 3.93, "Title")

# Blue plot
circle(1.75, 2.80)
text(1.75, 2.60, "Line\n(line plot)")

# Red plot
circle(1.20, 0.60)
text(1.20, 0.40, "Line\n(line plot)")

# Scatter plot
circle(3.20, 1.75)
text(3.20, 1.55, "Markers\n(scatter plot)")

# Grid
circle(3.00, 3.00)
text(3.00, 2.80, "Grid")

# Legend
circle(3.70, 3.80)
text(3.70, 3.60, "Legend")

# Axes
circle(0.5, 0.5)
text(0.5, 0.3, "Axes")

# Figure
circle(-0.3, 0.65)
text(-0.3, 0.45, "Figure")

color = 'blue'
ax.annotate('Spines', xy=(4.0, 0.35), xytext=(3.3, 0.5),
            weight='bold', color=color,
            arrowprops=dict(arrowstyle='->',
                            connectionstyle="arc3",
                            color=color))
```

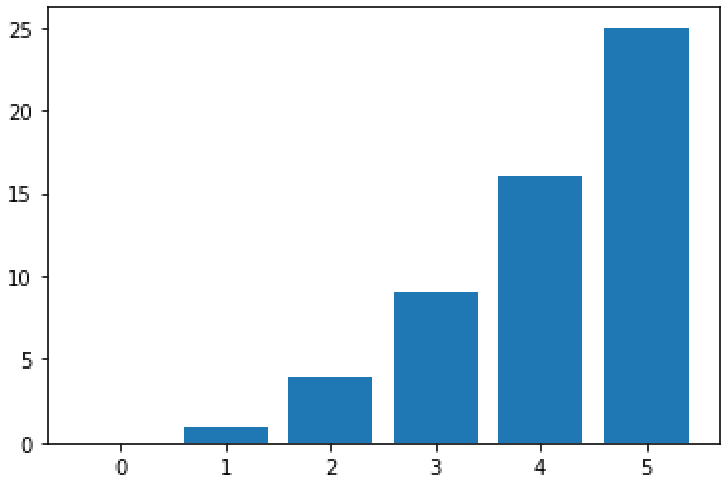
```
ax.annotate('', xy=(3.15, 0.0), xytext=(3.45, 0.45),
            weight='bold', color=color,
            arrowprops=dict(arrowstyle='->',
                            connectionstyle="arc3",
                            color=color))

ax.text(4.0, -0.4, "Made with http://matplotlib.org",
        fontsize=10, ha="right", color='.5')

plt.show()

## https://matplotlib.org/3.1.1/gallery/showcase/anatomy.html
```



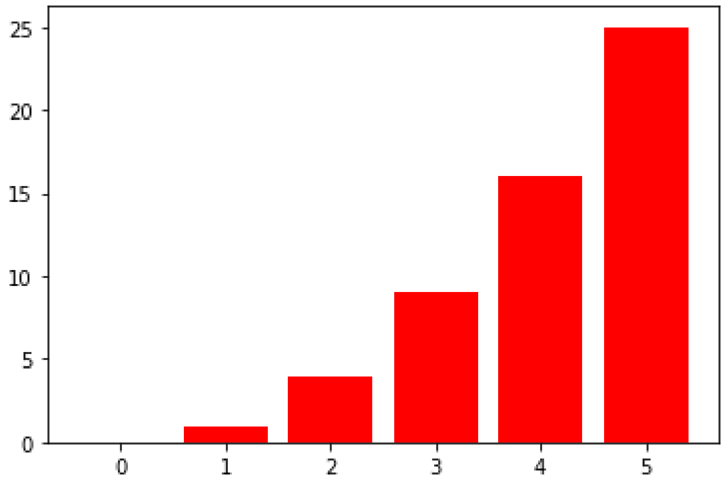

```
import matplotlib.pyplot as plt

# get the data ready
x = [0,1,2,3,4,5]
y = [0,1,4,9,16,25]

# a simple graph
plt.plot(x, y)

# show the graph
plt.show()
```



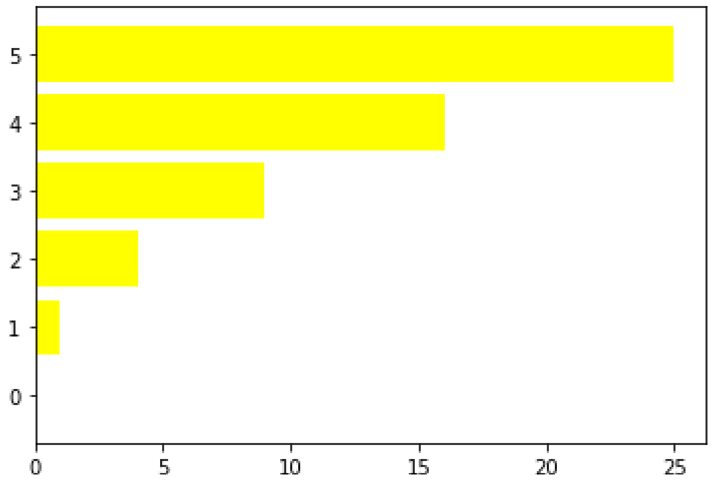

```
# make it a bar plot
plt.bar(x, y)
plt.show()
```



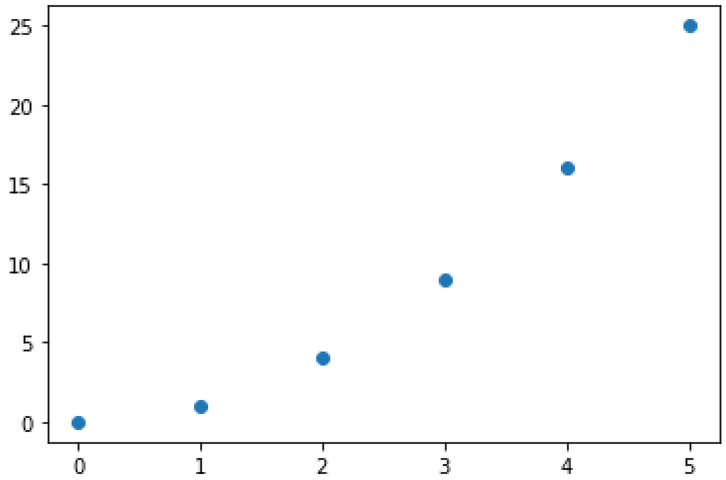

```
# change the color of bars
plt.bar(x, y, color='red')
plt.show()
```



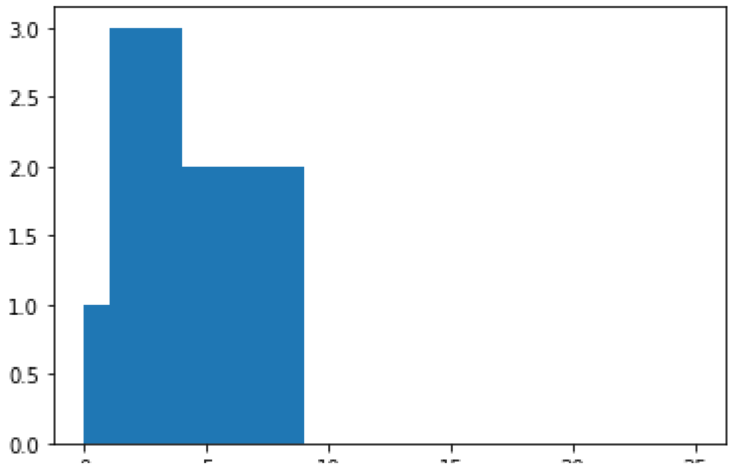

```
# make it horizontal bar
plt.barh(x, y, color='yellow')
plt.show()
```



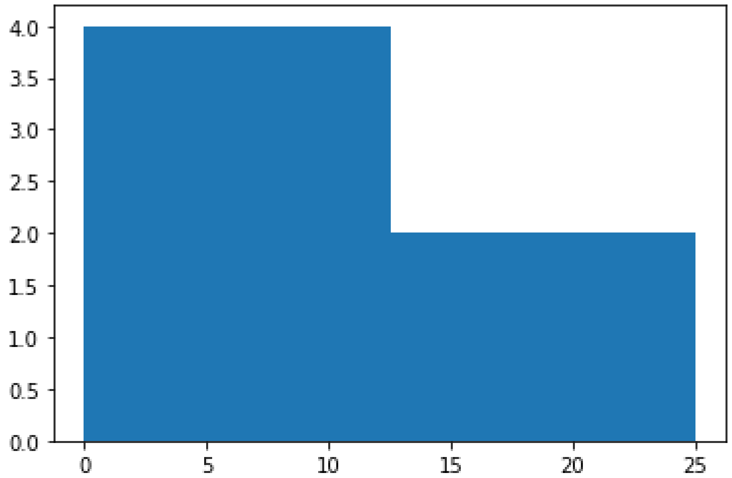

```
# make a scatter plot
plt.scatter(x, y)
plt.show()
```




```
# make those histograms
plt.hist(x, y)
plt.show()
```




```
# make a proper histograms
plt.hist(y, bins=2)
plt.show()
# identify the number of the bin that disctirubte is same ?
# 25
```

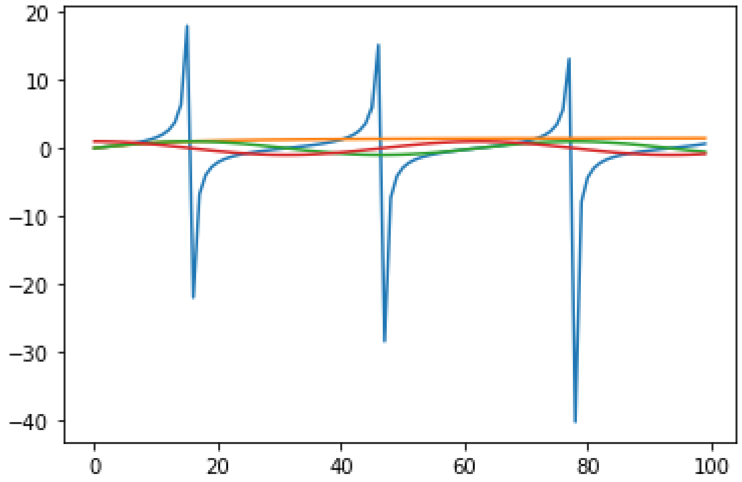



```
# Now lets explore with continuous data
import numpy as np
x = np.linspace(0, 10, 100)
print(x)
```

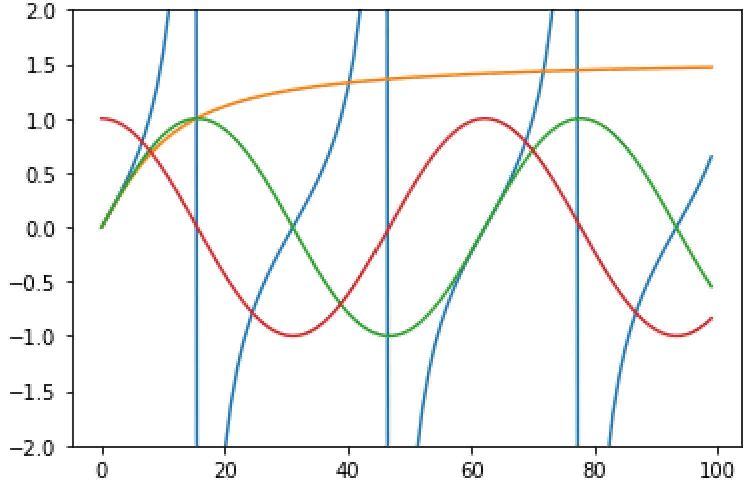
```
[ 0.          0.1010101   0.2020202   0.3030303   0.4040404   0.50505051
  0.60606061  0.70707071  0.80808081  0.90909091  1.01010101  1.11111111
  1.21212121  1.31313131  1.41414141  1.51515152  1.61616162  1.71717172
  1.81818182  1.91919192  2.02020202  2.12121212  2.22222222  2.32323232
  2.42424242  2.52525253  2.62626263  2.72727273  2.82828283  2.92929293
  3.03030303  3.13131313  3.23232323  3.33333333  3.43434343  3.53535354
  3.63636364  3.73737374  3.83838384  3.93939394  4.04040404  4.14141414
  4.24242424  4.34343434  4.44444444  4.54545455  4.64646465  4.74747475
  4.84848485  4.94949495  5.05050505  5.15151515  5.25252525  5.35353535
  5.45454545  5.55555556  5.65656566  5.75757576  5.85858586  5.95959596
  6.06060606  6.16161616  6.26262626  6.36363636  6.46464646  6.56565657
  6.66666667  6.76767677  6.86868687  6.96969697  7.07070707  7.17171717
  7.27272727  7.37373737  7.47474747  7.57575758  7.67676768  7.77777778
  7.87878788  7.97979798  8.08080808  8.18181818  8.28282828  8.38383838
  8.48484848  8.58585859  8.68686869  8.78787879  8.88888889  8.98989899
  9.09090909  9.19191919  9.29292929  9.39393939  9.49494949  9.5959596
  9.6969697   9.7979798   9.8989899  10.        ]
```

```
# Try with some real data
import numpy as np
x = np.linspace(0, 10, 100)
plt.plot(np.sin(x))
plt.plot(np.cos(x))
plt.show()

# Which one is sin cureve ??
```

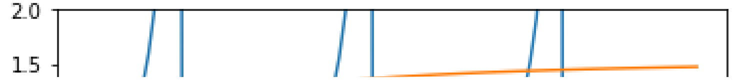

```
# do some real data [kind of]
import numpy as np
x = np.linspace(0, 10, 100)
plt.plot(np.tan(x))
plt.plot(np.arctan(x))
plt.plot(np.sin(x))
plt.plot(np.cos(x))
plt.show()
```



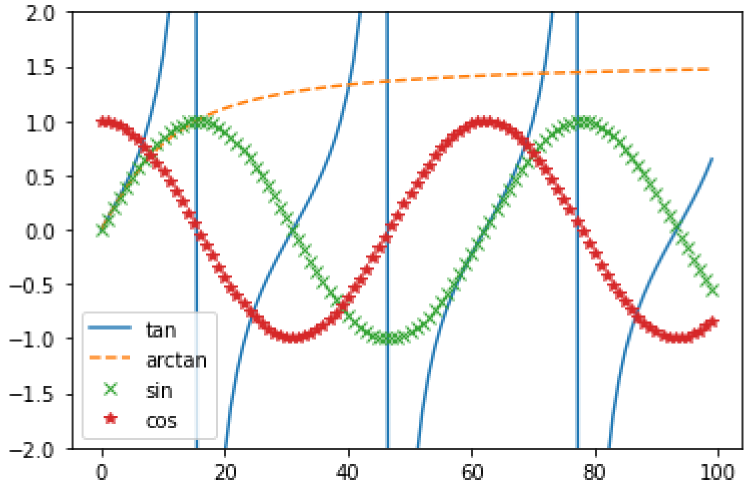

```
# make this look better
import numpy as np
x = np.linspace(0, 10, 100)
plt.plot(np.tan(x), label='tan')
plt.plot(np.arctan(x), label='arctan')
plt.plot(np.sin(x), label='sin')
plt.plot(np.cos(x), label='cos')
plt.ylim(-2, 2) ## Look here
plt.show()
```




```
# lets give a legend
import numpy as np
x = np.linspace(0, 10, 100)
plt.plot(np.tan(x), label='tan')
plt.plot(np.arctan(x), label='arctan')
plt.plot(np.sin(x), label='sin')
plt.plot(np.cos(x), label='cos')
plt.ylim(-2, 2)
plt.legend()
plt.show()
```

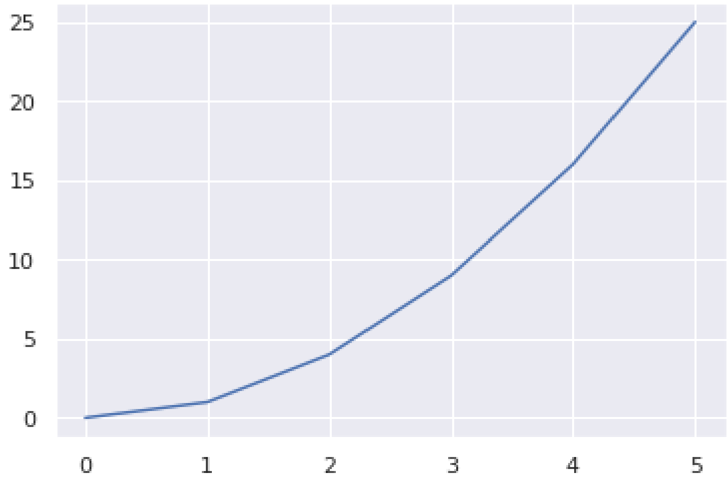



```
# Change dash styles
import numpy as np
x = np.linspace(0, 10, 100)
6
plt.plot(np.tan(x), '-', label='tan')
plt.plot(np.arctan(x), '--', label='arctan')
plt.plot(np.sin(x), 'x', label='sin')
plt.plot(np.cos(x), '*', label='cos')
plt.ylim(-2, 2)
plt.legend()
plt.show()
```

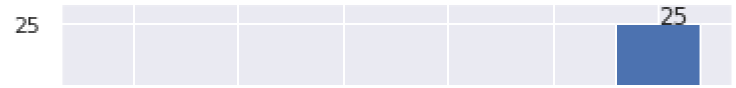



```
#Get necessary libraries
import matplotlib.pyplot as plt
import seaborn as sns
sns.set()
# get the data ready
x = [0,1,2,3,4,5]
y = [0,1,4,9,16,25]
# a simple graph
```

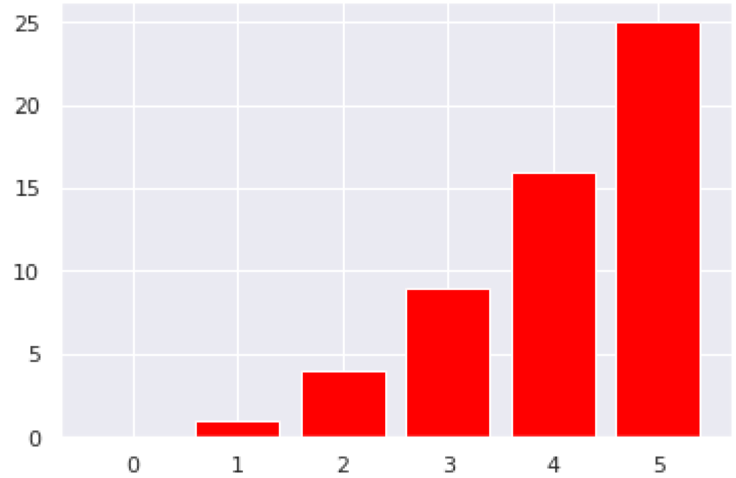
```
# a simple graph
plt.plot(x, y)
# show the graph
plt.show()
```




```
# make it a bar plot
plt.bar(x, y)
for index, value in enumerate(y):
  # print(index, value) # 3 rd value
  plt.text(index, value, str(value))
plt.show()
```



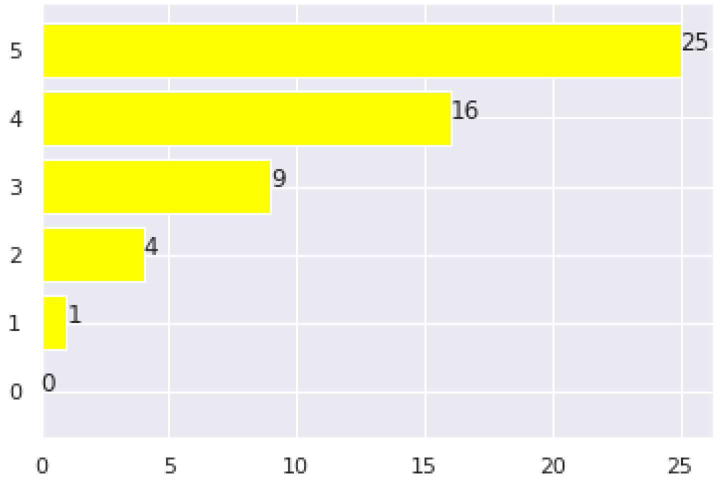

```
# change the color of bars
plt.bar(x, y, color='red')
plt.show()
```




```
# make it horizontal bar
plt.barh(x, y, color='yellow')
plt.show()
```

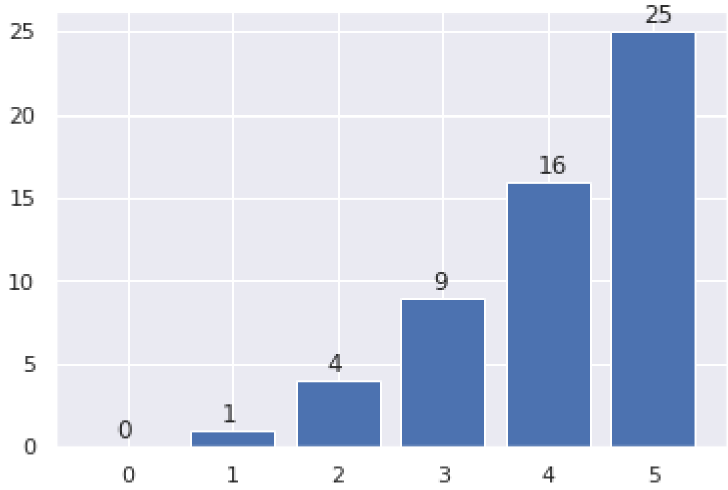
```
# make it horizontal bar
plt.barh(x, y, color='yellow')
for index, value in enumerate(y):
  print(index, value) # 3 rd value
  plt.text(value, index, str(value))
plt.show()
```

```
0 0
1 1
2 4
3 9
4 16
5 25
```

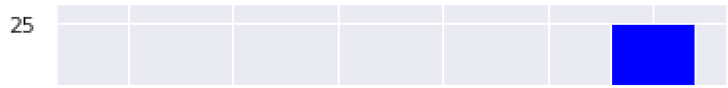



```
# make it horizontal bar
plt.bar(x, y)
for index, value in enumerate(y):
  print(index, value) # 3 rd value
  plt.text(index - 0.1, value + 0.5, str(value))
# plt.text(0, 15, 'hey')
plt.show()
```

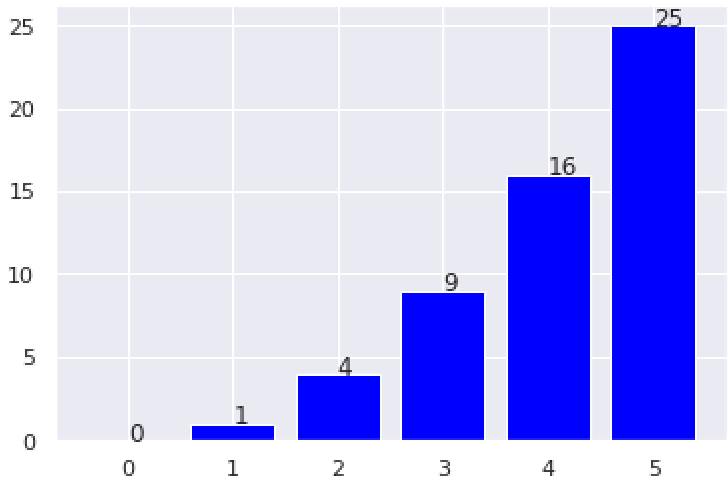
```
0 0
1 1
2 4
3 9
4 16
5 25
```



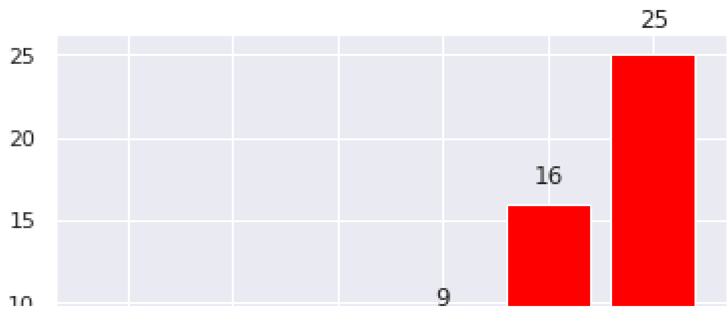

```
plt.bar(x, y, color='blue')
for index, value in enumerate(x):
  plt.text(value, index, str(value))
plt.show()
```



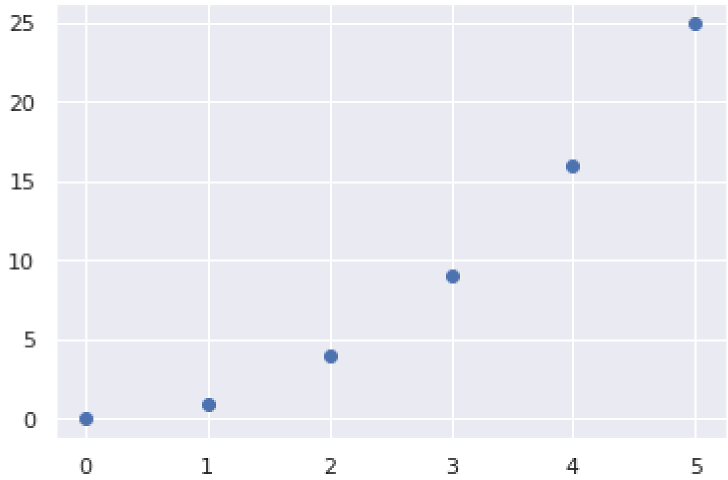

```
plt.bar(x, y, color='blue')
for index, value in enumerate(y):
  plt.text(index, value, str(value))
plt.show()
```



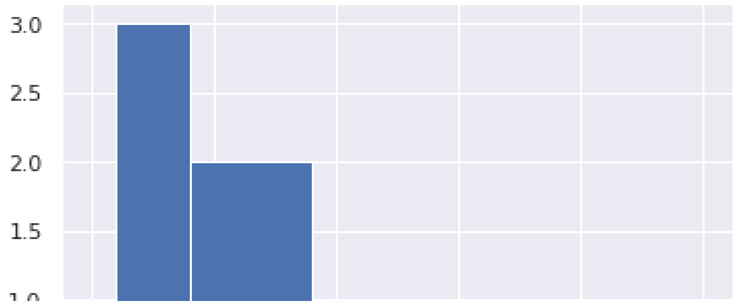

```
# Print the values a littile above
fig, ax = plt.subplots()
bars = ax.bar(x, y, color='red')
for bar in bars:
  height = bar.get_height()
  ax.text(bar.get_x() + bar.get_width()/2., 1.05*height,'%d' % int(height), ha='center', va='bottom')
plt.show()
```



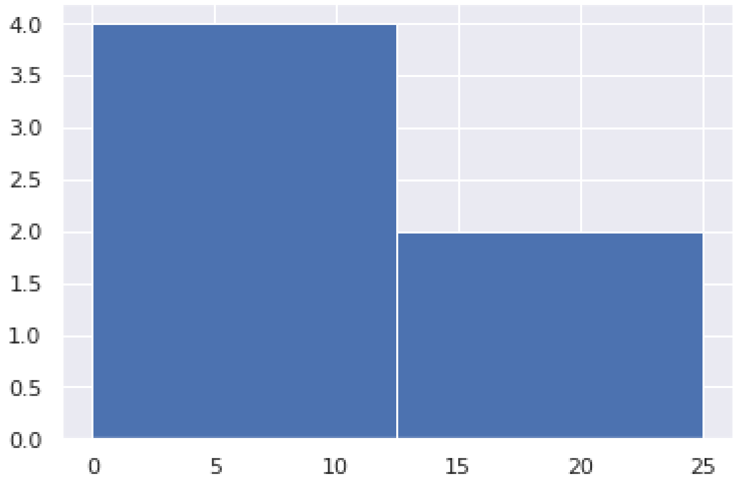

```
# make a scatter plot
plt.scatter(x, y)
plt.show()
```



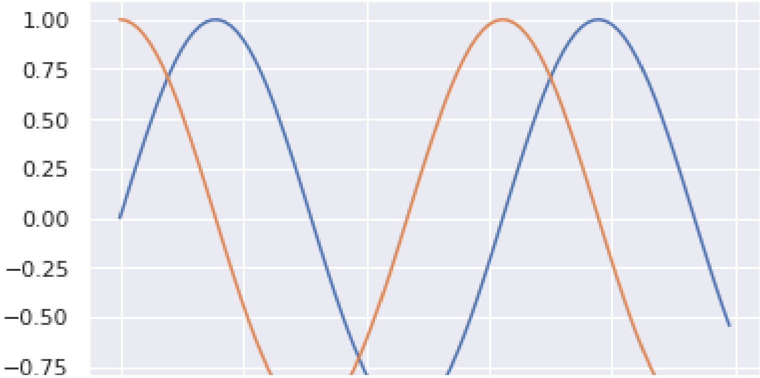

```
# make those histograms
plt.hist(x, y)
plt.show()
```



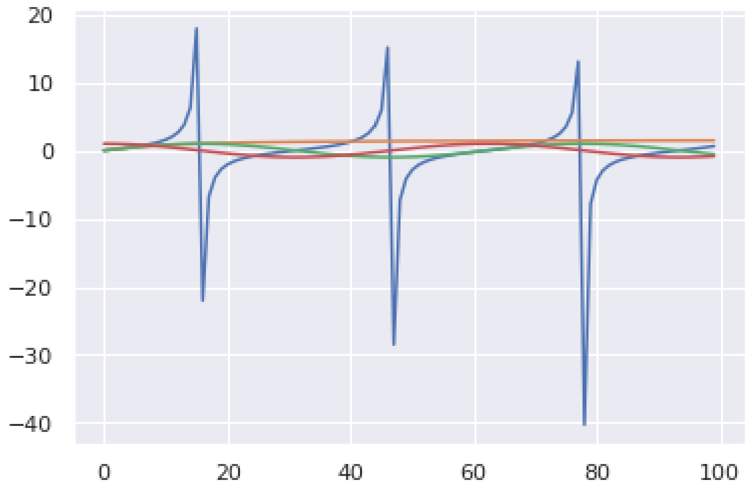

```
# make a proper histograms
plt.hist(y, bins=2)
plt.show()
```




```
import numpy as np
x = np.linspace(0, 10, 100)
plt.plot(np.sin(x))
plt.plot(np.cos(x))
plt.show()
```

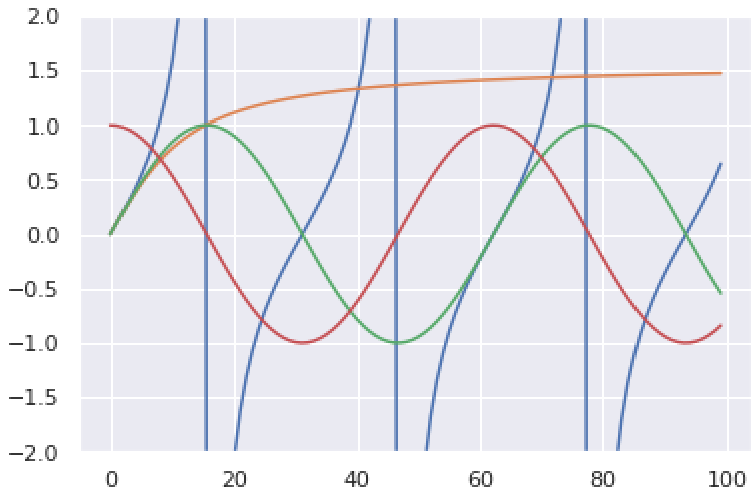



```
import numpy as np
x = np.linspace(0, 10, 100)
plt.plot(np.tan(x))
plt.plot(np.arctan(x))
plt.plot(np.sin(x))
plt.plot(np.cos(x))
plt.show()
```

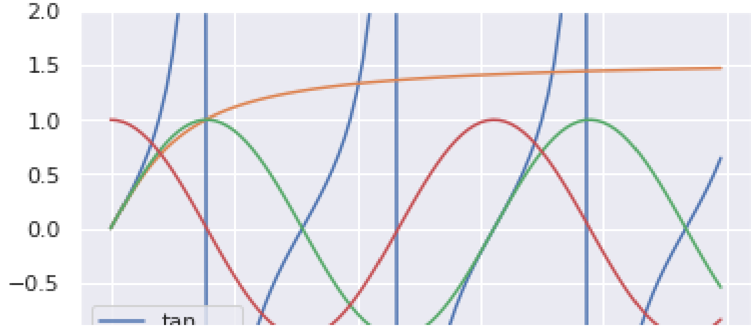



```
# make this look better
import numpy as np
x = np.linspace(0, 10, 100)
plt.plot(np.tan(x), label='tan')
```

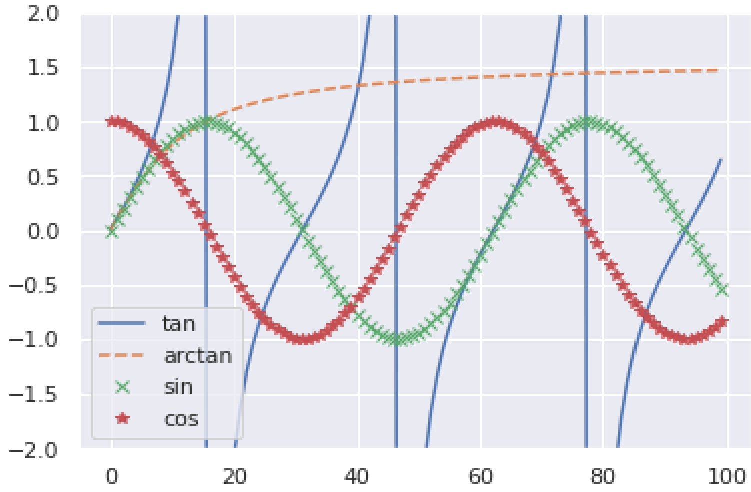
```
plt.plot(np.tan(x), label='tan')
plt.plot(np.arctan(x), label='arctan')
plt.plot(np.sin(x), label='sin')
plt.plot(np.cos(x), label='cos')
plt.ylim(-2, 2)
plt.show()
```




```
# lets give a legend
import numpy as np
x = np.linspace(0, 10, 100)
plt.plot(np.tan(x), label='tan')
plt.plot(np.arctan(x), label='arctan')
plt.plot(np.sin(x), label='sin')
plt.plot(np.cos(x), label='cos')
plt.ylim(-2, 2)
plt.legend()
plt.show()
```

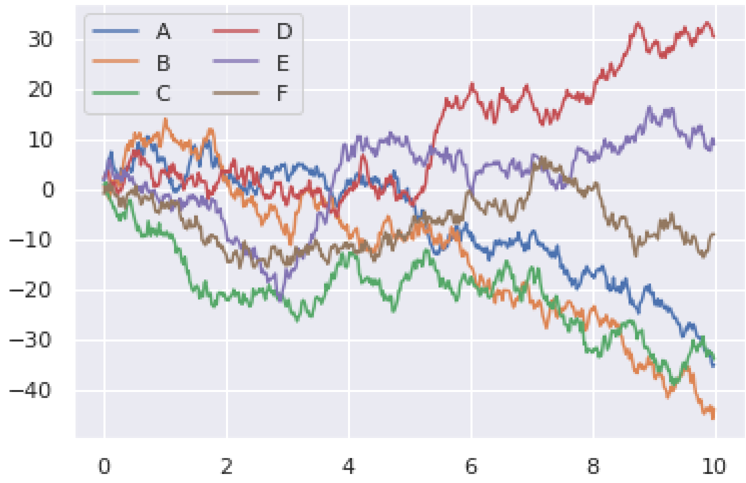



```
# change dash styles
# make this look better
import numpy as np
x = np.linspace(0, 10, 100)
plt.plot(np.tan(x), '-', label='tan')
plt.plot(np.arctan(x), '--', label='arctan')
plt.plot(np.sin(x), 'x', label='sin')
plt.plot(np.cos(x), '*', label='cos')
plt.ylim(-2, 2)
plt.legend()
plt.show()
```

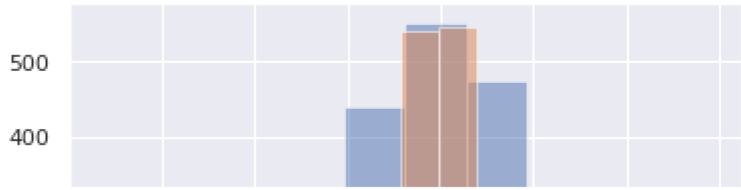



```
# generate some random data
```

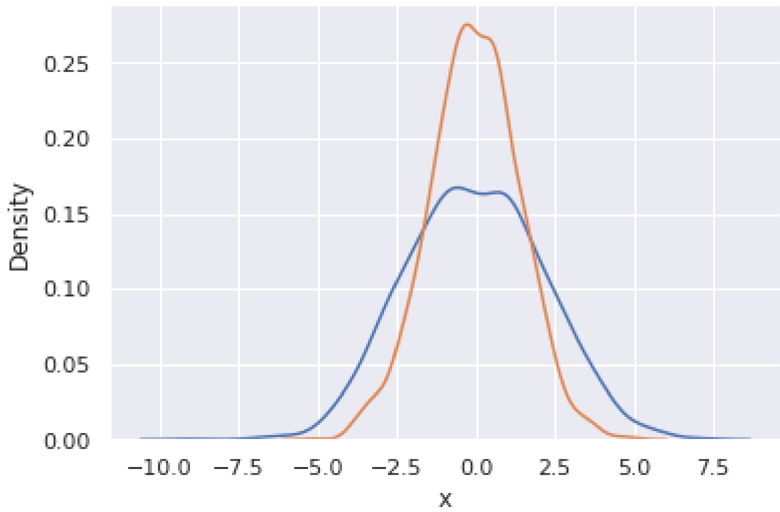
```
# Create some data
rng = np.random.RandomState(0)
x = np.linspace(0, 10, 500)
y = np.cumsum(rng.randn(500, 6), 0)
plt.plot(x, y)
plt.legend('ABCDEF', ncol=2, loc='upper left')
plt.show()
```




```
import pandas as pd
data = np.random.multivariate_normal([0, 0], [[5, 2], [2, 2]], size=2000)
data = pd.DataFrame(data, columns=['x', 'y'])
for col in 'xy':
  plt.hist(data[col], alpha=0.5)
```

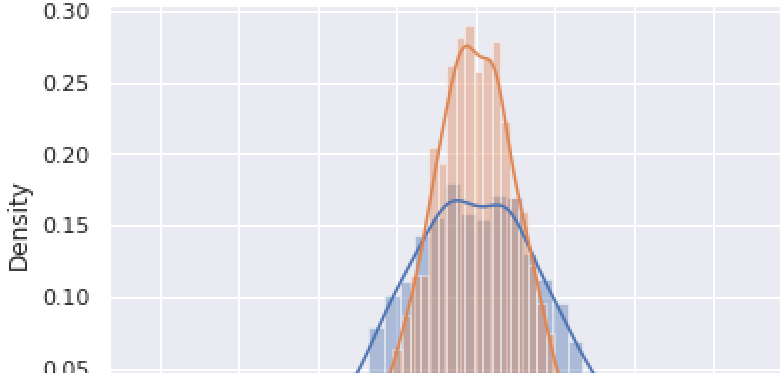



```
# KDE Plot shows the correclation between the data varaibles
#KDE Plot described as Kernel Density Estimate is used for visualizing the Probability Density of a continuous variable.
# It depicts the probability density at different values in a continuous variable.
for col in 'xy':
  sns.kdeplot(data[col])
```



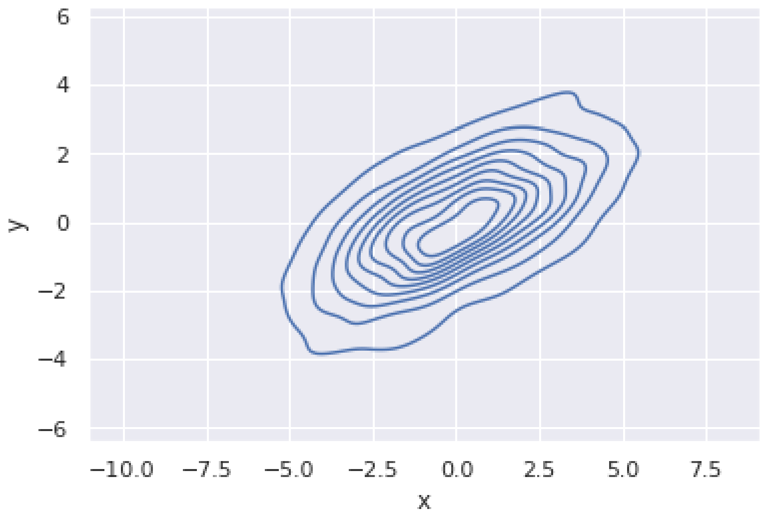

```
sns.distplot(data['x'])
sns.distplot(data['y'])
plt.show()
```

```
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2557: FutureWarning: `distplot` is a deprecated function and wi
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2557: FutureWarning: `distplot` is a deprecated function and wi
  warnings.warn(msg, FutureWarning)
```




```
# MAx difference between two variables in the plot
sns.kdeplot(data.x, data.y)
plt.show()
```

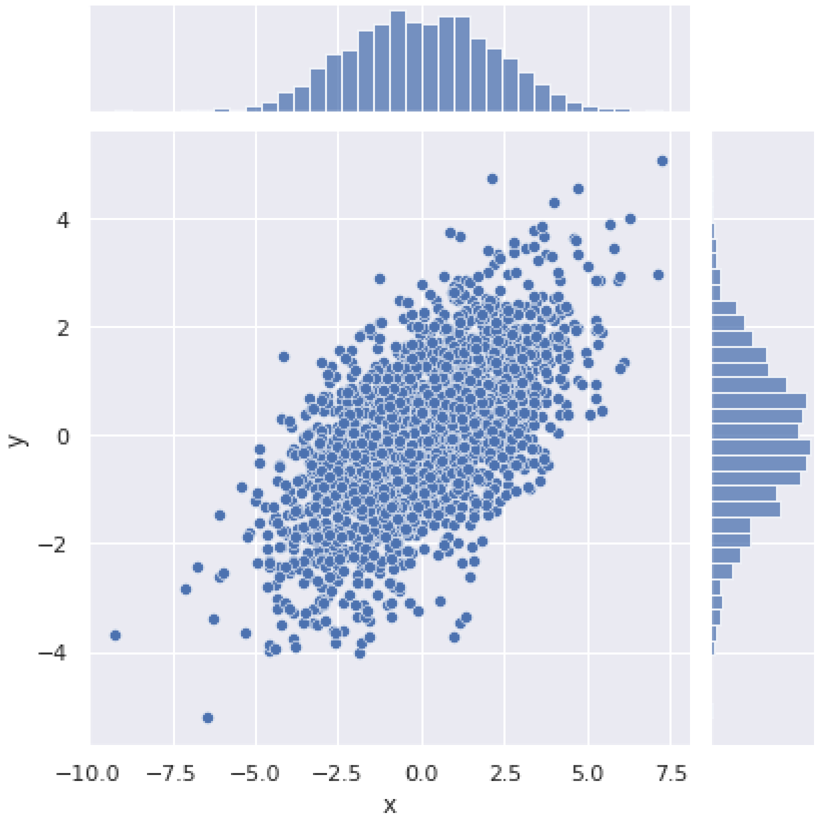
```
/usr/local/lib/python3.6/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the following variable as a keyword arg: y
  FutureWarning
```




```
sns.jointplot('x', 'y', data)
```

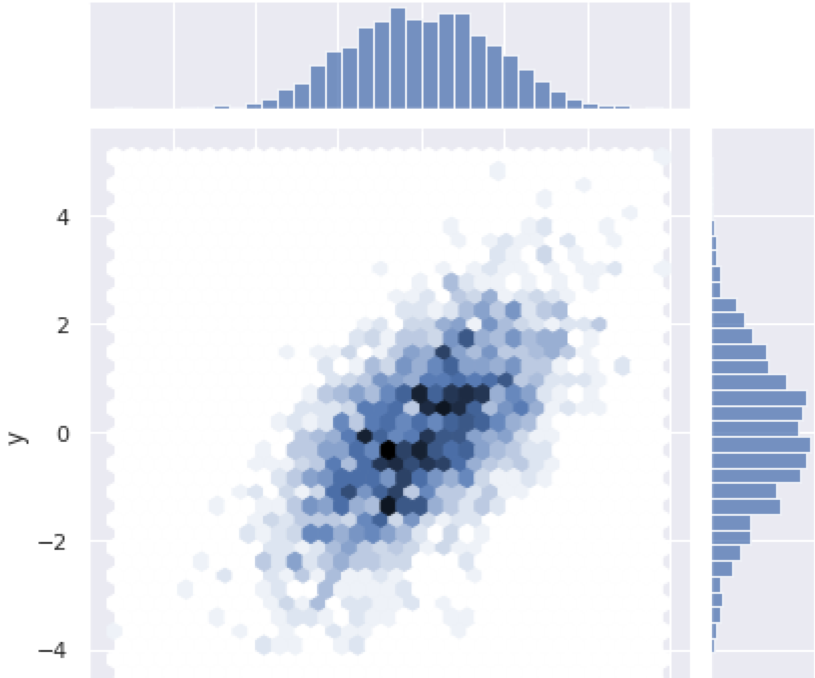
```
sns.jointplot('x', 'y', data)
plt.show()
```

```
/usr/local/lib/python3.6/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the following variables as keyword args:
  FutureWarning
```



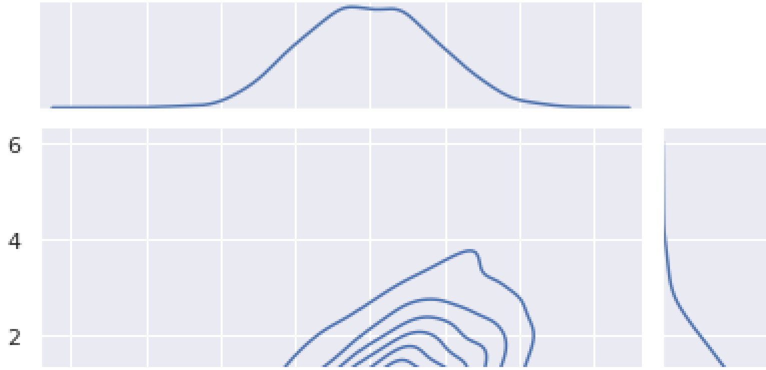

```
sns.jointplot('x', 'y', data, kind='hex')
plt.show()
```

```
/usr/local/lib/python3.6/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the following variables as keyword args:
  FutureWarning
```




```
sns.jointplot('x', 'y', data, kind='kde')
plt.show()
```

```
/usr/local/lib/python3.6/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the following variables as keyword args:
  FutureWarning
```



2.3 HandsOn on real dataset : IRIS Visualization

```
df = sns.load_dataset('iris')
df.head()
```

	sepal_length	sepal_width	petal_length	petal_width	species
0	5.1	3.5	1.4	0.2	setosa
1	4.9	3.0	1.4	0.2	setosa
2	4.7	3.2	1.3	0.2	setosa
3	4.6	3.1	1.5	0.2	setosa
4	5.0	3.6	1.4	0.2	setosa

```
df.shape
```

```
(150, 5)
```

```
df.info
```

```
<bound method DataFrame.info of      sepal_length  sepal_width  petal_length  petal_width    species
```

```
0             5.1          3.5           1.4          0.2     setosa
1             4.9          3.0           1.4          0.2     setosa
2             4.7          3.2           1.3          0.2     setosa
3             4.6          3.1           1.5          0.2     setosa
4             5.0          3.6           1.4          0.2     setosa
..            ...          ...           ...          ...        ...
145           6.7          3.0           5.2          2.3  virginica
146           6.3          2.5           5.0          1.9  virginica
147           6.5          3.0           5.2          2.0  virginica
148           6.2          3.4           5.4          2.3  virginica
149           5.9          3.0           5.1          1.8  virginica

[150 rows x 5 columns]>
```

```
df.describe()
```

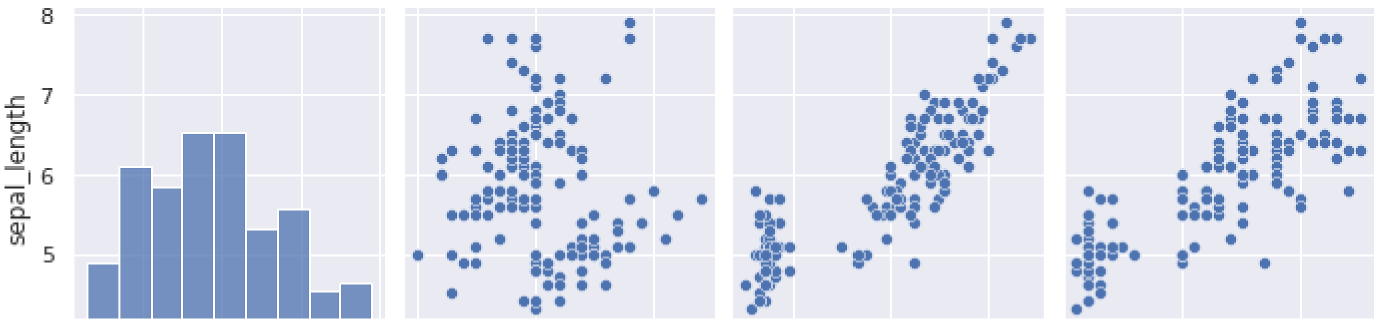
	sepal_length	sepal_width	petal_length	petal_width
count	150.000000	150.000000	150.000000	150.000000
mean	5.843333	3.057333	3.758000	1.199333
std	0.828066	0.435866	1.765298	0.762238
min	4.300000	2.000000	1.000000	0.100000
25%	5.100000	2.800000	1.600000	0.300000
50%	5.800000	3.000000	4.350000	1.300000
75%	6.400000	3.300000	5.100000	1.800000
max	7.900000	4.400000	6.900000	2.500000

```
df["sepal_length"].describe()
```

```
count    150.000000
mean       5.843333
std        0.828066
min        4.300000
25%        5.100000
```

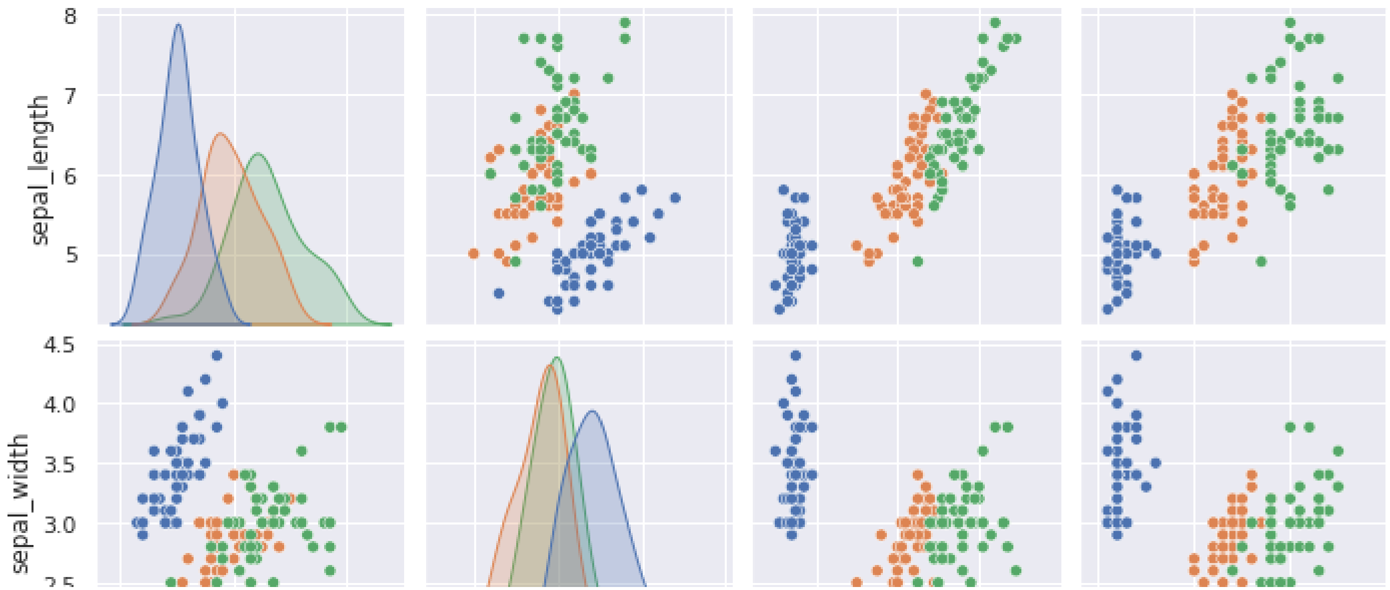
```
50%        5.800000
75%        6.400000
max        7.900000
Name: sepal_length, dtype: float64
```

```
sns.pairplot(df)
plt.show()
```



3 GOOD WAY TO See The relation

```
sns.pairplot(df, hue='species')
plt.show()
```

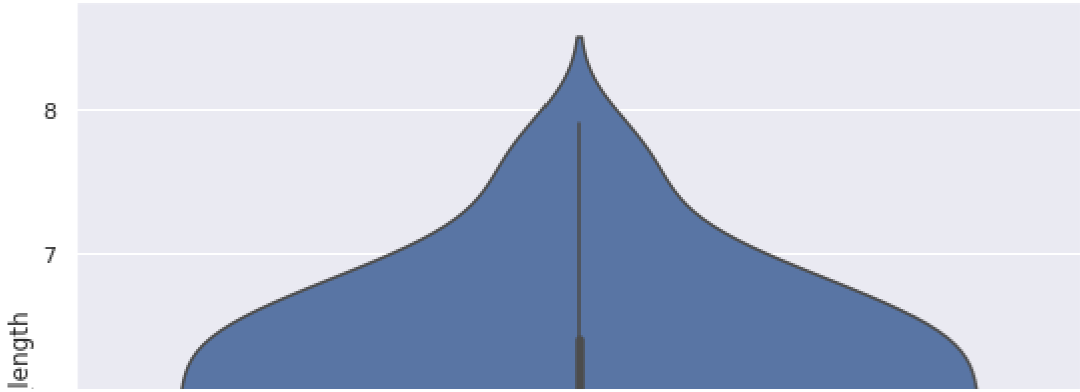


3.0.1 sns.violinplot()

Violin plot is a method of plotting numeric data. It is similar to a box plot, with the addition of a rotated kernel density plot on each side. Violin plots are similar to box plots, except that they also show the probability density of the data at different values, usually smoothed by a kernel density estimator. Wikipedia

```
fig, ax = plt.subplots(figsize =(9, 7))
sns.violinplot( ax = ax, y = df["sepal_length"] )
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f6ff2ddca20>
```




```
fig, ax = plt.subplots(figsize =(9, 7))
sns.violinplot(ax = ax, data = df.iloc[:, 1:3])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f6fe46a2be0>
```

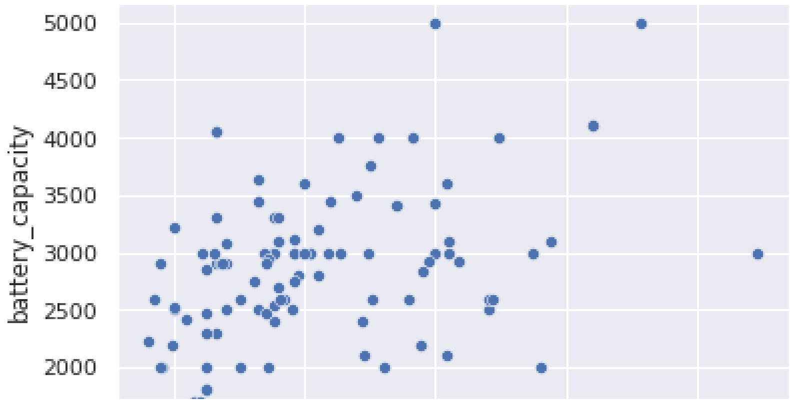
```
!wget https://www.dropbox.com/s/w94odi4aq1k44lf/mobile_cleaned.csv
```

```
--2021-01-25 09:31:04--  https://www.dropbox.com/s/w94odi4aq1k44lf/mobile_cleaned.csv
Resolving www.dropbox.com (www.dropbox.com)... 162.125.82.18, 2620:100:6032:18::a27d:5212
Connecting to www.dropbox.com (www.dropbox.com)|162.125.82.18|:443... connected.
HTTP request sent, awaiting response... 301 Moved Permanently
Location: /s/raw/w94odi4aq1k44lf/mobile_cleaned.csv [following]
--2021-01-25 09:31:04--  https://www.dropbox.com/s/raw/w94odi4aq1k44lf/mobile_cleaned.csv
Reusing existing connection to www.dropbox.com:443.
HTTP request sent, awaiting response... 404 Not Found
2021-01-25 09:31:04 ERROR 404: Not Found.
```

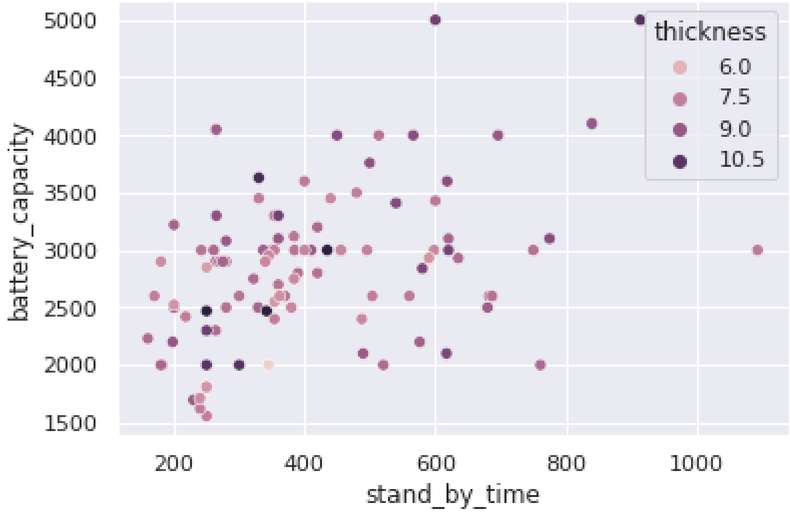
```
import pandas as pd
import seaborn as sns
data = pd.read_csv('mobile_cleaned.csv')
data.head()
```

	sim_type	aperture	gpu_rank	weight	stand_by_time	processor_frequency	thickness	flash_type	front_camera_resolution	au
0	0	12	55	155.0	250	1.3	10.5	5	2.00	
1	0	1	55	132.0	300	1.3	10.6	5	0.30	
2	0	9	55	142.0	329	1.5	8.5	5	2.00	
3	0	8	55	152.0	385	1.3	8.0	5	2.00	
4	1	1	55	234.0	385	1.3	7.9	5	1.92	

```
ax = sns.scatterplot(x="stand_by_time", y="battery_capacity", data=data)
```

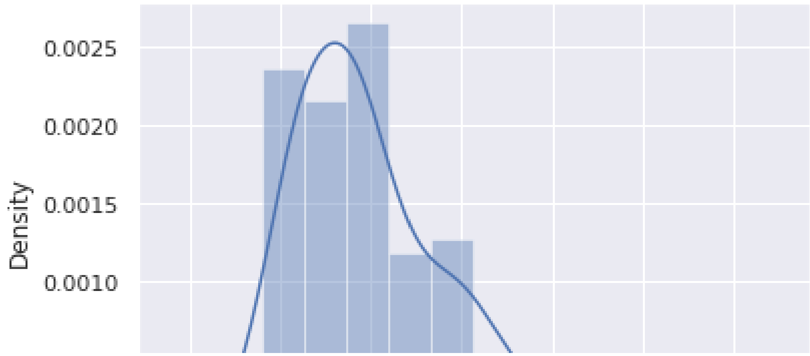



```
ax = sns.scatterplot(x = "stand_by_time", y = "battery_capacity",hue="thickness", data=data)
```



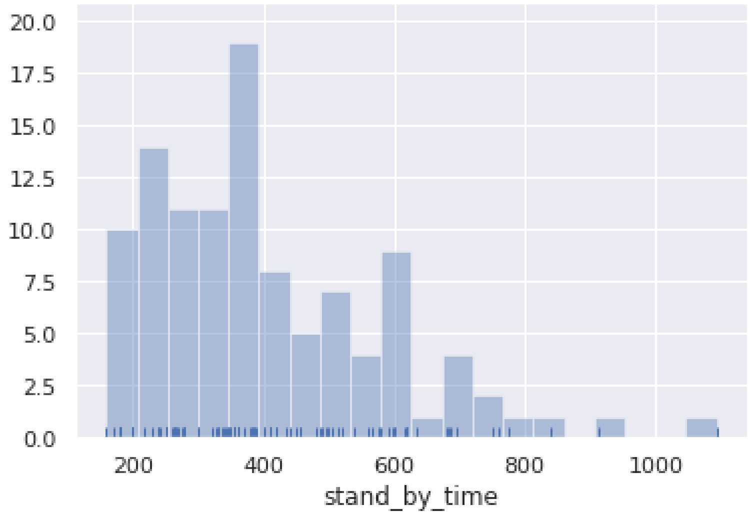

```
ax = sns.distplot(data["stand_by_time"])
```

```
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2557: FutureWarning: `distplot` is a deprecated function and wi
  warnings.warn(msg, FutureWarning)
```

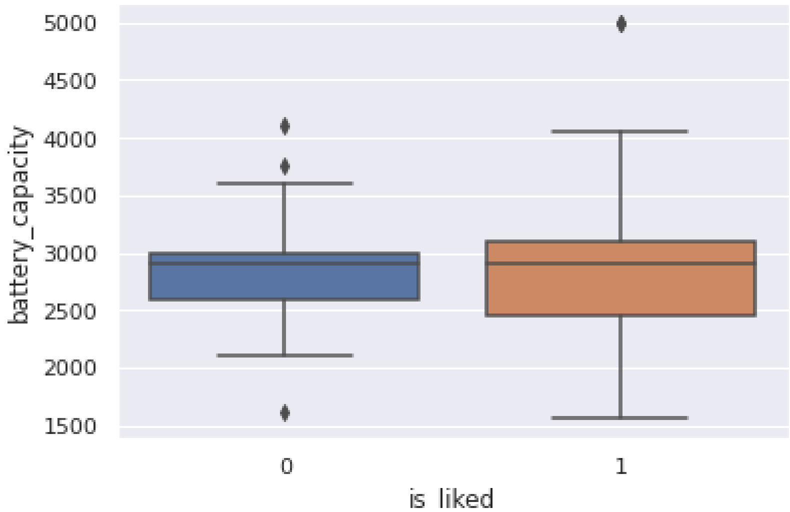



```
ax = sns.distplot(data["stand_by_time"], kde=False, rug=True, bins = 20)
```

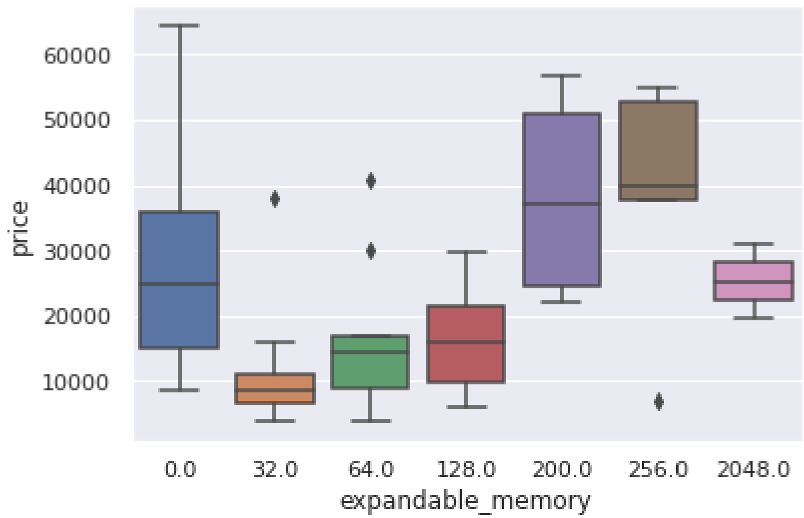
```
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2557: FutureWarning: `distplot` is a deprecated function and wi
  warnings.warn(msg, FutureWarning)
/usr/local/lib/python3.6/dist-packages/seaborn/distributions.py:2056: FutureWarning: The `axis` variable is no longer used and w
  warnings.warn(msg, FutureWarning)
```




```
ax = sns.boxplot(x="is_liked", y="battery_capacity", data=data)
```




```
ax = sns.boxplot(x = "expandable_memory", y = "price", data=data)
```

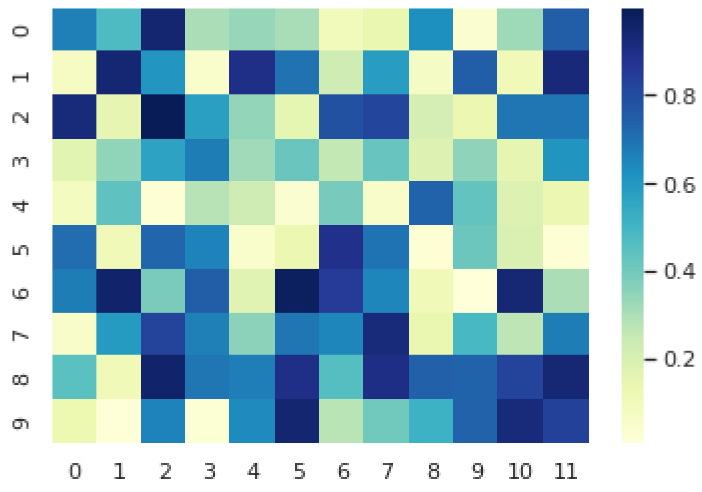



```
import numpy as np
uniform_data = np.random.rand(10, 12)
print(uniform_data)
```

```
[[0.66598831 0.47645545 0.9499697  0.30286815 0.33934392 0.30778577
```

```
  0.10654643 0.13952205 0.62852938 0.03902754 0.32664185 0.75021389]
 [0.07711365 0.9425221  0.60933812 0.04574301 0.89950115 0.70114991
  0.23454783 0.5890388  0.07517015 0.75194119 0.11291884 0.930454  ]
 [0.92527754 0.15410303 0.99874348 0.57746576 0.34353421 0.15998263
  0.78727324 0.8215636  0.21154059 0.13545222 0.69116786 0.69224481]
 [0.16876135 0.34861695 0.57160117 0.67307943 0.32054337 0.42447693
  0.25908689 0.4257711  0.18674472 0.35468475 0.15631576 0.61308739]
 [0.08642637 0.44088432 0.02466107 0.28500906 0.23411007 0.04053709
  0.39174814 0.05915203 0.73827179 0.43616846 0.18693014 0.13718455]
 [0.71294095 0.10699125 0.7280009  0.65779964 0.05224475 0.13560743
  0.89359824 0.69705022 0.02351442 0.41560058 0.19429251 0.02188504]
 [0.6732775  0.95836003 0.38657695 0.75174124 0.1705204  0.98251248
  0.85442847 0.65146354 0.11135823 0.00593975 0.93774397 0.30351887]
 [0.05666617 0.59287496 0.83181676 0.66776415 0.35628818 0.69397796
  0.65060678 0.92710565 0.14355164 0.48846045 0.27183107 0.67494332]
 [0.45177211 0.10910486 0.95678205 0.69173706 0.67297012 0.9017492
  0.46270328 0.90352536 0.74372098 0.73582472 0.83040545 0.93799957]
 [0.13089929 0.01692451 0.65975744 0.02678213 0.64300637 0.94864874
  0.27897326 0.40665158 0.51521157 0.73945579 0.9260223  0.83290822]]
```

```
ax = sns.heatmap(uniform_data, cmap="YlGnBu")
```



4 Visulization Using Images

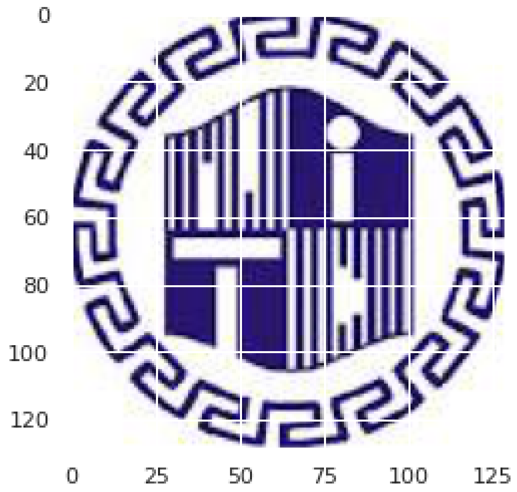
4.0.1 Image PRocessing using CV2 and PIL

```
## necessary libraries
import matplotlib.pyplot as plt
import matplotlib.image as img
from PIL import Image
import cv2
```

```
image= img.imread('NITD.jpeg')
```

```
# image= img.imread('S_1.png')
plt.imshow(image)
```

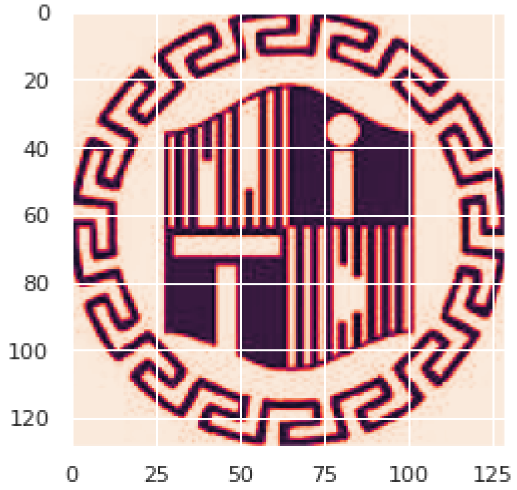
```
<matplotlib.image.AxesImage at 0x7f6fe44b0748>
```




```
# img= Image.open('S_1.png').convert('LA')
img = Image.open('NITD.jpeg').convert('L')
img.save('greyscale.png')
```

```
plt.imshow(img)
```

```
<matplotlib.image.AxesImage at 0x7f6fe45eaba8>
```




```
print('size of the image (width, height):',img.size)
```

```
size of the image (width, height): (129, 129)
```

Note: anti-aliasing is a technique for minimizing the distortion artifacts known as aliasing when representing a high-resolution image at a lower resolution.

```
# img = Image.open('S_1.png')
img = Image.open('NITD.jpeg')
img = img.resize((240, 200), Image.ANTIALIAS)
img.size
```

```
(240, 200)
```

```
plt.imshow(img)
```

```
<matplotlib.image.AxesImage at 0x7f6fdae510f0>
```


```
! pip install opencv-python
```

```
Requirement already satisfied: opencv-python in /usr/local/lib/python3.6/dist-packages (4.1.2.30)
Requirement already satisfied: numpy>=1.11.3 in /usr/local/lib/python3.6/dist-packages (from opencv-python) (1.19.5)
```

4.0.5 3. Rotate image

```
# im = Image.open("S_1.png")
im = Image.open("NITD.jpeg")
img=im.rotate(90)


plt.imshow(img)
```

```
<matplotlib.image.AxesImage at 0x7f6fdaeb0a58>
```

```
# img = cv2.imread('keras_sample.jpg')
img = cv2.imread('NITD.jpeg')

# WHY The ABOVE ERROR ???
# Update the code

# Get number of pixel horizontally and vertically.
(height, width) = img.shape[:2]


# WRITE CODE to Display the height and width


# Specify the size of image along with interploation methods.
# cv2.INTER_AREA is used for shrinking, whereas cv2.INTER_CUBIC
# is used for zooming.
res = cv2.resize(img,(int(width / 2), int(height / 2)), interpolation = cv2.INTER_AREA)
# Write image back to disk.
plt.subplot(121), plt.imshow(img),plt.title('Original')
plt.subplot(122), plt.imshow(res),plt.title('Scaled image')
```

```
(<matplotlib.axes._subplots.AxesSubplot at 0x7f6fda7af438>,
 <matplotlib.image.AxesImage at 0x7f6fda9eb668>,
 Text(0.5, 1.0, 'Scaled image'))
```

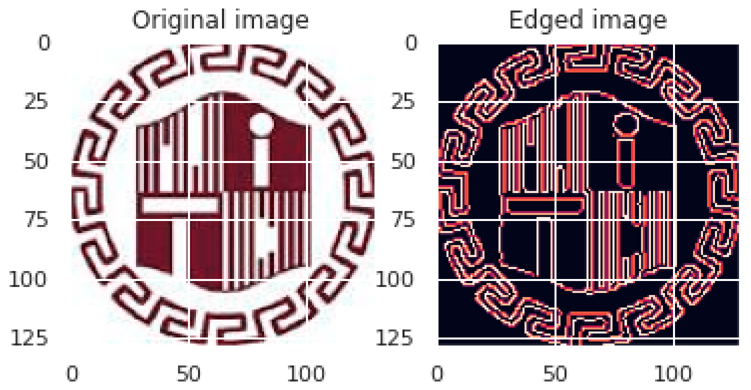

```
img.shape
```

```
(129, 129, 3)
```

4.0.7 Edge Detection


```
# Read image from disk.
img = cv2.imread('NITD.jpeg')
#img = cv2.imread('recess.png')
# Canny edge detection.
edges = cv2.Canny(img, 100, 200)
# Write image back to disk.
plt.subplot(121), plt.imshow(img),plt.title('Original image')
plt.subplot(122), plt.imshow(edges),plt.title('Edged image')
```

```
(<matplotlib.axes._subplots.AxesSubplot at 0x7f6fda625320>,
 <matplotlib.image.AxesImage at 0x7f6fda677c88>,
 Text(0.5, 1.0, 'Edged image'))
```



4.0.8 4. Applying Noise

```
import cv2
from matplotlib import pyplot as plt
%matplotlib inline
```

Color vision can be processed using RGB color space or HSV color space. RGB color space describes colors in terms of the amount of red, green, and blue present. HSV color space describes colors in terms of the Hue, Saturation, and Value. In situations where color description plays an integral role, the HSV color model is often preferred over the RGB model. The HSV model describes colors similarly to how the human eye tends to perceive color. RGB defines color in terms of a combination of primary colors, where as, HSV describes color using more familiar comparisons such as color, vibrancy and brightness.

The purpose of using plt.figure() is to create a figure object.

The whole figure is regarded as the figure object. It is necessary to explicitly use plt.figure() when we want to #tweak the size of the figure and when we want to add multiple Axes objects in a single figure.

```
image = cv2.imread('NITD.jpeg') # reads the image
image = cv2.cvtColor(image, cv2.COLOR_BGR2HSV) # convert to HSV
figure_size = 9
new_image = cv2.blur(image,(figure_size, figure_size))
plt.figure(figsize=(11,6))
plt.subplot(121), plt.imshow(cv2.cvtColor(image, cv2.COLOR_HSV2RGB)),plt.title('Original')
plt.subplot(122), plt.imshow(cv2.cvtColor(new_image, cv2.COLOR_HSV2RGB)),plt.title('Mean filter')
plt.xticks([]), plt.yticks([])
plt.show()
```


```
# The image will first be converted to grayscale
image2 = cv2.cvtColor(image, cv2.COLOR_HSV2BGR)
image2 = cv2.cvtColor(image2, cv2.COLOR_BGR2GRAY)
figure_size = 9
new_image = cv2.blur(image2,(figure_size, figure_size))
plt.figure(figsize=(11,6))
plt.subplot(121), plt.imshow(image2, cmap='gray'),plt.title('Original')
plt.subplot(122), plt.imshow(new_image, cmap='gray'),plt.title('Mean filter')
plt.show()
```


```
# reference: https://towardsdatascience.com/image-filters-in-python-26ee938e57d2
```

4.0.9 5. Segmentation

Image Segmentation. Image segmentation is the process of partitioning an image into multiple segments. Image segmentation is typically used to locate objects and boundaries in images.

```
image = cv2.imread('NITD.jpeg') # reads the image
# image = cv2.imread('S_1.png')
gray = cv2.cvtColor(image, cv2.COLOR_RGB2GRAY)
ret, thresh = cv2.threshold(gray, 0, 255, cv2.THRESH_BINARY_INV + cv2.THRESH_OTSU)
plt.figure(figsize=(11,6))
# Displaying segmented images
plt.subplot(121), plt.imshow(image),plt.title('Original')
plt.subplot(122), plt.imshow(thresh),plt.title('segmented image')
```

```
(<matplotlib.axes._subplots.AxesSubplot at 0x7f6ff4f1be80>,
 <matplotlib.image.AxesImage at 0x7f6ff2f42748>,
 Text(0.5, 1.0, 'segmented image'))
```

```
# Reference: https://www.geeksforgeeks.org/python-thresholding-techniques-using-opencv-set-1-simple-thresholding/
```

4.0.10 6. Morphology

```
import numpy as np
image = cv2.imread('NITD.jpeg') # reads the image
# image = cv2.imread('recess.png') # reads the image
hsv = cv2.cvtColor(image, cv2.COLOR_BGR2HSV)
# defining the range of masking
blue1 = np.array([110, 50, 50])
blue2 = np.array([130, 255, 255])
# initializing the mask to be
# convoluted over input image
mask = cv2.inRange(hsv, blue1, blue2)
# passing the bitwise_and over
# each pixel convoluted
res = cv2.bitwise_and(image, image, mask = mask)
# defining the kernel i.e. Structuring element
kernel = np.ones((5, 5), np.uint8)
# defining the opening function
# over the image and structuring element
opening = cv2.morphologyEx(mask, cv2.MORPH_OPEN, kernel)

plt.figure(figsize=(11,6))
plt.subplot(121), plt.imshow(image),plt.title('Original')
plt.subplot(122), plt.imshow(mask),plt.title('segmented image')
```

```
(<matplotlib.axes._subplots.AxesSubplot at 0x7f6fe445a748>,
 <matplotlib.image.AxesImage at 0x7f6fda69b978>,
 Text(0.5, 1.0, 'segmented image'))
```