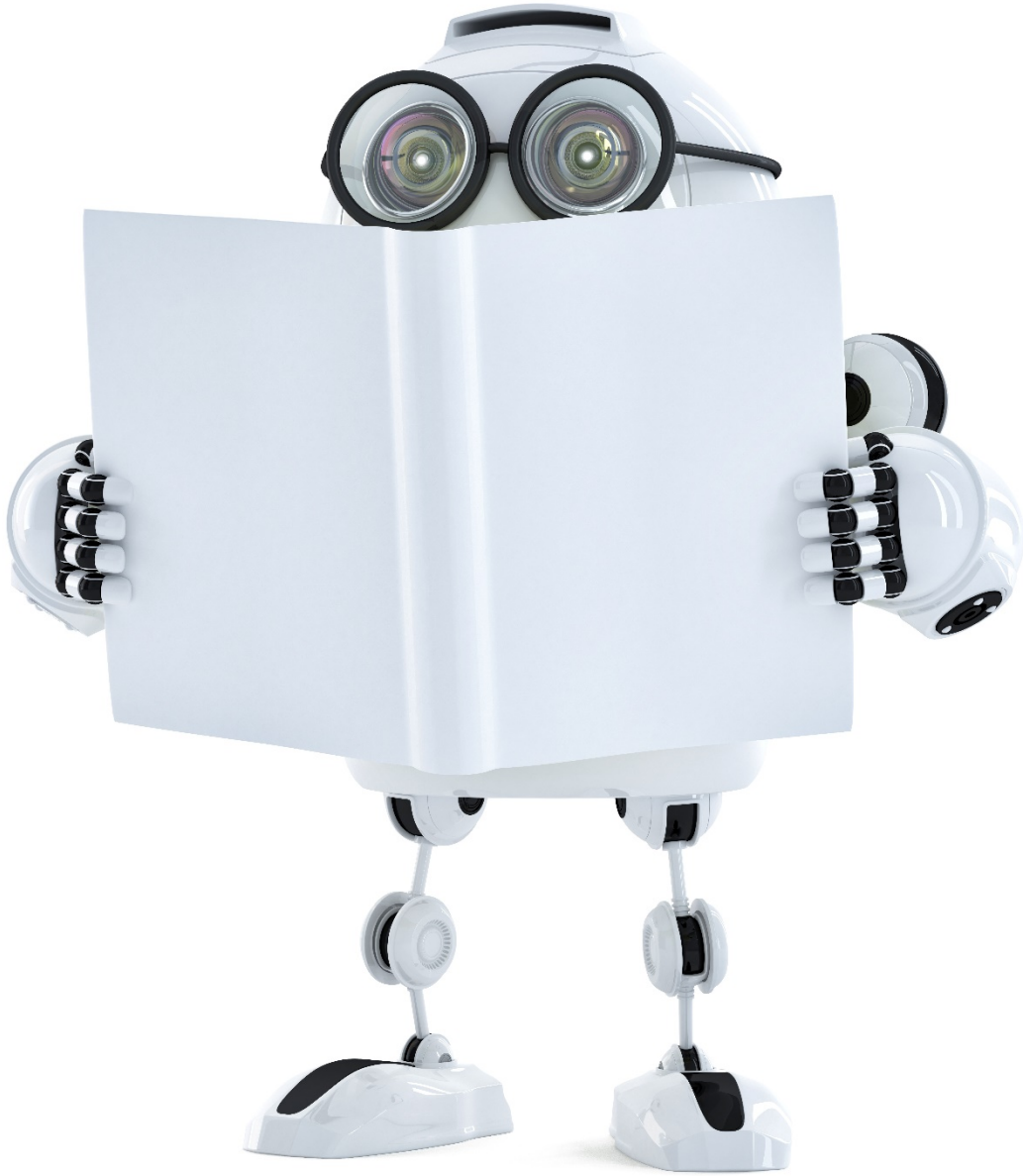
matplotlib

Visaulization

Director of TEAMLAB
Sungchul Choi



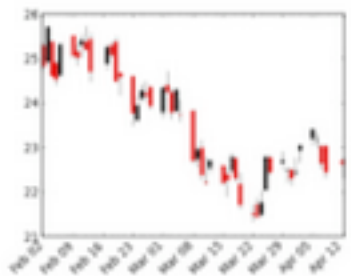

matplotlib

우리의 데이터는 어떻게 생겼을까?

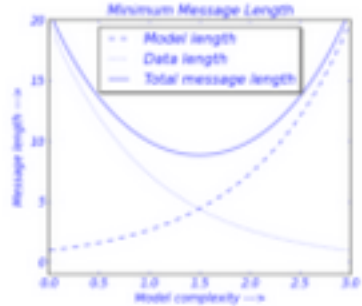
Visualization
데이터 시각화

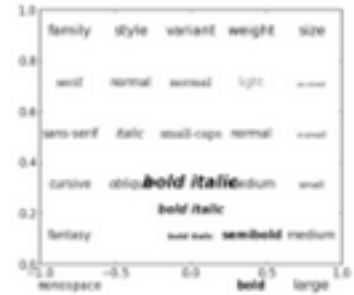
파이썬의 대표적인 시각화 도구


matplotlib




SPY daily


Minimum Message Length
Model length
Data length
Total message length
Message length ---»
Model complexity ---»


family
style
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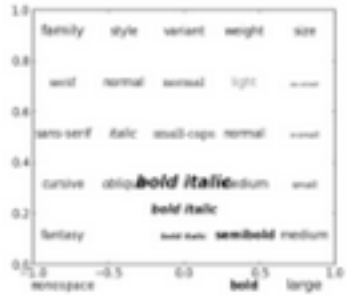
large


family
style
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weight
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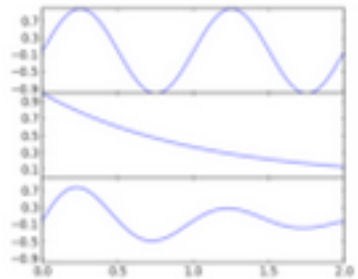
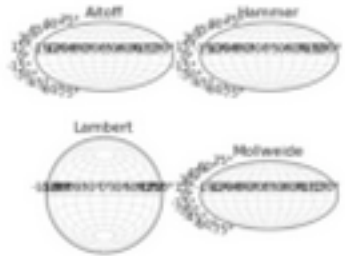
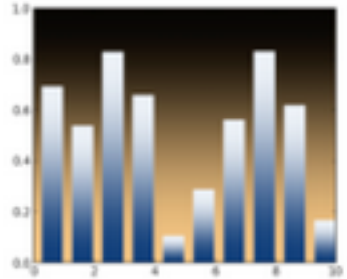
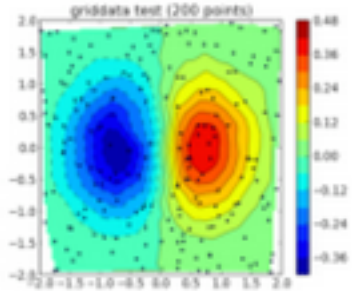
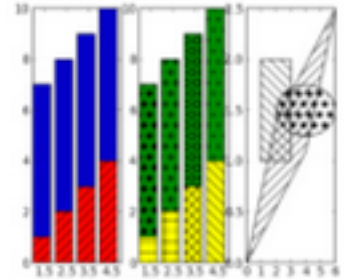
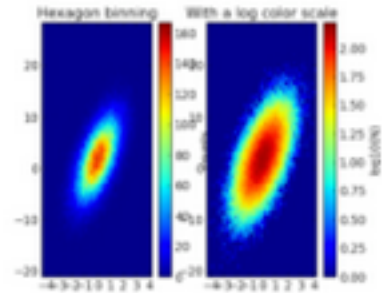


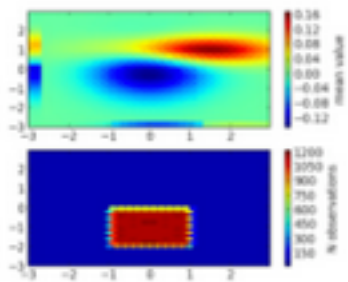

Aitoff
Hammer
Lambert
Mollweide

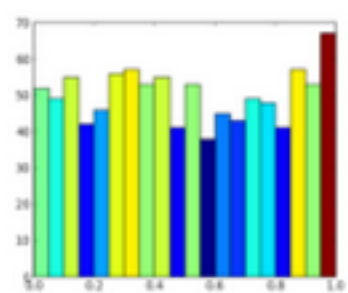


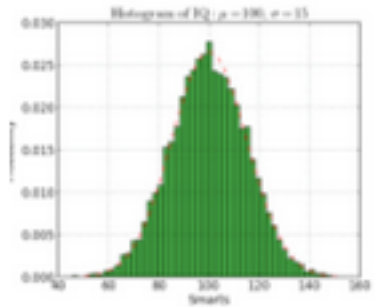

griddata test (200 points)

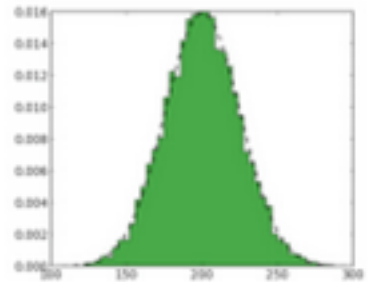


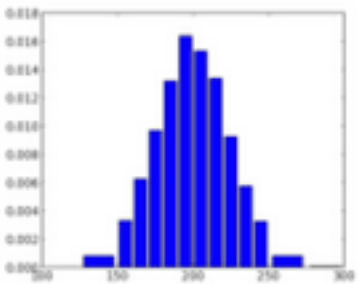

Hexagon binning
With a log color scale

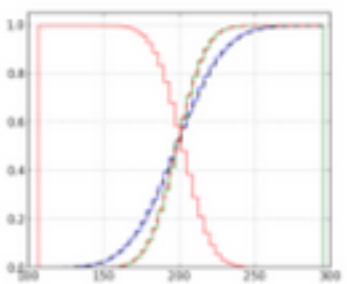

mean value
% observations

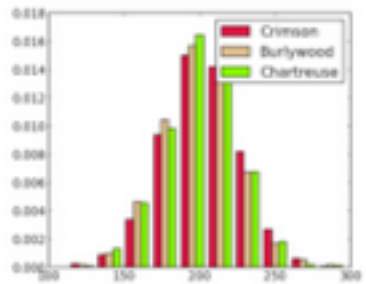


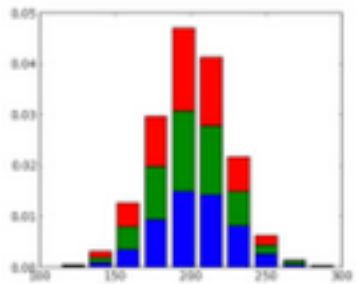

Histogram of IQ: $\mu = 100$, $\sigma = 15$
Smarts

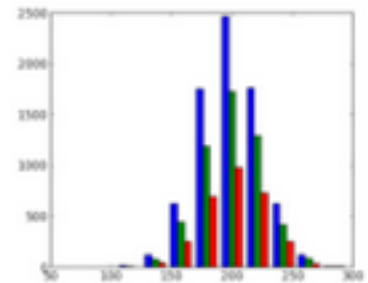







Crimson
Burlywood
Chartreuse





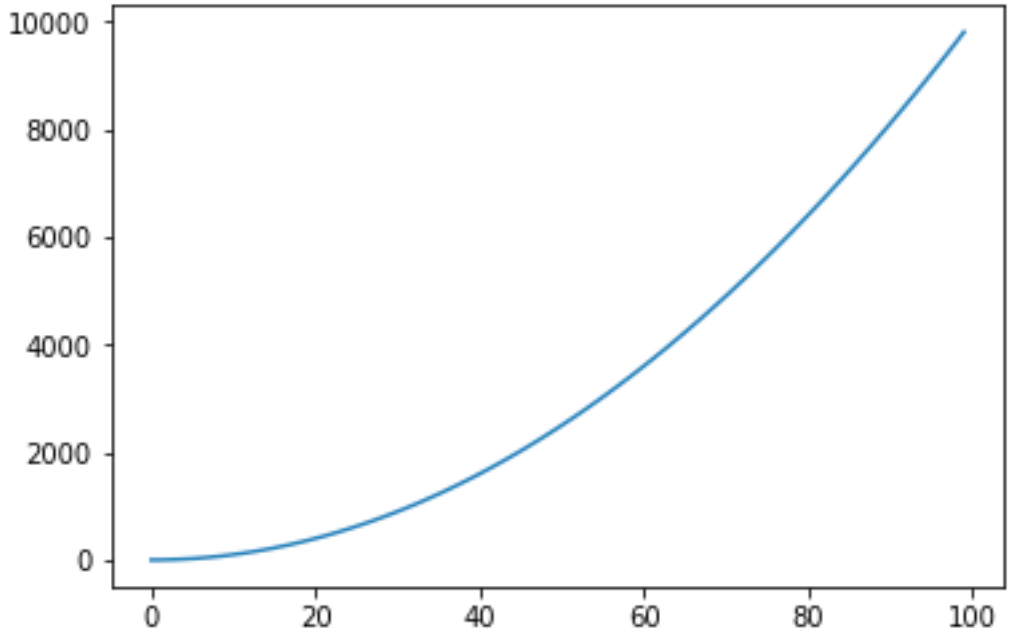
다양한 graph 지원
Pandas 연동!

기본 사용법

matplotlib

- pyplot 객체를 사용하여 데이터를 표시
- Pyplot 객체에 그래프들을 쌓은 다음 show로 flush

```
import matplotlib.pyplot as plt

X = range(100)
Y = [value**2 for value in X]
plt.plot(X, Y)
plt.show()
```



matplotlib

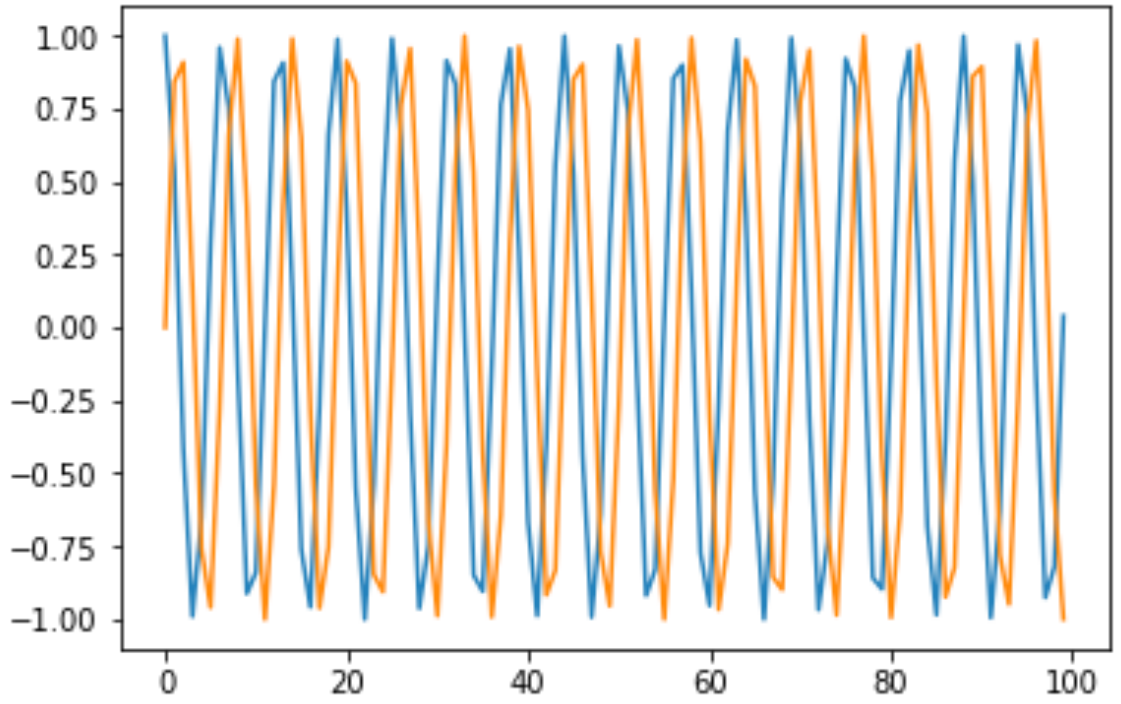
- 최대 단점 argument를 kwargs 받음,
- 고정된 argument가 없어서 alt+tab으로 확인이 어려움

```
Signature: plt.plot(*args, **kwargs)
Docstring:
Plot lines and/or markers to the
:class:`~matplotlib.axes.Axes`.  *args* is a variable length
argument, allowing for multiple *x*, *y* pairs with an
optional format string.  For example, each of the following is
legal::

    plot(x, y)         # plot x and y using default line style and color
    plot(x, y, 'bo')   # plot x and y using blue circle markers
    plot(y)            # plot y using x as index array 0..N-1
    plot(y, 'r+')      # ditto, but with red plusses
```

matplotlib

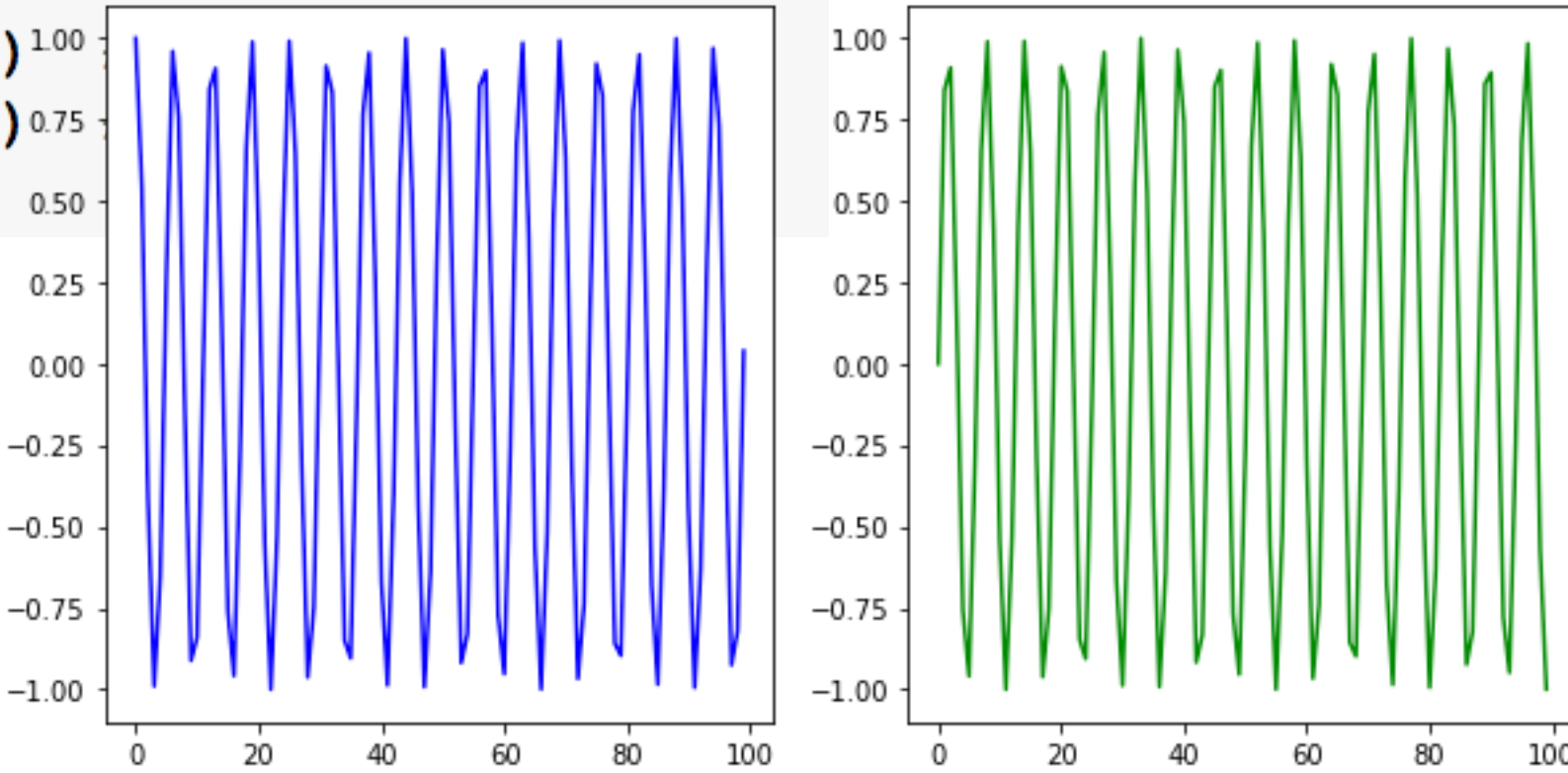
- Graph는 원래 figure 객체에 생성됨
- pyplot 객체 사용시, 기본 figure에 그래프가 그려짐

```
X_1 = range(100)
Y_1 = [np.cos(value) for value in X]

X_2 = range(100)
Y_2 = [np.sin(value) for value in X]

plt.plot(X_1, Y_1)
plt.plot(X_2, Y_2)
plt.show()
```



matplotlib

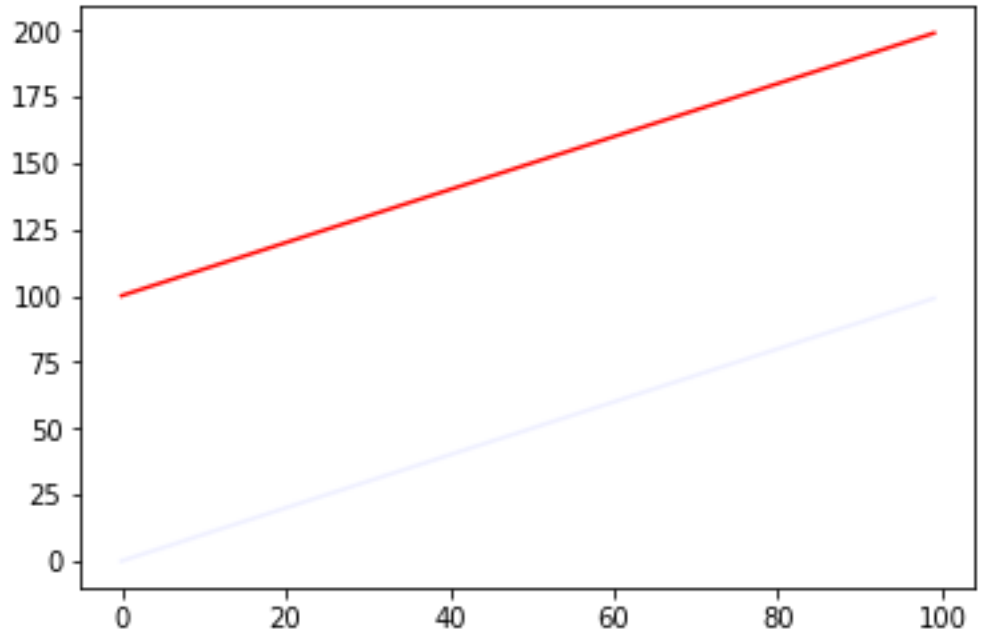
```
fig = plt.figure() # figure 반환
fig.set_size_inches(10,5) # 크기지정
ax_1 = fig.add_subplot(1,2,1) # 두개의 plot 생성
ax_2 = fig.add_subplot(1,2,2)  # 두개의 plot 생성

ax_1.plot(X_1, Y_1, c="b")
ax_2.plot(X_2, Y_2, c="g")
plt.show() # show & flush
```



Set color

- Color 속성을 사용
- Float → 흑백, rgb color, predefined color 사용

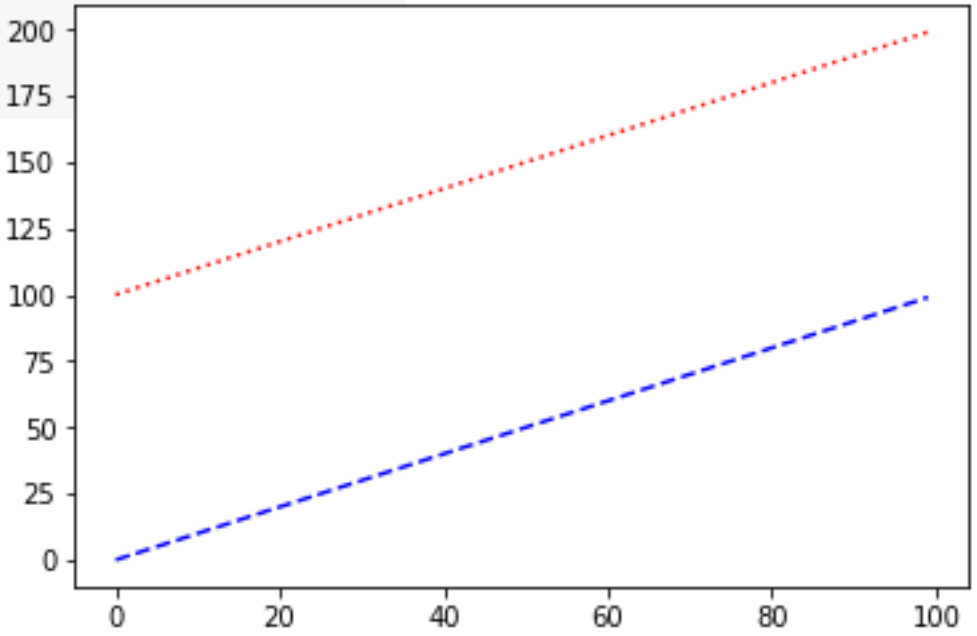
```
plt.plot(X_1, Y_1, color="#eeefff")
plt.plot(X_2, Y_2, color="r")

plt.show()
```



Set linstyle

- ls 또는 linestyle 속성 사용

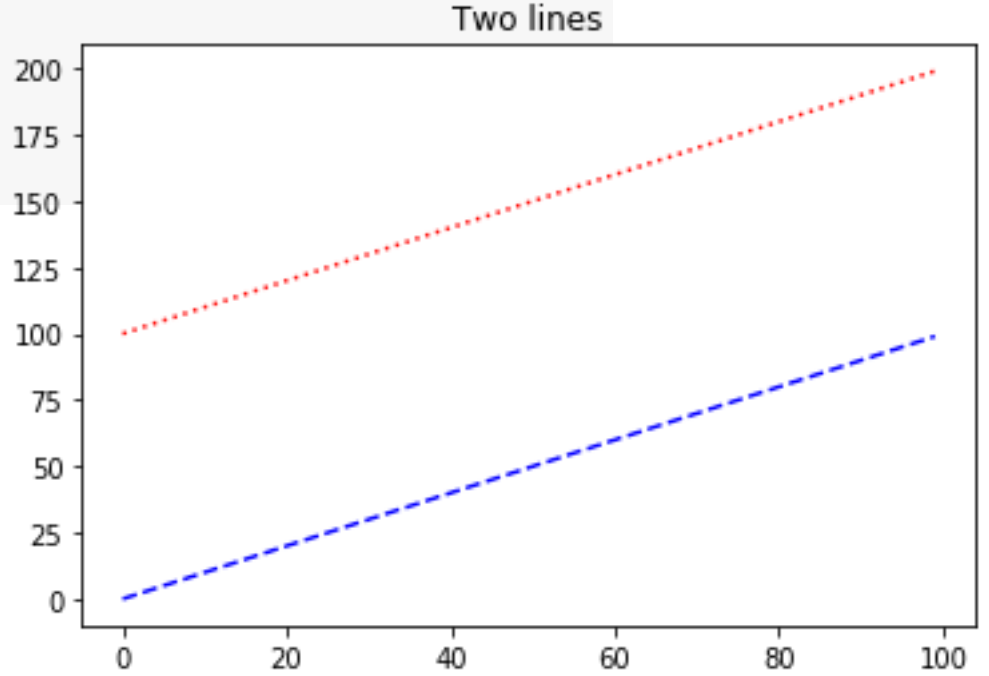
```
plt.plot(X_1, Y_1, c="b", linestyle="dashed")
plt.plot(X_2, Y_2, c="r", ls="dotted")

plt.show()
```



Set title

- Pyplot에 title함수 사용, figure의 subplot별 입력 가능

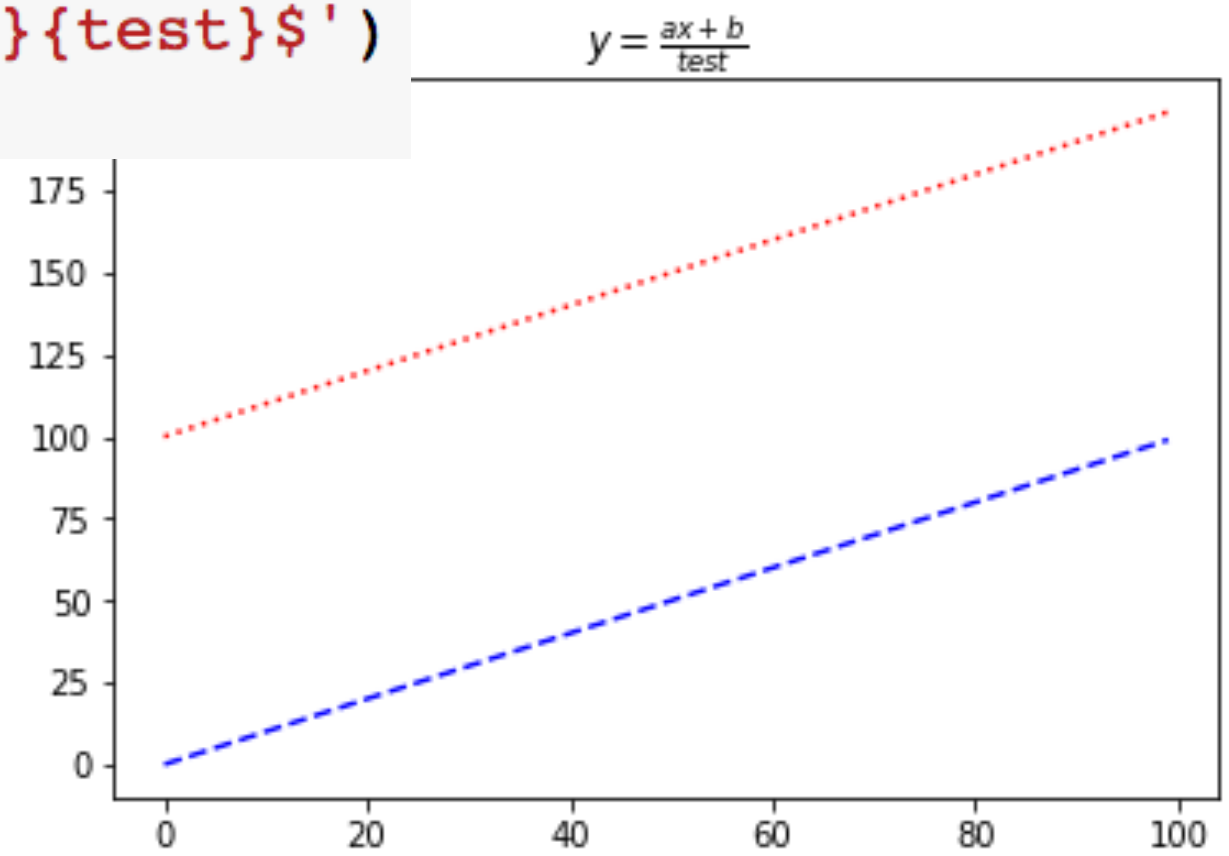
```
plt.plot(X_1, Y_1, color="b", linestyle="dashed")
plt.plot(X_2, Y_2, color="r", linestyle="dotted")

plt.title("Two lines")
plt.show()
```



Set title

- Latex 타입의 표현도 가능 (수식 표현 가능)

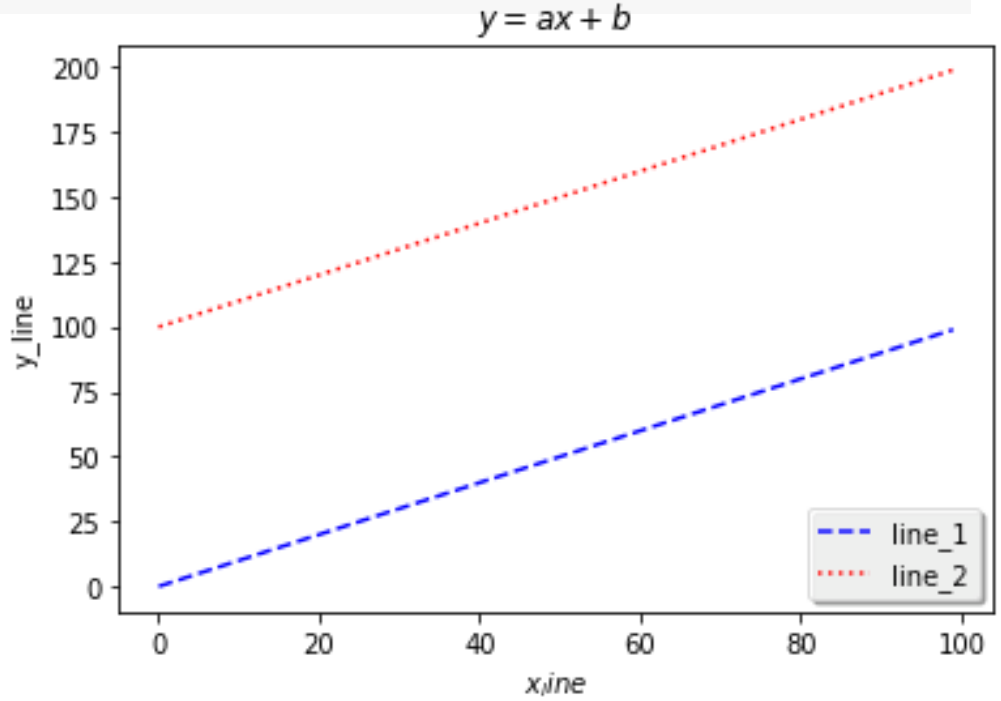
```
plt.title('$y = \\frac{ax + b}{test}$')
plt.show()
```



Set legend

- Legend 함수로 범례를 표시함, loc 위치등 속성 지정

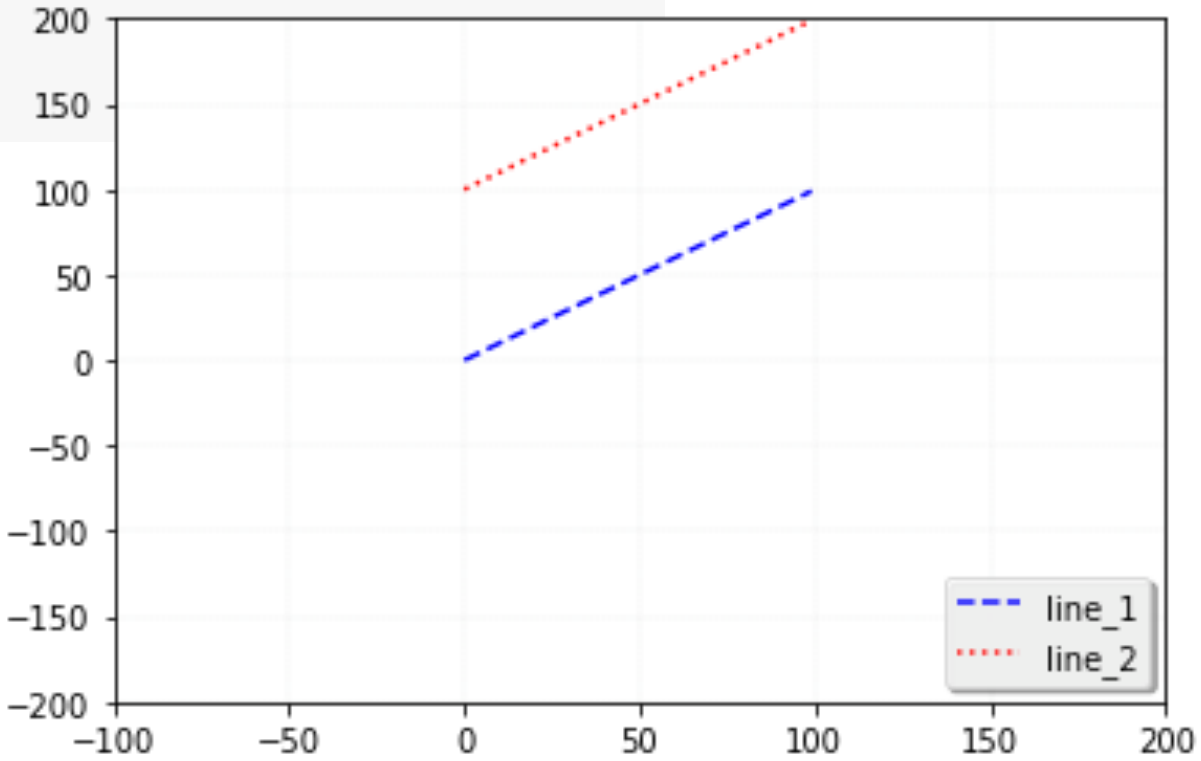
```
plt.plot(X_1, Y_1, color="b", linestyle="dashed", label='line_1')
plt.plot(X_2, Y_2, color="r", linestyle="dotted", label='line_2')
plt.legend(shadow=True, fancybox=True, loc="lower right")
```



Set grid & xylim

- Graph 보조선을 긋는 grid와 xy축 범위 한계를 지정

```
plt.grid(True, lw=0.4, ls="--", c=".90")
plt.xlim(-100, 200)
plt.ylim(-200, 200)
```

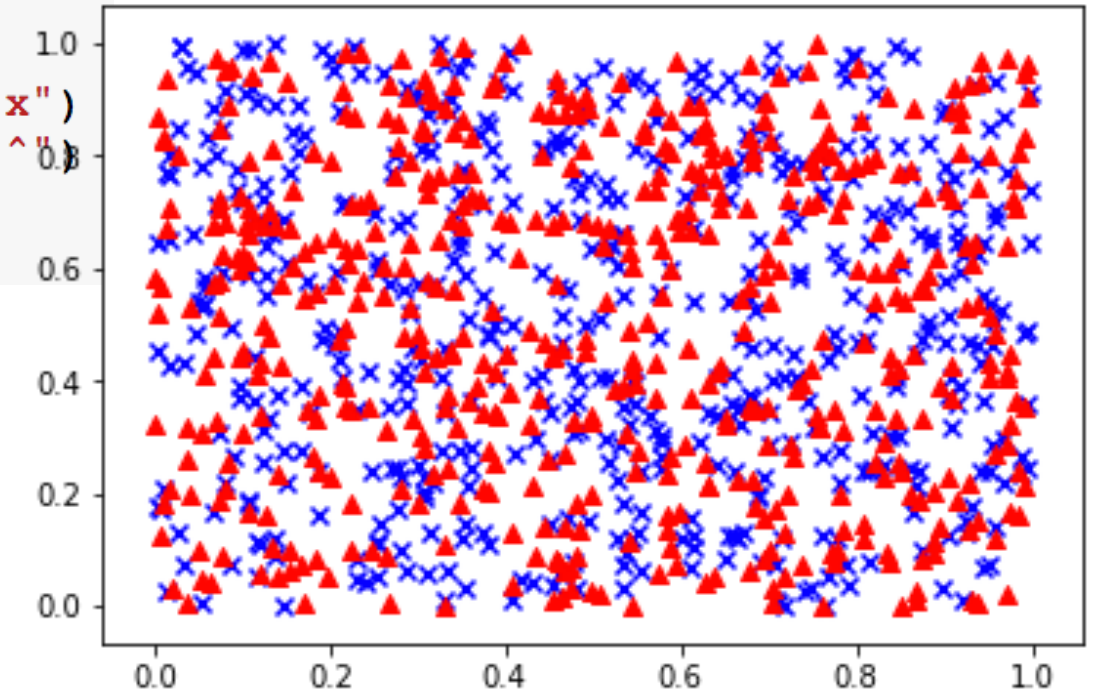


Matplotlib Graph

Scatter

- scatter 함수 사용, marker: scatter 모양지정

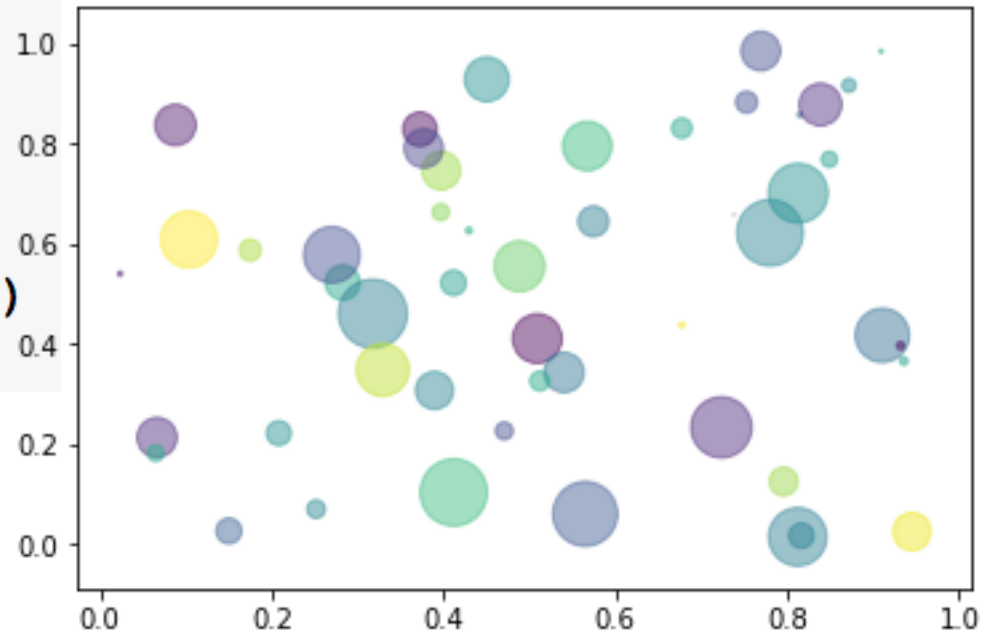
```
data_1 = np.random.rand(512, 2)
data_2 = np.random.rand(512, 2)

plt.scatter(data_1[:,0], data_1[:,1], c="b", marker="x")
plt.scatter(data_2[:,0], data_2[:,1], c="r", marker="^")

plt.show()
```



Scatter

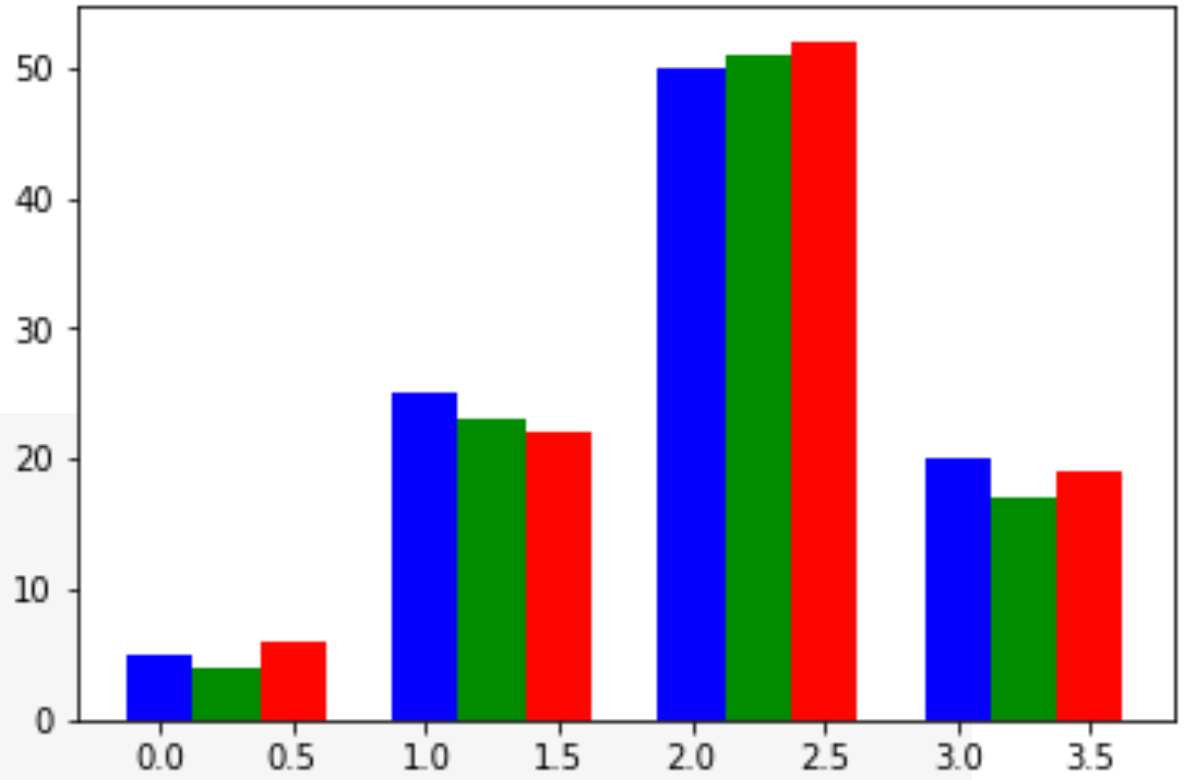
- s: 데이터의 크기를 지정, 데이터의 크기비교가능

```
N = 50
x = np.random.rand(N)
y = np.random.rand(N)
colors = np.random.rand(N)
area = np.pi * (15 * np.random.rand(N))**2
plt.scatter(x, y, s=area, c=colors, alpha=0.5)
plt.show()
```



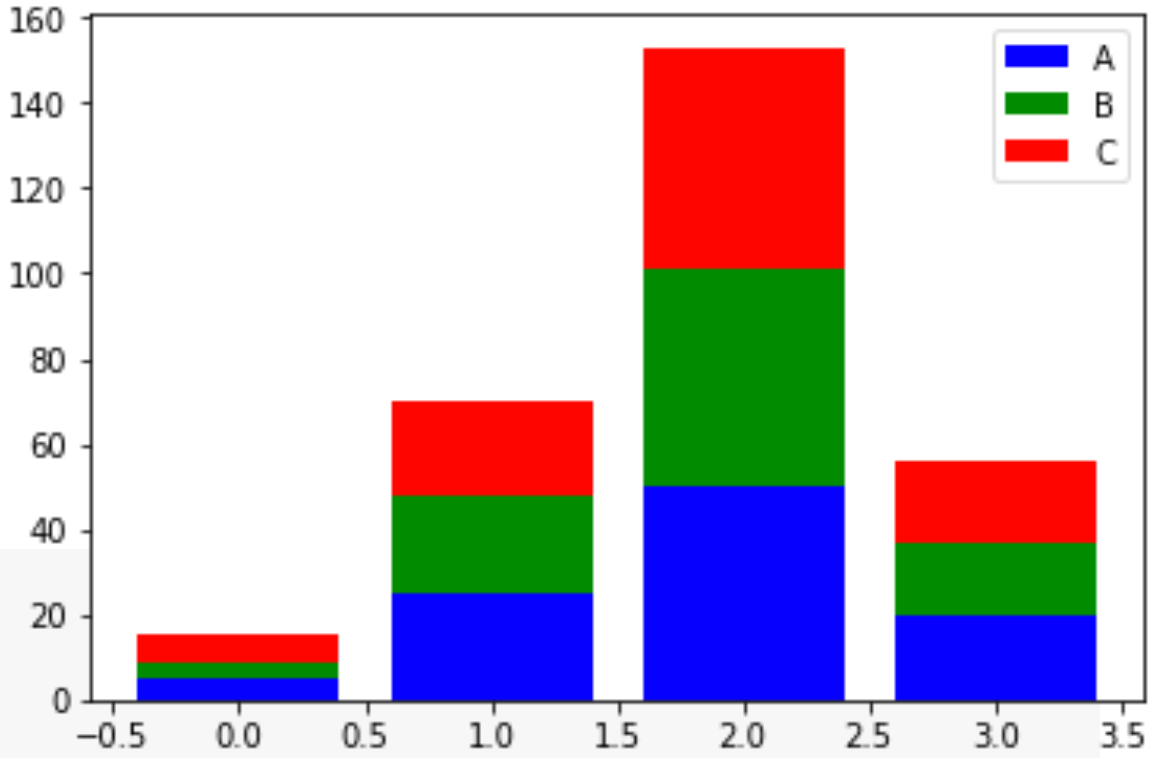
Bar chart

- Bar 함수 사용




```
data = [[5., 25., 50., 20.],
        [4., 23., 51., 17],
        [6., 22., 52., 19]]

X = np.arange(4)
plt.bar(X + 0.00, data[0], color = 'b', width = 0.25)
plt.bar(X + 0.25, data[1], color = 'g', width = 0.25)
plt.bar(X + 0.50, data[2], color = 'r', width = 0.25)
plt.xticks(X+0.25, ("A","B","C", "D"))
plt.show()
```

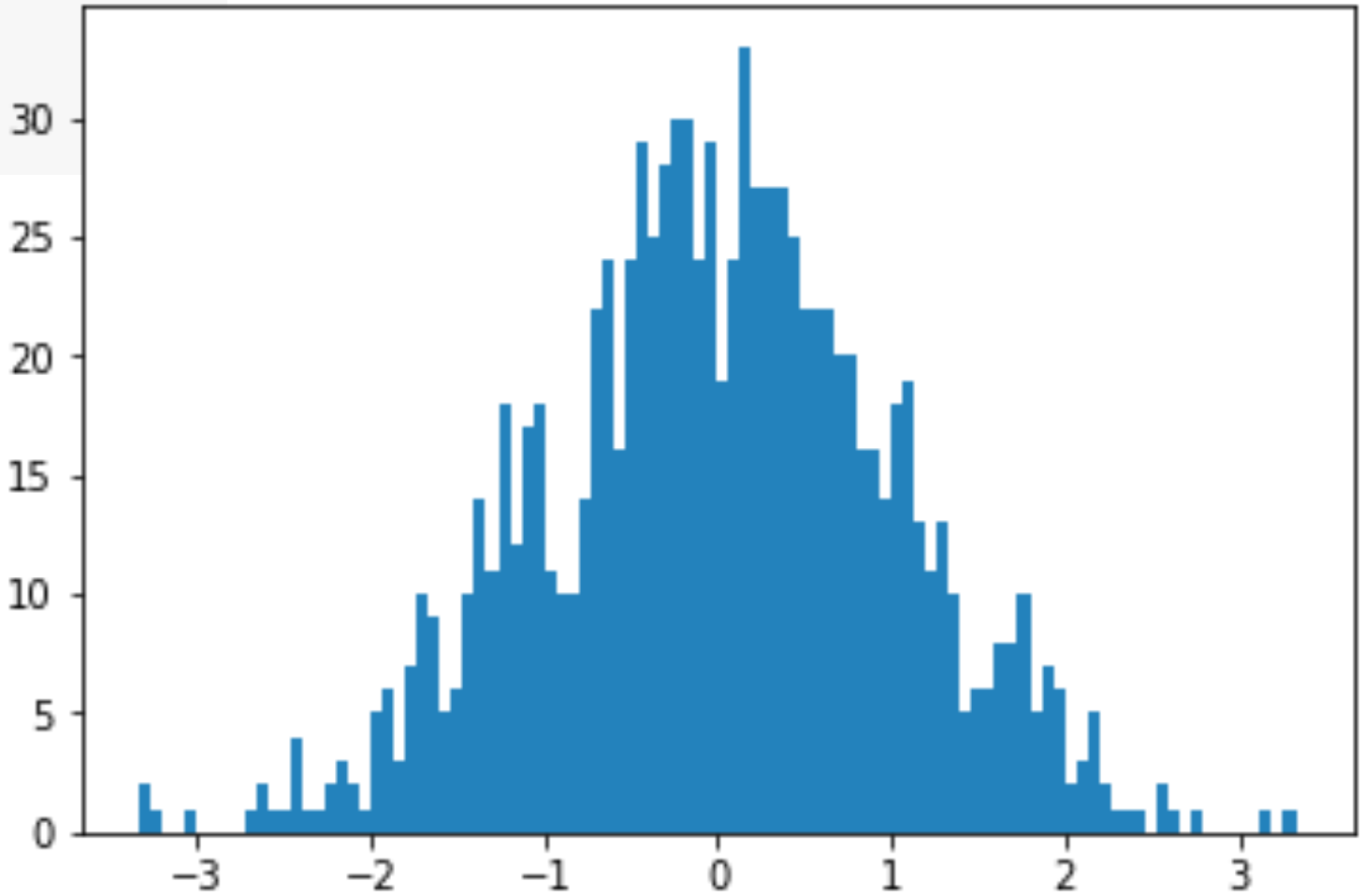
Bar chart




```
color_list = ['b', 'g', 'r']
data_label = ["A","B","C"]
X = np.arange(data.shape[1])
for i in range(data.shape[0]):
    plt.bar(X, data[i], bottom = np.sum(data[:i], axis=0),
            color = color_list[i], label=data_label[i])
plt.legend()
plt.show()
```

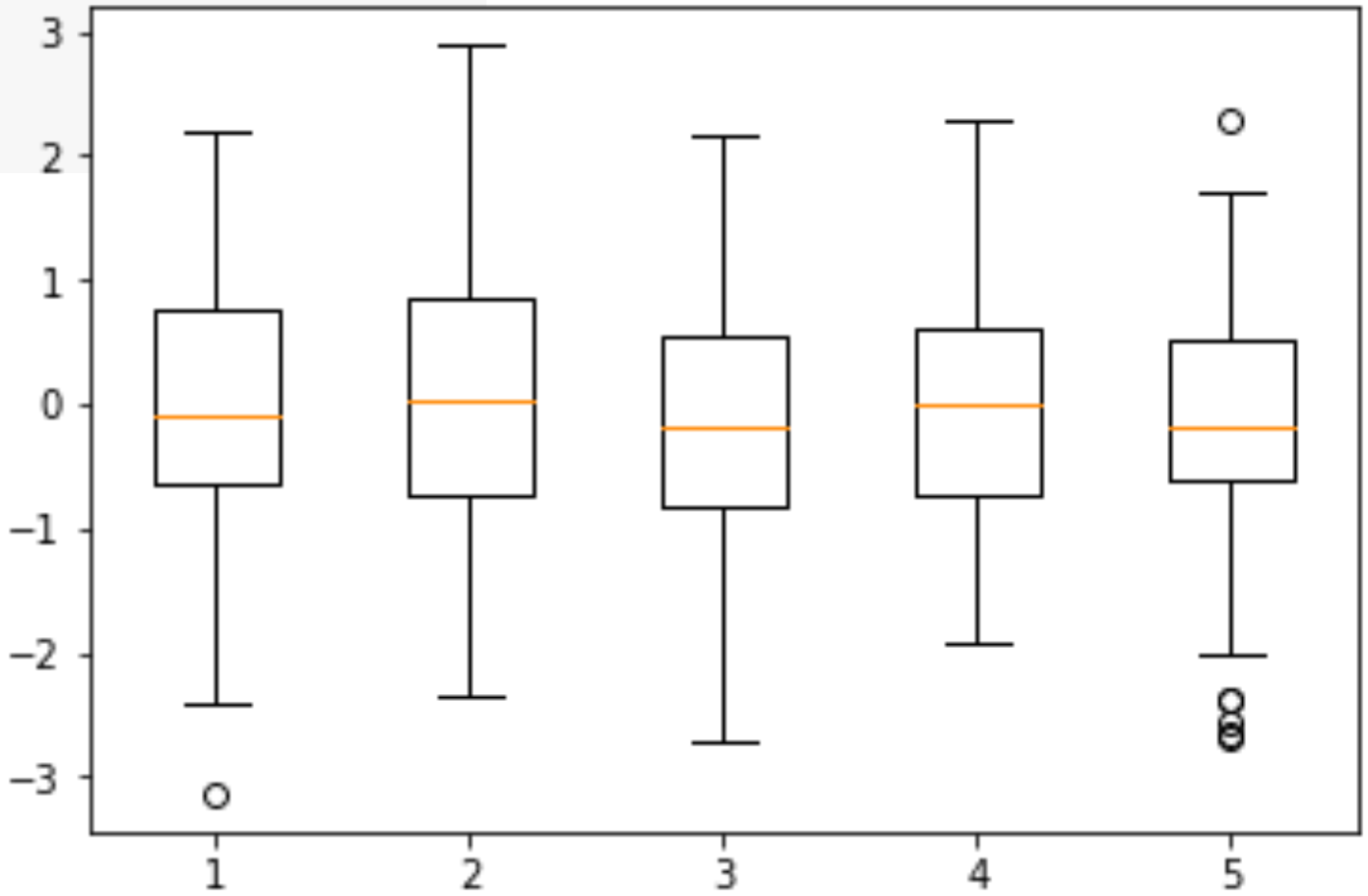
histogram

```
X = np.random.randn(1000)
plt.hist(X,bins=100)
plt.show()
```



boxplot

```
data = np.random.randn(100,5)
plt.boxplot(data)
plt.show()
```



matplotlib with pandas

pandas matplotlib

- Pandas 0.7 버전이상 부터 matplotlib를 사용한 그래프 지원
- Dataframe, series별로 그래프 작성 가능

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX	PTRATIO	B	LSTAT	MEDV
0	0.00632	18.0	2.31	0	0.538	6.575	65.2	4.0900	1	296.0	15.3	396.90	4.98	24.0
1	0.02731	0.0	7.07	0	0.469	6.421	78.9	4.9671	2	242.0	17.8	396.90	9.14	21.6
2	0.02729	0.0	7.07	0	0.469	7.185	61.1	4.9671	2	242.0	17.8	392.83	4.03	34.7
3	0.03237	0.0	2.18	0	0.458	6.998	45.8	6.0622	3	222.0	18.7	394.63	2.94	33.4
4	0.06905	0.0	2.18	0	0.458	7.147	54.2	6.0622	3	222.0	18.7	396.90	5.33	36.2

Boston House Price Dataset

- 머신 러닝 등 데이터 분석을 처음 배울 때,
  가장 대표적으로 사용하는 Example Dataset

- 1978년에 발표된 데이터로, 미국 인구통계 조사 결과
  미국 보스턴 지역의 주택 가격에 영향 요소들을 정리함

http://lib.stat.cmu.edu/datasets/boston

Boston House Price Dataset

X 변수
13개

Y 변수

[01] CRIM	자치시(town) 별 1인당 범죄율
[02] ZN	25,000 평방피트를 초과하는 거주지역의 비율
[03] INDUS	비소매상업지역이 점유하고 있는 토지의 비율
[04] CHAS	찰스강에 대한 더미변수(강의 경계에 위치한 경우는 1, 아니면 0)
[05] NOX	10ppm 당 농축 일산화질소
[06] RM	주택 1가구당 평균 방의 개수
[07] AGE	1940년 이전에 건축된 소유주택의 비율
[08] DIS	5개의 보스턴 직업센터까지의 접근성 지수
[09] RAD	방사형 도로까지의 접근성 지수
[10] TAX	10,000 달러 당 재산세율
[11] PTRATIO	자치시(town)별 학생/교사 비율
[12] B	1000(Bk-0.63)^2, 여기서 Bk는 자치시별 흑인의 비율을 말함.
[13] LSTAT	모집단의 하위계층의 비율(%)
[14] MEDV	본인 소유의 주택가격(중앙값) (단위: $1,000)

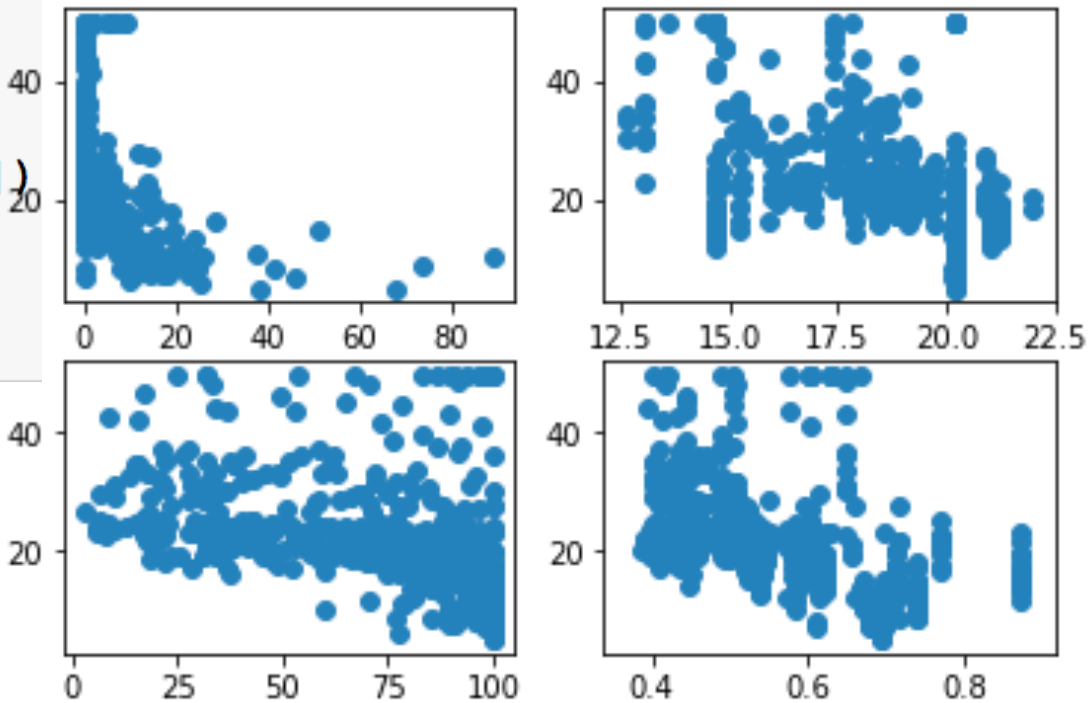
http://www.dator.co.kr/ctg258/textyle/1721307

http://www.cs.toronto.edu/~delve/data/boston/bostonDetail.html

pandas matplotlib

- 데이터간의 상관관계를 볼 때 scatter graph 사용 가능

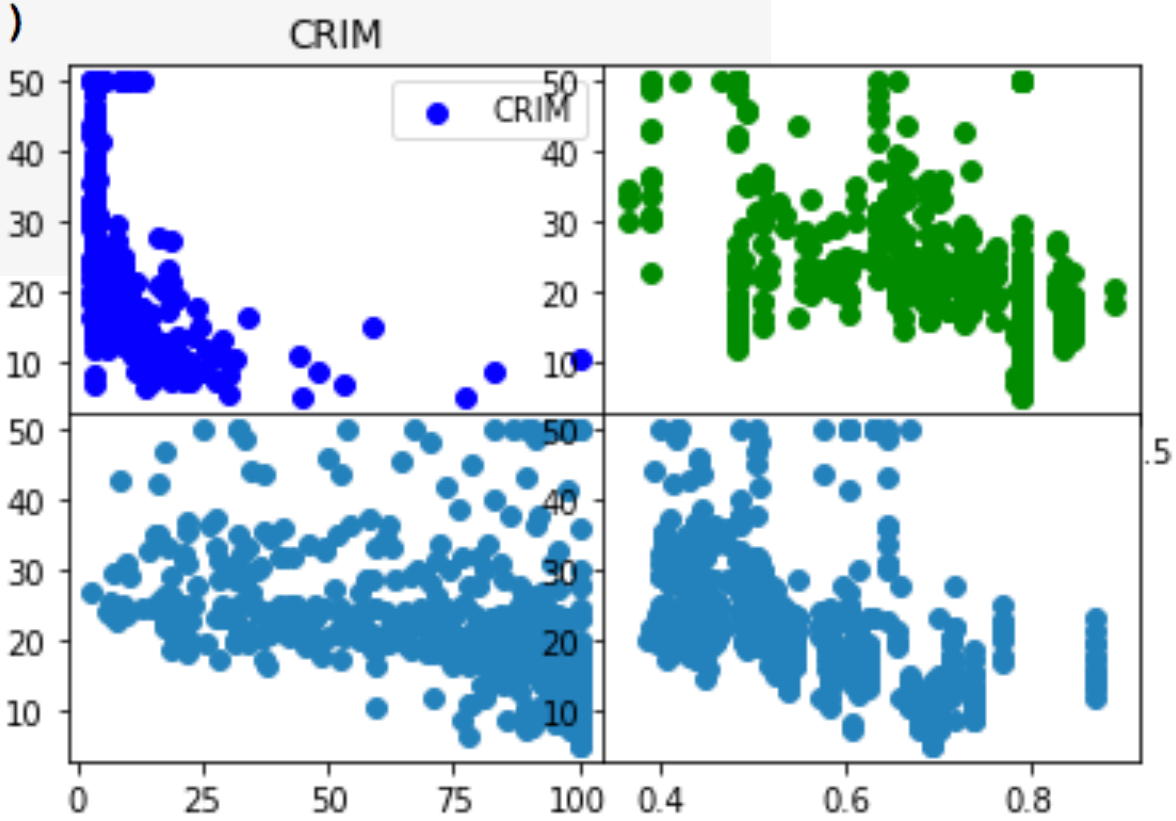
```
fig = plt.figure()
ax = []
for i in range(1,5):
    ax.append(fig.add_subplot(2,2,i))
ax[0].scatter(df_data["CRIM"], df_data["MEDV"])
ax[1].scatter(df_data["PTRATIO"], df_data["MEDV"])
ax[2].scatter(df_data["AGE"], df_data["MEDV"])
ax[3].scatter(df_data["NOX"], df_data["MEDV"])
plt.show()
```



pandas matplotlib

- matplotlib의 꾸미기 함수 그대로 사용함

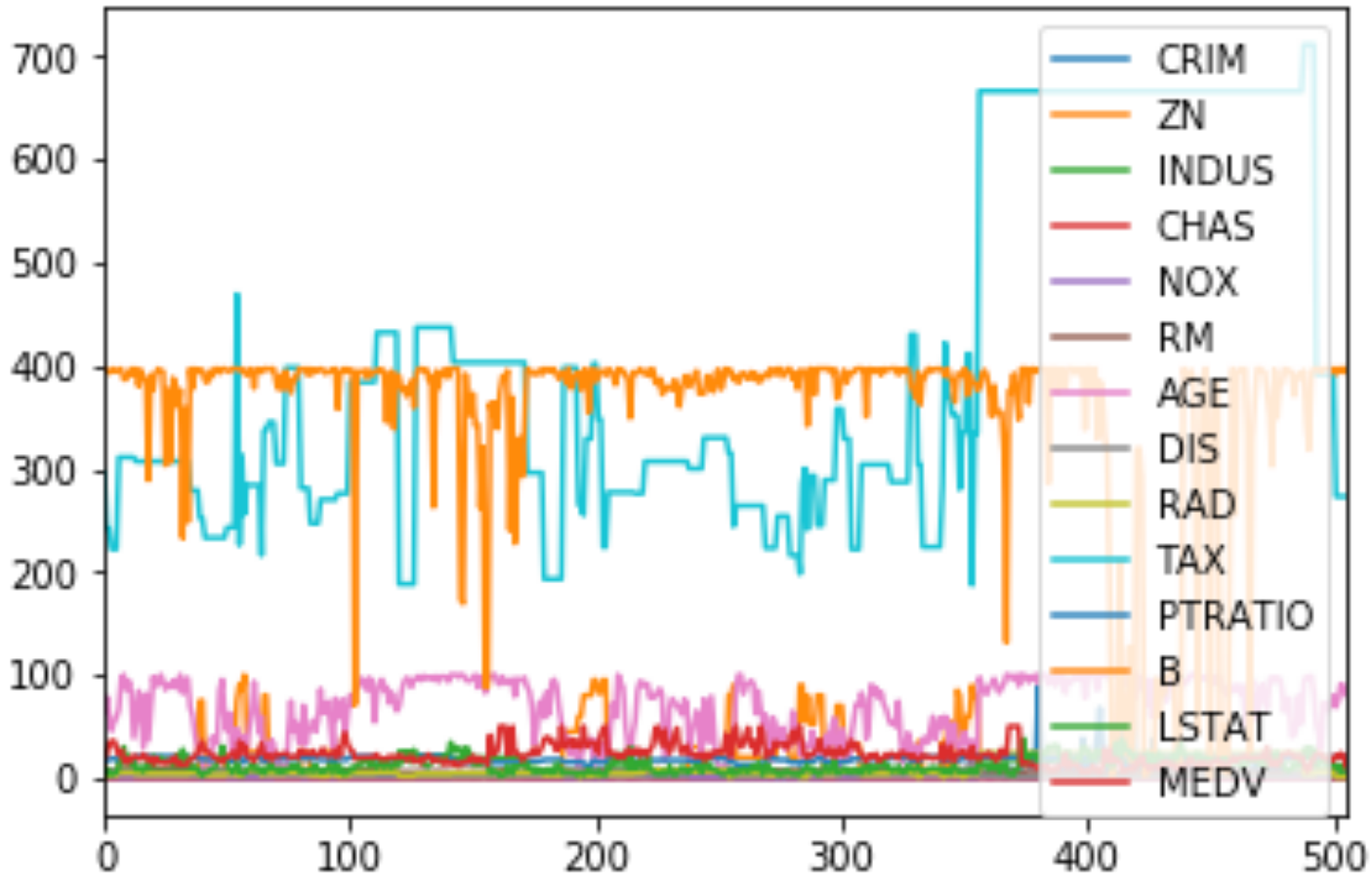
```
ax[0].scatter(df_data["CRIM"], df_data["MEDV"], color="b", label="CRIM")
ax[1].scatter(df_data["PTRATIO"], df_data["MEDV"], color="g"  )
ax[2].scatter(df_data["AGE"], df_data["MEDV"] )
ax[3].scatter(df_data["NOX"], df_data["MEDV"])
plt.subplots_adjust(wspace=0, hspace=0)
ax[0].legend()
ax[0].set_title("CRIM")
```



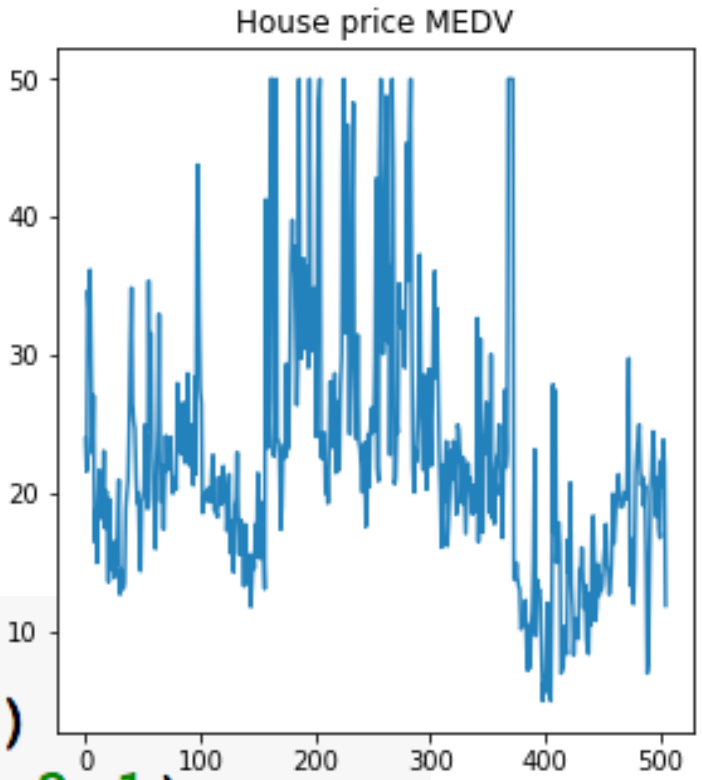
pandas matplotlib

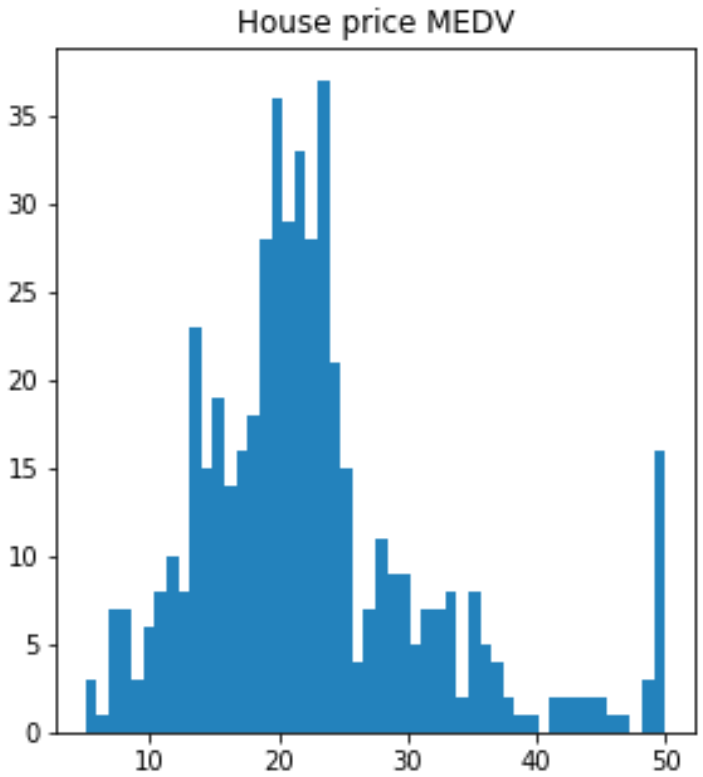
- plot 함수를 사용하면 전체 데이터의 graph를 그림

```
df_data.plot()
```



pandas matplotlib

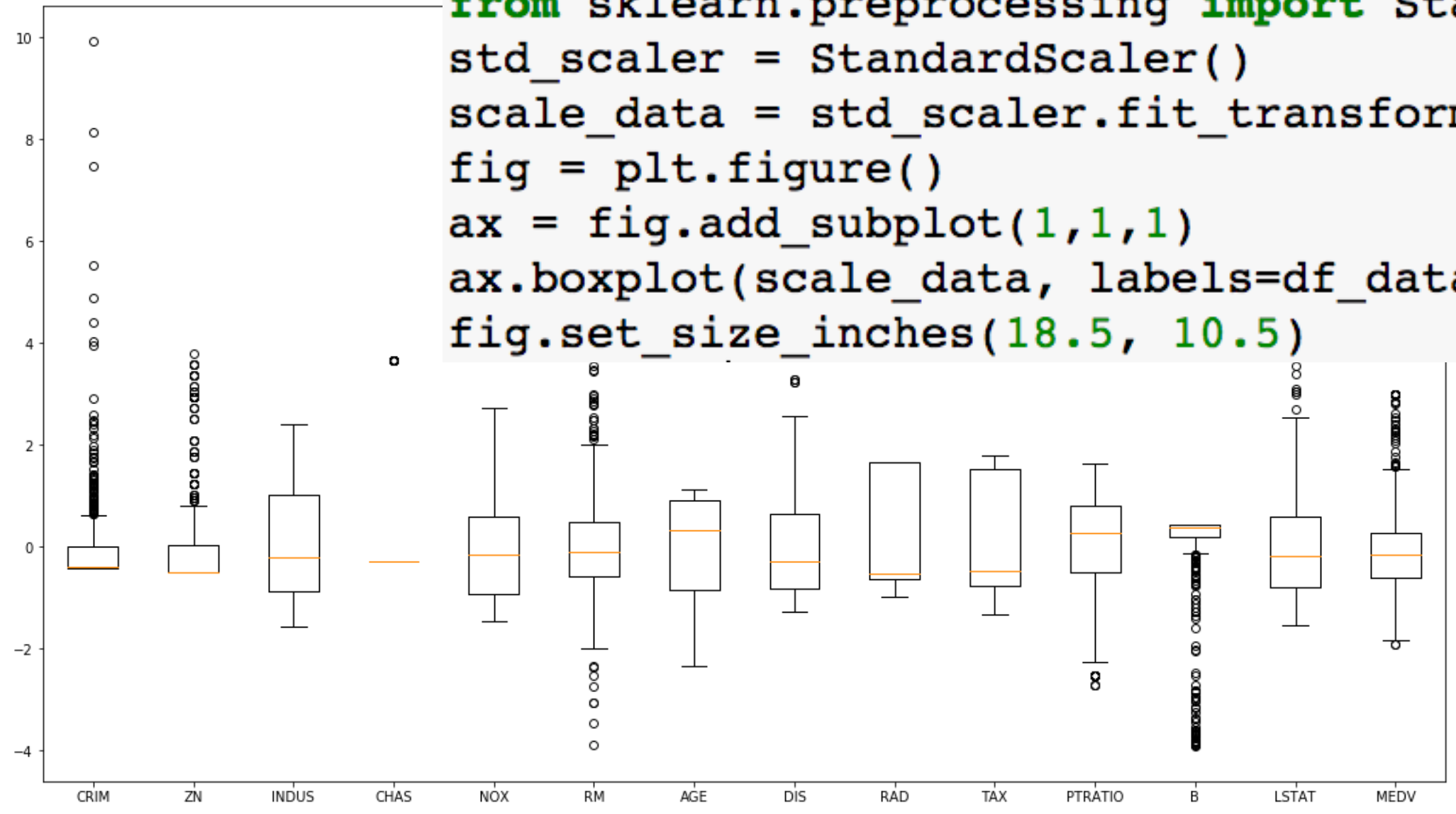




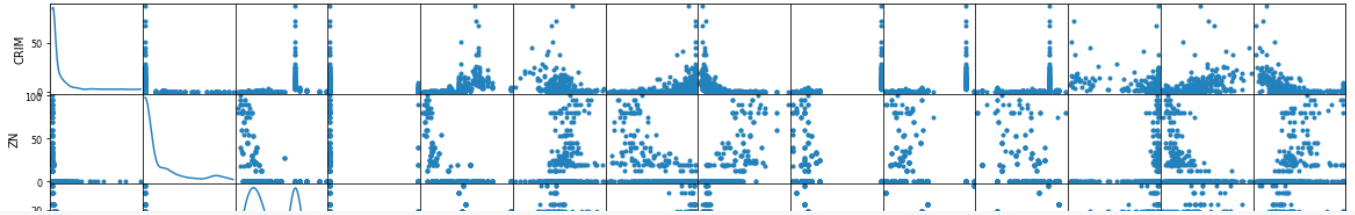

```
fig = plt.figure()
fig.set_size_inches(10,5)
ax_1 = fig.add_subplot(1,2,1)
ax_2 = fig.add_subplot(1,2,2)
ax_1.plot(df_data["MEDV"])
ax_2.hist(df_data["MEDV"], bins=50)
ax_1.set_title("House price MEDV")
ax_2.set_title("House price MEDV")
```

Scaled boxplot

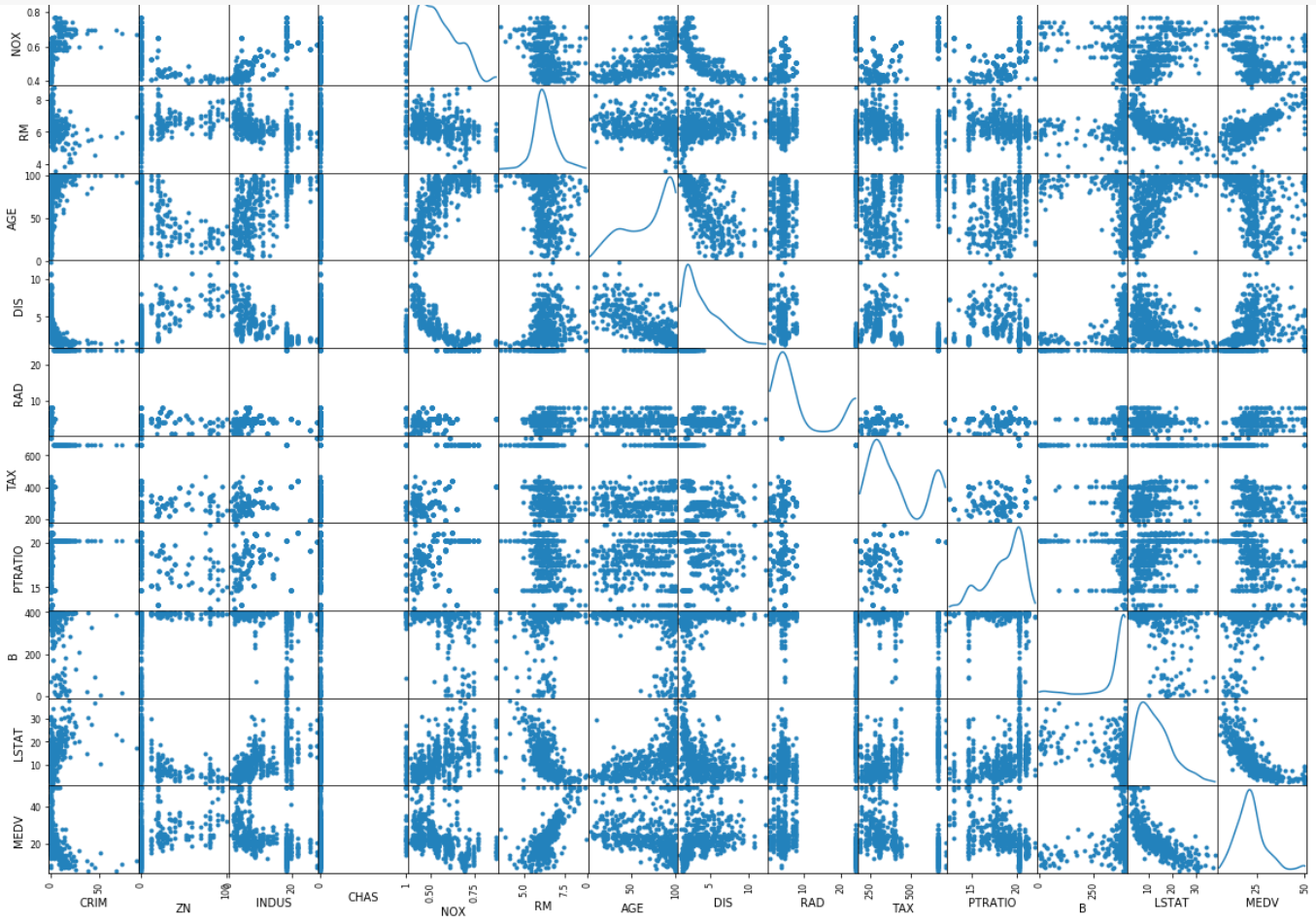
```
from sklearn.preprocessing import StandardScaler
std_scaler = StandardScaler()
scale_data = std_scaler.fit_transform(df_data)
fig = plt.figure()
ax = fig.add_subplot(1,1,1)
ax.boxplot(scale_data, labels=df_data.columns)
fig.set_size_inches(18.5, 10.5)
```



Scatter matrix




```
pd.scatter_matrix(df_data, diagonal="kde", alpha=1,  figsize=(20, 20))
plt.show()
```



Scatter matrix

```
fig = plt.figure()
ax = fig.add_subplot(111)
cax = ax.matshow(corr_data, vmin=-1, vmax=1,  interpolation='nearest')
fig.colorbar(cax)
fig.set_size_inches(10,10)
ticks= np.arange(0,14,1)
ax.set_xticks(ticks)
ax.set_yticks(ticks)

ax.set_xticklabels(df_data.columns)
ax.set_yticklabels(df_data.columns)
```