


程式設計概論 Programming 101 —matplotlib繪製圖表

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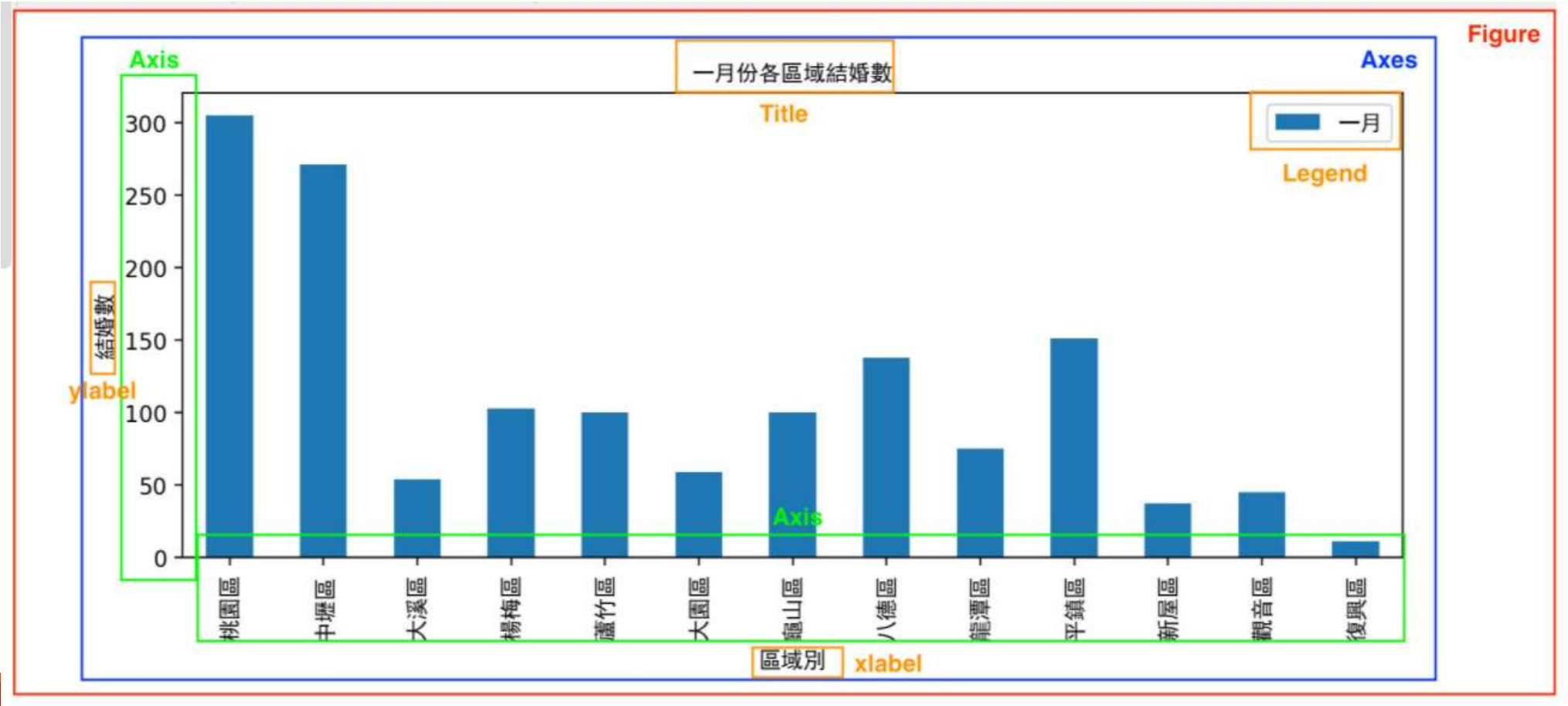
DATE:12/15/2023



Matplotlib (需安裝)

- Matplotlib (<https://matplotlib.org/>) 完全仿照Matlib 函數形式的繪圖介面
- Matplotlib最常運用的模組pyplot
- Matplotlib figure 架構
- Workflow
- 折線圖 (line plot): 使用函式 `plt.plot(x,y)`
- 長條圖 (bar plot): 使用函式 `plt.bar(x,y)`
- 直方圖 (histogram): 使用函式 `plt.hist(scores, bins, ...)`
- 散佈圖 (scatter plot): 使用函式 `plt.scatter(x,y)`
- 箱形圖 (boxplot): 使用函式 `dataframe.boxplot()`
- 圓形圖 (pie plot): 使用函式 `plt.pie(hours...)`

Figure



Figure

Workflow

用matplotlib串列建新圖，基本步驟：

1. Step1: Prepare Data
2. Step2: Create Plot
3. Step3: Plot
4. Step4: Customize Plot
5. Step5: Save Plot
6. Step6: Show Plot

Workflow對應程式

折線圖 (line plot)

用matplotlib串列建新圖：

1. Step1: Prepare Data
2. Step2: Create Plot
3. Step3: Plot
4. Step4: Customize Plot
5. Step5: Save Plot
6. Step6: Show Plot



```
import matplotlib.pyplot as plt
x = [1, 2, 3, 4, 5] # Step 1
y = [5, 10, 20, 35, 45] # Step 1
plt.figure(figsize=(4,6)) # Step 2
plt.plot(x, y, color='blue', linewidth=2, marker='o') # Step 3
plt.xlabel("x value") # Step 4
plt.savefig('wk1.png') # Step 5
plt.show() # Step 6
```

折線圖 (line plot)

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

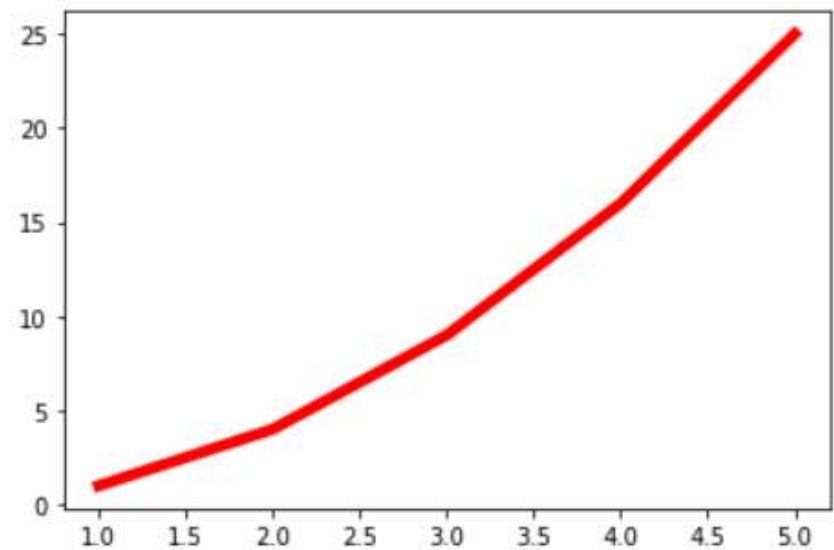
```
x=[1,2,3,4,5]
```

```
y=[1,4,9,16,25]
```

```
plt.plot(x,y, color="red",linewidth=5.0)
```

```
plt.show()
```

```
▶ plt.plot(x,y, color="red", linewidth=5.0)  
plt.show()
```

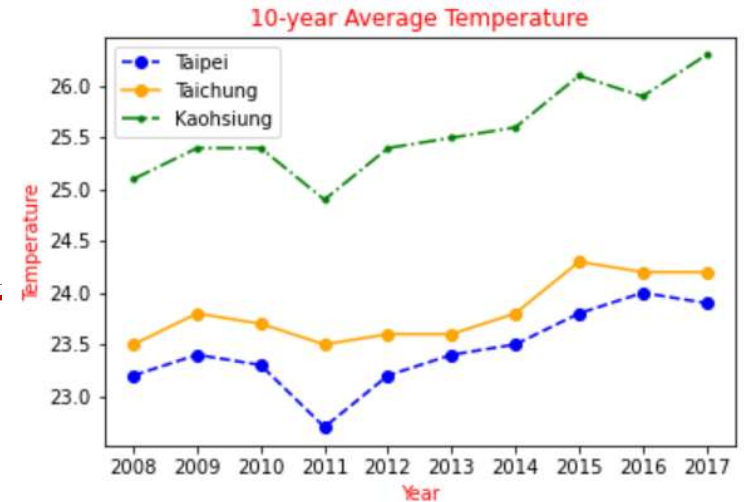


多條折線圖_程式例子

```
import matplotlib.pyplot as plt
Taipei_HTemp = [16.1, 16.5, 18.5, 21.9, 25.2, 27.7, 29.6, 29.2, 27.4, 24.5, 21.5, 17.9]
Taipei_LTemp = [13.9, 14.2, 15.8, 19.0, 22.3, 24.6, 26.3, 26.1, 24.8, 22.3, 19.3, 15.6]
month = range(1, 13)
plt.plot(month, Taipei_HTemp, 'red')
# 讀出month及Taipei_HTemp的資料，產生紅色線
plt.plot(month, Taipei_LTemp, 'blue')
# 讀出month及Taipei_LTemp的資料，產生藍色線
plt.xlabel('Month') # x軸的Label
plt.title('Taipei High and Low Temperature') # 此圖的title
plt.show()
```

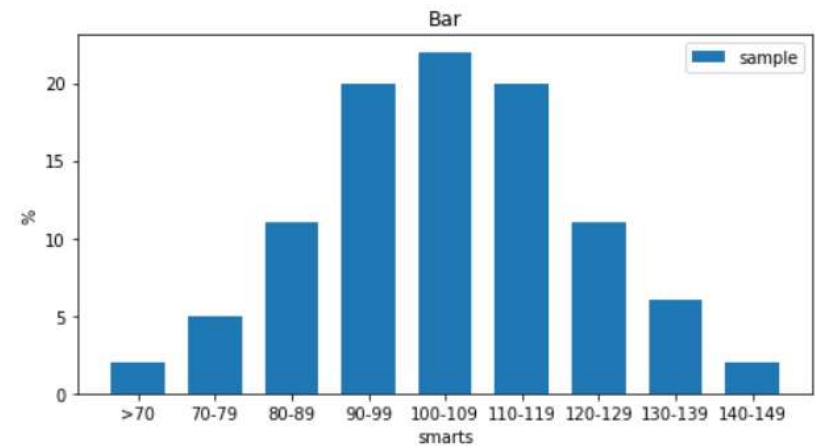
Add legend and save graph

```
from matplotlib import pyplot as plt
Taipei_temp = [23.2, 23.4, 23.3, 22.7, 23.2, 23.4, 23.5, 23.8, 24, 23.9]
Taichung_temp = [23.5, 23.8, 23.7, 23.5, 23.6, 23.6, 23.8, 24.3, 24.2, 24.2]
Kaohsiung_temp = [25.1, 25.4, 25.4, 24.9, 25.4, 25.5, 25.6, 26.1, 25.9, 26.3]
year = range(2008, 2018)
plt.plot(year, Taipei_temp, color = 'blue', marker='o', linestyle = '--', label='Taipei')
plt.plot(year, Taichung_temp, color = 'orange', marker='o', linestyle = '-', label='Taichung')
plt.plot(year, Kaohsiung_temp, color = 'green', marker='.', linestyle = '-.', label='Kaohsiung')
plt.legend(loc = 'upper left')
plt.xlabel('Year', color = 'red')
plt.ylabel('Temperature', color = 'red')
plt.title('10-year Average Temperature', color = 'red')
plt.xticks([2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017])
plt.savefig('wn2.png')
plt.show()
```



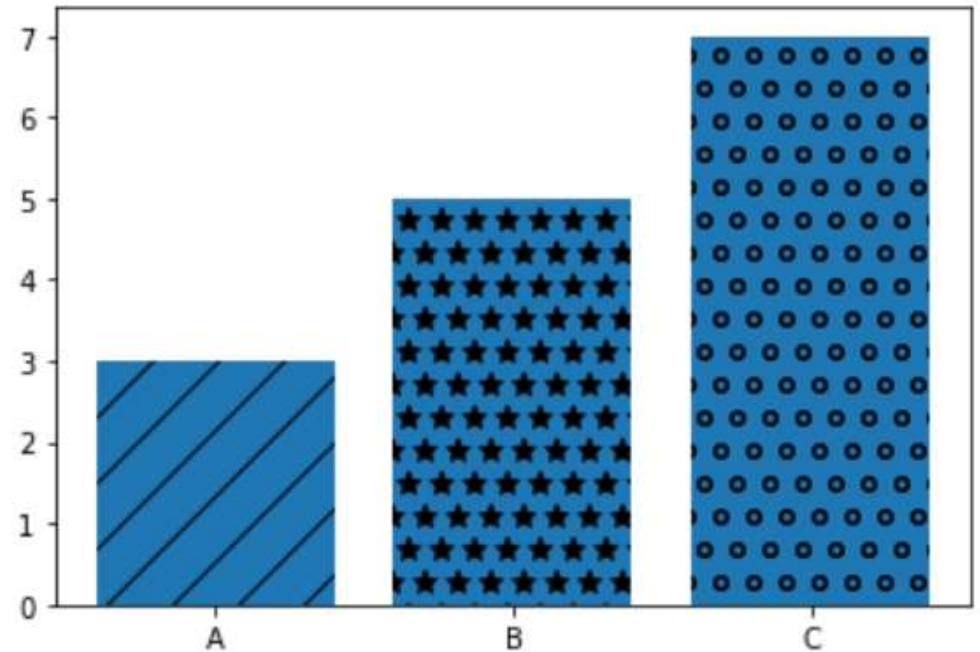
長條圖

```
import matplotlib.pyplot as plt
x=[70,80,90,100,110,120,130,140,150]
y=[2,5,11,20,22,20,11,6,2]
tit=['>70','70-79','80-89','90-99','100-109','110-119','120-129','130-139','140-149']
plt.figure(figsize=(8,4)) #8 inch, 4 inch
plt.bar(x,y, width=7, tick_label=tit,label='sample')
plt.legend() # 放置圖例
plt.xlabel('smarts')
plt.ylabel('%') # set label of y asix
plt.title('Bar') # set title
plt.show()
```



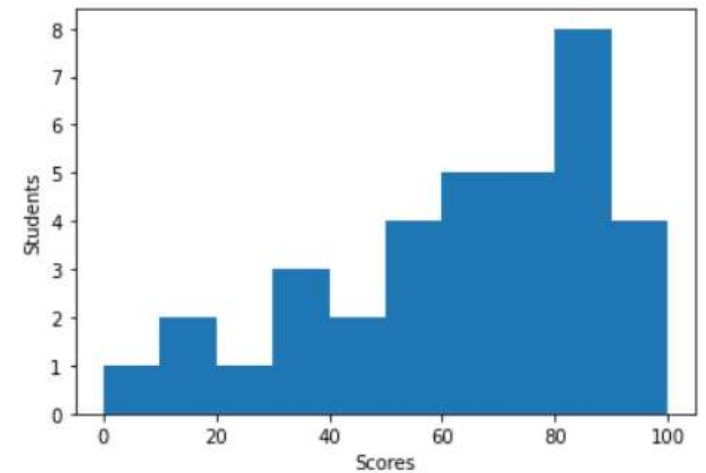
長條圖_改變圖案

```
x1=['A','B','C']  
y1=[3,5,7]  
bar1 = plt.bar(x1,y1)  
patterns=['/','*','o']  
for bar in bar1:  
    bar.set_hatch(patterns.pop(0))  
#bar1[0].set_hatch('/')  
#bar1[1].set_hatch('*')  
plt.show()
```



直方圖

```
import matplotlib.pyplot as plt
scores = [10, 15, 80, 22, 93, 55, 88, 62, 45, 75, 81, 34, 99, 84, 85, 55,
58, 63, 68, 82, 84, \
77, 69, 90, 100, 75, 65, 54, 34, 38, 48, 88, 71, 72, 5]
bins = [0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100]
plt.hist(scores, bins, histtype = "bar")
plt.xlabel("Scores")
plt.ylabel("Students")
plt.show()
```



圓形圖

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

```
activities = ["work", "sleep", "Internet", "others"]
```

```
hours = [8, 7, 2, 7]
```

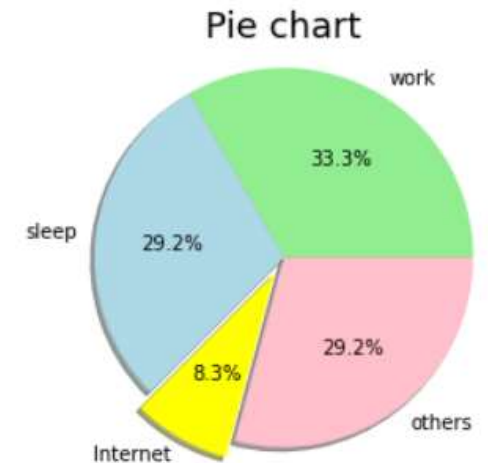
```
colors = ["lightgreen", "lightblue", "yellow", "pink"]
```

```
plt.pie(hours, labels = activities, colors = colors, shadow = True, explode = (0, 0, 0.1, 0),  
autopct = "%.1f%%") # 將數值百分比並留到小數點一位; 設定分隔的區塊位置
```

```
plt.axis("equal") # 使圓餅圖比例相等
```

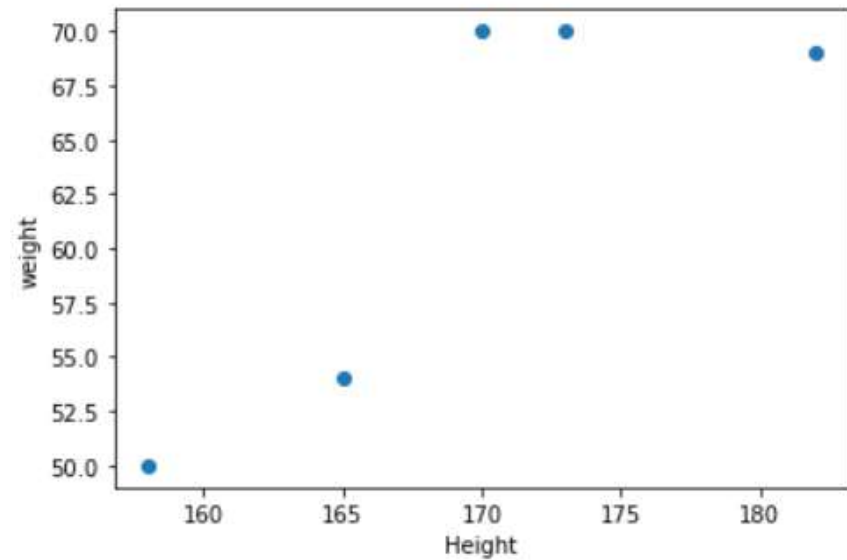
```
plt.title("Pie chart", {"fontsize" : 18})
```

```
plt.show()
```



散佈圖

```
x=[170,165,158,182,173]
y=[70,54,50,69,70]
plt.scatter(x,y)
plt.xlabel("Height")
plt.ylabel("weight")
plt.show()
```



另一種呈現方式 利用dataframe繪圖

建立DataFrame

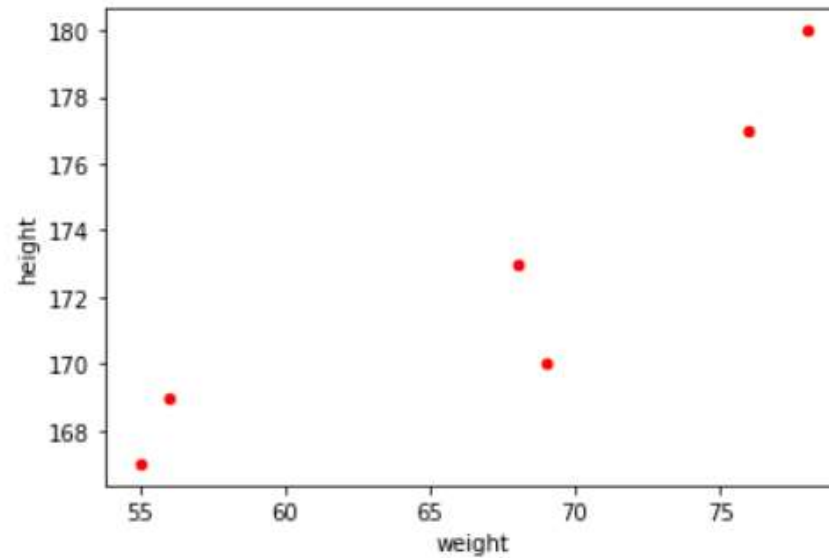
```
import matplotlib.pyplot as plt  
import pandas as pd
```

```
per_df = pd.DataFrame() # 產生一個空的dataframe  
col = ['class','name','Birthdate','salary','height','weight']  
data = [['class0', 'John', '1993-10-01',36000, 177, 76], ['class0', 'Bob', '1992-10-02',52000, 173, 68], ['class1', 'Helen', '1990-10-01',43000, 167, 55], ['class2', 'Alice', '1983-10-03', 27000, 169, 56], ['class1', 'Justin', '1991-10-02',22000, 180, 78], ['class0', 'David', '2001-10-03', 15000, 170, 69]]  
per_df = pd.DataFrame(data,columns=col, index=['1','2','3','4','5','6'])  
print(per_df)
```

Scatter plot

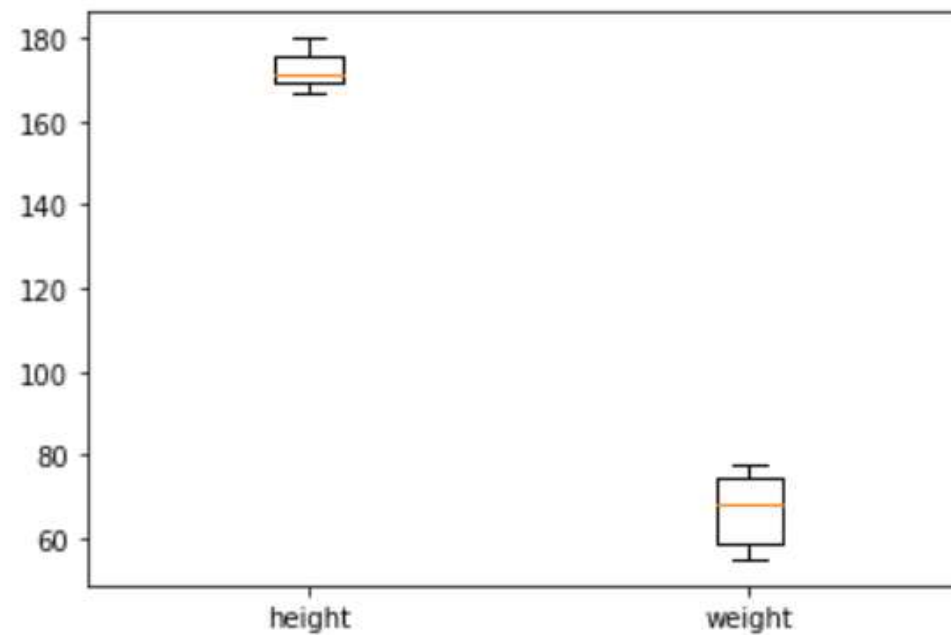
```
per_df.plot(kind='scatter',x='weight',y='height',color='red')  
plt.show()
```

```
per_df.plot(kind='scatter',x='weight',y='height',color='red')  
plt.show()
```



Boxplot

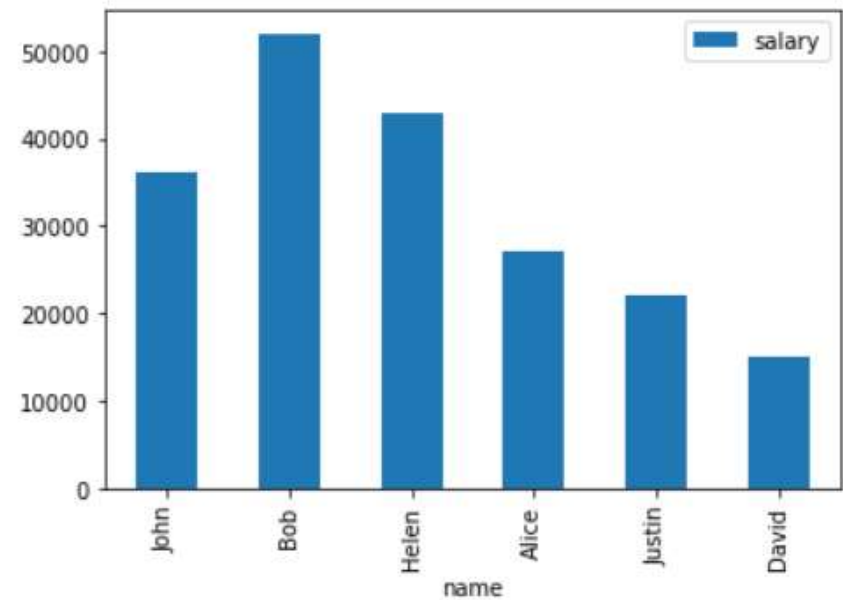
```
plt.boxplot([per_df.height,per_df.weight],labels=['height ','weight'])
```



Bar plot

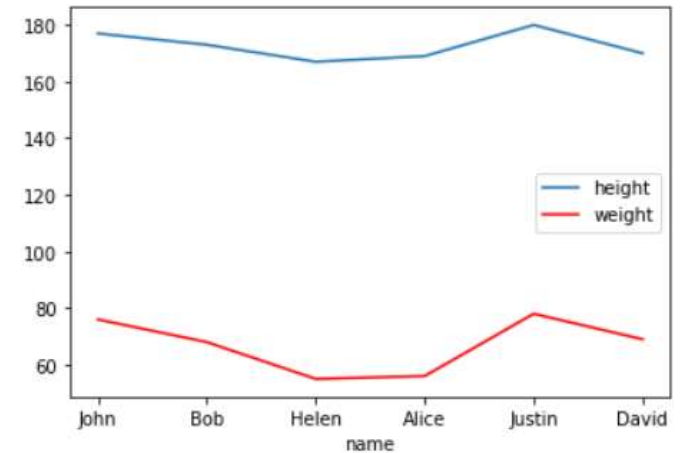
```
# a simple line plot
```

```
per_df.plot(kind='bar',x='name',y='salary')
```



Line plot, multiple columns

```
# gca stands for 'get current axis'  
ax = plt.gca()  
per_df.plot(kind='line',x='name',y='height',ax=ax)  
per_df.plot(kind='line',x='name',y='weight', color='red', ax=ax)  
plt.show()
```



Save plot to file

```
plt.savefig('outputfile.png')
```

```
per_df.plot(kind='bar',x='name',y='height')  
# the plot gets saved to 'output.png'  
plt.savefig('output.png')  
plt.show()
```

多個圖形的呈現

```
names = ['group_a', 'group_b', 'group_c']
values = [1, 10, 100]

plt.figure(figsize=(9, 3))

plt.subplot(131)
plt.bar(names, values)
plt.subplot(132)
plt.scatter(names, values)
plt.subplot(133)
plt.plot(names, values)
plt.suptitle('Categorical Plotting')
plt.show()
```

匯入csv file 後產生折線圖

```
import pandas as pd
from matplotlib import pyplot as plt
plt.figure(figsize=(8,5))
gas_df = pd.read_csv("gas_prices.csv")
for country in gas_df:
    print(country)
    if country != 'Year' and country!='group':
        plt.plot(gas_df.Year, gas_df[country], marker='.',label=country)
plt.legend()
x_list= list(range(1990,2009,2))
plt.xticks(x_list)
plt.show()
```

補充額外功能

X軸上加入自訂標籤

```
x = [1, 2, 3, 4]
```

```
y = [95, 38, 54, 35]
```

```
labels = ['Geeks1', 'Geeks2', 'Geeks3', 'Geeks4']
```

```
plt.plot(x, y)
```

```
plt.xticks(x, labels, rotation='vertical')
```

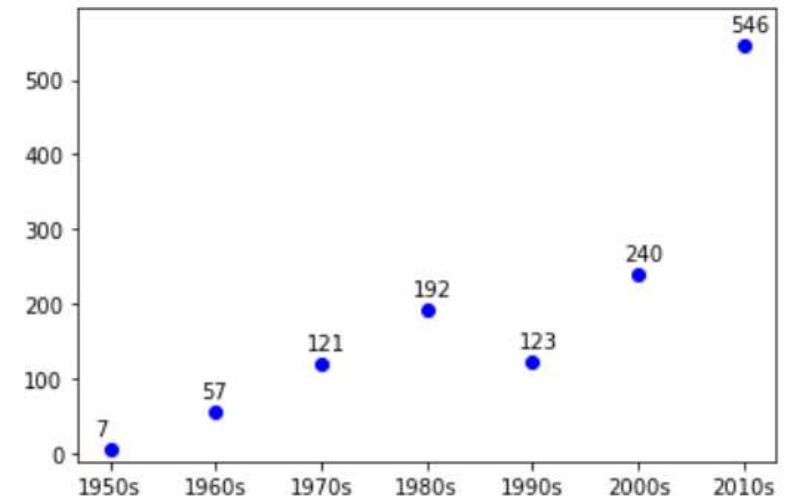
```
plt.show()
```


圖上顯示數值

```
fig = plt.figure()
ax = fig.add_subplot(111)
values = [7, 57, 121, 192, 123, 240, 546]
labels = ['1950s', '1960s', '1970s', '1980s', '1990s', '2000s', '2010s']
```

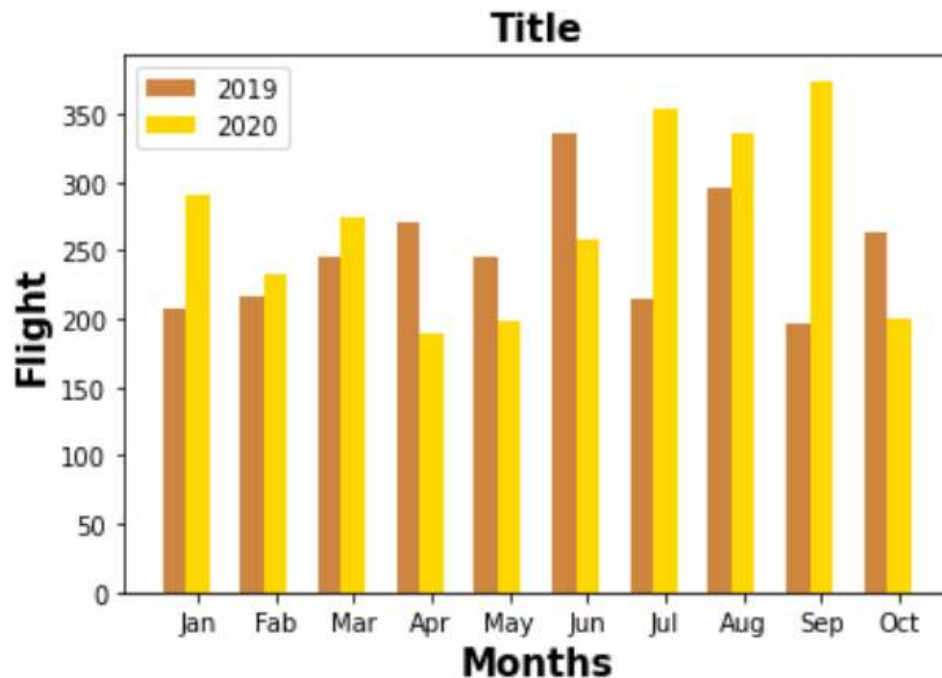
```
plt.plot(range(len(labels)), values, 'bo') # Plotting data
plt.xticks(range(len(labels)), labels) # Redefining x-axis labels
```

```
for i, v in enumerate(values):
    ax.annotate(str(v), xy=(i,v), xytext=(-7,7), textcoords='offset points')
plt.ylim(-10, 595)
plt.show()
```



分群的barplot

Grouped barplot by column



```
import numpy as np
import matplotlib.pyplot as plt
# set width of bar
barWidth = 0.3
# set height of bar
bars1=[208,216,246,270,246,336,214,296,196,264]
bars2=[290,232,274,190,198,258,354,336,374,200]
# Set position of bar on X axis
r1 = list(range(len(bars1)))
r2 = [x + barWidth for x in r1]
# Make the plot
plt.bar(r1, bars1, color='peru', width=barWidth, label='2019')
plt.bar(r2, bars2, color='gold', width=barWidth, label='2020')
# Add xticks on the middle of the group bars
plt.xlabel('Months',fontweight='bold',fontsize = 15)
plt.ylabel('Flight',fontweight='bold',fontsize = 15)
plt.xticks([r + barWidth for r in range(len(bars1))],
['Jan','Feb','Mar','Apr', 'May','Jun','Jul','Aug','Sep','Oct'])
# Create legend & Show graphic
plt.title(' Title',fontsize = 15,fontweight='bold')
plt.legend()
plt.show()
```

Grouped barplot by column

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

```
# set width of bar
```

```
barWidth = 0.25
```

```
# set height of bar
```

```
bars1 = [12, 30, 1, 8, 22]
```

```
bars2 = [28, 6, 16, 5, 10]
```

```
bars3 = [29, 3, 24, 25, 17]
```

```
# Set position of bar on X axis
```

```
r1 = [0,1,2,3,4]
```

```
r2 = [x + barWidth for x in r1]
```

```
r3 = [x + barWidth for x in r2]
```

```
# Make the plot
```

```
plt.bar(r1, bars1, color='gray', width=barWidth, edgecolor='white',  
label='var1')
```

```
plt.bar(r2, bars2, color='darkorange', width=barWidth,  
edgecolor='white', label='var2')
```

```
plt.bar(r3, bars3, color='navy', width=barWidth, edgecolor='white',  
label='var3')
```

```
# Add xticks on the middle of the group bars
```

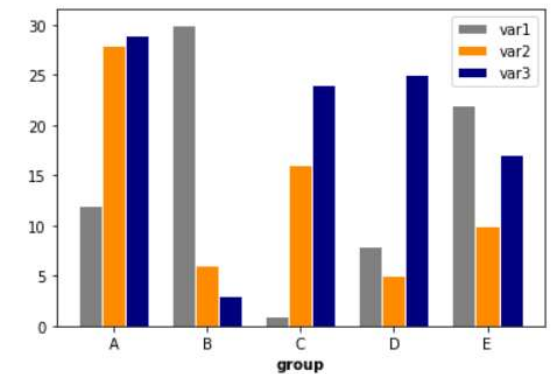
```
plt.xlabel('group', fontweight='bold')
```

```
plt.xticks([r + barWidth for r in range(len(bars1))], ['A', 'B', 'C', 'D', 'E'])
```

```
# Create legend & Show graphic
```

```
plt.legend()
```

```
plt.show()
```



Matplotlib 如何顯示中文字

留給同學搜尋方法

Ref: set color

Google search: color picker

颜色可以参考下面:

black	k	dimgray	gray	darkgray	darkgray	silver	lightgray	lightgray	gainsboro	whitesmoke	white	w	snow	rosybrown	lightcoral	indianred	brown	firebrick	maroon	darkred	red	r	mistyrose	salmon	tomato	darksalmon	coral	orangered	lightsalmon	sienna	seashell	chocolate	saddlebrown	sandybrown	peachpuff	peru	linen	bisque	darkorange	burlywood	antiquewhite	tan	navajowhite	blanchedalmond	papayawhip	moccasin	orange	wheat	oldlace	floralwhite	darkgoldenrod	goldenrod	cornsilk	lemonchiffon	khaki	palegoldenrod	darkkhaki	ivory	beige	lightyellow	lightgoldenrodyellow	olive	y	yellow	olivedrab	yellowgreen	darkolivegreen	greenyellow	chartreuse	lawngreen	sage	lightsage	darksage	honeydew	darkseagreen	palegreen	lightgreen	forestgreen	limegreen	darkgreen	green	g	lime	seagreen	mediumseagreen	springgreen	mintcream	mediumspringgreen	mediumaquamarine	aquamarine	turquoise	lightseagreen	mediumturquoise	azure	lightcyan	paleturquoise	darkslategray	darkslategray	teal	darkcyan	c	cyan	aqua	darkturquoise	cadetblue	powderblue	lightblue	deepskyblue	skyblue	lightskyblue	steelblue	aliceblue	dodgerblue	lightslategray	lightslategray	slategray	slategray	lightsteelblue	cornflowerblue	royalblue	ghostwhite	lavender	midnightblue	navy	darkblue	mediumblue	blue	b	slateblue	darkslateblue	mediumslateblue	mediumpurple	blueviolet	indigo	darkorchid	darkviolet	mediumorchid	thistle	plum	violet	purple	darkmagenta	m	fuchsia	magenta	orchid	mediumvioletred	deeppink	hotpink	lavenderblush	palevioletred	crimson	pink	lightpink
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