


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

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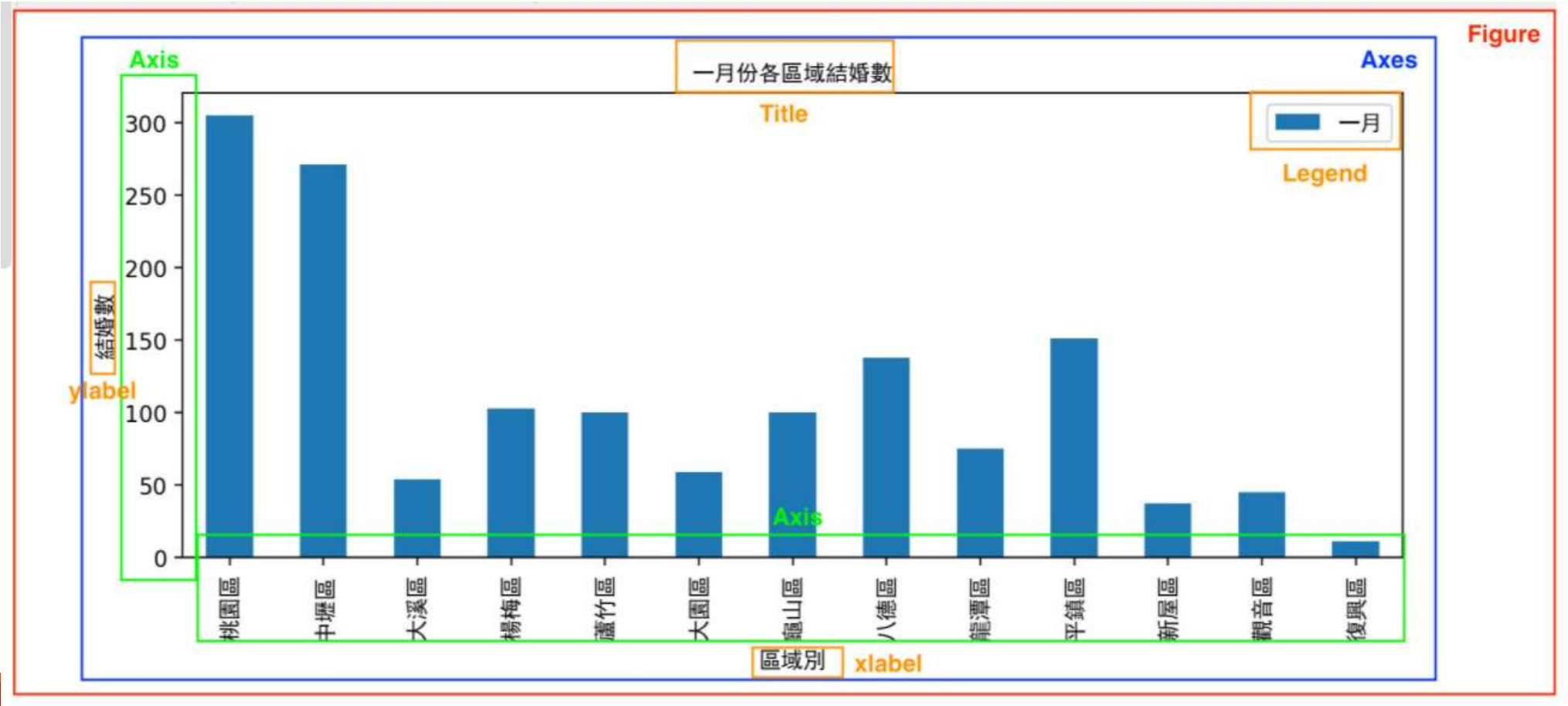
DATE: 5/22/2023



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
```

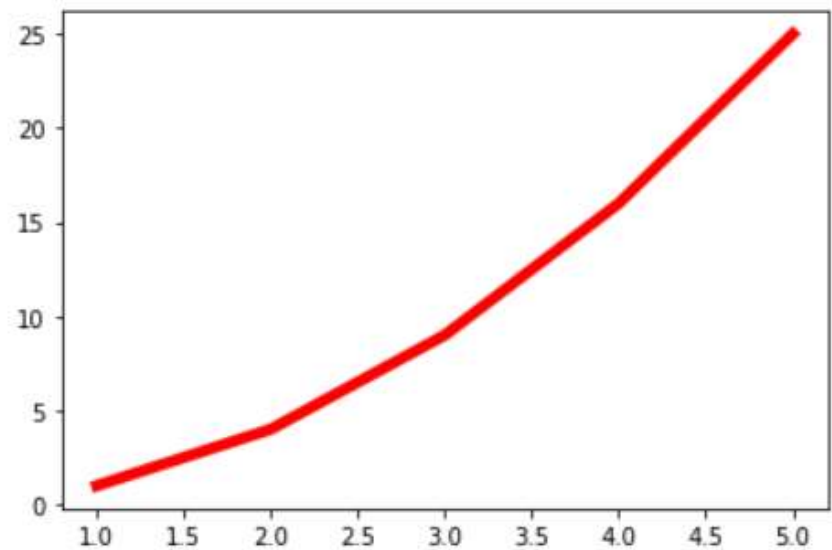
```
x=[1,2,3,4,5]
```

```
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()
```

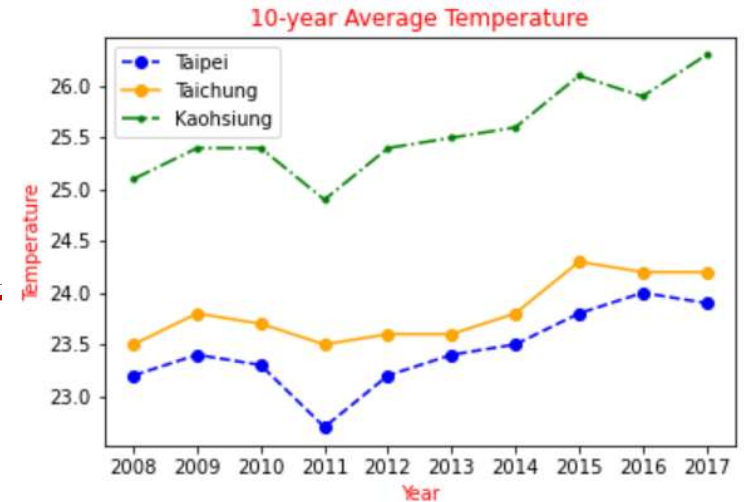


多條折線圖_程式例子

```
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()
```

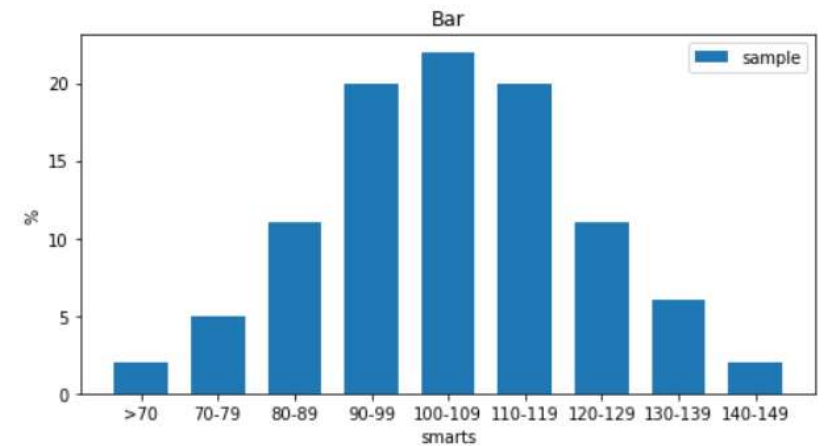
Add legend and save graph

```
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()
```



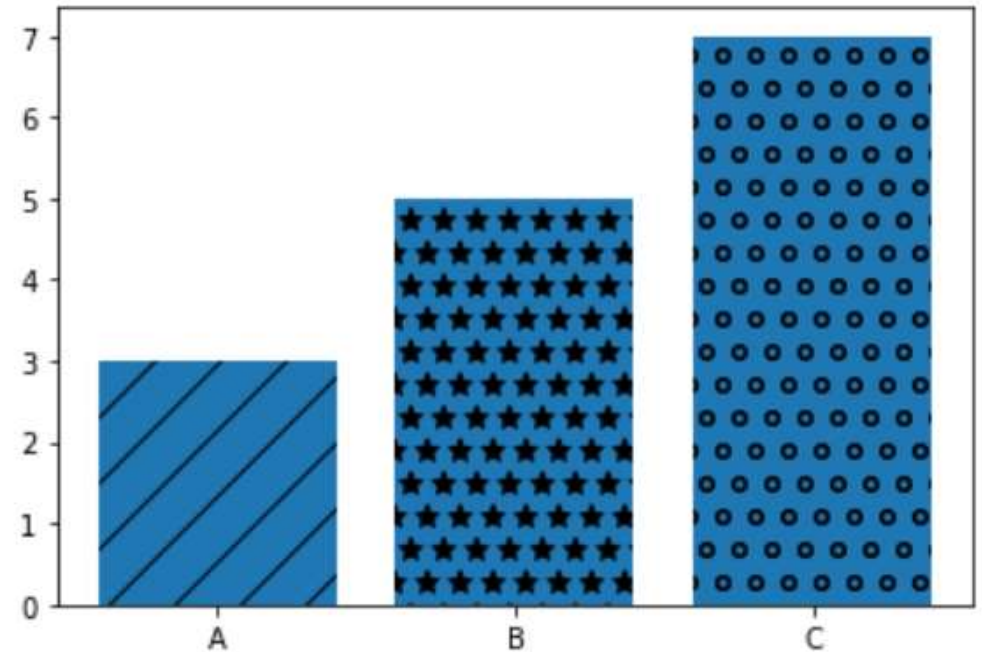
長條圖

```
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 axis
plt.title('Bar') # set title
plt.show()
```



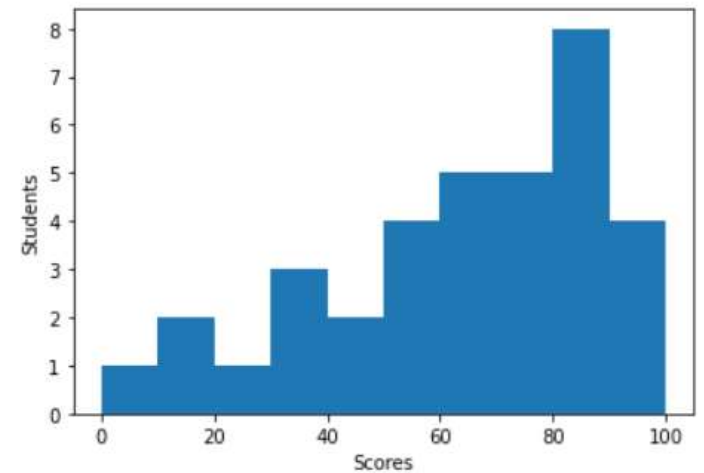
長條圖_改變圖案

```
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]
```

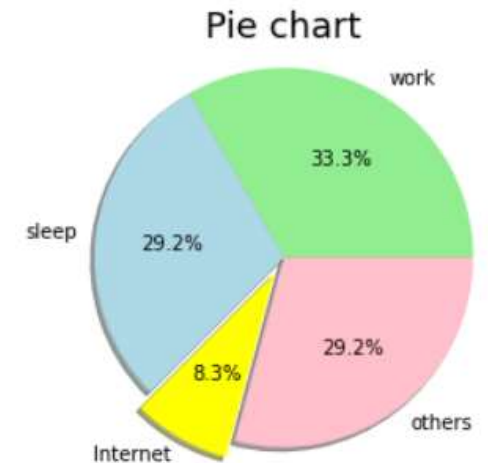
```
colors = ["lightgreen", "lightblue", "yellow", "pink"]
```

```
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
```

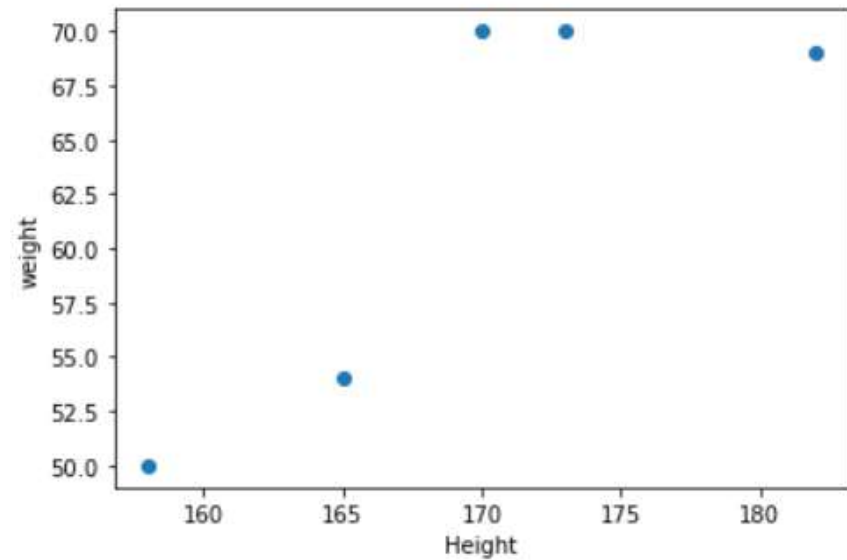
```
plt.title("Pie chart", {"fontsize" : 18})
```

```
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

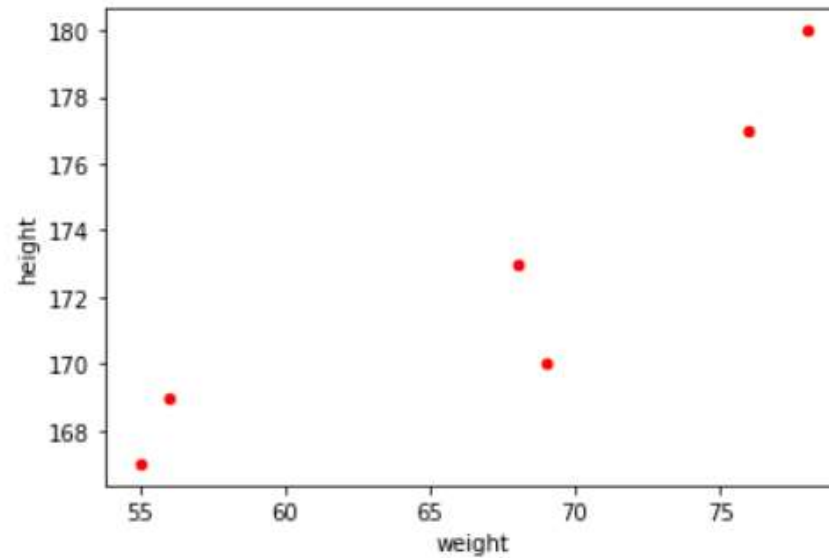
```
import matplotlib.pyplot as plt  
import pandas as pd
```

```
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

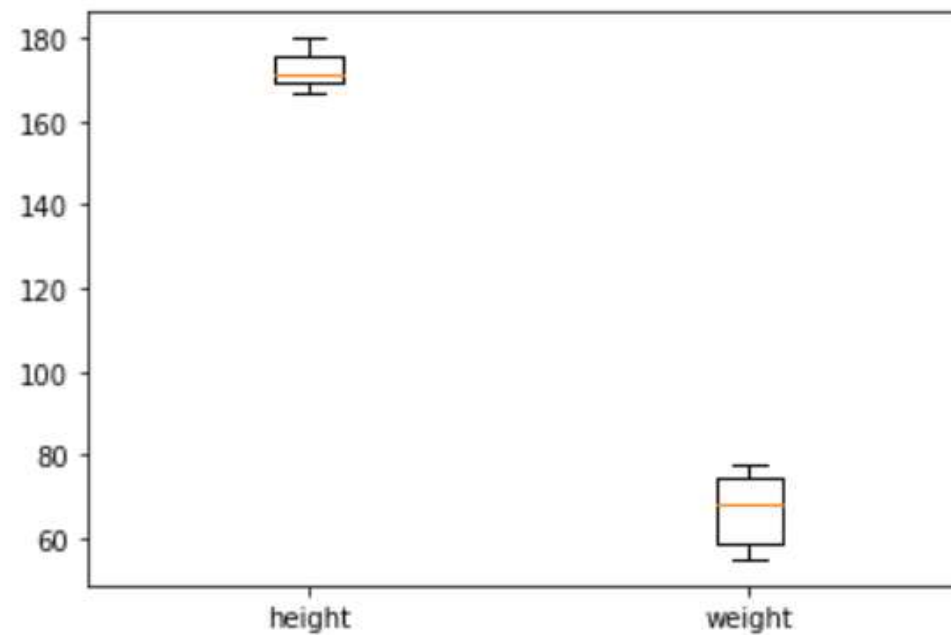
```
per_df.plot(kind='scatter',x='weight',y='height',color='red')  
plt.show()
```

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



Boxplot

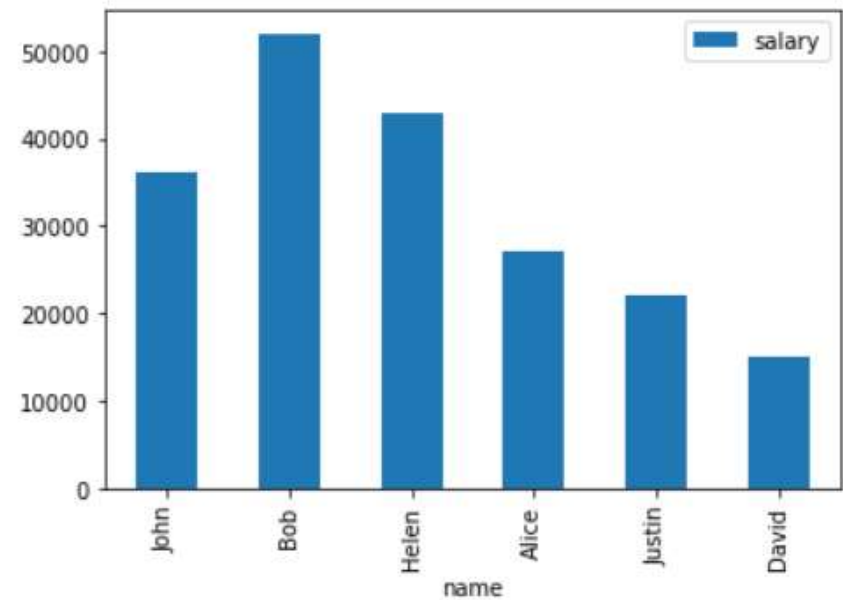
```
plt.boxplot([per_df.height,per_df.weight],labels=['height ','weight'])
```



Bar plot

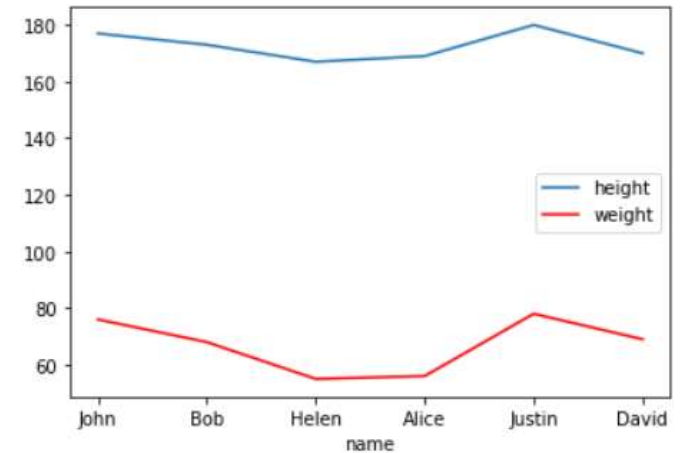
```
# a simple line plot
```

```
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')
```

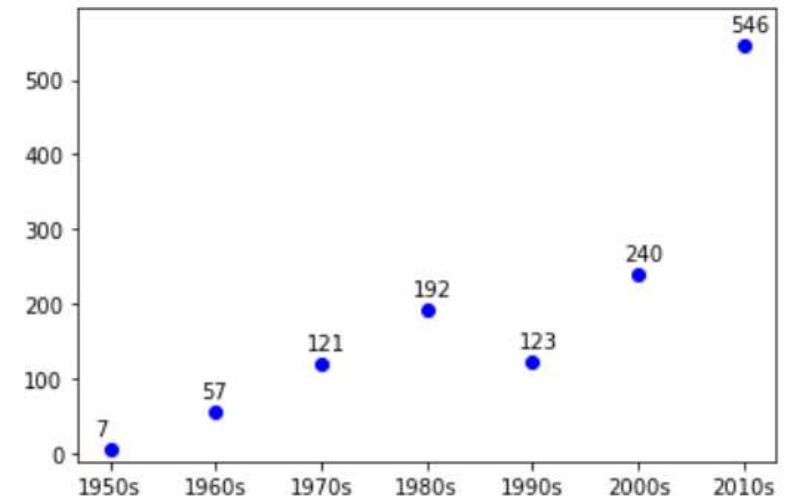
```
plt.show()
```


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']
```

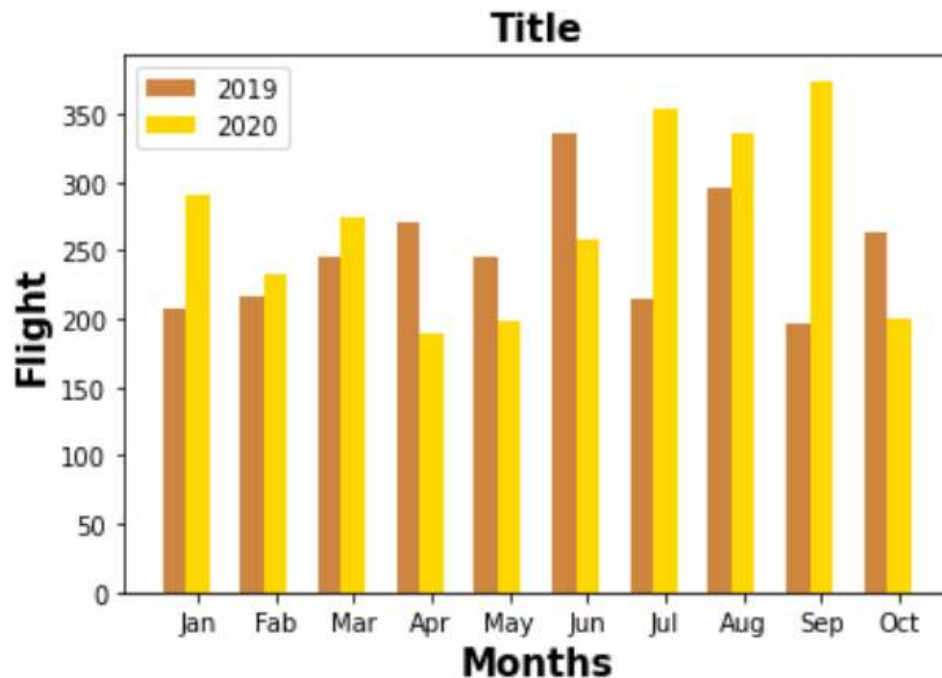
```
plt.plot(range(len(labels)), values, 'bo') # Plotting data
plt.xticks(range(len(labels)), labels) # Redefining x-axis labels
```

```
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
```

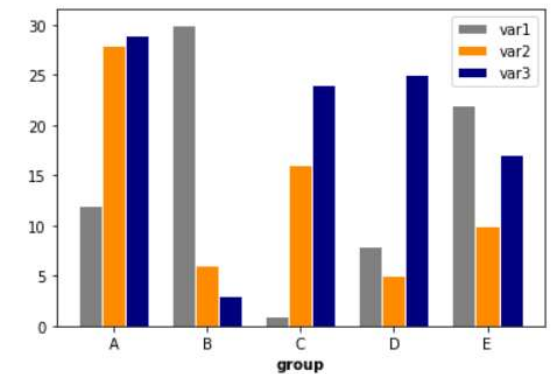
```
plt.xlabel('group', fontweight='bold')
```

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