

# SBS(ch04-code)

**scores\_** [ , , , , ]  
記錄每輪的最高分數

**subsets\_** [( ), ( ), ( ), ..... ( )]  
記錄每輪最高分那組的特徵index

**indices\_** [ x<sub>0</sub> x<sub>1</sub> x<sub>2</sub> x<sub>3</sub> x<sub>4</sub> x<sub>5</sub> x<sub>6</sub> x<sub>7</sub> x<sub>8</sub> x<sub>9</sub> x<sub>10</sub> x<sub>11</sub> x<sub>12</sub> ]  
記錄特徵index

**feature\_group** {特徵數：排列內容...}  
記錄所有特徵排列組合index

**feature\_score** {特徵數：排列分數...}  
記錄所有特徵排列組合index

**score** [ , , , , ]  
記錄每輪每組特徵計算的分數

**subset** [( ), ( ), ( ), ..... ( )]  
記錄每輪採用的特徵index

# SBS(ch04-code)

✂ / 次 while

**scores\_**

記錄每輪的最高分數

[ 91 , , , , ]

while

**subsets\_**

記錄每輪最高分那組的特徵index

[ ( ), ( ), ( ), ..... ( ) ]

**indices\_**

記錄所有特徵index

[ X<sub>0</sub> X<sub>1</sub> X<sub>2</sub> X<sub>3</sub> X<sub>4</sub> X<sub>5</sub> X<sub>6</sub> X<sub>7</sub> X<sub>8</sub> X<sub>9</sub> X<sub>10</sub> X<sub>11</sub> X<sub>12</sub> ]

**score**

記錄每輪每組特徵計算的分數

[ 87 , 86 , 91 , , 80 ]

for

**subset**

記錄每輪採用的特徵index

[ (  $\begin{smallmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \end{smallmatrix}$  ), (  $\begin{smallmatrix} 0 & 2 \\ 2 & 1 \end{smallmatrix}$  ), (  $\begin{smallmatrix} 1 & 2 \\ 2 & - \end{smallmatrix}$  ), ..... ( ) ]

$C_{12}^{13}$

13

13种排列方式

# SBS(ch04-code)

#2

**scores\_** [ , 88 , , ]  
記錄每輪的最高分數

**subsets\_** [ ( 1 ), ( 2 ), ( 3 ), ..... ( ) ]  
記錄每輪最高分那組的特徵index  
 $C_{12}^3$   $C_{11}^{12}$   $C_{10}^{11}$   $C_1^{12}$

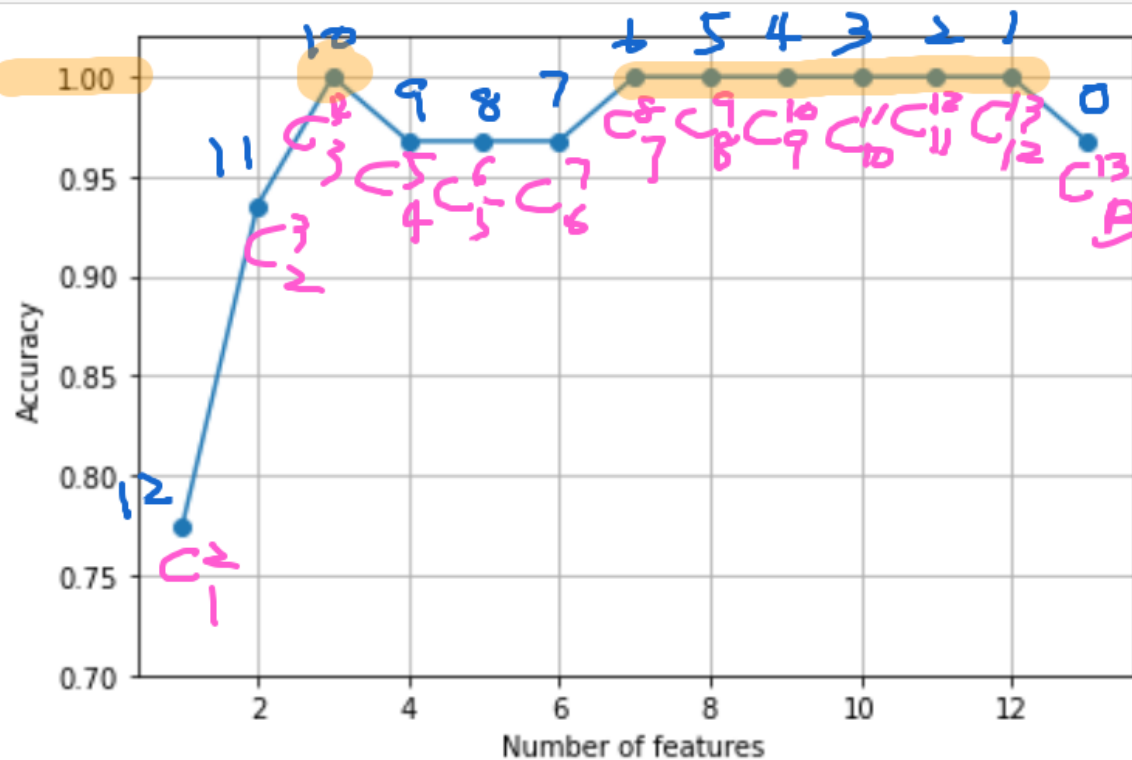
**indices\_** [  $x_0$   $x_1$   $x_2$   $x_3$   $x_4$   $x_5$   $x_6$   $x_7$   $x_8$   $x_9$   $x_{10}$   $x_{11}$   $x_{12}$  ]  
記錄所有特徵index

**score** [ 88, 87, 79, , 77 ]  
記錄每輪每組特徵計算的分數  
 $best_0$

**subset** [ ( 0 1 ), ( 1 2 ), ( 2 3 ), ..... ( ) ]  
記錄每輪採用的特徵index  
 $C_{11}^{12}$

12 種排列

```
plt.show()
```



全部特征  $\rightarrow$  score  
冗余特征  $\uparrow$  相同

# feature\_group

## 13特徵取12個進行排列，會得到13種排列結果

```
{13: [(0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11), (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12), (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12),
      (0, 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12), (0, 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12), (0, 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12),
      (0, 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12), (0, 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12), (0, 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12),
      (0, 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12), (0, 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12), (0, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12),
      (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)],
 12: [(0, 1, 2, 3, 4, 5, 6, 7, 9, 10, 11), (0, 1, 2, 3, 4, 5, 6, 7, 9, 10, 12), (0, 1, 2, 3, 4, 5, 6, 7, 9, 11, 12),
      (0, 1, 2, 3, 4, 5, 6, 7, 10, 11, 12), (0, 1, 2, 3, 4, 5, 6, 9, 10, 11, 12), (0, 1, 2, 3, 4, 5, 7, 9, 10, 11, 12),
      (0, 1, 2, 3, 4, 6, 7, 9, 10, 11, 12), (0, 1, 2, 3, 5, 6, 7, 9, 10, 11, 12), (0, 1, 2, 4, 5, 6, 7, 9, 10, 11, 12),
      (0, 1, 3, 4, 5, 6, 7, 9, 10, 11, 12), (0, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12), (1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12)],
 11: [(0, 1, 2, 3, 4, 5, 6, 7, 9, 10), (0, 1, 2, 3, 4, 5, 6, 7, 9, 11), (0, 1, 2, 3, 4, 5, 6, 7, 10, 11),
      (0, 1, 2, 3, 4, 5, 6, 9, 10, 11), (0, 1, 2, 3, 4, 5, 7, 9, 10, 11), (0, 1, 2, 3, 4, 6, 7, 9, 10, 11),
      (0, 1, 2, 3, 5, 6, 7, 9, 10, 11), (0, 1, 2, 4, 5, 6, 7, 9, 10, 11), (0, 1, 3, 4, 5, 6, 7, 9, 10, 11),
      (0, 2, 3, 4, 5, 6, 7, 9, 10, 11), (1, 2, 3, 4, 5, 6, 7, 9, 10, 11)],
 10: [(0, 1, 2, 3, 4, 5, 6, 7, 9), (0, 1, 2, 3, 4, 5, 6, 7, 11), (0, 1, 2, 3, 4, 5, 6, 9, 11), (0, 1, 2, 3, 4, 5, 7, 9, 11),
      (0, 1, 2, 3, 4, 6, 7, 9, 11), (0, 1, 2, 3, 5, 6, 7, 9, 11), (0, 1, 2, 4, 5, 6, 7, 9, 11), (0, 1, 3, 4, 5, 6, 7, 9, 11),
      (0, 2, 3, 4, 5, 6, 7, 9, 11), (1, 2, 3, 4, 5, 6, 7, 9, 11)],
 9: [(0, 1, 2, 3, 4, 5, 7, 9), (0, 1, 2, 3, 4, 5, 7, 11), (0, 1, 2, 3, 4, 5, 9, 11), (0, 1, 2, 3, 4, 7, 9, 11), (0, 1, 2, 3, 5, 7, 9, 11),
      (0, 1, 2, 4, 5, 7, 9, 11), (0, 1, 3, 4, 5, 7, 9, 11), (0, 2, 3, 4, 5, 7, 9, 11), (1, 2, 3, 4, 5, 7, 9, 11)],
 8: [(0, 1, 2, 3, 5, 7, 9), (0, 1, 2, 3, 5, 7, 11), (0, 1, 2, 3, 5, 9, 11), (0, 1, 2, 3, 7, 9, 11), (0, 1, 2, 5, 7, 9, 11), (0, 1, 3, 5, 7, 9, 11),
      (0, 2, 3, 5, 7, 9, 11), (1, 2, 3, 5, 7, 9, 11)],
 7: [(0, 1, 2, 3, 5, 7), (0, 1, 2, 3, 5, 11), (0, 1, 2, 3, 7, 11), (0, 1, 2, 5, 7, 11), (0, 1, 3, 5, 7, 11), (0, 2, 3, 5, 7, 11), (1, 2, 3, 5, 7, 11)],
 6: [(0, 1, 2, 3, 5), (0, 1, 2, 3, 11), (0, 1, 2, 5, 11), (0, 1, 3, 5, 11), (0, 2, 3, 5, 11), (1, 2, 3, 5, 11)],
 5: [(0, 1, 2, 3), (0, 1, 2, 11), (0, 1, 3, 11), (0, 2, 3, 11), (1, 2, 3, 11)],
 4: [(0, 1, 2), (0, 1, 11), (0, 2, 11), (1, 2, 11)],
 3: [(0, 1), (0, 11), (1, 11)],
 2: [(0,), (11,)]}
```

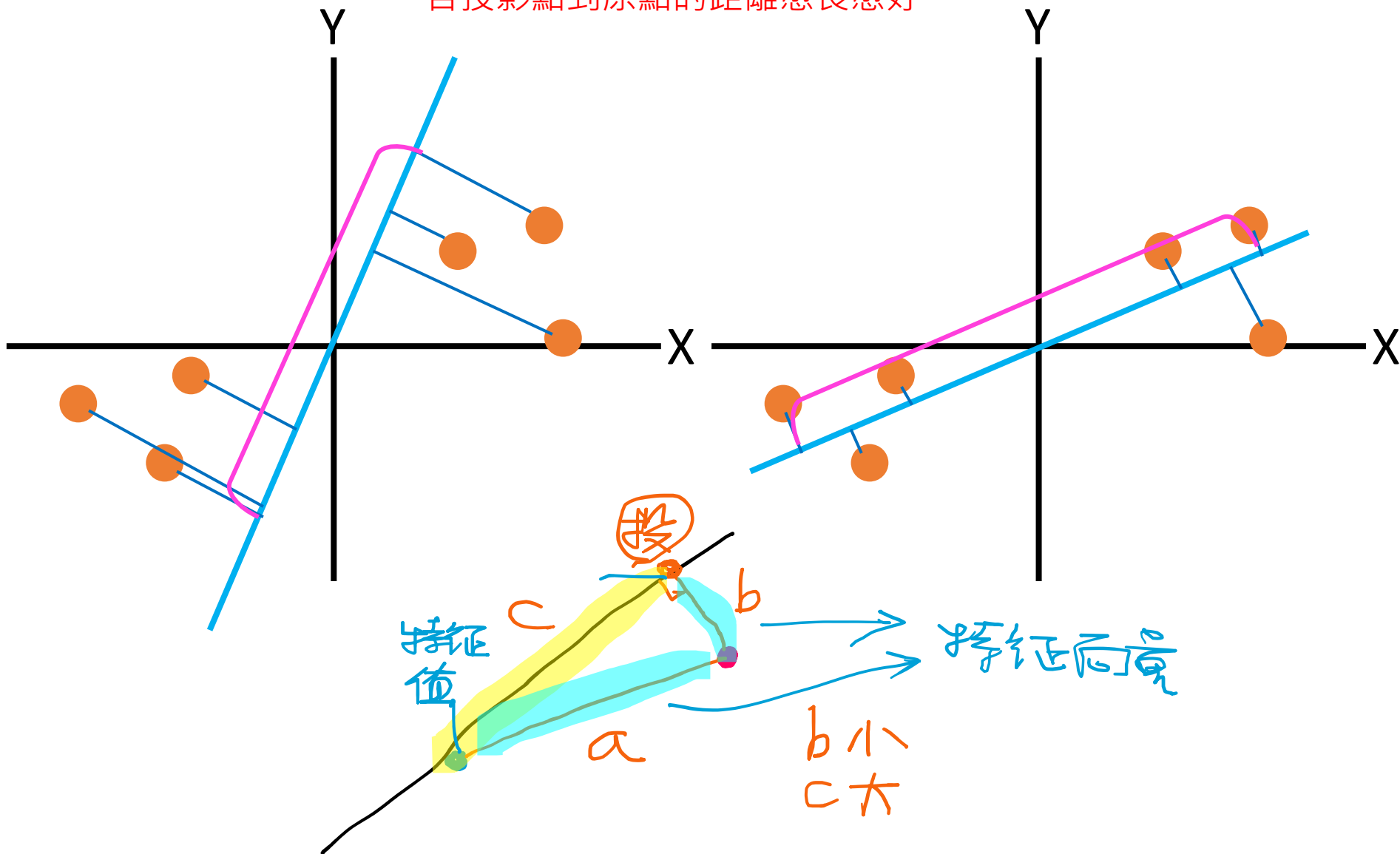
# feature\_score

13特徵取12個進行排列評分，會得到13個結果，取最高者記錄

```
{13: [0.9354838709677419,0.967741935483871, 0.967741935483871, 0.967741935483871,  
      1.0,0.967741935483871,0.967741935483871,0.967741935483871,1.0,0.967741935483871,  
      0.967741935483871,0.967741935483871,0.9354838709677419],  
12: [1.0,1.0,1.0,0.967741935483871,1.0,1.0,1.0,1.0,0.967741935483871,1.0,0.967741935483871,1.0],  
11: [0.967741935483871,1.0,1.0, 0.967741935483871, 1.0, 1.0, 0.967741935483871,  
      0.9354838709677419, 1.0, 0.967741935483871,0.9354838709677419],  
10: [0.967741935483871, 0.967741935483871, 0.967741935483871, 1.0,0.967741935483871,  
      0.967741935483871, 0.9354838709677419, 0.967741935483871, 0.967741935483871,  
      0.9354838709677419],  
9: [0.967741935483871,0.967741935483871,0.967741935483871,0.967741935483871,1.0,  
     0.967741935483871,0.967741935483871,0.967741935483871, 0.967741935483871],  
8: [0.967741935483871,1.0,0.967741935483871, 0.967741935483871,1.0, 0.9354838709677419,  
     0.9354838709677419,0.9354838709677419],  
7: [0.9032258064516129,0.967741935483871, 0.9354838709677419, 0.967741935483871,  
     0.9354838709677419, 0.9354838709677419,0.8709677419354839],  
6: [0.8387096774193549, 0.967741935483871, 0.9354838709677419, 0.9354838709677419,  
     0.9354838709677419,0.7741935483870968],  
5: [0.7419354838709677, 0.967741935483871, 0.967741935483871, 0.967741935483871,  
     0.8064516129032258],  
4: [0.7741935483870968, 1.0, 0.9354838709677419, 0.7419354838709677],  
3: [0.8387096774193549, 0.9354838709677419, 0.7741935483870968],  
2: [0.7741935483870968, 0.5806451612903226]}
```

# PCA

各向量點投影到擬合線的距離愈短愈好  
各投影點到原點的距離愈長愈好



$$\underline{\dot{A}} \underline{\dot{v}} = \underline{\dot{\lambda}} \underline{\dot{v}} \rightarrow \text{eigvector}$$

$\downarrow$   
 eigvalue

$$S^2_{\text{var}} = \frac{\sum (x_i - \bar{x})^2}{n-1}$$

$$\text{Cov} \Rightarrow \text{Cov}(x, y) = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{n-1}$$

0  $\rightarrow$  不相关  
 1  $\rightarrow$  正相关  
 -1  $\rightarrow$  负。

$$\text{Cov 矩阵} \Rightarrow \begin{bmatrix} \text{Cov}(x, x) & \text{Cov}(x, y) \\ \text{Cov}(y, x) & \text{Cov}(y, y) \end{bmatrix}$$



```
import numpy as np
```

```
#建立共變異數矩陣
```

```
cov_mat = np.cov(X_train_std.T) #178*13--> 13*178
```

```
eigen_vals, eigen_vecs = np.linalg.eig(cov_mat)
```

```
print('\nEigenvalues \n%s' % eigen_vals)
```

```
print("\n特徵向量:", eigen_vecs)
```

PC1 最大變異數(累加)

Eigenvalues

[4.84274532 2.41602459 1.54845825 0.96120438 0.84166161 0.6620634  
0.51828472 0.34650377 0.3131368 0.10754642 0.21357215 0.15362835  
0.1808613 ]

特徵向量: [[-1.37242175e-01 5.03034778e-01 -1.37748734e-01 -3.29610003e-03

2.90625226e-01 -2.99096847e-01 -7.90529293e-02 3.68176414e-01

3.98377017e-01 -9.44869777e-02 3.74638877e-01 -1.27834515e-01

2.62834263e-01]

[2.47243265e-01 1.64871190e-01 9.61503863e-02 5.62646692e-01

-8.95378697e-02 -6.27036396e-01 2.74002014e-01 1.25775752e-02

-1.10458230e-01 2.63652406e-02 -1.37405597e-01 8.06401578e-02

-2.66769211e-01]

[-2.54515927e-02 2.44564761e-01 6.77775667e-01 -1.08977111e-02

$$(13 \times 178) \times (178 \times 13)$$

13x13

13  
row

特徵

