

exercise3 (Score: 9.0 / 9.0)

1. [Test cell](#) (Score: 2.0 / 2.0)
2. [Test cell](#) (Score: 1.0 / 1.0)
3. [Test cell](#) (Score: 2.0 / 2.0)
4. [Test cell](#) (Score: 2.0 / 2.0)
5. [Test cell](#) (Score: 2.0 / 2.0)

Lab 3

1. 提交作業之前，建議可以先點選上方工具列的**Kernel**，再選擇**Restart & Run All**，檢查一下是否程式跑起來都沒有問題，最後記得儲存。
2. 請先填上下方的姓名(name)及學號(student_id)再開始作答，例如：

```
name = "我的名字"  
student_id= "B06201000"
```

3. 演算法的實作可以參考[lab-3 \(https://yuanyuyuan.github.io/itcm/lab-3.html\)](https://yuanyuyuan.github.io/itcm/lab-3.html), 有任何問題歡迎找助教詢問。
4. **Deadline: 10/30(Wed.)**

In [1]:

```
name = "歐陽秉志"  
student_id = "B05201012"
```

Exercise 3

The price (in euros) of a magazine has changed as follows:

Nov. 87	Dec. 88	Nov. 90	Jan. 93	Jan. 95	Jan. 96	Nov. 96	Nov. 00
4.5	5.0	6.0	6.5	7.0	7.5	8.0	8.0

1. Use the interpolating polynomial of ***degree 7*** to estimate the price in February 1989, in April 1998 and in November 2002.

Part 0. Import libraries.

In [2]:

```
import matplotlib.pyplot as plt  
import numpy as np
```

Part 1. Define the polynomial interpolation function.

Please refer part of polynomial interpolation function in " *lagrange.ipynb* ".

In [3]:

(Top)

```
def lagrange(points):  
    # 請參考 hands-on 的 Lagrange polynomial interpolation  
    # ===== 請實做程式 =====  
    def polynomial(x):  
        total_sum = 0  
        n = len(points)  
  
        for i in range(n):  
            x_i, y_i = points[i]  
  
            # Construct the cardinal function  
            def g(i, n):  
                product = 1  
  
                for j in range(n):  
                    # Skip when i = j  
                    if i == j:  
                        continue  
  
                    # multiply when i ≠ j  
                    # ===== 請實做程式 =====  
                    x_j, y_j = points[j]  
                    product *= (x-x_j)/float(x_i-x_j)  
                    # =====  
  
                return product  
            # End construct the cardinal function  
  
            # Add each term  
            # ===== 請實做程式 =====  
            total_sum += y_i * g(i, n)  
            # =====  
  
        return total_sum  
    # End construct Lagrange polynomial  
  
    # Return polynomial  
    return polynomial  
    # =====
```

In [4]:

interpolation_function

(Top)

```
# Test  
P = lagrange((  
    (0, 0),  
    (1, 1),  
    (-1, 1)  
))  
  
print('P(2) =', P(2))  
  
### BEGIN HIDDEN TESTS  
P = lagrange((  
    (0, 0),  
    (1, 1),  
    (-1, 1)  
))  
  
assert P(0) == 0, 'P(0) is wrong!'  
assert P(1) == 1, 'P(1) is wrong!'  
assert P(-2) == 4, 'P(-2) is wrong!'  
assert P(3) == 9, 'P(3) is wrong!'  
### END HIDDEN TESTS
```

P(2) = 4.0

Part 2. Transfer data to input points (x: dates, y: prices).

In [5]:

```
# Hint: points = ((*, *), ..., (*, *))
# ===== 請實做程式 =====
points = ((87+11/12, 4.5),
          (88+12/12, 5.0),
          (90+11/12, 6.0),
          (93+1/12, 6.5),
          (95+1/12, 7.0),
          (96+1/12, 7.5),
          (96+11/12, 8.0),
          (100+11/12, 8.0))
# =====
```

(Top)

In [6]:

```
points_date

print('points:', points)

### BEGIN HIDDEN TESTS
data = np.ndarray.flatten(np.array(points))
prices = [4.5, 5., 6., 6.5, 7., 7.5, 8.]

assert len(data) == 16, 'points is wrong!'
assert np.sum(np.isin(data, prices)) == 8, 'Wrong prices in points!'
### END HIDDEN TESTS
```

(Top)

points: ((87.91666666666667, 4.5), (89.0, 5.0), (90.91666666666667, 6.0), (93.08333333333333, 6.5), (95.08333333333333, 7.0), (96.08333333333333, 7.5), (96.91666666666667, 8.0), (100.91666666666667, 8.0))

Part 3-1. Estimate the price in February 1989.

In [7]:

```
# ===== 請實做程式 =====
P = lagrange(points)
estimated_price = P(89+2/12)
# =====
```

(Top)

In [8]:

```
print("My estimated price in February 1989 is", estimated_price)

### BEGIN HIDDEN TESTS
assert abs(estimated_price - 5.09) < 5e-2, 'Estimated price is wrong!'
### END HIDDEN TESTS
```

(Top)

My estimated price in February 1989 is 5.095083945259743

Part 3-2. Estimate the price in April 1998.

In [9]:

(Top)

```
# ===== 請實做程式 =====  
estimated_price = P(98+4/12)  
# =====
```

In [10]:

April_1998

(Top)

```
print("My estimated price in April 1998 is", estimated_price)  
  
### BEGIN HIDDEN TESTS  
assert abs(estimated_price - 8.67) < 5e-2, 'Estimated price is wrong!'  
### END HIDDEN TESTS
```

My estimated price in April 1998 is 8.676742602621506

Part 3-3. Estimate the price in November 2002.

In [11]:

(Top)

```
# ===== 請實做程式 =====  
estimated_price = P(102+11/12)  
# =====
```

In [12]:

Nov_2002

(Top)

```
print("My estimated price in November 2002 is", estimated_price)  
  
### BEGIN HIDDEN TESTS  
assert abs(estimated_price - 11.24) < 5e-2, 'Estimated price is wrong!'  
### END HIDDEN TESTS
```

My estimated price in November 2002 is 11.24125797673549