

# Q1: 追蹤程式: 印出結果? 搶答

```
int p=0, i=1, n=9;
while (i<=n) {
    p=p*i;
    i=i+2;
}
System.out.println("p="+p+"n="+n);
```

# 陣列(array)基本概念

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# 利用大量變數，處理大量資料？

- 有何缺點及問題??

例子：輸入100筆整數資料，要求出平均數，如何做？若找最大值、要求變異數，如何做？

討論：

```
input.nextInt(x1);  
input.nextInt(x2);  
...  
input.nextInt(x100);  
avg=(x1+x2+...+x100)/100;  
Var= (x1-avg)* (x1-avg);  
Var=(x2-avg) (x2-avg);  
...  
Var=(x100-avg) (x100-avg);  
//最後變異數結果敘述
```

(1)需100行讀取資料之敘述

(2)須很長的累加運算敘述，需很長運算式解平均數，需100行找最大值、處理變異數之敘述。

(3)極為暴力方式(brute force)

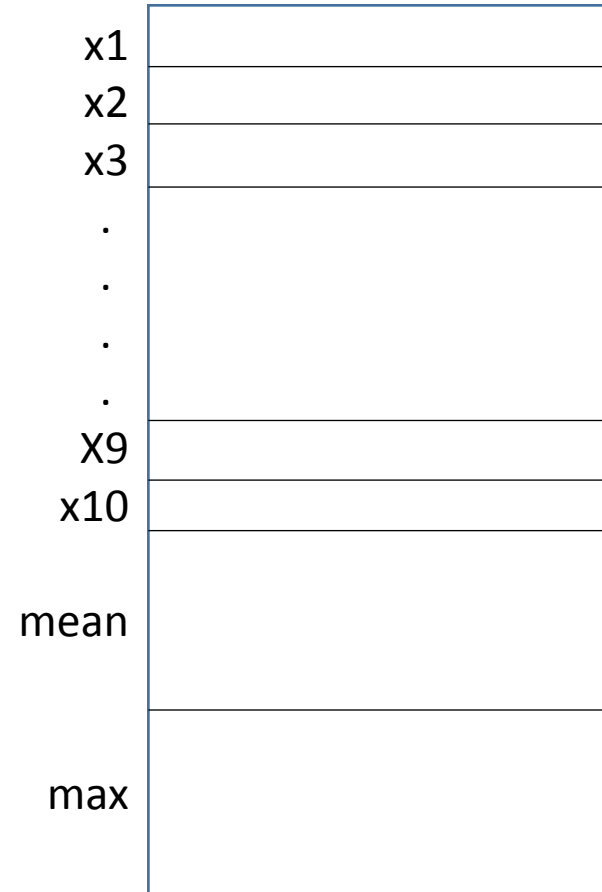
(4)沒有彈性，例如要處理1000筆？Big Data？

問題剖析：資料記錄存放問題！

不可以只用大量變數而已。

# 利用多個變數，處理資料(未使用陣列)

- 任何時候，若再多一筆資料，需再增加程式碼，求 **max**、**mean** 敘述都須修改程式。
- 皆是序列(**Sequence**)，無法使用迴圈，缺乏自動化機制。
- 屬於暴力法。

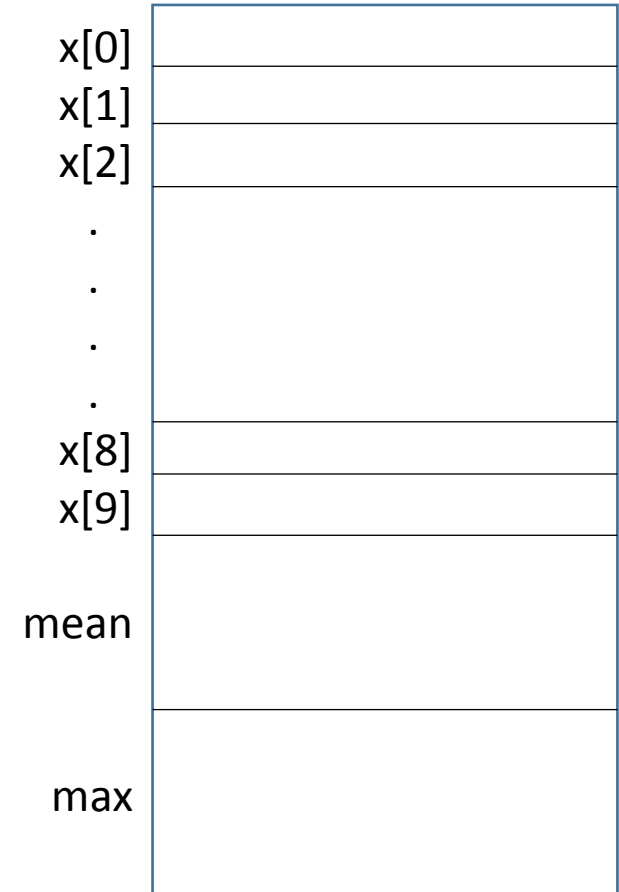


# 陣列(array):物以類聚

- 相同型態(ex. int, double...)的元素所形成有序的有限集合
- 陣列的元素被存放在**連續**的記憶體

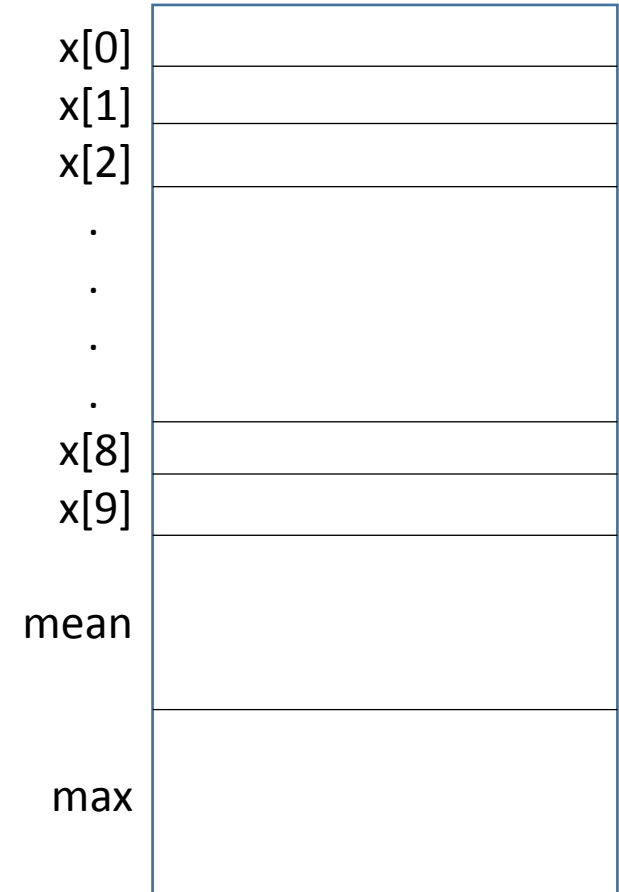
# 陣列

- 以一名稱代表一**序列資料的集合**，陣列**命名與變數命名相同**
- 以**索引(index)/註標(subscript)**來控制某一元素存取
  - 索引可用**變數**，因此可用**迴圈控制變數**，再控制陣列存取
  - **索引由0開始**。
- 宣告  
`int [] x=new int[100];` //**索引:0~99**，**長度: 100**
- 陣列**長度**(陣列的屬性)；`x.length`
- 可在宣告時給予**初值**(不用指定長度)  
`int [] sc={20,30,40};`  
`String [] diages={"體重過輕Underweight","正常Normal","過重Overweight"};`



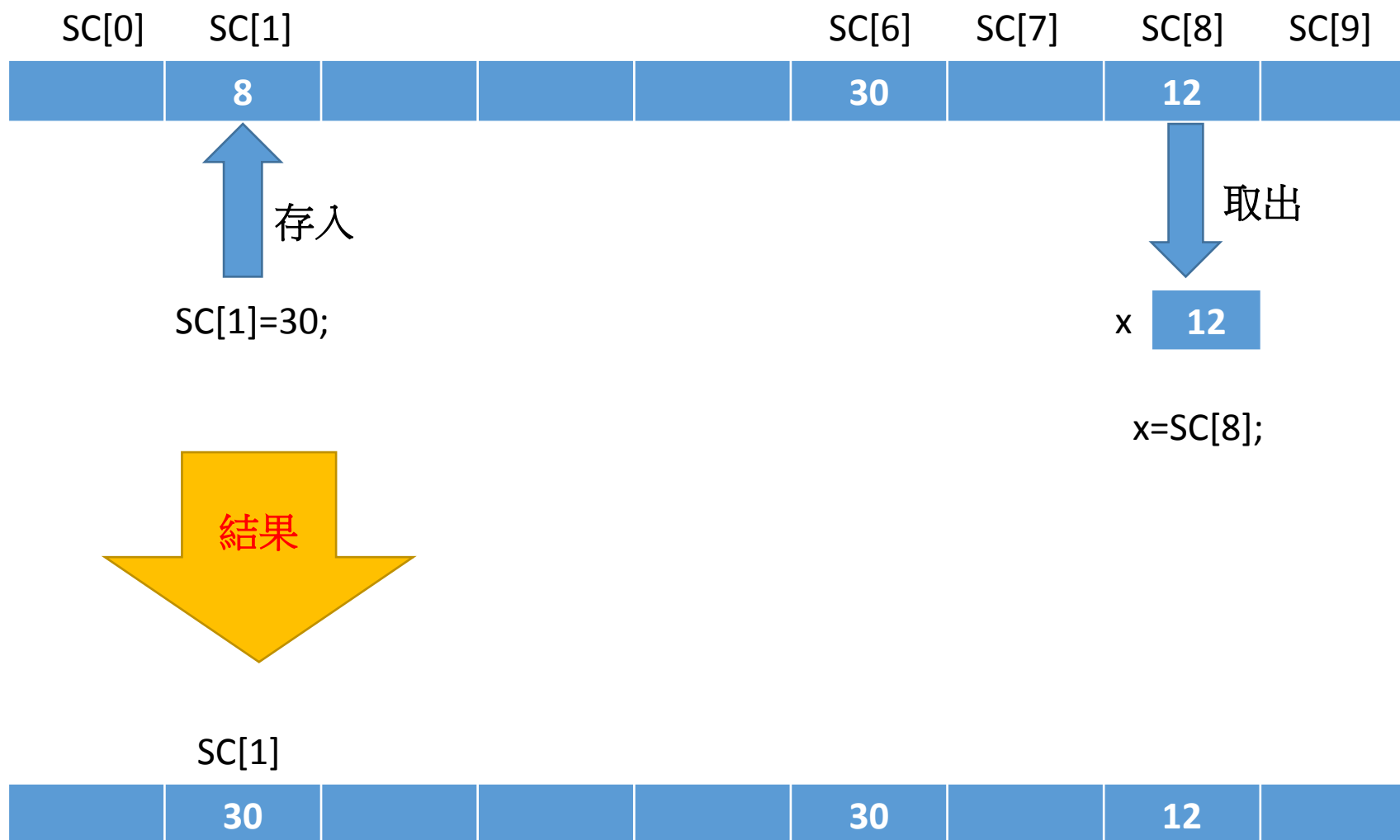
# 陣列的特性

- 定義：相同型態(ex. int, double...)的元素所形成有序的有限集合
- 以索引值(index) 與 值(value) 來表示其對應關係。
- 通常陣列的元素被存放在**連續**的記憶體上，可以支援直接存取。
- 陣列元素存取時，將元素的索引/註標(Index/Subscript) 以位址函數(Address Function)計算出(對應)記憶體位址，再存取記憶體中的內容(元素的值)。
  - 以索引存取陣列元素之值(value)
    - `i=8;`
    - `x[i]=100;`
  - 存: `x[8]=100;` //將100存入x[8]
  - 取: `System.out.print (x[8]);` //取x[8]
  - `y=x[8]+x[9];` //取x[8]、x[9]  
`x[7]=x[8]+x[9];`

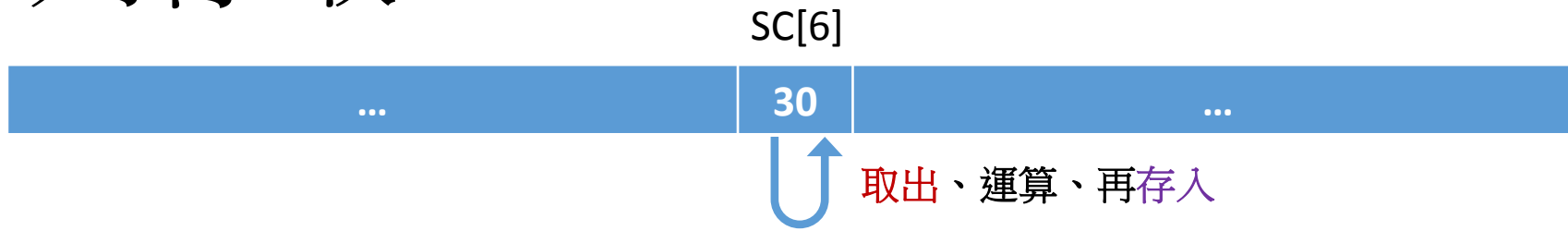




# 陣列存取



# 陣列存取



$SC[6] = SC[6] + 20;$



陣列應用:處理10筆資料

# 應用陣列存放**10筆資料**，then**處理**

```
1. public class Tendata_array0{
2.     public static void main(String[] args){
3.         int [] x={70,90,55,66,12,27,34,47,80,100};
4.         int mean=0,max=0,i=0, sum=0, flunk=0;
5.         for(i=0;i<x.length;i++) {
6.             System.out.println("x["+i+"] :"+x[i]);
7.             sum=sum+x[i];
8.             max=(max<x[i])?x[i]:max;
9.             if (x[i]<60) flunk++;//不及格人數
10.        }
11.        mean=sum/10;//平均數
12.        System.out.println("陣列長度: "+x.length);
13.        System.out.println("mean = "+mean);
14.        System.out.println("max = "+max);
15.        System.out.println("不及格人數: "+flunk);
16.    }//main
17. }//class
```

```
C:\Users\user\Desktop\11-3>java Tendata_array0
```

```
x[0] :70
x[1] :90
x[2] :55
x[3] :66
x[4] :12
x[5] :27
x[6] :34
x[7] :47
x[8] :80
x[9] :100
陣列長度: 10
mean = 58
max = 100
不及格人數: 5
```

x[0]	70
x[1]	90
x[2]	55
.	
.	
.	
.	
x[8]	80
x[9]	100
mean	
max	

**未提供輸入資料**

```
E:\java-2017\11-3>java Tendata_array1
```

```
input data for x[0] :80  
input data for x[1] :70  
input data for x[2] :80  
input data for x[3] :66  
input data for x[4] :77  
input data for x[5] :44  
input data for x[6] :55  
input data for x[7] :33  
input data for x[8] :22  
input data for x[9] :11
```

```
x[0] :80  
x[1] :70  
x[2] :80  
x[3] :66  
x[4] :77  
x[5] :44  
x[6] :55  
x[7] :33  
x[8] :22  
x[9] :11
```

```
mean = 53
```

```
max = 80
```

```
不及格人數: 5
```

```
import java.util.Scanner;  
public class Tendata_array1  
{  
    public static void main(String[] args){  
        Scanner input = new Scanner(System.in);  
        int [] x=new int[10];  
        int mean=0,max=0,i=0, sum=0, flunk=0;  
        while (i<=9) {  
            System.out.println("input data for x["+i+"] :");  
            x[i]=input.nextInt();  
            i++;}  
        System.out.print("\n");  
        for(i=0;i<x.length;i++) {  
            System.out.println("x["+i+"] :"+x[i]);  
            sum=sum+x[i];  
            max=(max<x[i])?x[i]:max;  
            if (x[i]<60) flunk++;  
        }  
        mean=sum/10;  
        System.out.println("mean = "+mean);  
        System.out.println("max = "+max);  
        System.out.println("不及格人數: "+flunk);  
    }  
}
```

```
import java.util.Scanner;
public class Tendata_array1{
    public static void main(String[] args){
        Scanner input = new Scanner(System.in);
        int [] x=new int[10];
        int mean=0,max=0,i=0, sum=0, flunk=0;
        while (i<=9) {
            System.out.print("input data for x["+i+"] :");
            x[i]=input.nextInt();
            i++;}
        System.out.print("\n");
        for(i=0;i<x.length;i++) {
            System.out.println("x["+i+"] :"+x[i]);
            sum=sum+x[i];
            max=(max<x[i])?x[i]:max;
            if (x[i]<60) flunk++;
            }
        mean=sum/10;
        System.out.println("mean = "+mean);
        System.out.println("max = "+max);
        System.out.println("不及格人數: "+flunk);
        //main
    }
//class
```

宣告陣列

輸入10筆資料:  
i=0:第1筆放入x[0]  
i=1:第2筆放入x[1]  
  
i=9:第10筆放入x[9]

分析10筆資料:  
印出10筆資料  
加總  
找最大值  
算出不及格人數

運用陣列存放BMI狀態  
運用陣列存放weekname

# 運用陣列存放BMI狀態

```
String [] diages={"體重過輕Underweight","正常Normal","過重Overweight"};
int status;

if (bmi < 18.5) status = 0;
else if (bmi < 24) status = 1;  //(bmi>=18.5 && bmi < 24)
else status = 2;

System.out.println("BMI : "+bmi+" , 狀態: "+diages[status]);
```

<b>diages [0]</b>	體重過輕Underweight
<b>diages [1]</b>	正常Normal
<b>diages [2]</b>	過重Overweight

RAM

```
import java.util.Scanner;
public class BMI_array {
public static void main(String[] args) {
String ok="Y";
System.out.println("=====歡迎量測體位=====");
Scanner input = new Scanner(System.in);
double height, weight;
String [] diages={"體重過輕Underweight","正常Normal","過重Overweight"};
int status;
while (ok.toUpperCase().equals("Y")) {
System.out.print("輸入身高 : ");
height = input.nextDouble();
System.out.print("輸入體重 : ");
weight = input.nextDouble();
double bmi = Math.round((weight/(height*height) )*100)/100.0;
if (bmi < 18.5) status = 0;
else if (bmi < 24) status = 1;  //(bmi>=18.5 && bmi < 24)
else status = 2;
System.out.println("BMI : "+bmi+" , 狀態: "+diages[status]);
System.out.print("(繼續(Y/N) : ");
ok= input.next().toUpperCase();
} //while
System.out.println("=====bye bye=====");
} //main
} //class
```



```

import java.util.Scanner;
public class weekname_2 {
    public static void main(String[] args) {
        Scanner input = new Scanner(System.in);
        String [] weekname= {"Sunday","Monday","Tuesday","Wednesday","Thursday","Friday","Saturday","Sunday"};
        int week = 0;
        while (week>=0) {
            System.out.print("輸入星期幾?");
            week = input.nextInt();
            if (week >= 0 && week <=7) {
                switch (week) {
                    case 0:
                    case 7:
                        System.out.println(weekname[0]);
                        break;
                    case 1:
                        System.out.println(weekname[1]);
                        break;
                    case 2:
                        System.out.println(weekname[2]);
                        break;
                    case 3:
                        System.out.println(weekname[3]);
                        break;
                    case 4:
                        System.out.println(weekname[4]);
                        break;
                    case 5:
                        System.out.println(weekname[5]);
                        break;
                    case 6:
                        System.out.println(weekname[6]);
                        break;
                } //switch
            } //if
            else
                System.out.print("無法判讀\n");
        } //while
    } //main
} //class

```

- 運用陣列存放 weekname，看步道好處?

<b>weekname[0]</b>	Sunday
<b>weekname[1]</b>	Monday
<b>weekname[2]</b>	Tuesday
<b>weekname[6]</b>	Sunday

```
import java.util.Scanner;
public class weekname_3 {
    public static void main(String[] args) {
        Scanner input = new Scanner(System.in);
        String [] weekname= {"Sunday", "Monday", "Tuesday", "Wednesday", "Thursday", "Friday", "Saturday", "Sunday"};
        int week = 0;
        while (week>=0) {
            System.out.print("輸入星期幾?");
            week = input.nextInt();
            if (week >= 0 && week <=7) {
                System.out.println(weekname[week]);
            } //if
            else
                System.out.println("無法判讀\n");
        } //while
    } //main
} //class
```

# 平行陣列(Parallel Arrays)

```
import java.util.Scanner;

public class weekname_array {
    public static void main(String[] args) {
        Scanner input = new Scanner(System.in);
        int week = 0;
        String [] wname={"Sunday","Monday","Tuesday","Wednesday","Thursday","Friday","Saturday","Sunday"};
        String [] cnumber={"日","一","二","三","四","五","六","七"};

        while (week<=7) {
            System.out.print("輸入星期幾?");
            week = input.nextInt();
            if (week >= 0 && week <=7)
                System.out.println("輸入星期"+cnumber[week]+" ,英文為"+wname[week]);
            else
                System.out.println("無法判讀\n");
        }//while
    }//main
}//class
```

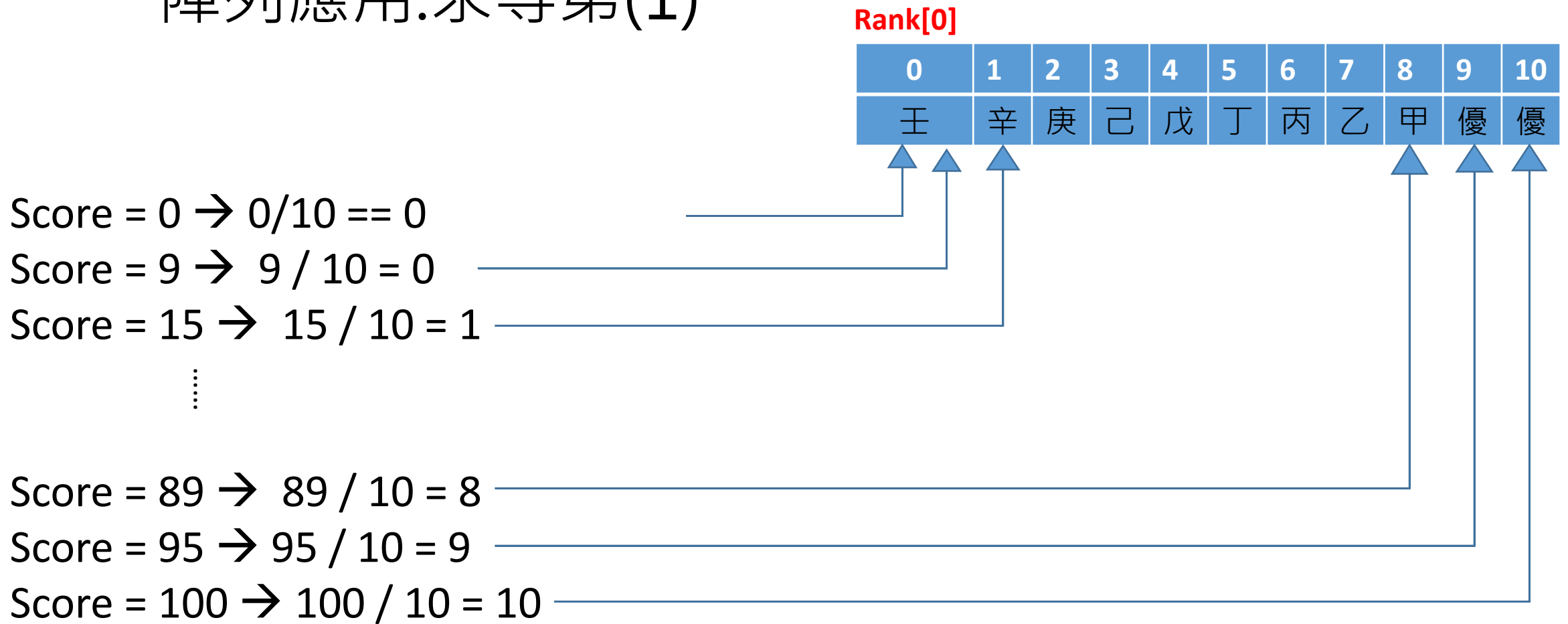
```
C:\Users\user\Desktop\11-3>java weekname_array
輸入星期幾?3
輸入星期三 ,英文為Wednesday
輸入星期幾?0
輸入星期日 ,英文為Sunday
輸入星期幾?7
輸入星期七 ,英文為Sunday
輸入星期幾?3
輸入星期三 ,英文為Wednesday
輸入星期幾?
```

陣列應用:求等第

# 陣列應用:求等第i

```
import java.util.Scanner;
public class scorerank_array {
    public static void main(String[] args) {
        Scanner input = new Scanner(System.in);
        int score = 0;
        String [] rank= {"王","辛","庚","己","戊","丁","丙","乙","甲","優","優"};
        while (score>=0) {
            System.out.print("輸入分數(整數, -1:end) : ");
            score = input.nextInt();
            //100~90優 89~80甲 79~70乙 69~60丙 59~50丁 49~40戊 39~30己 29~20庚 19~10辛 9~0王
            if (score >= 0)
                System.out.println("等第 : "+rank[score/10]);
            else
                System.out.println("無法判讀, bye!\n");
        }//while
    }//main
}//class
```

# 陣列應用:求等第(1)



\*透過Score/10取得對應等第陣列索引，及Score/10計算結果為整數，作為索引(index)

\*以空間換取時間，if之selection分支結構幾乎可忽略

# 陣列應用:求等第ii

```
import java.util.Scanner;
public class scorerank_array_2 {
    public static void main(String[] args) {
        Scanner input = new Scanner(System.in);
        int score = 0;
        String [] rank= {"優","優","甲","乙","丙","丁","戊","己","庚","辛","壬"};
        while (score>=0) {
            System.out.print("輸入分數(整數, -1:end) : ");
            score = input.nextInt();
            //100~90優 89~80甲 79~70乙 69~60丙 59~50丁 49~40戊 39~30己 29~20庚 19~10辛 9~0壬
            if (score<=100 && score >= 0)
                System.out.println("等第 : "+rank[10-(int)Math.floor(score/10)]);
            else if (score>100)
                System.out.println("無法判讀!\n");
            else
                System.out.println("bye!\n");
        }
    }
}
```

# 陣列應用:求等第(2)

0	1	2	3	4	5	6	7	8	9	10
優	優	甲	乙	丙	丁	戊	己	庚	辛	壬

Score = 100  $\rightarrow$   $10 - (100/10) == 0$

Score = 95  $\rightarrow$   $10 - (\text{int})\text{Math.floor}(95 / 10)$   
= 1

Score = 89  $\rightarrow$   $10 - \text{Math.floor}(89 / 10) = 2$

Score = 9  $\rightarrow$   $10 - \text{Math.floor}(9 / 10) = 10$

Score = 0  $\rightarrow$   $10 - \text{Math.floor}(0/10) = 10$

\*不同運算式，產生不同索引值，因此等第在陣列排列不同

\* $(\text{int})\text{Math.floor}(95 / 10)$

Math.floor(95 / 10) : double type

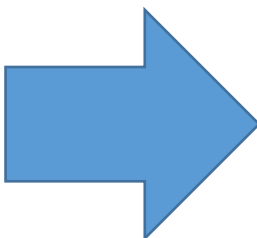
(int): type casting, convert double to int



```

switch (score / 10) {
    //由於100~90都為(10~9)優等，因此兩case印出相同
    case 10:
    case 9:
        System.out.print("等第：優\n");
        break;//結束執行,break switch判斷;
    case 8:
        System.out.print("等第：甲\n");
        break;
    case 7:
        System.out.print("等第：乙\n");
        break;
    case 6:
        System.out.print("等第：丙\n");
        break;
    case 5:
        System.out.print("等第：丁\n");
        break;
    case 4:
        System.out.print("等第：戊\n");
        break;
    case 3:
        System.out.print("等第：己\n");
        break;
    case 2:
        System.out.print("等第：庚\n");
        break;
    case 1:
        System.out.print("等第：辛\n");
        break;
    case 0://由於9~0除10結果均為0，但9~1 & 0屬不同等地，因此判斷後才印出
        if (score != 0)
            System.out.print("等第：壬\n");
        else
            System.out.print("等第：癸\n");
}

```



```

int score = 0;
String [] rank= {"優","優","甲","乙","丙","丁","戊","己","庚","辛","壬"};
while (score>=0) {
    System.out.print("輸入分數(整數, -1:end) : ");
    score = input.nextInt();
    //100~90優 89~80甲 79~70乙 69~60丙 59~50丁 49~40戊 39~30己 29~20庚
    if (score<=100 && score >= 0)
        System.out.println("等第："+rank[10-(int)Math.floor(score/10)]);
    else if (score>100)
        System.out.println("無法判讀!\n");
    else
        System.out.println("bye!\n");
} //while

```

## 第周習題 (任選一題，亦可全做):將陣列加入第四周程式

**習題A:**輸入個人淨所得，求其應繳稅額 (陣列存放"稅率")

說明: (1)先上網搜尋個人淨所得之稅率資訊(須呈現於設計歷程檔中); (2)請繳交.java及設計歷程檔(.DOCX)。

**習題B:**輸入個人生日，求其星座及個性(陣列存放"星座資訊")

說明: (1)先上網搜尋12星座資訊(須呈現於設計歷程檔中);

(2)例如: **假設**處女座日期:8月23日~9月22日

- 輸入生日月份:9
- 輸入生日日期:1
- 結果:你的生日是**9月1日**，屬於**處女座**，個性:為人仔細，作事認真，對於是非善惡，判斷分明。

**習題C:**將BMI診斷分成六層次(陣列存放"六診斷層次")

例子：輸入100筆整數資料，要求出平均數，如何做？若要求變異數，如何做？ (c)

```
scanf("%d", &x1);  
scanf("%d", &x2);  
...  
scanf("%d", &x100);  
avg=(x1+x2+...+x100)/100;  
Var+=(x1-avg)^2;  
Var+=(x2-avg)^2;  
...  
Var+=(x100-avg)^2;  
//最後變異數結果敘述
```

```
int x[100], i,  
avg=0;  
for(i=0;i<100;i  
++)  
    scanf("%d",  
x[i]);  
for(i=0;i<100;i  
++)  
    avg=avg+x[i];  
avg=avg/100;
```

Review

switch case

# 改為5等第

```
import java.util.Scanner;
public class scorerank_2a {
    public static void main(String[] args) {
        Scanner input = new Scanner(System.in);
        int score = 0;
        while (score >= 0) {
            System.out.print("輸入分數(整數>=0) : ");
            score = input.nextInt();
            if (score < 0) break;
            //100~90優 89~80甲 79~70乙 69~60丙 59~0丁
            switch (score / 10) {
                case 10:
                case 9:
                    System.out.print("等第 : 優\n");
                    break; //結束執行, break switch判斷;
                case 8:
                    System.out.print("等第 : 甲\n");
                    break;
                case 7:
                    System.out.print("等第 : 乙\n");
                    break;
                case 6:
                    System.out.print("等第 : 丙\n");
                    break;
                case 5:
                case 4:
                case 3:
                case 2:
                case 1:
                case 0:
                    System.out.print("等第 : 丁\n");
                    break;
                default:
                    System.out.print("無法判讀\n");
                    break;
            } //switch
        } //while
    } //main
} //class
```

# 改變運算式

- $(score-50)/10$

```
import java.util.Scanner;
public class scorerank_2b {
    public static void main(String[] args) {
        Scanner input = new Scanner(System.in);
        int score = 0;
        while (score >= 0) {
            System.out.print("輸入分數(整數 >= 0) : ");
            score = input.nextInt();
            if (score < 0)
                {System.out.print("Bye\n"); break;}
            //100~90優 89~80甲 79~70乙 69~60丙 59~0丁
            if (score <= 100 && score >= 0) {
                switch ((score-50)/10) {
                    case 5:
                    case 4:
                        System.out.print("等第 : 優\n");
                        break; //結束執行, break switch 判斷;
                    case 3:
                        System.out.print("等第 : 甲\n");
                        break;
                    case 2:
                        System.out.print("等第 : 乙\n");
                        break;
                    case 1:
                        System.out.print("等第 : 丙\n");
                        break;
                    case 0:
                    default:
                        System.out.print("等第 : 丁\n");
                        break;
                } //switch
            }
            else
                System.out.print("超過範圍\n");
        } //while
    } //main
} //class
```

# 質數： 不用boolean時

- import java.util.Scanner;
- public class prime\_0 {
- static Scanner input = new Scanner(System.in);
- public static void main(String[] args) {
- System.out.println("====輸入>=2整數，判斷是否為質數?====");
- int n=3, i;
- String dif;
- //boolean prime;
- int prime;
- System.out.print("輸入>=2整數：");
- n = input.nextInt();
- i=2;
- //prime=true;
- prime=0;
- while (i<=n-1) {
- if (n%i==0)
- {prime=1; //prime=false;
- System.out.println(n+"可被"+i+"整除。");
- break;}
- else
- System.out.println(n+"不可被"+i+"整除。");
- ++i; }
- if (prime==0) dif="是質數!";
- else dif="不是質數!";
- System.out.println(n+dif);
- } //main
- } //class

# Debug :輸入奇數n,求 $S=1+3+5+\dots+n$

```
1.import java.util.Scanner;
2.public class loop_debug_1 {
3. public static void main(String[] args) {
4. Scanner input = new Scanner(System.in);
5. int n=7,i=0, s=0;
6. System.out.println("輸入奇數n,求S=1+3+5+.....+n\n");
7. while (n>=1) {
8. System.out.print("輸入奇數(-1:end) : ");
9. n = input.nextInt();
10. if (n%2==0) {
11. System.out.println("輸入錯誤，須為奇數!");
12. continue;}
13. for(i=1;i<=n;++i)
14. s=s+i;
15. System.out.println("1+3+5+..."+n+"="+s);
16. }//while
17.
18. }//main
19.}//class
```

處理輸入錯誤