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？

input.nextInt(x_1);

input.nextInt(x_2);

…

input.nextInt(x_{100});

avg=(x_1+x_2+…+x_{100})/100;

Var= (x_1-avg)* (x_1-avg);

Var=(x_2-avg) (x_2-avg);

…

Var=(x_{100}-avg) (x_{100}-avg);

//最後變異數結果敘述

討論：

(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)

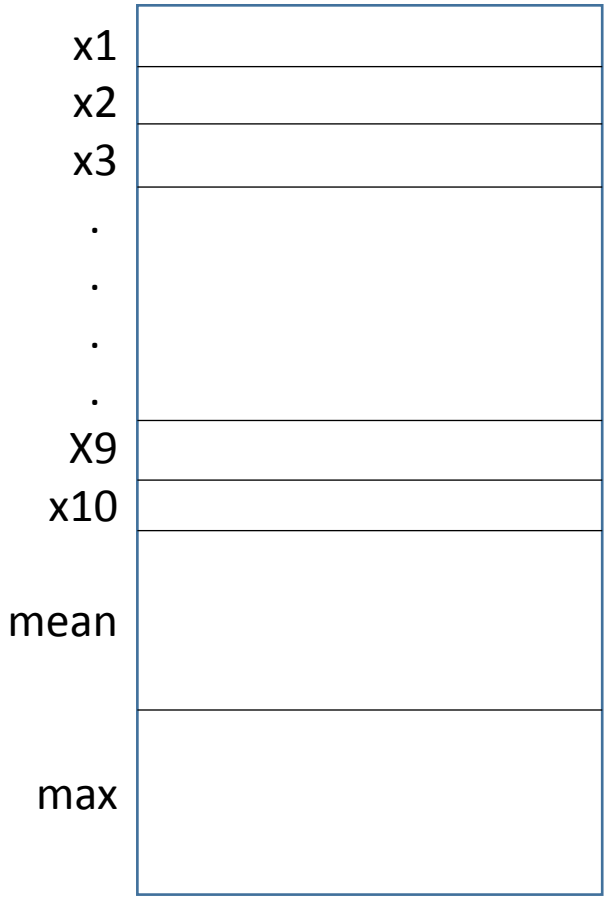
(4)沒有彈性，例如要處理1000筆？Big Data？

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

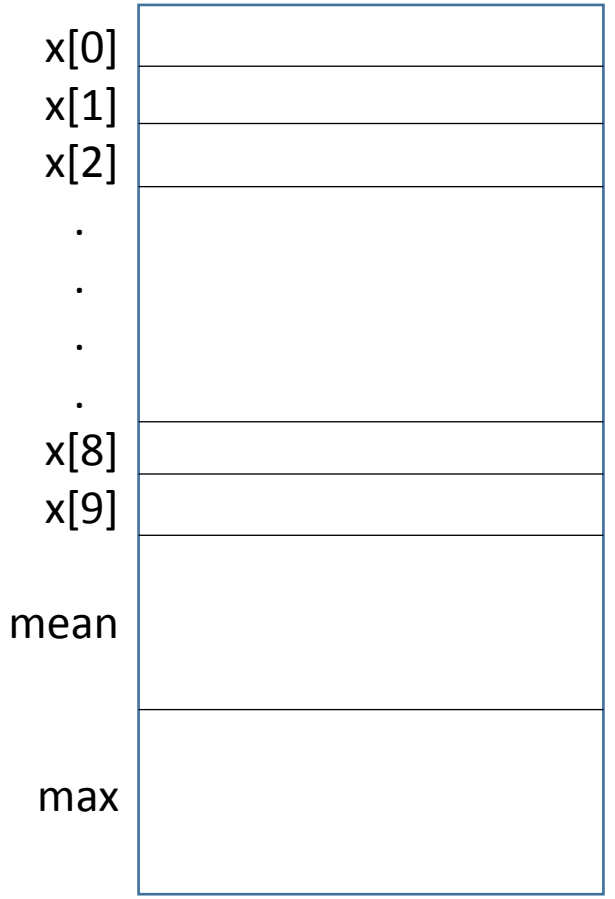
陣列

- 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)

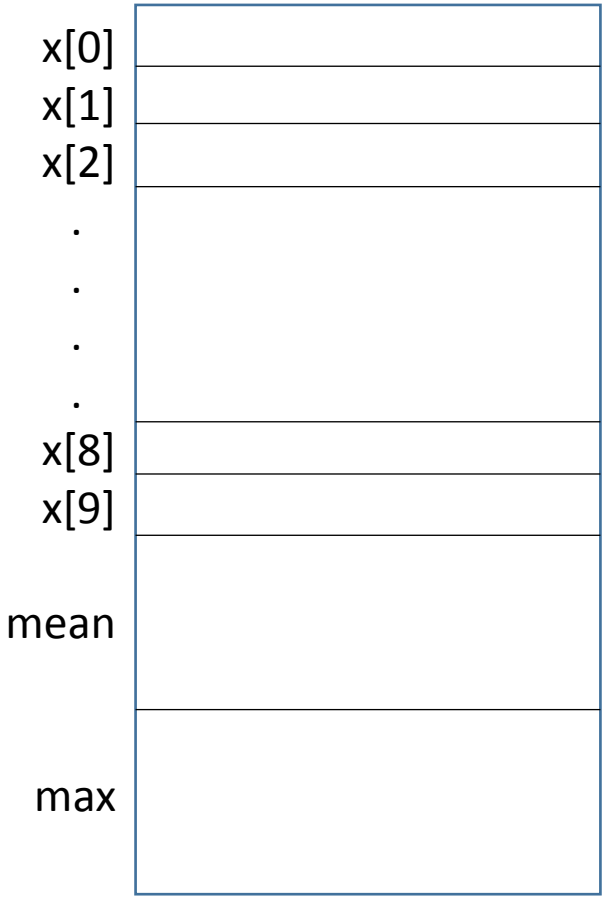
  int [] sc={20,30,40};

  String [] diagres={"體重過輕Underweight","正常Normal","過重Overweight"};

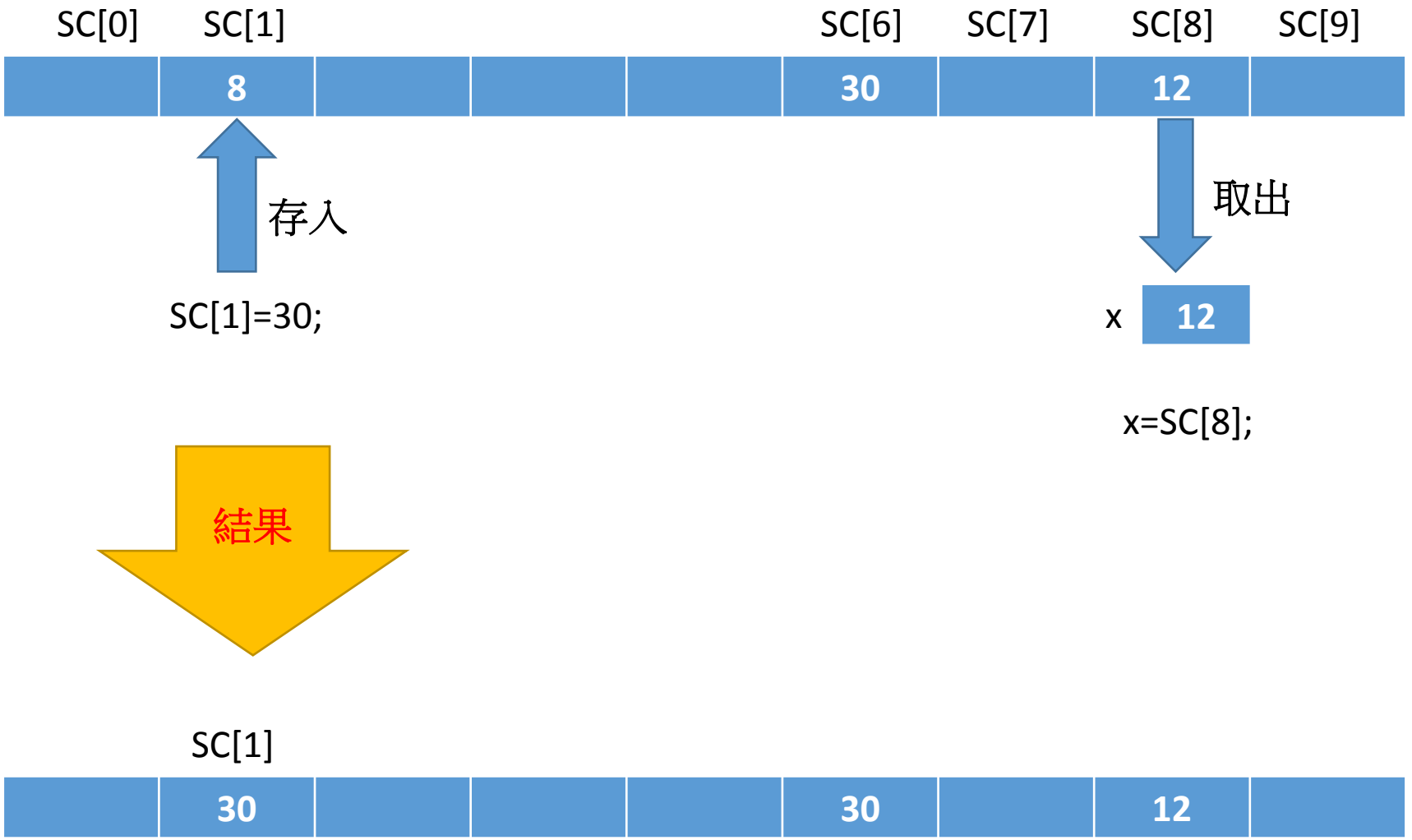


陣列的特性

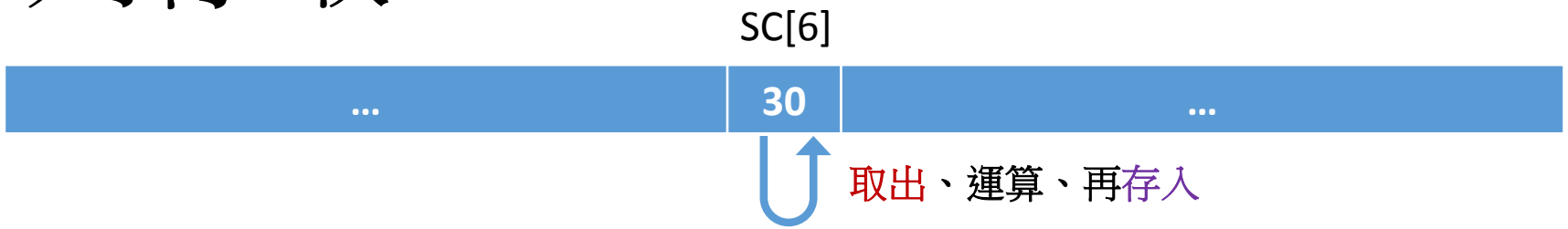
- 定義：相同型態(ex. int, double…)的元素所形成有序的有限集合
- 以索引值(index) 與 值(value) 來表示其對應關係。
- 通常陣列的元素被存放在**連續**的記憶體上，可以支援直接存取。
- 陣列元素存取時，將元素的索引/註標(Index/Subscript)以位址函數(Address Function)計算出(對應)記憶體位址，再存取記憶體中的內容(元素的值)。
  - 以索引存取陣列元素之值(value)
    - i=8;
    - x[i]=100;
  - 存: x[8]=100; //將100存入x[8]
  - 取: System.out.print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



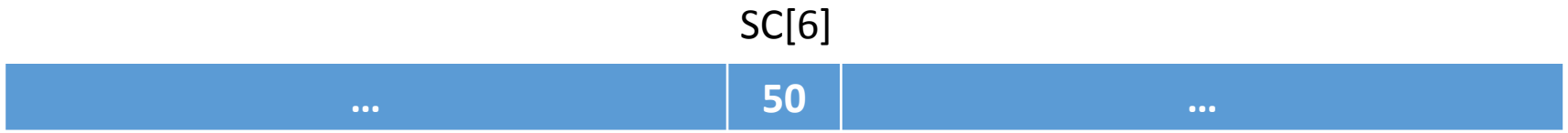
陣列存取


SC[0]
SC[1]
SC[6]
SC[7]
SC[8]
SC[9]
8
30
12
存入
取出
SC[1]=30;
x
12
x=SC[8];
結果
SC[1]
30
30
12

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.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

```
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
```

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 [] diagres={"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: "+diagres[status]);
```

diagres [0]	體重過輕Underweight
diagres [1]	正常Normal
diagres [2]	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 [] diagres={"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: "+diagres[status]);
  System.out.print("(繼續(Y/N)：");
  ok= input.next().toUpperCase();
 }//while
 System.out.println("==========bye bye==========");
 }//main
}//class
```

- 運用陣列存放weekname，看步道好處?

weekname[0]	Sunday
weekname[1]	Monday
weekname[2]	Tuesday
weekname[6]	Sunday

```
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
```

```
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>=0) {
    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
```

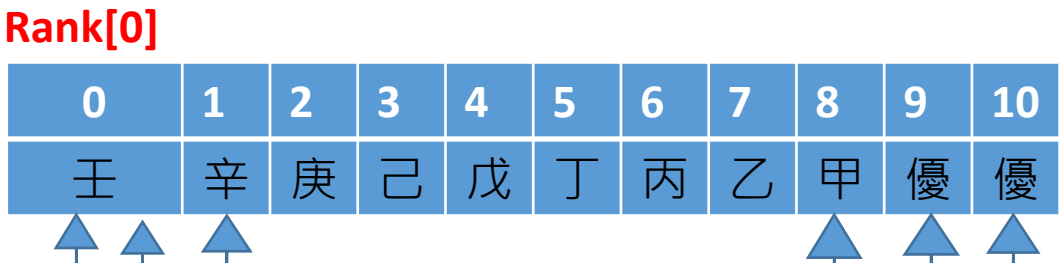
```
C:\Users\user\Desktop\11-3>java  weekname_array
輸入星期幾?3
輸入星期三 ,英文為Wednesday
輸入星期幾?0
輸入星期日 ,英文為Sunday
輸入星期幾?7
輸入星期七 ,英文為Sunday
輸入星期幾?3
輸入星期三 ,英文為Wednesday
輸入星期幾?
```

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= {"壬","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壬
    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)



Score = 0 → 0/10 == 0

Score = 9 → 9 / 10 = 0

Score = 15 → 15 / 10 = 1

⋮

Score = 89 → 89 / 10 = 8

Score = 95 → 95 / 10 = 9

Score = 100 → 100 / 10 = 10

*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");
    }//while
  }//main
}//class
```

陣列應用:求等第(2)

Score = 100 → 10 - (100/10) == 0

Score = 95 → 10 – (int)Math.floor(95 / 10)
= 1

Score = 89 → 10 - Math. floor(89 / 10) = 2

Score = 9 → 10 - Math. floor(9 / 10) = 10

Score = 0 → 10 - Math. floor(0/10) = 10

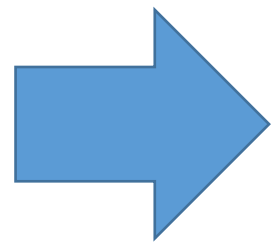
*不同運算式，產生不同索引值，因此等第在陣列排列不同

*(int)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\n", &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+.....+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