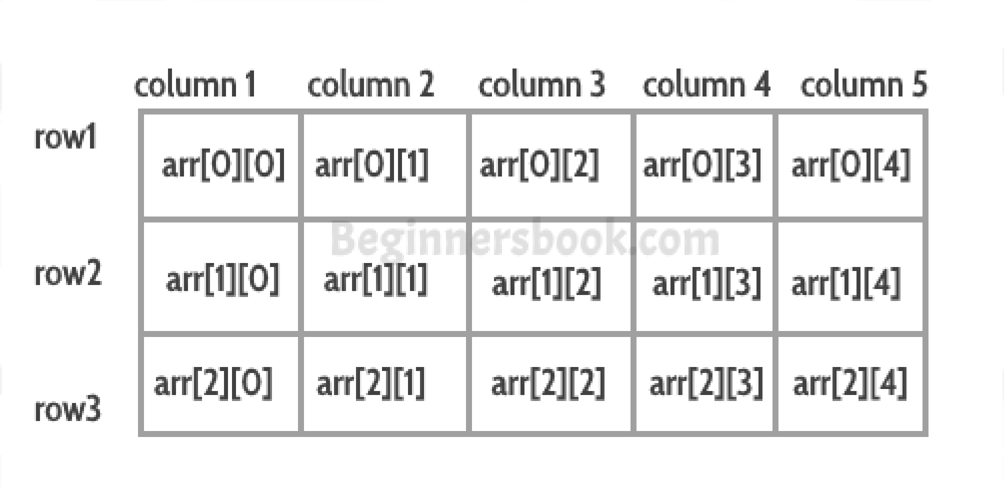
MultiDimensional Arrays



	column 1	column 2	column 3	column 4	column 5
row1	arr[0][0]	arr[0][1]	arr[0][2]	arr[0][3]	arr[0][4]
row2	arr[1][0]	arr[1][1]	arr[1][2]	arr[1][3]	arr[1][4]
row3	arr[2][0]	arr[2][1]	arr[2][2]	arr[2][3]	arr[2][4]

Computer Engineering

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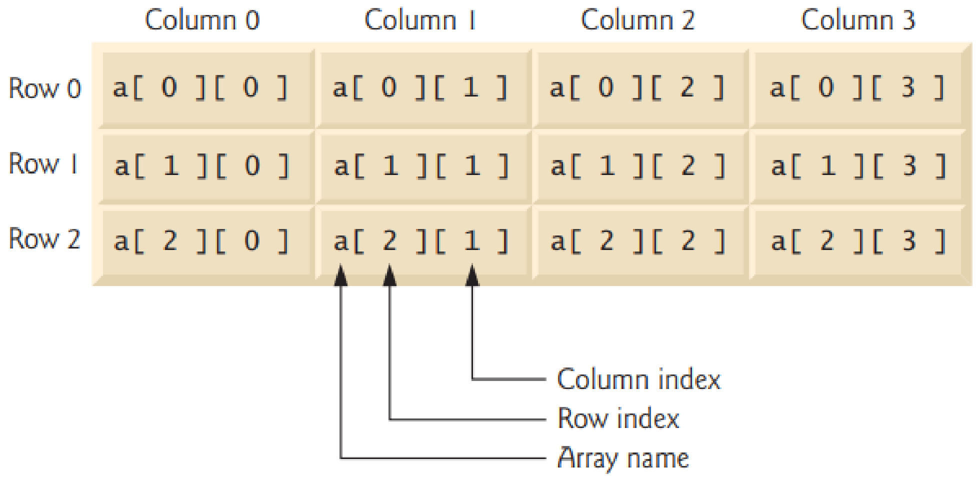
What is two dimensional array?

- Multidimensional arrays with two dimensions are often used to represent *tables* of values consisting of information arranged in *rows* and *columns*.
- To identify a particular table element, we must specify two indices. By convention, the first identifies the element’s row and the second its column.



	Column 0	Column 1	Column 2	Column 3
Row 0	a[0][0]	a[0][1]	a[0][2]	a[0][3]
Row 1	a[1][0]	a[1][1]	a[1][2]	a[1][3]
Row 2	a[2][0]	a[2][1]	a[2][2]	a[2][3]

Column index

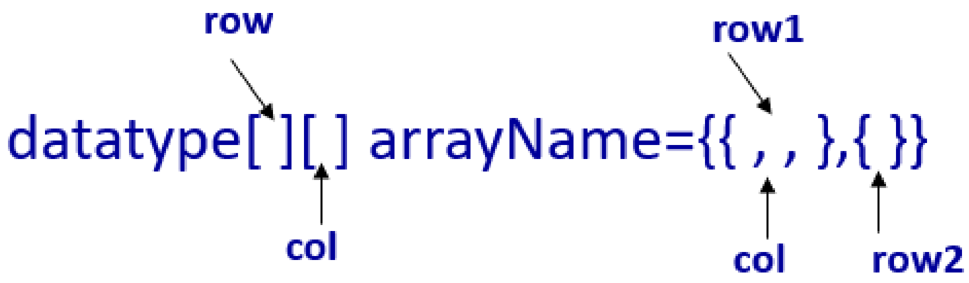
Row index

Array name

- two-dimensional array named a that contains three rows and four columns (i.e., a three-by-four array). In general, an array with *m* rows and *n* columns is called an ***m*-by-*n* array**.

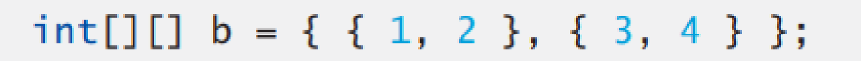
Declaring & Initializing two dimensional array

- Multidimensional arrays can be initialized with array initializers in declarations.

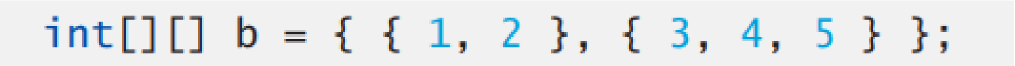


datatype[ ][ ] arrayName={{ , , },{ }}

- A two-dimensional array b with two rows and two columns could be declared and initialized with **nested array initializers** as follows:
- Example:



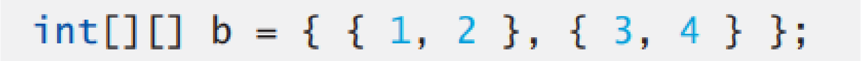
```
int[][] b = { { 1, 2 }, { 3, 4 } };
```



```
int[][] b = { { 1, 2 }, { 3, 4, 5 } };
```

Declaring & Initializing two dimensional array

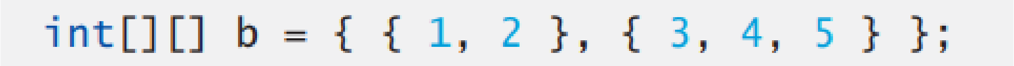
- Example:



```
int[][] b = { { 1, 2 }, { 3, 4 } };
```

- Creates a two dimensional array with two row, first row has two column and second row has two columns:

- We can create two dimensional array with different lengths.

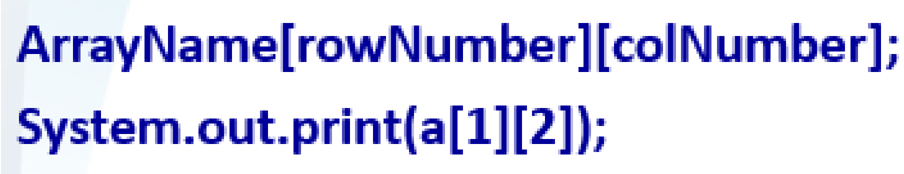


```
int[][] b = { { 1, 2 }, { 3, 4, 5 } };
```

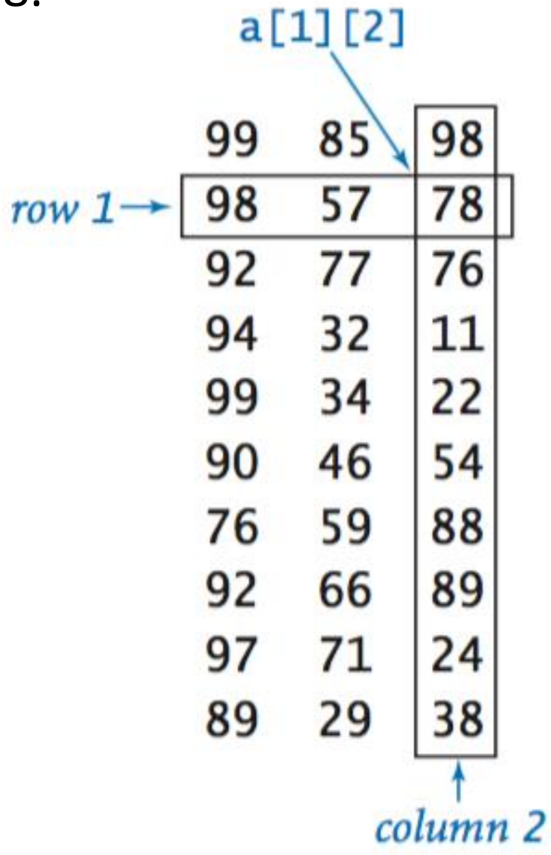
- Creates a two dimensional array with two row, first row has two column and second row has three columns:

Display an element of a Two Dimensional Array

- To display an element in a two dimensional array we don’t need the nested for statements. We just mention the array element, for example:
- We have a two dimensional array named ***“a”*** and we want to get the value 78.
- we just write:



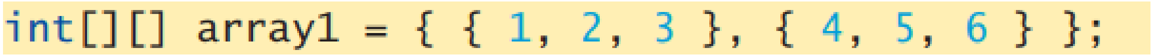
```
ArrayName[rowNumber][colNumber];
System.out.print(a[1][2]);
```



99	85	98
98	57	78
92	77	76
94	32	11
99	34	22
90	46	54
76	59	88
92	66	89
97	71	24
89	29	38

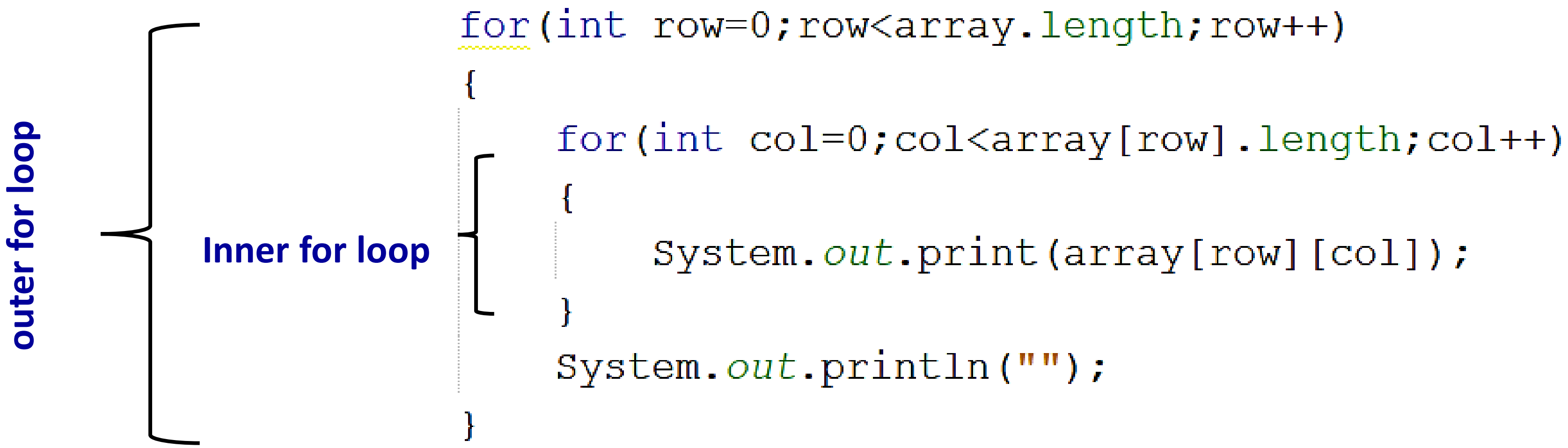
Displaying Two Dimensional Array Elements

- Let is take an Example: We have a two dimensional array



```
int[][] array1 = { { 1, 2, 3 }, { 4, 5, 6 } };
```

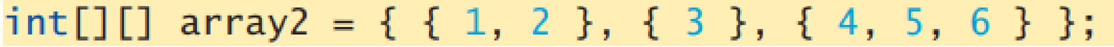
- To output a two dimensional array elements, we need a nested for loops. Outer for loop for rows and inner for loop for columns. The inner loop is goes through the outer loop index length.



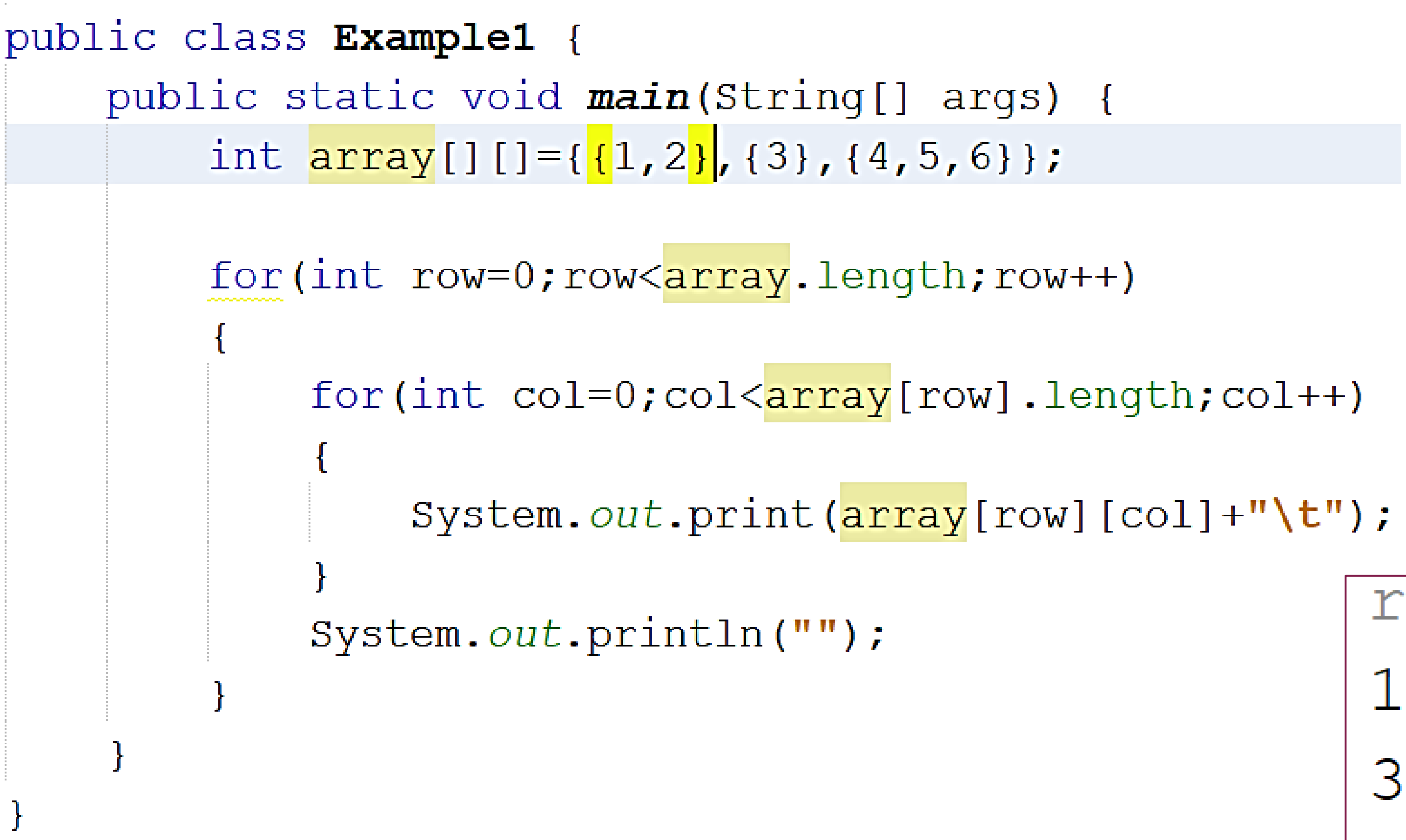
```
for(int row=0;row<array.length;row++)
{
    for(int col=0;col<array[row].length;col++)
    {
        System.out.print(array[row][col]);
    }
    System.out.println("");
}
```

Displaying Two Dimensional Array Elements

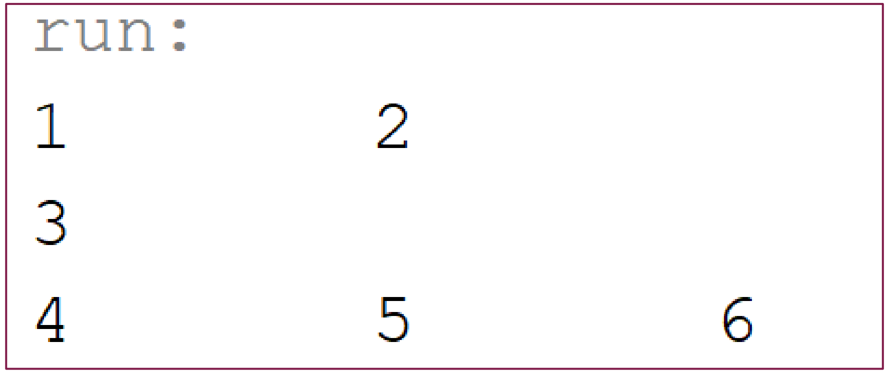
- Example 2:



```java
int[][] array2 = { { 1, 2 }, { 3 }, { 4, 5, 6 } };
```

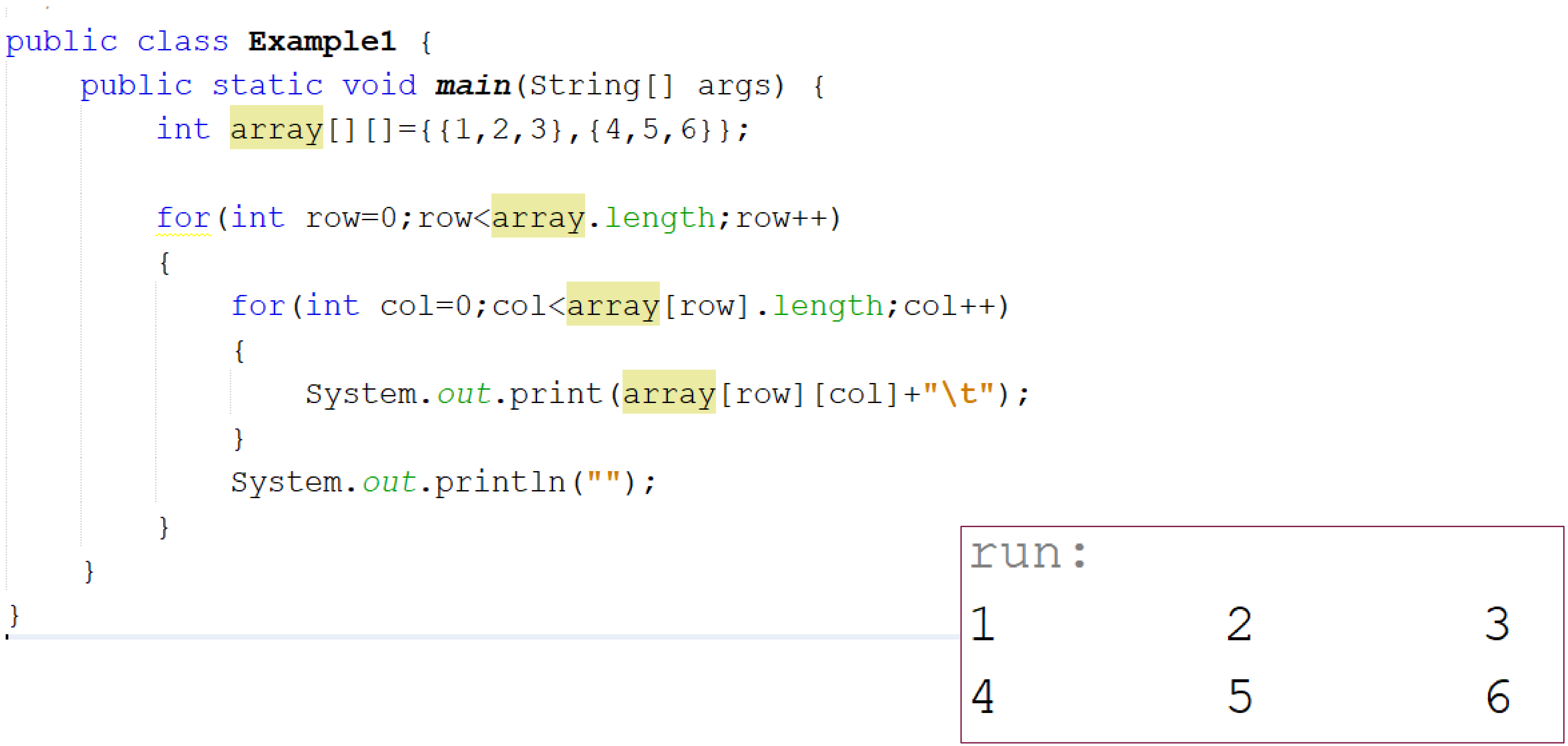


```java
public class Example1 {
    public static void main(String[] args) {
        int array[][]={{1,2},{3},{4,5,6}};

        for(int row=0;row<array.length;row++)
        {
            for(int col=0;col<array[row].length;col++)
            {
                System.out.print(array[row][col]+"\t");
            }
            System.out.println("");
        }
    }
}
```



```
run:
1       2
3
4       5       6
```

Displaying Two Dimensional Array Elements



```
public class Example1 {
    public static void main(String[] args) {
        int array[][]={{1,2,3},{4,5,6}};

        for(int row=0;row<array.length;row++)
        {
            for(int col=0;col<array[row].length;col++)
            {
                System.out.print(array[row][col]+"\t");
            }
            System.out.println("");
        }
    }
}
```

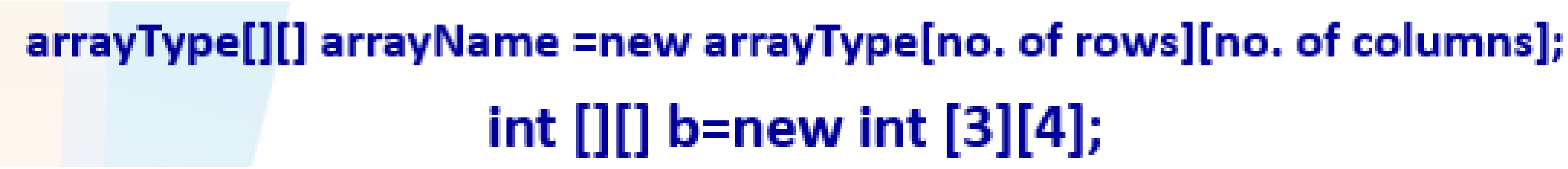
```
run:
1              2              3
4              5              6
```

Self-Test

- Try to create the arrays below and output the elements of the array.
- int[][] a = { {1, 2, 3}, {4, 5, 6, 9}, {7}, };
- String arrayString[][]={{"name 1","name 2"},{"yusra","mohammad"}};
- String arrayString1[][]={{"name 1","yusra"} , {"name 2“ ,"mohammad"}};

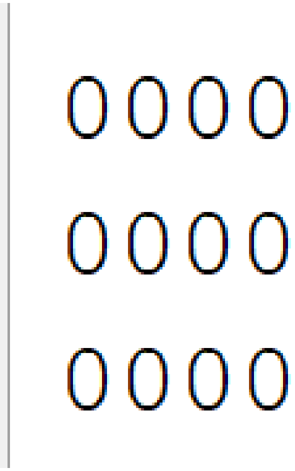
Creating Two-Dimensional Arrays

- As declaration of one dimensional array we can declare the two dimensional array.



```
arrayType[][] arrayName =new arrayType[no. of rows][no. of columns];
int [][] b=new int [3][4];
```

- The two dimensional array b has three rows and 4 columns, with no data in it.



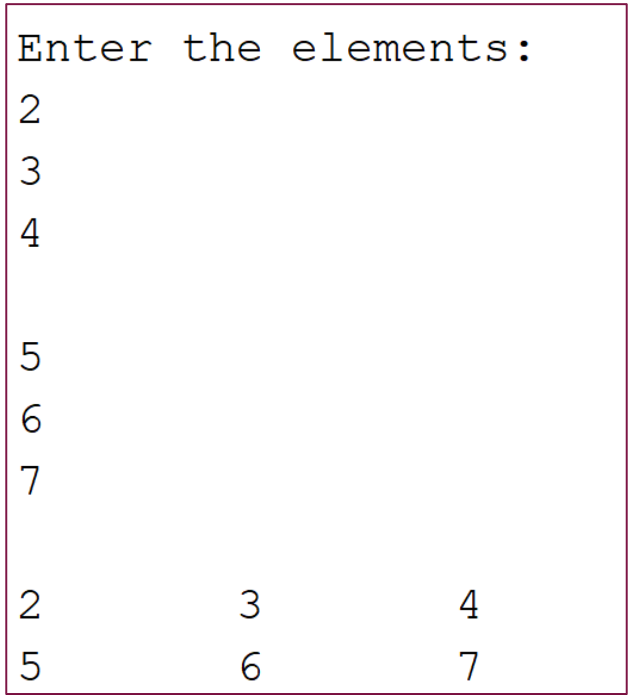
```
0000
0000
0000
```

Input values to the Two Dimensional Array

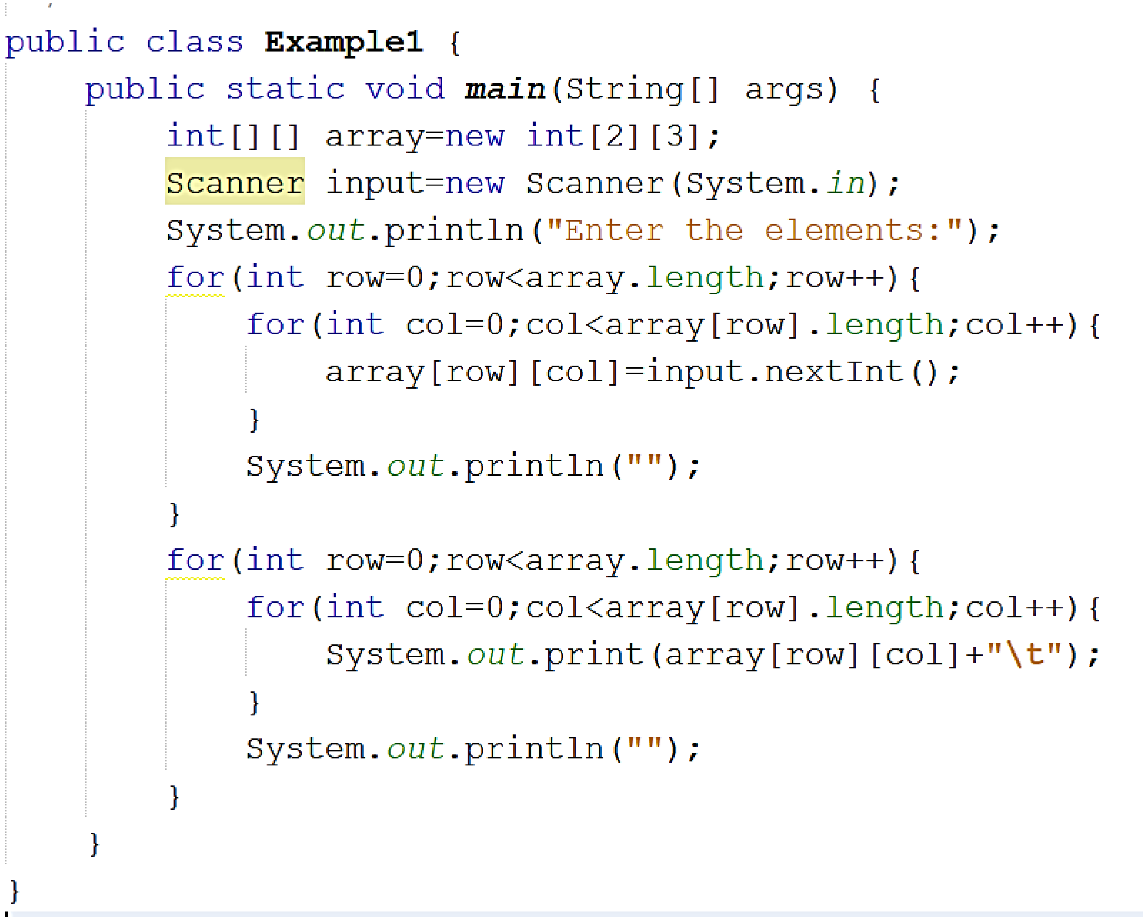
- Two input values to two dimensional array we need nested loop to enter the values to the array. And for output the array we need another nested for loop.
- For Example we have an array of 2 rows by 3 columns which store integer values:

int [][] array=new int [2][3];

- **output**



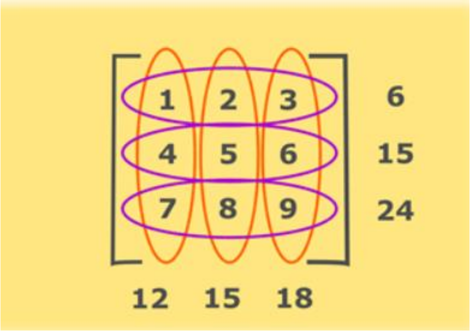
```
Enter the elements:
2
3
4

5
6
7

2          3          4
5          6          7
```



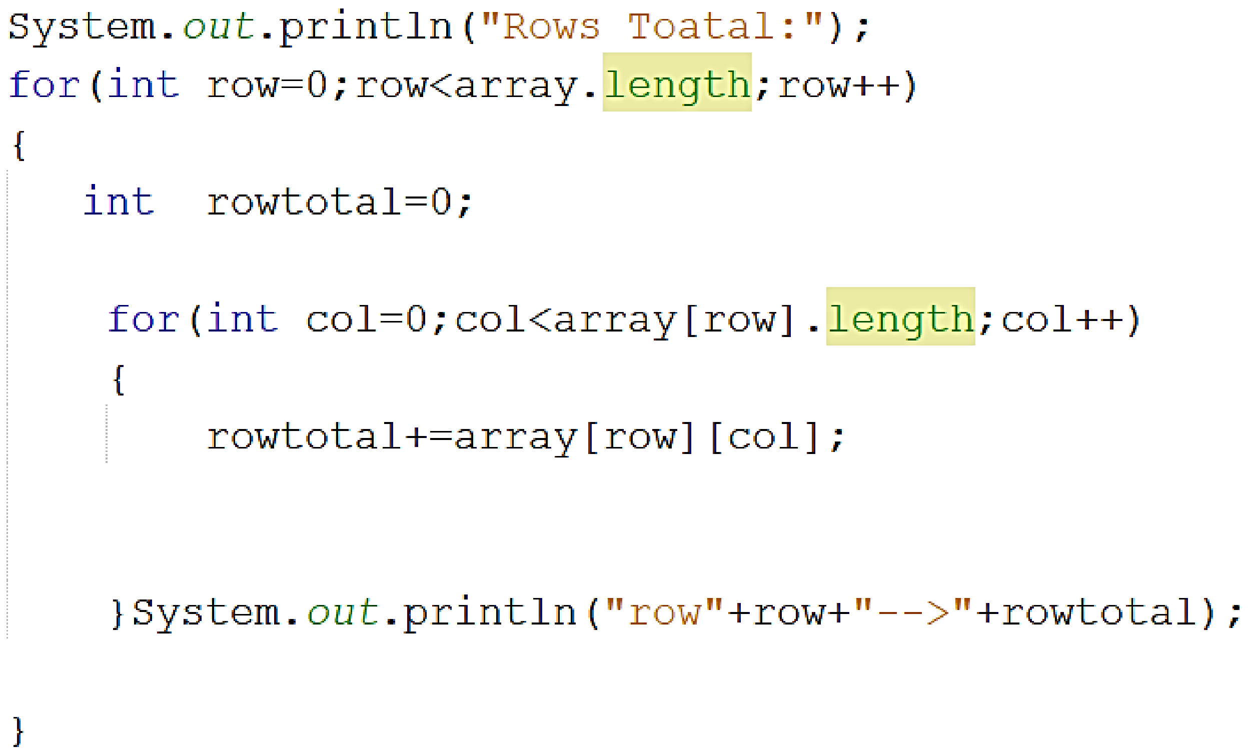
```java
public class Example1 {
    public static void main(String[] args) {
        int[][] array=new int[2][3];
        Scanner input=new Scanner(System.in);
        System.out.println("Enter the elements:");
        for(int row=0;row<array.length;row++){
            for(int col=0;col<array[row].length;col++){
                array[row][col]=input.nextInt();
            }
            System.out.println("");
        }
        for(int row=0;row<array.length;row++){
            for(int col=0;col<array[row].length;col++){
                System.out.print(array[row][col]+"\t");
            }
            System.out.println("");
        }
    }
}
```

Sum of rows and columns in Two Dimensional Array

- Suppose we have an array as follows:

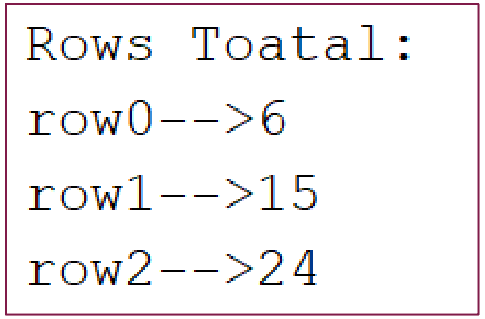


- Sum of rows in the array



```
System.out.println("Rows Toatal:");
for(int row=0;row<array.length;row++)
{
   int  rowtotal=0;

    for(int col=0;col<array[row].length;col++)
    {
        rowtotal+=array[row][col];


    }System.out.println("row"+row+"-->"+rowtotal);

}
```

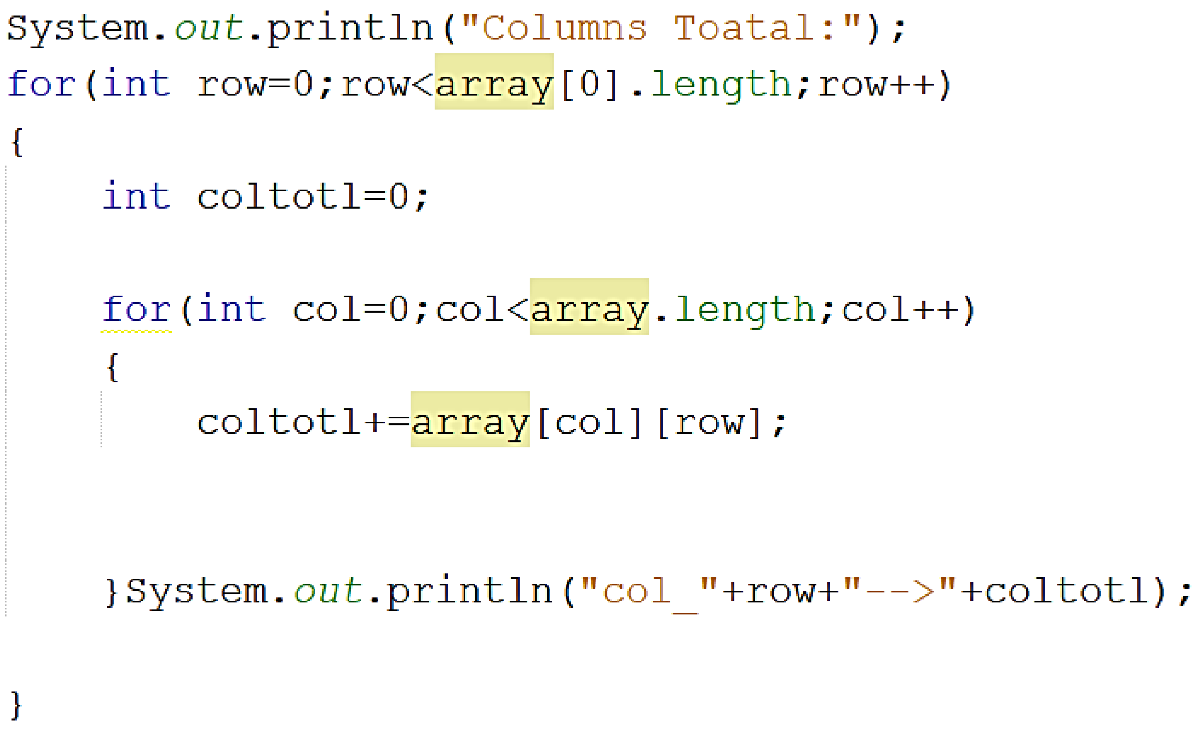
- **output**



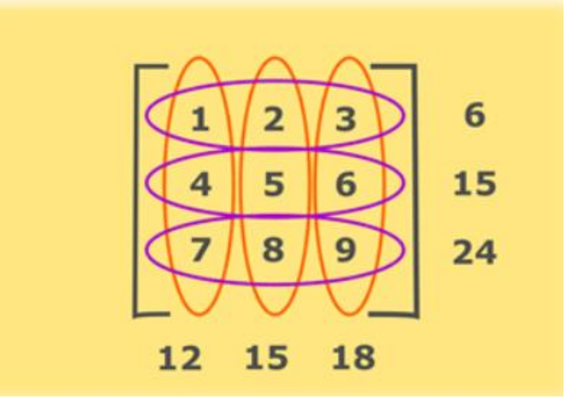
```
Rows Toatal:
row0-->6
row1-->15
row2-->24
```

Sum of rows and columns in Two Dimensional Array

- Sum of columns in the array

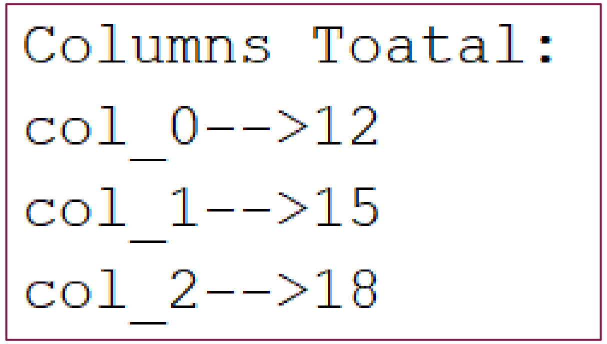


```
System.out.println("Columns Toatal:");
for(int row=0;row<array[0].length;row++)
{
    int coltotl=0;

    for(int col=0;col<array.length;col++)
    {
        coltotl+=array[col][row];


    }System.out.println("col_"+row+"-->"+coltotl);

}
```



$$\begin{array}{ccc|c} 1 & 2 & 3 & 6 \\ 4 & 5 & 6 & 15 \\ 7 & 8 & 9 & 24 \\ \hline 12 & 15 & 18 & \end{array}$$

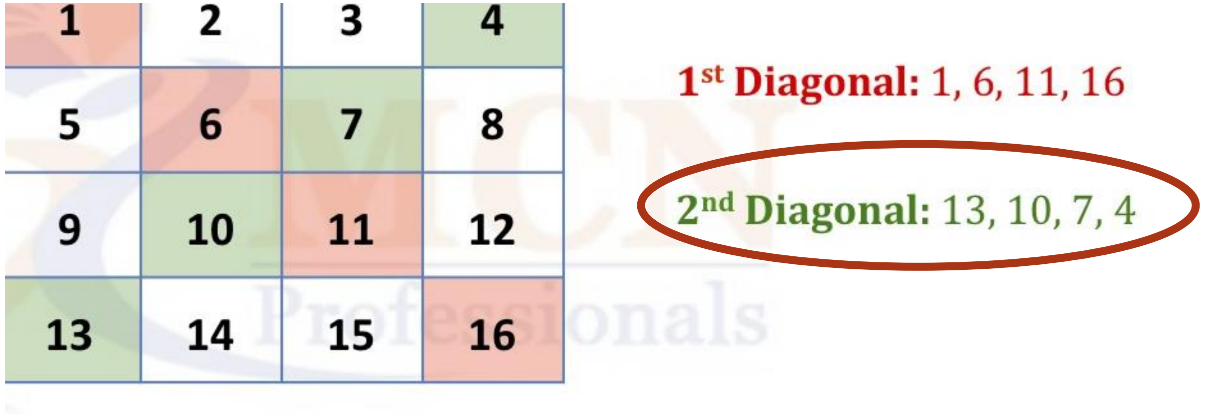
- **output**



```
Columns Toatal:
col_0-->12
col_1-->15
col_2-->18
```

Output the two dimensional array diagonally

- To output the two dimensional array elements diagonally

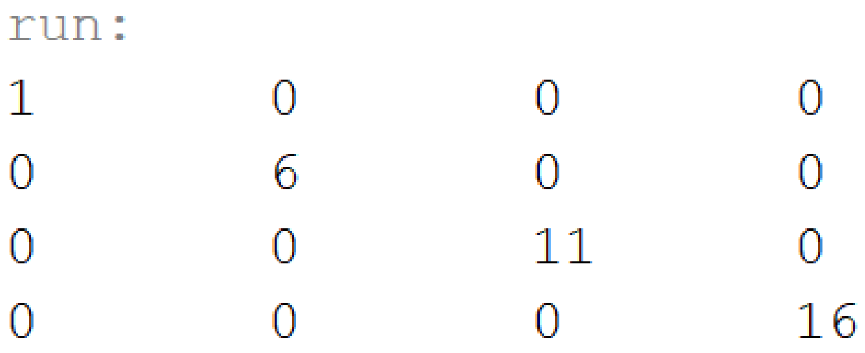


1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

1st Diagonal: 1, 6, 11, 16

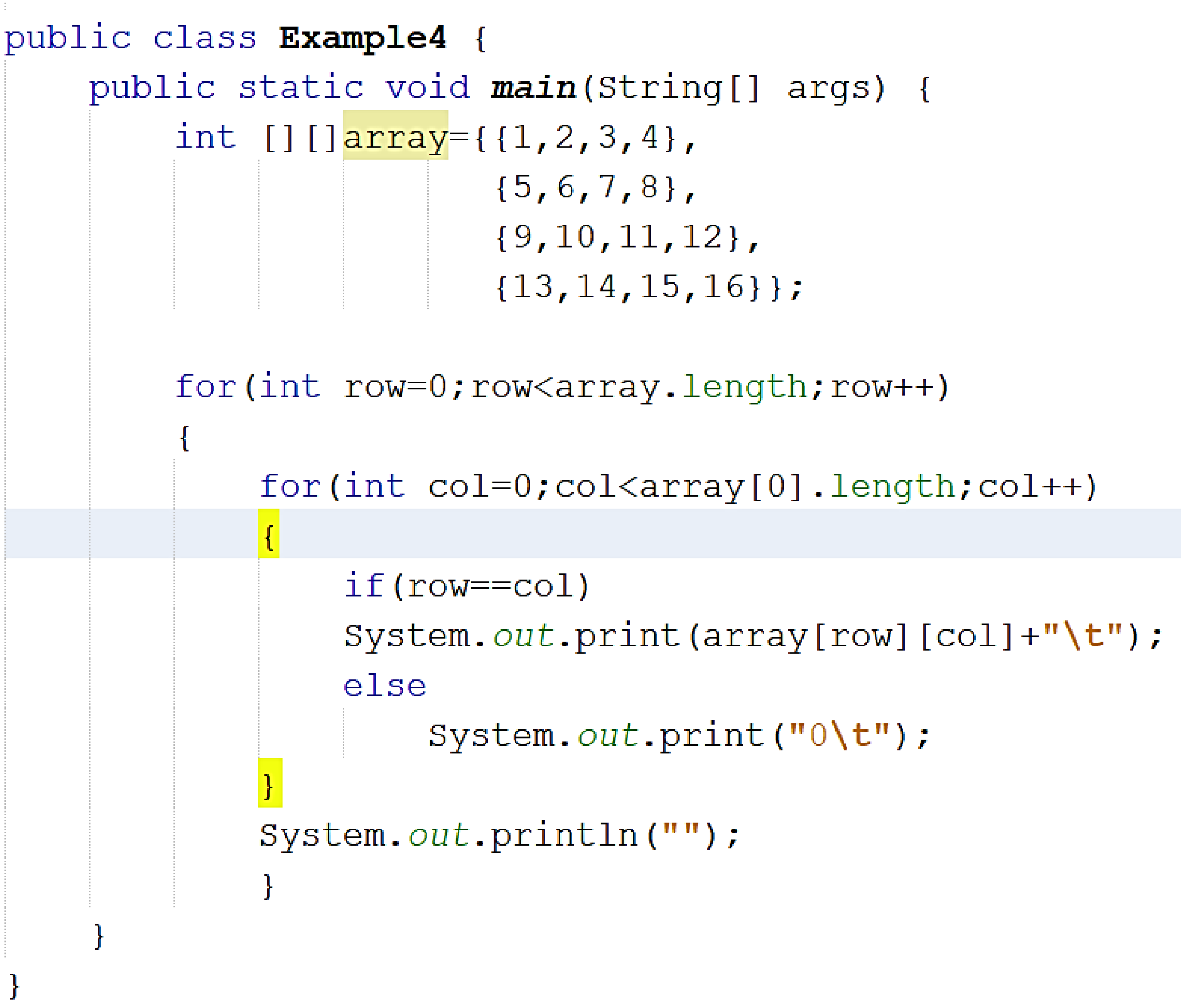
2nd Diagonal: 13, 10, 7, 4

Homework



```
run:
1           0           0           0
0           6           0           0
0           0           11          0
0           0           0           16
```

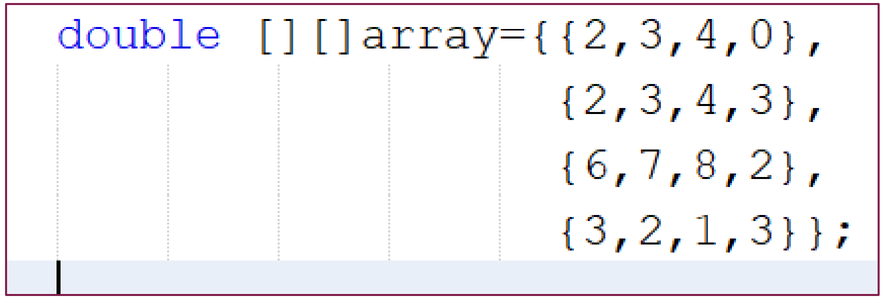
Output the two dimensional array diagonally



```
public class Example4 {
    public static void main(String[] args) {
        int [][]array={{1,2,3,4},
                       {5,6,7,8},
                       {9,10,11,12},
                       {13,14,15,16}};

        for(int row=0;row<array.length;row++)
        {
            for(int col=0;col<array[0].length;col++)
            {
                if(row==col)
                System.out.print(array[row][col]+"\t");
                else
                    System.out.print("0\t");
            }
            System.out.println("");
            }
    }
}
```

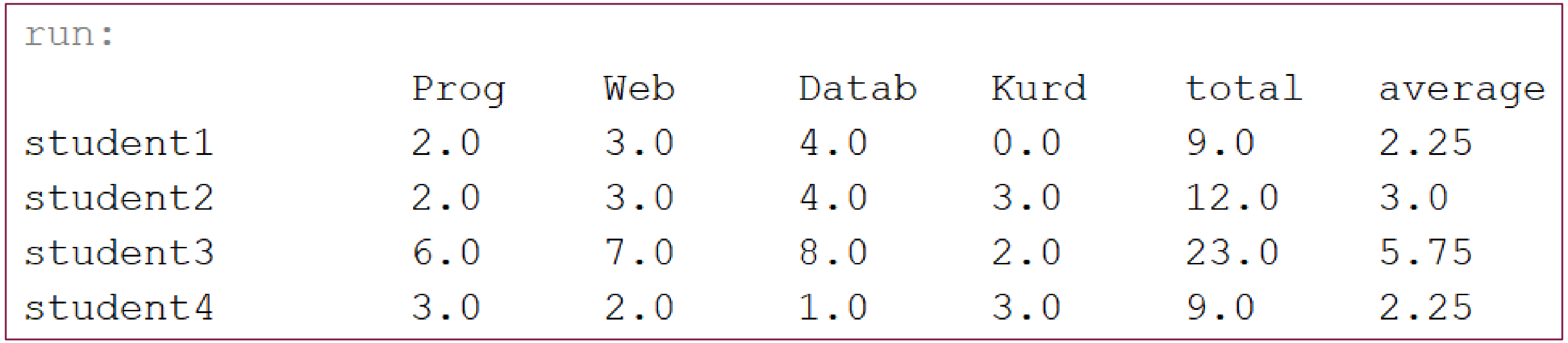
Sample Development

- A class with 4 students had exam on four subjects (programming, Database, Web, and Kurdology).



```
double [][]array={{2,3,4,0},
                  {2,3,4,3},
                  {6,7,8,2},
                  {3,2,1,3}};
```

- Write a program to show the grade of each student and the average of each student. As follows:



```
run:
                Prog    Web     Datab   Kurd    total   average
student1        2.0     3.0     4.0     0.0     9.0     2.25
student2        2.0     3.0     4.0     3.0     12.0    3.0
student3        6.0     7.0     8.0     2.0     23.0    5.75
student4        3.0     2.0     1.0     3.0     9.0     2.25
```