CS1010J Programming Methodology
Tutorial 7: Simple OOP Part I and 2D Arrays

> Being ignorant is not so much a shame, as being unwilling to learn.
>
> ~ *Benjamin Franklin*

To students:

The concept of OOP is split into three tutorials (the last one in week 13) in order not to overwhelm you with too much detail at once. As OOP may be a new programming paradigm to you, do make sure you get the basics clear, as the subsequent programming module (CS2030) expects a good grasp of full-fledged OOP in a short while.

Please be reminded of the submission deadline of **Problem Set 3: this Saturday 6pm**.

I. Manual Tracing on OOP

1. Consider the following class definition:

```
class Q1 {

  private int one;
  private int two;

  public Q1() {
    one = 1;
    two = 2;
  }

  public int changeOne() {
    one++;
    return one;
  }

  private int changeTwo() {
    two++;
    return two;
  }
}
```

Identify all the invalid statements in the following **user class**. For each invalid statement, state why it is invalid.

```
class TestQ1 {

  public static void main(String[] args) {
    Q1 obj;                                  // Line 1
    obj.one = 1;                             // Line 2
    obj.two = 2;                             // Line 3
```

```
    System.out.println( obj.changeOne() );  // Line 4
    System.out.println( obj.changeTwo() );  // Line 5
  }
}
```

2. Consider the following class definition:

```
class Q2 {

  private int count;

  public Q2() {
    count = 1;
  }

  public void increase() {
    count++;
  }

  public int getCount() {
    return count;
  }
}
```

(a) What's the output of the following **user method**?

```
public static void test1() {

  Q2 obj = new Q2();
  obj.increase();
  obj.increase();
  System.out.println( obj.getCount() );
}
```

(b) What's the output of the following **user method**?

```
public static void test2() {

  Q2 obj1 = new Q2();
  Q2 obj2 = new Q2();

  obj1.increase();
  obj2.increase();

  System.out.println( obj1.getCount() );
  System.out.println( obj2.getCount() );
}
```

3. The following class definition is slightly modified from that of Q2 above.

```
class Q3 {

  private int count;

  public Q3() {
    count = 1;
  }

  public int increase() {
    count++;
    return count;
  }

  public void setCount(int newCount) {
    count = newCount;
  }
}
```

(a) What's the output of the following **user method**?

```
public static void test3() {

  Q3 obj = new Q3();

  int val = obj.increase();
  obj.setCount(val);
  System.out.println( obj.increase() );
}
```

(b) What's the output of the following **user method**?

```
public static void test4() {

  Q3 obj = new Q3();

  obj.setCount( obj.increase() + obj.increase() );

  System.out.println( obj.increase() );
}
```

II. Manual Tracing on 2D Array

4. For each of the code fragments below, write down its output.

(a) [CS1010E AY2010/2011 Semester 2 Exam, Q4]

```
int[][] arr = {{1, 2, 3}, {4, 5, 6}, {7, 8, 9}};

for(int i = 0; i < 3; i++) {
  for(int j = 0; j < 3; j++) {
    System.out.print(arr[j][i] + " ");
  }
}
System.out.println();
```

(b) [CS1101C AY2008/2009 Sem1 Exam, Q10]

```
int[][] a = {{0, 1, 2, 3}, {1, 2, 3, 0},
             {2, 3, 0, 1}, {3, 0, 1, 2}};
int[] b = new int[4];

for (int i = 0; i < 4; i++) {
  b[i] = a[a[i][i]][a[i][i]];
}
System.out.println( Arrays.toString(b));
```

(c) [CS1101 AY2008/2009 Semester 1 Exam, Q4]

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

for (int i = 0; i < 3; i++) {
  for (int j = 0; j < 3; j++) {
    array[i][j] += array[j][i];
  }
}

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

III. Exploration

5. Study the following program.

```
import java.util.*;

class T7Q5 {

  public static void main(String[] args) {

    Scanner scanner = new Scanner(System.in);

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

    for (int row = 0; row < 2; row++) {
      for (int col = 0; col < 3; col++) {
        values[row][col] = scanner.nextInt();
      }
    }

    for (int row = 0; row < 2; row++) {
      System.out.println( Arrays.toString(values[row]) );
    }
  }
}
```

Enter the data in each of the following formats. Do they work? What can you deduce?

```
8 1 2
3 0 9
```

```
  8  1   2
 3  0     9
```

```
8 1
2 3
0 9
```

```
8
1 2 3

0 9
```

```
8
1
2
3
0
9
```

IV. Programming with 2D Arrays

6. **[Problem Set 3 Exercise #20] Min Max**

7. **[Problem Set 3 Exercise #23] Square Matrix**