**AMERICAN UNIVERSITY OF ARMENIA**
*College of Science and Engineering*
**COMP120 Introduction to Object-Oriented Programming**

# MIDTERM 1 EXAM

**Date:** Tuesday, February 17 2015
**Starting time:** 10:30
**Duration:** 1 hour 20 minutes
**Attention:** **ANY TYPE OF COMMUNICATION IS STRICTLY PROHIBITED**

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*Please write down your name at the top of all used pages*

**Problem 1**

Square arrays can be rotated by $90^0$, say, in clock-wise direction. For example:

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 |

→

| | | | | |
|---|---|---|---|---|
| 21 | 16 | 11 | 6 | 1 |
| 22 | 17 | 12 | 7 | 2 |
| 23 | 18 | 13 | 8 | 3 |
| 24 | 19 | 14 | 9 | 4 |
| 25 | 20 | 15 | 10 | 5 |

The easiest way to implement the rotation by $90^0$ is to transpose the initial square array and then to reverse all its rows separately. Write a Java method ***void rotate(int[][] array2D)*** that takes as its argument a square ***int[][] array2D*** and rotates its. Use already implemented methods ***void reverse(int[] array1D)*** and ***void transpose(int[][] array2D)***:

```
public static void reverse(int[] array1D) {
      for (int i = 0; i < array1D.length / 2; i++) {
            array1D[array1D.length - 1 - i] += array1D[i];
            array1D[i] = array1D[array1D.length - 1 - i] - array1D[i];
            array1D[array1D.length - 1 - i] -= array1D[i];
      }
}

public static void transpose(int[][] array2D) {
      for (int row = 0; row < array2D.length; row++)
            for (int col = row + 1; col < array2D.length; col++) {
                  array2D[row][col] += array2D[col][row];
                  array2D[col][row] = array2D[row][col] - array2D[col][row];
                  array2D[row][col] -= array2D[col][row];
      }
}
```

```
public static void rotate(int[][] array2D)
{
    array2D = transpose(array2D);
    for (int i=0; i<array2D.length; i++)
    {
        array2D[i] = reverse(array2D[i]);
    }
}
```

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see SS, LH, LH, MG, HG

*Use the backside, if needed*

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**Problem 2**

Colors in Java can be represented by objects of type ***Color***. Each such object contains the ***red***, ***green*** and ***blue*** components of the corresponding color as integer values from **0** to **255**. Consider below a Java code that creates and initializes a rectangular array of ***Color*** type:

```
import java.util.Scanner;
import java.awt.Color;

public class Colors {

public static void main(String args[]) {
      Scanner in = new Scanner(System.in);

// Read number of rows and columns and create a Color array of such size
      Color[][] c = new Color[in.nextInt()][in.nextInt()];

// For each element read the red, green and blue components as integers and
// create a Color object by calling Color(int, int, int) constructor
      for (int row = 0; row < c.length; row++)
            for (int col = 0; col < c[0].length; col++)
                  c[row][col] = new Color(in.nextInt(), in.nextInt(), in.nextInt());
// TO BE CONTINUED
}
}
```

Continue with a Java code that creates another array ***Color[][] g*** of the same size and fills it with gray equivalents of the colors from the array ***Color[][] c***. To get a grey equivalent of a given color ***c[i][j]***, it is enough to construct a ***Color*** object, whose red, green and blue components all are equal to the calculated average of red, green and blue components of the initial ***c[i][j]***. Use ***int getRed()***, ***int getGreen()*** and ***int getBlue()*** methods of class ***Color***.

```
Color[][] g = new Color[c.length][c[0].length];
for (int i=0; i< g.length; i++)
{
  for (int j=0; j< g[0].length; j++)
   {
   int average = (c[i][j].getRed()+c[i][j].getGreen()
                 + c[i][j].getBlue())/3
   g[i][j] = new Color(average, average, average);
   }
}
```

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**Problem 3**

Similar to files, strings also can be related to streams in C++, this time using ***stringstream*** objects. Particularly, it is enough to create an object of type ***istringstream*** to organize formatted reading from a string. Consider, for example, a C++ code below:

```
#include <string>
#include <sstream>
#include <iostream>
using namespace std;

void main()
{
	string text = "Before_increment: 199999999", word;
	int num;
	istringstream tokens(text);

	tokens >> word >> num;
	cout << "After " << word.substr(7) << num + 1 << endl;
}
// After increment:200000000
```

Write a C++ function ***double value(string expression)*** that takes as its argument a string representing an arithmetic expression, evaluates it and returns its value. The expression includes only '+' and '–' operations and double operands, both positive and negative. The operands and operations are delimited by spaces.

For example, ***value("5.1 – -0.7 + 1.2")*** results in *7.0*.

```
double value(string expression)
{
istringstream token(expression)
char actron;
double a;
double k;
tokens>>k;
while(tokens>>actron)
{if(actron == "+") '+'
{ tokens>>a;
k+=a;
} else if(actron == "-") '-'
{ tokens>>a;
k-=a;
} return k; }
```

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see LH, MG, SS, LJ

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*Use the backside, if needed*