**Name and, if possible, ID#:**__

**AMERICAN UNIVERSITY OF ARMENIA**

*College of Science and Engineering*

# COMP120 Introduction to Object-Oriented Programming

# MIDTERM 2 EXAM

|  |  |
|---|---|
| **Date:** | Tuesday, March 24 2015 |
| **Starting time:** | 10:30 |
| **Duration:** | 1 hour 20 minutes |
| **Attention:** | **ANY COMMUNICATION IS STRICTLY PROHIBITED** |

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

## Problem 1

The easiest way to implement rotation by **90⁰** of a square array is to transpose it and then reverse all its rows separately. Transposing once more after the rotation will result in vertical flip – the top row will appear at the bottom, the second row will become the last but one, etc. Write a C++ function ***void flip(int *a2D, int size)*** that takes as its argument a pointer to the first element of a square array ***int *a2D*** of the specified ***int size*** and flips it vertically. Use already implemented functions ***void reverse(int a1D[], int length)*** and ***void transpose(int *a2D, int size)***:

```
void reverse(int a1D[], int length)
{
        for (int i = 0; i < length / 2; i++)
                swap(a1D[i], a1D[length - 1 - i]);
}

void transpose(int *a2D, int size)
{
        for (int row = 0; row < size; row++)
                for (int col = row + 1; col < size; col++)
                        swap(a2D[row * size + col], a2D[col * size + row]);
}
```

```
void flip(int *a2D, int size)
{
  for (int col=0; col<size; col++)
     for (int row = col+1; row< size; row++)
     swap(a2D[col * size + row], a2D[row * size + col]);

  }
```

flip (int *a2D)
transpose(int * a2D)
flip(int * a2D/

OR

```
void flip(int *a2D, int size)
 { for (int row = 0; row<size; row++)
     for (int col= row + 1; col<size; col++)
       swap a2D[row * size + col], a2D[col * size + row]);

 }
```

=)

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```
swap(a1D[i], a1D[length-1-i]);}
```

– a row-by-row loop as required

```
{for (int row =0; row<size; row++)
    for (int col = row+1; col<size ;col++)
        swap(a2D [row*size+col] a2D[col*size+row]);
  }
```

Why not to use the existing reverse() and transpose()?

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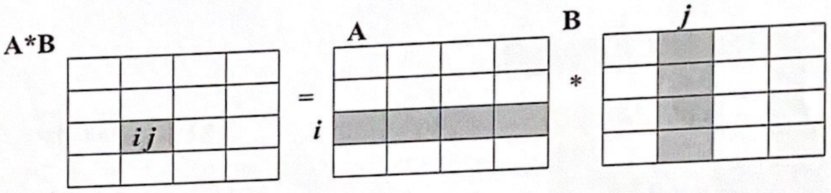
**Problem 2**

Using functions ***transpose()*** from **Problem 1** and ***scalar()*** from below, write a C++ function ***void mult(int *a2D, int *b2D, int *product, int size)*** that takes as its arguments pointers to the first elements of square arrays ***int *a2D*** and ***int *b2D*** of the same specified ***int size***, computes their product and saves it in another square array of the same size, the pointer to the first element of which is given by ***int *product***. Each element $p_{ij}$ in the $i^{th}$ row and $j^{th}$ column of the array ****product*** is the scalar product of the $i^{th}$ row of ****a2D*** and $j^{th}$ column of ****b2D*** and is calculated by the expression: $p_{ij} = \sum_{k=0}^{size-1} a_{ik} b_{kj}$

```
int scalar(int a[], int b[], int length)
{
        int result = 0;
        for (int i = 0; i < length; i++)
              result += a[i] * b[i];
        return result;

}
```



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void/m

~~void transpose(int*a2D, int size)~~

{
~~for(int row=0; row<size; row++)~~
~~for( (int col = row +1; col<size; col++)~~
~~swap(a2D[row*size +col]. a2D[col*size+row]);~~

}

=>

~~void mult(int *a2D, int *b2D, int *product, int size)~~

{
~~i~~ ~~int resu~~
~~for( (i++/ *product=0; *product<int size; *product++)~~
~~for~~ }

~~int int int array[i][j]~~ =>

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

Use the backside, if needed

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```
                                                ze)
[illegible]
  { trans pose( *B2D)
   for (i=0; i<int size; i++)
      for (j = 0; j<int size j++) }
```

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**Problem 3**

Using functions ***segment()*** from below and ***rotate()*** from **Problem 1**, write a C++ function ***void spiral2(int *a2D, int even_size)*** that takes as its argument a pointer to the first element of a square array ***int *a2D*** of the specified even size ***int even_size*** and fills it with two spirals of ***zeros*** and ***ones***. The entire first row starting from the first element is filled with ***zeros*** and, symmetrically, entire last row starting from the last element is filled with ***ones***. Then, the entire last column, except the last element, is filled with ***zeros*** and, symmetrically, the entire first column, except the first element – with ***ones***. And so on, until the central elements are reached. A shaded example is shown below:

```
int* segment(int *start, int length, int direction, int increment)
{
        for (; length > 0; length--)
        {
                *(start + direction) = *start + increment;
                start += direction;
        }
        return start;
}
```

|   | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 2 | 1 | 0 | 0 | 0 | 1 | 0 |
| 3 | 1 | 0 | 1 | 1 | 1 | 0 |
| 4 | 1 | 0 | 0 | 0 | 0 | 0 |
| 5 | 1 | 1 | 1 | 1 | 1 | 1 |

[0][0], [0][1],
[0][2], [0][3]
[0][4], [0][5] } 0

[5][0], [5][1]
[5][2], [5][3]
[5][4], [5][5] = } 1

[0][5], [1][5], [2][5]
[3][5], [5][5]
" 0

[2][3]

void spiral2(int * a2D, int even_size).

{
for(int i=0; i<length/2; i++)
swap(a2D[i]; a2D[length-1-i])
}.

~~for(k~~

in~~t array[5]~~[5].

~~// for (int row=0; row<array; row++)~~ [illegible]

~~for(int row=0; row<array; row++)~~

intarray int ~~firstrow[0][5]~~ =

6 6
int array[5][5] = {{0,0,0,0,0,0};{1,1,1,1,1,0};
{1,0,0,0,1,0},{1,0,1,1,1,0},{1,0,0,0,0,0}:
{1,1,1,1,1,1}.}

{ for (int row=0; row<array ; row++)
for(int col=0; col<array; col++) }.

cout<< array[row][col] < " ";

cout<<endl;

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}

Use the backside, if needed

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