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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 90^0 of a square array is to transpose it and then reverse all its rows separately. Write a C++ function ***void rotate(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 rotates its. 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 rotate(int *a2D, int size)
{
    for (int i = 0; i < size; i++)
        swap(a2D[i], a2D[size - 1 - i]);
}
```

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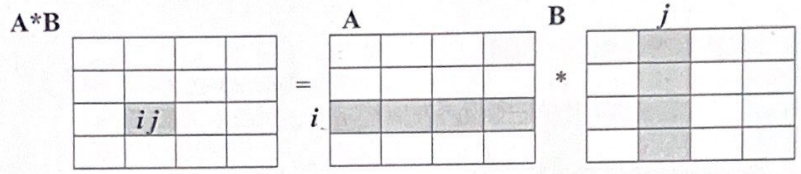
Problem 2

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;
}
```



{

~~for (int i=0~~

for (int j = 0; j < length; j++)

result += a[i] * b[i];

return result;

~~A*B 2D [i][j] ;~~

Void transpose (int * a2D, int size)

Void mult (int *a2D, int* b2d, int* product, int size)

~~While~~ int product = ~~0~~ a2D(i;j) * b2D(j;i)

~~for (a2D(i;j)~~

for (product=0 ; i,j < size, i++, j++)

return A*B2D [product];

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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	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

```
Void spiral(int* a2D, int even_size)

for (i=0 ; i< even_size; i++)

{ if (i= even_size'

Void rotate ()

if  j = even_size -1 ;

Void rotate ()

if i= even_size - 1',

Void rotate ()

return a2D(i,j);
}
```

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