

CSC 150 LAB 6-1 ARRAYS OF ARRAYS

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DEPT OF COMPUTER SCIENCE

1. REPRESENTATION OF MATRICES

Matrices are represented as arrays of arrays. Start with the following program, which creates a 4×4 matrix, fills it with random integers in the range $0 \dots 200$, and prints it out.

```
#include <iostream>
#include <ctime>
#include <cstdlib>
#include <iomanip>
using namespace std;

const int SIZE = 4;

// function to print the first nRows of a
// matrix with SIZE columns
void print(int mat[][SIZE] , int nRows)
{
    for (int row = 0; row < nRows; row++)
    {
        for (int col = 0; col < SIZE; col++)
        {
            cout << setw(5) << mat[row][col];
        }
        cout << endl;
    }
}

int main()
{
    // initialize random number generator
    srand(time(NULL));

    int matrix[SIZE][SIZE];

    // Fill the matrix with random values in range 0..200
    for (int row = 0; row < SIZE; row++)
    {
        for (int col = 0; col < SIZE; col++)
```

```

    {
        matrix[row][col] = rand() % 200;
    }
}

// output the matrix
cout << "Here is a random matrix of integers: " << endl;
print(matrix, SIZE);
}

```

The output should look like this:

Here is a random matrix of integers:

```

152  18  170  189
 27  190  90  158
149  180  23   70
 92   63  140  136

```

2. PRINTING THE TRANSPOSE OF A MATRIX

The *transpose* of a matrix is the same matrix, with the rows and columns interchanged. Add a function to your program

```
print_transpose(int mat[ ][SIZE], int nRows)
```

that takes a matrix as parameter and prints its transpose. Make use of the function to print the transpose. When you run the program, the output should look like this

Here is a random matrix of integers:

```

140  139  67  82
 9   82  161  50
 23  124  99  190
 98  100  25  25

```

Here is the transposed matrix:

```

140   9  23  98
139  82 124 100
 67 161  99  25
 82  50 190  25

```

3. PRINTING THE LOWER TRIANGULAR HALF OF THE MATRIX

Add a function

```
void print_lower_triangle(int mat[ ][SIZE], int nRows)
```

and make use of the function to print the lower triangular half:

Here is a random matrix of integers:

```

47  152  119  185
 8  133   25   57
32  132   25  146
41  194   88  158

```

Here is the transposed matrix:

```

47   8  32  41
152 133 132 194

```

```

119  25  25  88
185  57 146 158
Here is the lower triangular half:
  47
   8 133
  32 132 25
  41 194 88 158
Press any key to continue . . .

```

4. PRINTING THE UPPER TRIANGULAR HALF

Add a function

```
void print_upper_triangle(int mat[ ][SIZE], int nRows)
```

and make use of the function to print the upper triangular half:

Here is a random matrix of integers:

```

143  30 107  33
 94 148  84 177
133 181  75  64
151 118 184 100

```

Here is the transposed matrix:

```

143  94 133 151
 30 148 181 118
107  84  75 184
 33 177  64 100

```

Here is the lower triangular half:

```

143
 94 148
133 181 75
151 118 184 100

```

Here is the upper triangular half:

```

143  30 107  33
    148  84 177
        75  64
            100

```

5. TRANSPOSITION OF THE MATRIX IN PLACE

You can transpose the matrix in place, without introducing another matrix, just by swapping the entry in a position (r, c) with the entry in (c, r) .

Add a method

```
void transpose(int mat[ ][SIZE], int nRows)
```

that transposes a matrix in place. Add code to transpose the matrix and then print the transpose with the original `print(int mat[][SIZE], int nRows)` function.

Here is a random matrix of integers:

```

194 101 173 106
 16 158 105 143
 48 167 163 134
 28 137 102  85

```

Here is the transposed matrix:

```
194  16  48  28
101 158 167 137
173 105 163 102
106 143 134  85
```

Here is the lower triangular half:

```
194
 16 158
 48 167 163
 28 137 102  85
```

Here is the upper triangular half:

```
194 101 173 106
    158 105 143
        163 134
            85
```

Here is the transposed matrix:

```
194  16  48  28
101 158 167 137
173 105 163 102
106 143 134  85
```

6. DUE DATE

This lab is due Thursday of Week 6.