1st Midterm Exam: Solution
COEN 243: Programming Methodology I

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Instructions:

1. Time Allowed is 1 Hour. Total Marks are 100. **Answer ALL questions.**
2. No Material, No Calculators, and No Electronic Devices are allowed.
3. **Return the question paper (5 pages) before you leave the exam room.**

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4. **Handwriting must be clear and readable.**
5. Follow the course grading criteria as provided in the course web site.
6. Write readable code; add comments; select proper names; do not use global variable.
7. In all programming questions, separate declaration from implementation.
8. Full marks will be given to correct, general, and efficient solutions.

Pay attention to select the adequate C++ elements to implement your solution. Failure to do so may result in a very poor grade, for example, if you are asked to write a function and you include all code in main().

Q1 _____ (**30 marks**)

What is the *exact* output of the following code segment? Use a small rectangular to indicate a space character and a line to indicate an empty line, if needed.

```
for (int i = 0; i < 4; i++)
 {
  cout << i << " ";

  for (int j = 0; j <= i; j++)
   cout << j << " ";

  cout << endl;

  for (int k =4; k>i; k--)
   cout << k << " ";

  cout << endl;
 }
OUTPUT:
0 0
4 3 2 1
1 0 1
4 3 2
2 0 1 2
4 3
3 0 1 2 3
4
```

Q2 (**20 marks**)

Write a program that reads in the user's name: first and last, then prints out, on a new line, the first letter of the last name followed by a space, and then the full first name.

For example, if the input is *Frank Musterman* the program should produce *M Frank*.

Make use of the string class function(s).

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

int main()
{
  string fname, lname;

 cout << "Enter your full name (first followed by last name, i.e. John Doe): ";
 cin >> fname >> lname;

 //the string class member function at() is used to display the
 //first letter of the last name
 cout << lname.at(0) << " " << fname << endl;

 return 0;
}
```

Q3 (**50 marks**)

Write a program that allows the user to iteratively solve as many quadratic equations as desired.

Your program asks the user to input the parameters of a quadratics equation and it outputs either

- the two roots of the equation or
- a warning message for exceptional input data, e.g., "Division by zero" or "negative values".

The user enters a flag = 'F' when done, i.e., no longer wishes to solve more equations.

You program should be modular, i.e., divide it into functions:

- *root(...)* to find the roots. (What are the input arguments?)
- *error()* to output an error or a warning message. A message is of type *string* and should be passed to the function. (Carefully decide where to place this function!)

Note: $x_{1,2} = \frac{(-b \pm \sqrt{(b^2-4ac)})}{(2a)}$

```
#include <iostream>
#include <string>
#include <math.h>
using namespace std;

void error(string message)
{
   cout<< "error :"<< message << endl;
}

float root(float a, float b, float c, bool flag)
```

```
{
    if(flag)
     return  (-b+sqrt(b*b-4*a*c))/(2*a);
    else
     return (-b-sqrt(b*b-4*a*c))/(2*a);
}

int main()
{

 float a,b,c;
 char flag ;
 string msg = " ";

 float delta;

 flag = 'B';
 while(flag!='F')
  {
   cout<<"Enter the parameters a, b and c ";
   cout<<"for the quadratic equation aX^2+bX+c=0" << endl;
   cin>>a>>b>>c;

   if(a==0)
    {
     msg = "Division by Zero";
     error(msg);
    }
   else
    {
     delta = b*b-4*a*c;
     if ( delta < 0)
      {
       msg="Imaginary Numbers";
       error(msg);
      }
     else
     {
      cout << "The roots are"<< endl;
      cout << "x1 = " << root(a,b,c,true)  << endl;
      cout << "x2 = " << root(a,b,c,false) << endl;
     }
    }

    cout << "Enter F to stop or any letter to continue" << endl;
    cin  >> flag;
   }

  cout<< "Thank You" << endl;

  return 0;
}
OUTPUT:
Enter the parameters a, b and c for the quadratic equation aX^2+bX+c=0
```

```
0 2 9
error :Division by Zero
Enter F to stop or any letter to continue
k
Enter the parameters a, b and c for the quadratic equation aX^2+bX+c=0
9 1 8
error :Imaginary Numbers
Enter F to stop or any letter to continue
w
Enter the parameters a, b and c for the quadratic equation aX^2+bX+c=0
4 8 1
The roots are
x1 = -0.133975
x2 = -1.86603
Enter F to stop or any letter to continue
g
Enter the parameters a, b and c for the quadratic equation aX^2+bX+c=0
7 8 0
The roots are
x1 = 0
x2 = -1.14286
Enter F to stop or any letter to continue
F
Thank You
```

A bonus question:

Q4 _____ (**15 marks**)

Write a function (not a program) that computes the average test grade for each student in a class of 20. Four tests have been taken during the semester. Your program should work for different class sizes and tests taken. Check the program input.

```
//Here is a program-based solution. Convert to a function-based solution

//This program computes the average test grade for each student in a class.
#include <iostream.h>

int main ()
{
 int no_grds, no_stds;

 cout << ‘‘Enter class size’’; cin>>no_stds;
 cout << ‘‘Enter number of tests taken’’; cin>>no_grds;

 if(no_stds<=0 || no_grds<=0)
  {
   cout<<’’Incorrect input for class size or number of tests!!’’;
   exit(1);
  }

  float grade, total, average;
```

```
 Â Â Â  Â Â Â  Â Â Â  Â Â Â  Â Â Â  Â Â Â  Â Â  Â Â Â Â  Â Â Â  Â Â Â  Â Â Â  Â Â Â  Â Â Â  Â Â
Â  for (int i = 0; i < no_stds; i++ ) Â  Â  Â  //Start of outer loop
   {
    total = 0; Â  Â  Â  Â   //Reset total for next student
    for (int  j = 0; j < no_grds; j++ ) Â  //Start of inner loop
     {
        cout << ``Enter an exam grade for this student:'';
cin >> grade;
total = total + grade;
     }Â  Â //End of inner loop - totally contained within outer loop
Â Â Â  Â Â Â  Â Â Â  Â Â Â  Â Â Â  Â Â Â  Â Â Â  Â Â Â  Â Â Â
    if(no_grds>0)
     {
      average = total /no_grds;  Â //check for divide by 0
      cout << ``\nThe average for student ``<<i<< `` is ``<<average<< ``\n\n'';
     }
    }Â //End of outer loop

  return 0;
}// End of main()
```