CSCI 13500 Midterm Fall 2021 EMPLID

NAME: FIRST LAST

SEAT ROW NUMBER

1. (30 points) Answer the following questions.

   (1) What is the value of 6 / 5 * r * r * r when variable r is 2 in C++?
   Answer: 6 / 5 is integer division, which returns 1. So 6 / 5 * r * r * r when r is 2 is 8.

   (2) Declare function foo whose input parameter is int and return is a string. You just need to write the function header, no implementation is needed.
   Answer: Since we did not say anything about pass by reference or pass by value, you may have the following solutions, either one is fine.

```
string foo(int); //pass by value, formal parameter is not named or
string foo(int&); //pass by reference, formal parameter is not name or
string foo(int num); //pass by value, formal parameter is named or
string foo(int& num); //pass by reference, formal parameter is named
```

   (3) Write code to generate a random int in [100, 300].
   Answer: srand(time(NULL)); //can be omitted
   Int value = rand() % 201 + 100;
   Any answer with rand() % 201 + 100 is fine.

   (4) Given array of strings as follows
   string greetings[] = {"Hello", "Morning", "Hi"};
   What is the value for greetings[2].length()?
   Answer: greetings[2] is the third string in array greetings, so greetings[2].length() is 2.

   (5) Suppose we generate a.out, and we would like redirect the input from console to a file called data.txt. What is the command?
   Answer: a.out < data.txt

(6) What is the output of the following code?

```
int value = 1;
for (int i = 1; i < 6; i += 2)
    value *= i;

cout << value;
```

Answer: value is the product of 1, 3, and 5, so the output is 15.

(7) Write code to declare an array of int with size 100, call it **scores**. Initialize each element by 0.

Answer:

```
int scores[100];
for (int i = 0; i < 100; i++)
    scores[i] = 0;
```

(8) What is the output of the following code?

```
for (int i = 0; i < 3; i++)
 {
    for (int j = 0; j < 3; j++)
        if (i % 2 == j % 2)
            cout << "X";
        else cout << "O";

     cout << endl;
}
```

Answer: When i is 0, variable j goes through 0 to 2, condition i % 2 == j % 2 means i and j have the same parity, that is, both I and j are even or both I and j are odd, print X, otherwise, print out O.
So, the first row is XOX. Similarly, the second row is OXO, and the third row is XOX.
So the output is
XOX
OXO
XOX

(9) Write a condition to represent that both x and y are in the range of [0, 100], where both ends are included. Suppose x and y are properly declared and initialized.
Answer: condition that x is in [0, 100] is (x >= 0 && x <= 100). Condition that y is in [0, 100] is (y >= 0 && y <= 100). Condition that both x and y are in [0, 100] is (x >= 0 && x <= 100) && (y >= 0 && y <= 100)
Some students might write && as and. That is fine.
Warning: and cannot be written as AND.

(10) Suppose n is an int, write code to throw away its last digit? For example, suppose n is 21, after your code, n should be 2.

Answer: n = n / 10; or

n /= 10; //no space between / and =

Warning: n / 10 only returns all the digits of n except the last one. It does not let n throw away the last digit. Thus, n / 10 is not a correct answer.

2. (30 points) short answer questions

(2.1) Given three integers a, b and c, properly declared and initialized, write code to find out the largest number.

Answer:

```
int maxVal = a; //initialize a to be maximum

if (maxVal < b) //compare b with current maximum, if b is bigger, replace maxVal by b
  maxVal = b;

//compare c with current maximum, which is saved in maxVal, before running the
//following if statement, maxVal is the maximum of a and b.
//if c is bigger than the current maximum, replace current maximum with c.
//That is, set maxVal to be c.
if (maxVal < c)
  maxVal = c;
```

Another solution is to use max function from cmath library.

```
int maxVal = max(a, b); //find out the maximum of a and b
//find the maximum of maxVal and c and put the maximum to maxVal.
maxVal = max(maxVal, c);
```

(2.2) Read codes and write output.

```
void foo(int& a, int& b);

int main()
{
   int a = 11;
   int b = 6;

   foo(a, b);
   cout << "a = " << a << endl;
   cout << "b = " << b << endl;

   int c = 8;
   int d = 2;

   foo(c, d);
   cout << "c = " << c << endl;
   cout << "d = " << d << endl;

   return 0;
}

void foo(int& a, int& b)
{
   int temp;
   if (a % b != 0)
   {
      temp = a;
      a = b;
      b = temp;
   }
}
```

Answer: foo swaps a and b if a is not divide by b, otherwise, no change to a and b. Note that we use pass by reference in foo function, see & following int, so the values of a and b are swapped. Condition (a % b != 0) means the remainder of a divided by b is not zero, that is, a is not divided by b.

So, when a is 11 and b is 6, a is not divided by b, so the values of a and b are swapped after calling foo(a, b). So output is
a = 6
b = 11

When c is 8 and d is 2, variable c is divided by d, so c and d are not swapped – the if-body in foo function does not run – so c and d keep their original values. So output is
c = 8
d = 2

The output for the above code is
a = 6
b = 11
c = 8
d = 2

(2.3) Read code and answer questions.

```
string foo(int num)
{
  string result = "";
  do {
    result = to_string(num % 2) + result;
      //to_string convert an int to the corresponding string
    num /= 2;
  } while (num != 0);

  return result;
}
```

What are the return for foo(6) and foo(8)?

Answer:
When num is 6,

```
result = ""; //initialization

result = to_string(num % 2) + result;
     //6 % 2 is 0,
    //to_string(6 % 2) returns "0",
    // to_string(num % 2) + result; returns "0",
   //so result = "0".
num /= 2; //same as num = num / 2; so num is 3.

//3 is not 0, so come back to the loop body
result = to_string(num % 2) + result;
     //3 % 2 is 1,
    //to_string(3 % 2) returns "1",
    // to_string(num % 2) + result; returns "1" concatenated (followed by) "0",
   //so result = "10".
num /= 2; //same as num = num / 2; so num is 1.

//1 is not 0, so come back to the loop body
result = to_string(num % 2) + result;
     //when num is 1, expression num % 2 is 1,
    //to_string(1 % 2) returns "1",
    // to_string(num % 2) + result; returns "1" concatenated (followed by) "10",
   //so result = "110".
num /= 2; //same as num = num / 2; before this statement, num is 1, after it num is 0.
```

Now num is 0 and the do-while loop is finished. Return the value of result. So foo(6) returns "110".

A tabular representation is as follows.

num is initialized to be 6 when calling foo(6).
result = ""; //initialization before do-while loop
//The first two columns are statements inside the loop,
//the last column is condition to continue the loop.

result = to_string(num % 2) + result;	num /= 2;	num != 0
When num is 6, expression num % 2 returns 0. to_string(num % 2) returns string is "0". result is "0" concatenated by empty string, so result is "0".	3	yes
When num is 3, expression num % 2 returns 1. to_string(num % 2) returns string is "1". result is "1" concatenated by the previous value of result, which was "0", so result is changed to "10".	1	Yes
When num is 1, expression num % 2 returns 1. to_string(num % 2) returns string is "1". result is "1" concatenated by the previous value of result, which was "10", so result is changed to "110".	0	no

In fact, foo returns binary representation of num in the format of string.

So foo(8) returns "1000".

3. (20 points) **Define a function**, for a given string str, return a string whose letters are the even-index letters in str with the same order. That is, suppose str is “abc”, then return “ac”.

Answer: a code to define function is as follows.

```
string evenIndices(string source)
{
   string result = "";
   for (int i = 0; i < source.length(); i += 2)
      result += source[i];

   return result;
}
```

A complete code (including main function and necessary libraries.

```
//File name: /Users/laptopuser/Documents/courses/cs135/midterm/F21/evenIndexString.cpp
#include <iostream>
using namespace std;

string evenIndices(string source);

int main()
{
   cout << evenIndices("abc"); //sample output "ac"
   return 0;
}

string evenIndices(string source)
{
   string result = "";
   for (int i = 0; i < source.length(); i += 2)
      result += source[i];

   return result;
}
```

4. (20 points) Write code inside main function, no need to include libraries.
   (1) Enter two numbers a and b, which can contain decimals.
   (2) If a is larger than or equal to b, then calculate and output to the screen result of $\sqrt{a-b}$ + b^a.
   (3) Otherwise, calculate and print $\frac{a+5}{3(b-a)}$.

A solution

```
//declare a and b as double type.
double a, b;

//Enter values to a and b.
cout << "Enter values for a and b: ";
cin >> a;
cin >> b;

if (a >= b)
  cout << sqrt(a - b) + pow(b, a) << endl;
else cout << (a + 5) / ( 3 * (b - a) ) << endl;
```