COE 301 Introduction to Computer Programming Fall, 2019

Homework 7 – Due: 10/25/2019 9:00 am

Problem 1. (25 points) Short answers.

(1) [5 points] Explain what this function computes.

```
double somefunc(int n){

  if(n==1){
    return 1.0;
  }else{
    return somefunc(n-1)+1.0/n;
  }

}
```

(2) [2.5 points] what will the following code output?

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

void doubleNumber(int num){

  num = num*2;

}

int main(){

  int num = 35;
  doubleNumber(num);
  cout << num << endl;

  return 0;

}
```

(3) [2.5 points] what will the following code output? Explain why the result is different from problem 1(2).

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

void doubleNumber(int &num){
  num = num*2;
}

int main(){
  int num = 35;
  doubleNumber(num);
  cout << num << endl;
  return 0;
}
```

(4) [5 points] What is the output?

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

int main() {

  int x[5] = {-1, 9, -3, 2, 8};

  cout << "x =";
  for( int i=0; i<5; i++ ) {
    cout << " " << x[i];
  }
  cout << endl;

  return 0;

}
```

(5) [5 points] what is the output for the following code segment?

```
int x[7] = {3, 5, -1, 9, -3, 2, 8};
int y[5] = {0, 1, 2, 3, 5};
int *px;

px = x;
px[3] = 5;
cout << "x[3] =" << x[3] << endl;

px = y;
cout << "px[3] =" << px[3] << endl;
```

(6) [5 points] what is the output of the following C++ code?

```
int myArray[5] = {-3, 5, 10, -1, 4};
int *myPointer = myArray;
cout << myArray[2] << endl;

myArray[4] = myArray[0];
cout << myPointer[4] << endl;

myPointer[3] *= myArray[3];
cout << myArray[3] << endl;
```

Problem 2. (25 points) The Fibonacci sequence is defined as:

$x_0 = 0$ and $x_1 = 1$
$x_n = x_{n-1} + x_{n-2}$ for n= 2, 3, 4, ….

(1) Write a function `fibonacci_loop` that computes the n^{th} element x_n in the Fibonacci sequence **without using function recursion.** (2) Write another function `fibonacci_rec` that computes the n^{th} element x_n in the Fibonacci sequence recursively **without using any loops.** (3) Write a `main` program to validate both functions generate the same results for i = 0, 1, 2,…, 10. Add function prototypes before the main function.

Report your result in the write-up.
Please submit your .cpp file as "yourLastName_hw7_prob2.cpp".

Problem 3. (25 points) Write a function that takes an input argument vector<double> &x and returns the mean of all entries in x. Here the mean $\bar{x}$ is defined as:

$$\bar{x} = \frac{1}{N}\left(\sum_{i=1}^{N} x_i\right) = \frac{x_1 + x_2 + \cdots + x_n}{N}$$

where x_i is the i^{th} entry in x and N is the total number of entries in x.

Write another function that takes an input argument vector<double> &x and returns the standard deviation of all entries in x. Here the standard deviation s is defined as:

$$s = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \bar{x})^2}{N-1}}$$

where x_i is the i^{th} entry in x, $\bar{x}$ is the mean of all entries in x and N is the total number of entries in x. Write a simple test program to demonstrate that both functions generate the correct results for vector<double> x = {1.5, 5.5, -1.7, 9.6, 0, -2.7, 18.5};
Report your result in the write-up.
Please submit your .cpp file as "yourLastName_hw7_prob3.cpp".

Problem 4. (25 points) Write a function `isSorted` that takes an input vector of integers called vec and return true if vec is sorted in increasing order. Write a simple test program to demonstrate that the function returns the correct values for the following vector<int> vec inputs.
Report your result in the write-up.
Please submit your .cpp file as "yourLastName_hw7_prob4.cpp".

vec	Returns
{1, 2, 5, 6}	true
{5, 6, 0, 1}	false
{}	true
{10}	true
{10, 10}	true
{10, 10, 20}	true
{10, 10, 20, 5}	false

Submission Instructions:

There should be 4 files in your submission:

1. A write up (any type- .txt, .docx, .pdf are all fine) that contains your answers to all questions in problem 1-4.
2. The .cpp file for problem 2.
3. The .cpp file for problem 3.
4. The .cpp file for problem 4.

Please make sure your last name is included in the filename.