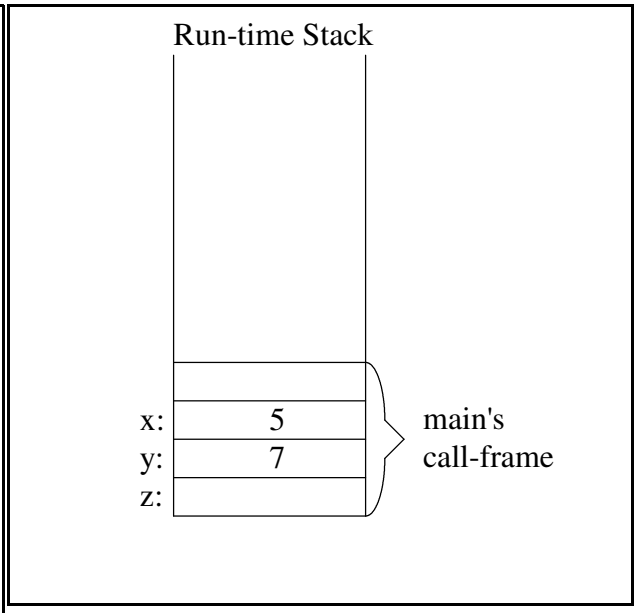
C/C++ Programming Test 2

Question 1. (15 points) Complete the tracing of the following code to show the expected output and the run-time stack as the program executes. Recall that a function's call-frame contains the return address, formal parameter(s), and local variable(s).

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

int doSomething(int a, int & b);

int main() {
   int x = 5, y = 7, z;

   z = doSomething(x, y);

   cout << "x = " << x << " y = " << y
        << " z = " << z << endl;
} // end main

int doSomething(int a, int & b) {
   int x = 3;

   x = 2 * a;
   b = x + b;
   return x;

} // end doSomething
```

Continue trace from here



Expected Output

Question 2. (10 points) Use the gradebook example discussed in class to describe what is meant by the term "*parallel arrays*".

columnTitles:

0	1	2	3	4	5		49
HW 1	HW 2	Lab 1	Lab 2	Test 1			

studentNames:

0	"Doe, Jane"
1	"Morse, Cody"
2	"Smith, John"
3	
99	

scores:

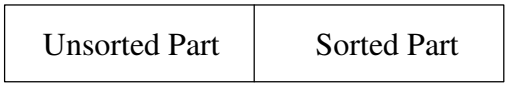
	0	1	2	3	4	5		49
0	1.0	2.0	3.0	4.0	5.0			
1	1.1	2.2	3.3	4.4	5.5			
2	10.0	20.0	30.0	40.0	50.0			
3								
99								

Question 3. (15 points) All simple sorts consist of two nested loops. The role of each loop is:

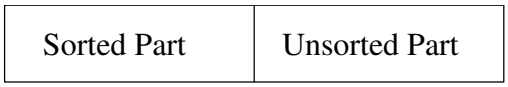
- outer loop - keeps track of the dividing line between the sorted part and unsorted part of the array
- inner loop - extends the size of the sorted part by one element

For each simple sort listed below, describe **in English** how the inner loop extends the size of the sorted part by one element. Assume that all sorts are sorting from smallest to largest elements (ascending order).

a) bubble sort:



b) selection sort:



Question 4. (35 points) Complete the following program by (1) writing the calls in the main to both functions, and (2) writing both of the functions: FillArray and FindFirstAndCount. These functions' prototypes are shown below, and they should behave as follows:

FillArray - reads values interactively into the "numbers" array until the specified sentinelValue is read. After the function, "elementCount" should reflect the number of values read into "numbers."

FindAll - scans the array "numbers" looking for all occurrences of "target". The index locations of all occurrence of "target" is returned in the "foundIndexes" array, and "foundCount" returns a count of the number of times "target" occurs in the array "numbers".

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

const int SIZE = 100;  // maximum number of elements in array

// function prototypes
void FillArray(double numbers[], int & elementCount, double sentinelValue);
void FindAll(double numbers[], int elementCount, double target, int foundIndexes[],
             int & foundCount);

int main ( ) {
   int countOfNumbers, targetCount, targetLocations[SIZE];
   double numbers[SIZE], sentinel = -999, target = 100;

   // COMPLETE THE CALLS TO THE FUNCTIONS

   FillArray(                                                              );

   FindAll(                                                                );

   if (targetCount == 0) {
      cout << "The target of " << target << " was not found." << endl;
   } else {
      cout << "The target " << target << " was found " << targetCount
           << " times with the first occurrence at " << targetLocations[0] << endl;
   } // end if
} // end main
```

```
// WRITE THE CODE FOR THE FUNCTIONS FillArray and FindAll BELOW
void FillArray(double numbers[], int & elementCount, double sentinelValue) {









} // end FillArray


void FindAll(double numbers[], int elementCount, double target, int foundIndexes[],
             int & foundCount) {









} // end FindAll
```

Question 5. (10 points) Suppose you have a sorted array containing 1,000 elements.
a) In the worst case, how many comparisons between the target and an array element would be performed in an **unsuccessful binary search**?

b) In the worst case, how many comparisons between the target and an array element would be performed in an **unsuccessful linear search** (assume the linear search algorithm **does not** expect the array is sorted)?

Question 6. (15 points) Below is the textbook's code for a *binary search* on a sorted array.

```
int binarySearch(int array[], int size, int value) {
   int first = 0,              // First array element
       last = size - 1,        // Last array element
       middle,                 // Mid point of search
       position = -1;          // Position of search value
   bool found = false;         // Flag

   while (!found && first <= last) {
      middle = (first + last) / 2;     // Calculate mid point
      if (array[middle] == value) {    // If value is found at mid
         found = true;
         position = middle;
      } else if (array[middle] > value) {  // If value is in lower half
         last = middle - 1;
      } else {
         first = middle + 1;           // If value is in upper half
      } // end if
   } // end while
   return position;
} // end binarySearch
```

Trace the `binarySearch` code using the following actual parameters by showing the changes to first, last, middle, position, and found.

	0	1	2	3	4	5	6	(MAX-1)
array:	2	3	4	5	7	8	9	

size: 7 value: 7

first	last	middle	position	found
0	6		-1	false