CSE 225

Homework 1

Question 1

(2.1) Analyze the running time of the function *InsertItem* shown below (sorted list). To get credit, you need to be as specific as possible.

```cpp
template <class ItemType>
void SortedType<ItemType>::InsertItem(ItemType item)
{
 int location = 0;
 bool found;

 found = false;
 while( (location < length) && !found) {

   if(item > info[location])
     location++;
   else
     found = true;

 }

 for(int index = length; index > location; index--)
   info[index] = info[index - 1];
 info[location] = item;
 length++;
}
```

(2.2) What are the main differences between static and dynamic array allocation?

Question 2

Order the following functions by growth rate: N, $\sqrt{N}$, $N^{1.5}$, N^2, $N \log N$, $N \log \log N$, $N \log^2 N$, $N \log(N^2)$, $2/N$, 2^N, $2^{N/2}$, 37, $N^2 \log N$, N^3. Indicate which functions grow at the same rate.

Question 3

For each of the following program fragments give an analysis of the running time using Big-Oh

```
(1)   sum = 0;
      for( i = 0; i < n; ++i )
          ++sum;
(2)   sum = 0;
      for( i = 0; i < n; ++i )
          for( j = 0; j < n; ++j )
              ++sum;
(3)   sum = 0;
      for( i = 0; i < n; ++i )
          for( j = 0; j < n * n; ++j )
              ++sum;
(4)   sum = 0;
      for( i = 0; i < n; ++i )
          for( j = 0; j < i; ++j )
              ++sum;
(5)   sum = 0;
      for( i = 0; i < n; ++i )
          for( j = 0; j < i * i; ++j )
              for( k = 0; k < j; ++k )
                  ++sum;
```

Question 4

The Sorted List ADT is to be extended with a Boolean member function, IsThere, which takes as a parameter an item of type ItemType and determines whether there is an element with this key in the list.

a. Write the specification for this function.

b. Write the prototype for this function.

c. Write the function definition using the binary search algorithm.

d. Describe this function in terms of Big-O notation.

Question 5

Using one or more stacks, write a code segment to read in a string of characters and determine whether it forms a palindrome. A palindrome is a sequence of characters that reads the same both forward and backward—for example: ABLE WAS I ERE I SAW ELBA.

The character '.' ends the string. Write a message indicating whether the string is a palindrome. You may assume that the data are correct and that the maximum number of characters is 80.

Question 6

Write the body for a function that replaces each copy of an item in a stack with another item. Use the following specification. (This function is in the *client* program.)

ReplaceItem(StackType& stack, ItemType oldItem, ItemType newItem)

Function:	Replaces all occurrences of oldItem with newItem.
Precondition:	stack has been initialized.
Postcondition:	Each occurrence of oldItem in stack has been replaced by newItem.

Question 7

Write the C++ code for evaluating a postfix expression (The algorithm was discussed in Stack and Queue Slide).

Question 8

One queue implementation discussed in this chapter dedicated an unused cell before the front of the queue to distinguish between a full queue and an empty queue. Write another queue implementation that keeps track of the length of the queue in a data member `length`.

a. Write the class definition for this implementation.

b. Implement the member functions for this implementation. (Which of the member functions have to be changed and which do not?)

c. Compare this new implementation with the previous one in terms of Big-O notation.