Homework 1
Data Structures and Object-oriented Programming

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Due: ***March 21, 2022***

1. a. The STL Algorithm *count* which has the syntax

   $$count(start, end, value)$$

   returns the number of occurrences of value in the range $[start, end]$. Write a program that uses this algorithm to determine the number of occurrences of $a[0]$ in the integer array $a[0:n-1]$. Test your code.

   b. Write <mark>a function</mark> for Matrix transpose.

2. Show that the following equalities are correct.
   a. $\sum_{i=0}^{n} i^2 = \Theta(n^3)$
   b. $n! = O(n^n)$

3. Show that the following equalities are incorrect.
   a. $10n^2 + 9 = O(n)$
   b. $\frac{n^2}{\log n} = \Theta(n^2)$

4. Implement a class *Complex,* which represents the Complex Number data type. Implement a constructor (including a default constructor which creates the complex number 0 +0i).

5. Implement a class *Quadratic* that represent 2-degree polynomials i.e., polynomials of type $ax^2 + bx + c$. Your class will require three data members corresponding Overload **operator+** to add polynomials of degree 2.

6. Implement *Qu*eue as a public derived class of Bag using templates.

7. What is the prefix form of the expression A * B * C?

8. Write and test a copy constructor for sparse matrices. What is the computing time of our copy constructor?

9. Use the insertion sort to put the elements of the list 3, 2, 4, 1, 5 in increasing order.

10. A palindrome is a string that reads the same forward, and backward. For example, **level**, **bob**, **civic**, and **radar** are all palindromic words.

    Write a C++ function for determining whether a string of *n* characters is a palindrome or not.