

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
$$\text{count}(\text{start}, \text{end}, \text{value})$$
returns the number of occurrences of value in the range $[\text{start}, \text{end}]$. 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 a function 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 *Queue* 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.