

Systems Software

Lab 5: Template Classes and Hash Tables

Lab Objectives

In this activity, students should demonstrate the following abilities:

1. Implement and test linked list and binary search tree template classes
2. Implement and test Hash Table class
3. Compare the three data structure performance for the search operation

Lab Assignment

In this lab, you will implement the three data structures, Linked List, BST, and Hash Table, and compare the performance of their search operation.

1. Create the class **Student** as seen in class with the data members **id**, **name**, and **gpa**. The class has two constructors, getters and setters for every data member, and overloading operator functions for the following operators: **==**, **>**, **<**, **>>**, and **<<**.
2. Create the template class **LinkedList** as seen in class.
3. Create the template abstract class **Tree** and the template class **BST** that inherits **Tree** as seen in class.
4. Create the class **HashTable** as seen in lecture 10 for the type **Student**.
5. Modify the search methods in the three classes to return the number of iterations performed to find, or not, the student record.
6. Write a C++ program that creates two instances of the classes **LinkedList** and **BST** for the type **Student** and a **HashTable** object with a capacity equal to **500**. The program reads in the text file **students.txt** and loads the students' information in the linked list, the BST, and the hash table using the insert methods from the three classes.
7. Create an array of 10 student IDs and initialize it to the following IDs: {91242, 87351, 13385, 55555, 37867, 98296, 22222, 62985, 33333, 48851}
8. Search for each student id, from the list above, in the three data structures. Display the number of iterations for each search operation as shown in the sample output below. What are your observations on the performance of the search operation in the three data structures? If you reduce the size of the hash table to 250, how does the performance of the search operation compare to that of the linked list and the BST?

9. Create a makefile to build the executable of the program.
10. Submit all your files on courseSite as a zipped folder named **lab5**.

----- Program Output -----			
ID	HASH	LL	BST
91242	3	500	1
87351	2	489	6
13385	4	404	9
55555	1	500	12
37867	1	143	12
98296	1	83	10
22222	1	500	9
62985	1	42	13
33333	1	500	8
48851	1	1	14