# Programming Assignment 4

Kirsten Madina

UIN 626003641

1. A description of the assignment objective, how to compile and run your programs, and an explanation of your program structure (i.e. a description of the classes you use, the relationship between the classes, and the functions or classes in addition to those in the lecture notes).
   a. The objective of this assignment is to familiarize ourselves with the binary tree ADT by implementing a basic binary tree.
   b. This program has two .cpp files and 1 .h file and to compile the program you use the command **g++ main.cpp BTree.cpp -std=c++11** and the executable command **./a.out** to execute the program.
   c. There are two classes involved in this program, including a BTree (binary tree) and a Node. The Node contains an integer value, a search_cost, and two pointers to the left and right child. A BTree has a pointer to it's root Node and an integer relating to size. As the tree grows, it contains more Nodes.
2. 2. A brief description of the data structure you created (i.e. a theoretical definition of the data structure and the actual data arrangement in the classes).
   a. A BTree has the data members listed above and the following functions: get_size(), get_root(), set_root(); insert(), search(), update_search_cost(), inorder(), print_level_by_level(). I used the helper functions preordercopy(), inorderprint() and search_cost_help() to recursively implement inorder() and update_search_cost() as well as the copy constructor.
3. I implemented the calculation for individual search cost by starting the search cost for the root at 1 and traversing through the tree recursively and for every Node, it's search cost would be 1 more than it's parent. Average search cost can be found by summing up the search cost for every node and dividing by the number of nodes. My algorithm did not work however and so the table is made by calculations by hand.
4. 
5. Include a table and a plot of average search cost you obtain. In your discussions of the experimental results, compare the curves of search cost with the theoretical analysis results presented in item 4.

| File | Number of Nodes | Avg Search Cost |
|------|-----------------|-----------------|
| 1l | 1 | 1 |
| 1r | 1 | 1 |
| 1p | 1 | 1 |
| 2l | 3 | 2 |
| 2r | 3 | 1.6 |
| 2p | 3 | 1.6 |
| 3l | 7 | 4 |
| 3r | 7 | 2.71 |

| | | |
|---|---|---|
| 3p | 7 | 2.42 |
| 4l | 15 | 8 |
| 4r | 15 | 3 |
| 4p | 15 | 3.26 |