# CS 202, Summer 2012
Homework Assignment 4
Due: 23:59, July 24, 2012

In this assignment, you are supposed to implement a binary search tree (BST) and a 2-3-4 tree with simple insert and retrieve methods. Your program will first read integers from an input file and build the corresponding BST and 2-3-4 tree. This input file consists of an unsorted list of integers. Your program MUST build the trees by inserting these integers in the order that they appear in the input file.
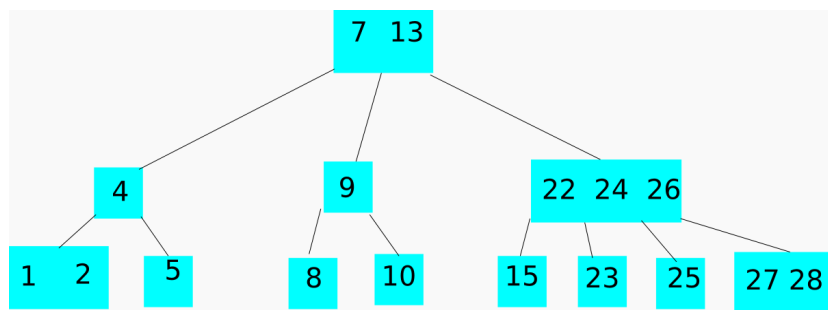
After building the trees, your program will read the second input file (query) that contains sample integers, search each of these sample integers in the tree, and generate an output file consisting of search statistics as given below. For example, for the numbers.txt file given below, your program builds the corresponding BST and 2-3-4 tree. In this file, there is an integer at each line. An example of more comprehensive file could be found at http://www.cs.bilkent.edu.tr/~ogur/cs202/numbers.txt. In this assignment, you may assume that an integer is not listed twice.

Sample Input File
(numbers.txt)

```
8
7
1
4
5
2
13
9
10
15
22
23
24
25
26
27
28
```
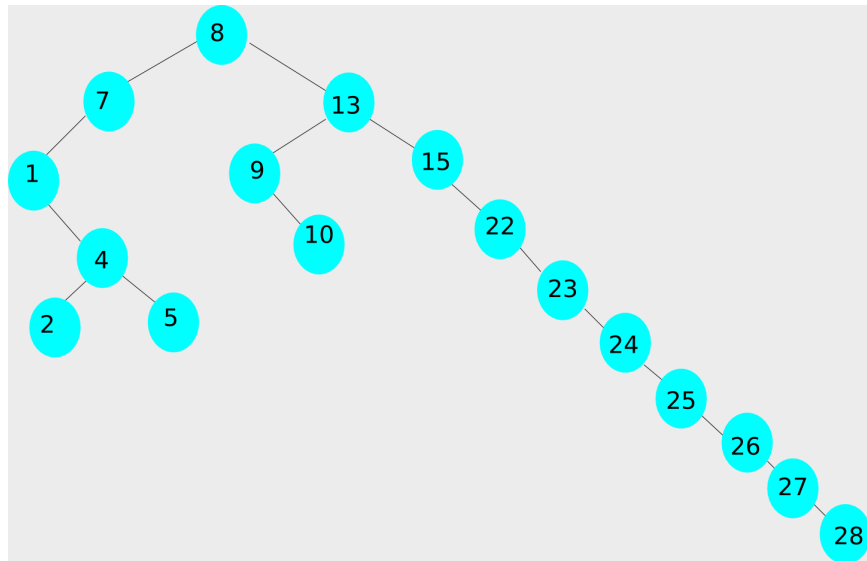

BST

2-3-4 Tree

After building the trees, you need to retrieve the integers given in the second input file (query) and print the results into an output file (output). An example of the query file and its corresponding output file are given below. Your program will search each sample integer in the query file in both the BST and the 2-3-4 tree and print the number of key comparisons that are made to search the number into the output file. Please note that, for 2-3-4 trees, the number of comparisons at a 2-node is 1, at a 3-node is 2 and at a 4-node is 3.

For example, using the input file given above, your program should print "true 4 3 4" for the integer "4". This output means that the number is found in the trees, the number of comparisons for the BST search tree is 4, and the number of comparisons for the 2-3-4 tree is 3. As another example, your program should print "false 4 4 12" for the integer "12". The outputs of all sample numbers in the query file are given below.

Sample Query File (query.txt)

| 4 |
| 12 |
| 28 |

Sample Output File (output.txt)

True	4	3	4
False	4	4	12
True	10	7	28

The name of the input file, the query file, and the output file will be provided as command line arguments to your program. Thus, we call your programs using three command line arguments in the following format:
user@dijkstra:~>./search <inputFile> <queryFile> <outputFile>

Notes:
1. This assignment is due by 23:59 on Tuesday, July 24th, 2012. You should upload your homework to the upload page (http://www.cs.bilkent.edu.tr/~ogur/cs202/hw4.html) before the deadline. No hardcopy submission is needed. The standard rules about late homework submissions apply. Please see the course syllabus for further discussion of the late homework policy as well as academic integrity.
2. Your code must not have any memory leaks. You will lose points if you have memory leaks in your program even though the outputs of the operations are correct.
3. You should upload all files as a single zip file.
4. You are free to write your programs in any environment (you may use either Linux or Windows). However, we will test your programs on "dijkstra.ug.bcc.bilkent.edu.tr" and we will expect your programs to compile and run on the "dijkstra" machine. If we could not get your program properly work on the "dijkstra" machine, you would lose a considerable amount of points. Thus, we recommend you to make sure that your program compiles and properly works on "dijkstra.ug.bcc.bilkent.edu.tr" before submitting your assignment.