



### Objectives of this assignment:

- To verify empirically Theorem 12.3 (Chapter 12, Textbook) that states:  
“The expected height of a randomly built binary search tree on  $n$  distinct keys is  $O(\lg n)$ .”

### What you need to do:

1. Implement the *Tree-Insert*( $T, z$ ) operation on a binary search tree.
2. Repeatedly Insert  $n$  randomly picked numbers in a binary search tree and collect the height  $h$ .
3. Plot on the same plot the quantity  $h/\lg(n)$  versus  $n$ .
4. Discuss the results.

### Objective:

The objective of this programming assignment is to verify empirically Theorem 12.3 that states that “the expected height of a randomly built binary search tree on  $n$  distincts keys is  $O(\lg n)$ .”

In order to conduct this experiment, you must implement in Java the *Tree-Insert*( $T, z$ ) operation. Below, I explain in pseudocode the program you must write to collect data and verify Theorem 12.3.

### Program to implement

```
collectData()
  for n = 250 to 10,000 by 250 // 250, 500, 750, ... 10,000
    sum_heightn = 0
    for j = 1 to 10 do //Take 10 measurements mj for j=1 to 10
      for i = 1 to n
        pick randomly a number p in the range [0,n]
        create a node z
        set z.key = p
        Tree-Insert(T,z)
        Measure the height hj of the tree
        Discard Tree
        sum_height += hj
    collect Height(n)= sum_heightn/10 // Average height for n
    Write in a file F the value n and Height(n)
```

### Data Analysis

Use any plotting software (e.g., Excel) to plot the quantity  $\text{Height}(n)/\lg n$  in File F as a function of  $n$ . File F is the file produced by the program you implemented. Discuss your results based on the plots.

### Report

- Write a report that will contain, explain, and discuss the plot. The report should not exceed one page.
- In addition, your report must contain the following information:
  - whether the program works or not (this must be just ONE sentence)
  - the directions to compile and execute your program
- Good writing is expected.
- Recall that answers must be well written, documented, justified, and presented to get full credit.

### What you need to turn in:

- Electronic copy of your source program (standalone)
- Electronic copy of the report (including your answers) (standalone). Submit the file as a Microsoft Word or PDF file.

### Grading

- Program is worth 30% if it works and provides data to analyze
- Quality of the report is worth 70% distributed as follows: good plot (25%), explanations of plot (10%), discussion and conclusion (35%).