

Homework Assignment #1

Problems

- Write a recursive algorithm that returns the number of 1's in the binary representation of an input integer N . Use the fact that this is equal to the number of 1's in the representation of $N/2$, plus 1 if N is odd.
- Let f_i be the Fibonacci numbers as defined in class (*i.e.*, $f_0 = 0, f_1 = 1, \dots, f_N = f_{N-1} + f_{N-2}$). Prove the following:

$$\sum_{i=0}^{N-2} f_i = f_N - 1$$

- For each of the following program fragments, give the big-Oh analysis and justify your answer.

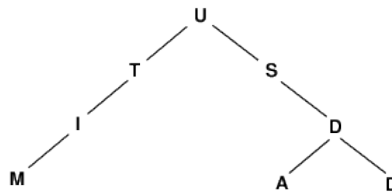
(a)

```
sum = 0;
for(int i=0; i < N ;i++)
    for(int j=0; j < N*N ;j++)
        sum++;
```

(b)

```
sum = 0;
for(int i=0; i < N ;i++)
    for(int j=0; j < i*i ;j++)
        for(int k=0; k < j ;k++)
            sum++;
```

- Exercise 3.3 in page 85. [Growth rate]
- Determine the best asymptotic upper (\mathcal{O}) and lower (Ω) bounds for each of the following functions, and justify your answer.
 - $3n^5 + 5n^2 + 3n - 1$
 - 2^{n+5}
 - $\sum_{i=1}^n i^2$
- Exercise 3.11 in page 86. [Asymptotic analysis]
- Write an algorithm in pseudo-code that converts a fully-parenthesized infix expression into a postfix expression.
- Below is a binary tree containing character data.



Describe the characters encountered in pre-, post- and inorder traversal.

- Exercise 5.28 in page 191. [Huffman Coding]
- Exercise 5.29 in page 191. [Huffman Coding]
- Show the result of inserting 3, 1, 4, 6, 9, 2, 5, 7 into an initially empty binary search tree. Show the result of deleting the root node.

12. Consider building two binary search trees containing integer keys from 1 to 63 inclusive, inserted into the trees in the following orders.
- (a) All the odd integers in order $(1, 3, 5, \dots, 63)$, then 32, 16, 48, then remaining even integers in order $(2, 4, 6, \dots, 62)$.
 - (b) All the odd integers in order $(1, 3, 5, \dots, 63)$, then remaining even integers in order $(2, 4, 6, \dots, 62)$.

Which of these trees will be quicker to build? Explain why without actually drawing the trees.

13. Exercise 13.5 in page 454. [AVL Tree]
14. Exercises 13.6 and 13.7 in page 454. [Splay Tree]

Due date

There is no due date for this homework assignment because it will not be graded. The purpose of this homework assignment is to provide students with additional opportunities to review the materials covered in the class.