

COMP 5112 Data Structures and Database Systems

Assignment 1

PolyU, Hong Kong

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Logistics: You should submit your solutions through Blackboard. The deadline is Sunday September 19, 11:59 PM. I will not accept submission from any other channels except Blackboard. These are the best exercises that could help you be well prepared for quizzes. Thus, please work independently.

Problem 1 (3 points)

Rank the following functions in order of complexity, from the least complex to the most complex.

$8n!$, $\log 9n$, $2n \log n + 7n^2$, $4n + 6 \log n$, $5n^3 + 6n^2$, $0.00001 \times n^n$.

Problem 2 (10 points) If you have proposed five frameworks and the running times are listed as follows. What are the time complexities of your frameworks in big-O notation (in the simplest form)?

(A) $4n + 6 \log n$.

(B) $30n + 2n \log(9n) + 800$.

(C) $1n + 2n + 3n + 4n + 5n + 6n$.

(D) $\sum_{i=1}^n 3n$.

(E) $\sum_{i=1}^n (i \times n)$.

Problem 3 (28 points) Assume that you have written seven code fragments. What is the order of growth of their running times as a function of N in big-O notation? Explain and justify your answer in detail.

(A)

```
1 int function1(int N) {  
2     int sum = 0;  
3     for (int i = 0; i < N; i++)  
4         sum += 1;  
5     for (int j = 1; j < N; j*= 2)  
6         sum += 1;  
7     return sum;  
8 }
```

(B)

```
1 int function2(int N) {
2     int sum = 0;
3     for (int i = 1; i < N; i *= 2)
4         for (int j = 1; j < N; j++)
5             sum += 1;
6     return sum;
7 }
```

(C)

```
1 int function3(int N) {
2     if (N > 0)
3         return 1 + function3(N-1);
4     else
5         return 0;
6 }
```

(D)

```
1 int function4(int N) {
2     int sum = 0;
3     for (int i = 0; i < N; i++)
4         sum += 1;
5     if (N > 0)
6         return sum + function4(N-1);
7     else
8         return 0;
9 }
10 }
```

(E)

```
1 int function5(int N) {
2     int sum = 0;
3     for (int i = 0; i < N; i++)
4         sum += 1;
5     if (N > 1)
6         return sum + function5(N/2);
7     else
8         return 0;
9 }
```

(F)

```
1 int function6(int N) {
2     if (N == 0)
3         return 0;
4     else
5         return function6(N-1) + function6(N-1);
6 }
```

(G)

```
1 int function7(int N) {  
2     int sum = 0;  
3     for (int i = 0; i < N; i++)  
4         sum += 1;  
5     if (N > 1)  
6         return sum + function7(N/2) + function7(N/2);  
7     else  
8         return 0;  
9 }
```

Problem 4 (3 points) What are the pros and cons of linked lists, comparing with arrays? (You have to use your own words. Copying from the slides would not get any credits.)

Problem 5 (3 points) Given an empty stack, an intermixed sequence of push and pop operations are performed on it. The pushes push the integers 0 through 9 in order; the pops print out the return value. Which of the following sequence(s) can never occur?

- (A) 1 4 7 9 8 6 5 3 0 2
- (B) 0 4 6 5 3 8 1 7 2 9
- (C) 4 3 2 1 0 9 8 7 6 5
- (D) 1 2 3 4 5 6 9 8 7 0
- (E) 4 6 8 7 5 3 2 9 0 1
- (F) 2 5 6 7 4 8 9 3 1 0

Problem 6 (2 points) Given an empty queue, a client performs an intermixed sequence of enqueue and dequeue operations on it. The enqueue operations put the integers 0 through 9 in order onto the queue; the dequeue operations print out the return value. Which of the following sequence(s) can never occur?

- (A) 4 3 2 1 0 5 6 7 8 9
- (B) 0 1 2 3 4 5 6 7 8 9
- (C) 2 5 6 7 4 8 9 3 1 0
- (D) 4 6 8 7 5 3 2 9 0 1

Problem 7 (4 points) Apply preorder traversal to the binary tree in Figure 1 and list the printed nodes in order.

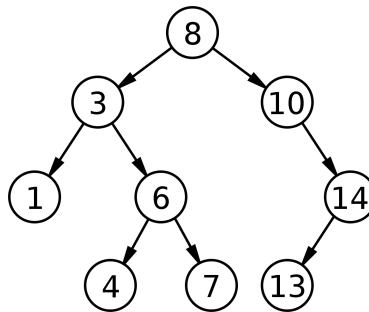


Figure 1: The first binary tree.

Problem 8 (3 points) Apply inorder traversal to the binary tree in Figure 2 and list the printed nodes in order.

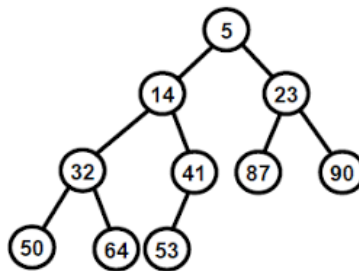


Figure 2: The second binary tree.