

University of Nevada, Las Vegas Computer Science 477/677 Fall 2024

Assignment 3:

Name: _____

This assignment will not be graded. Answers will be posted on Tuesday September 23, 2024.

1. Here is a prefix code for the alphabet $\{E, H, L, O, R, W\}$. Why is it called a prefix code?

D	00
E	10
H	110
L	010
O	011
R	1110
W	1111

Decode the string

110100100100111111011111001000

2. Let L be the language generated by the following CNF (Chomsky Normal Form) grammar.

$$S \rightarrow AS \mid CD \mid e$$

$$C \rightarrow AS$$

$$D \rightarrow BS$$

$$A \rightarrow a$$

$$B \rightarrow b$$

Use the CYK algorithm to

determine whether $aaebae \in L$.

3. Solve the following recurrences using the anti-derivative method.

(a) $F(n) = F(n-1) + n^2$

(b) $F(n) = F(n - \log n) + \log n$

4. Solve the following recurrences using the master theorem.

(a) $F(n) = 2F(n/2) + n$

(b) $F(n) = F(n/2) + 1$

(c) $F(n) = 4F(n/2) + n$

(d) $F(n) = 4F(n/2) + n^2$

(e) $F(n) = 4F(n/2) + n^3$

5. Solve the following recurrences.

(a) $F(n) = 2F(n - 1) + 1$

(b) $F(n) = F(\sqrt{n}) + 1$ Hint: use substitution.

(c) $F(n) = F(\log n) + 1$ You may have a hard time finding this on the internet.

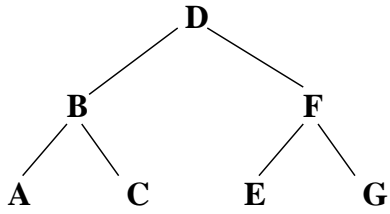
6. Find the value of each expression.

(a) $\log_4 \sqrt{2}$

(b) $4^{\log_9 27}$

7. Illustrate a circular queue whose items are F , K , L , Q in that order. Then, illustrate the steps of inserting item R .

8. Given the following binary tree:



Write the nodes in inorder, preorder, postorder, and level order.

9. Suppose a stack of integers is implemented as a linked list, as in the handout:

```
struct stacknode;
typedef stacknode*stack;
struct stacknode
{
    int item;
    stack link;
}
```

Write C++ code for the operators push and pop.

10. Assume that A is an array declared as follows: `int A[N]`; Finish writing C++ code for determining whether a given number x is an entry of A , assuming that A is sorted in increasing order.

```
bool findinA(int x)
```

11. Use Huffman's algorithm to find an optimal prefix code for the alphabet $\{A, B, C, D, E\}$ with the following frequencies.

A	11
B	5
C	8
D	14
E	20

12. Given the list E U W R B Q P X H L Z G, walk through two sorting algorithms for that list, polyphase mergesort and heapsort.