

Homework 7, CPSC 4100 – 01, Winter 2017

I have not received unauthorized aid on this assignment. I understand the answers that I have submitted. The answers submitted have not been directly copied from another source, but instead are written in my own words.

1) What is an optimal Huffman code for the following set of frequencies, based on the first 8 Fibonacci numbers? a:1 b:1 c:2 d:3 e:5 f:8 g:13 h:21 Can you generalize your answer to find the optimal code when the frequencies are the first n Fibonacci numbers?

a: 1111111
b: 1111110
c: 111110
d: 11110
e: 1110
f: 110
g: 10
h: 0

For the first n Fibonacci numbers as frequencies and $i = 1$ to n , the i^{th} frequency has $(n - i)$ ones followed by $(1 - i)$ zeros.

2) Generalize Huffman's algorithm to ternary codewords (i.e., codewords using the symbols 0, 1, and 2), and write down the corresponding pseudo-code using priority queue.

Instead of joining the 2 lowest frequencies, we join the lowest 3 frequencies.

Huffman(C)

```
1   $n = |C|$ 
2   $Q = C$ 
3  for  $i = 1$  to  $n - 1$ 
4      allocate a new node  $z$ 
5       $z.left = x = \text{Extract-Min}(Q)$ 
6       $z.mid = w = \text{Extract-Min}(Q)$ 
7       $z.right = y = \text{Extract-Min}(Q)$ 
8       $z.freq = x.freq + w.freq + z.freq$ 
9      Insert( $Q, z$ )
10 return Extract-Min( $Q$ )    // return the root of the tree
```

3) Use Dijkstra shortest path algorithm to determine shortest paths from S to other nodes in the following graph. Show all the steps in a table.

Step	Last Node	Current Node	S	T	X	Y	Z
1	-	S	0, -	∞ , -	∞ , -	∞ , -	∞ , -
2	S	T		3, S		5, S	
3	T	Y			9, T	5, T	
4	Y	X		3, S	9, Y		11, Y
5	X	Z					11, X
6	Z	-	0, -		9, Y		

Shortest path from S to: T = S, T with weight 3

X = S, T, Y, X with weight 9

Y = S, T, Y with weight 5

Z = S, T, Y, X, Z with weight 11