

## 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  $i^{\text{th}}$  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 = Extract-Min (Q)
6       z.mid = w = Extract-Min (Q)
7       z.right = y = 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, - | $\infty, -$ | $\infty, -$ | $\infty, -$ | $\infty, -$ |
| 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