University of Nevada, Las Vegas Computer Science 477/677 Fall 2023

Assignment 4: Due Friday October 13 2023 11:59 PM

Upload your homework to Canvas.

Name:_____

You are permitted to work in groups, get help from others, read books, and use the internet. Your answers must be written in a pdf file and uploaded to canvas, by midnight September 2nd. Your file must not be unnecessarily long. If you have any questions, or you are having trouble uploading the assignment you may email the grader, Sebrina Wallace, at `wallace4@unlv.nevada.edu`. You may also send me email to ask questions.

1. Fill in the blanks. No shortest path algorithm works for a weighted directed graph which has a _____ _____.

2. Use Huffman's algorithm to find an optimal prefix code for the alphabet $\{a, b, c, d, e, f\}$ where frequency of each symbol is given in the following array.

a	6
b	4
c	2
d	5
e	20
f	1

3. What is the asymptotic time complexity of the function `george(n)` given below? Hint: The answer is one of the following: $\Theta(\log n)$, $\Theta(n)$, $\Theta(n \log n)$, $\Theta(n^2)$.

```
void george(int n)
 {
  for(int i = 0; i < n; i++)
   cout << "Hello world" << end;
  if(n > 1)
   {
    george(n/2);
    george(n/2);
   }
 }
```

4. Write pseudocode for the Floyd-Warshall algorithm on a weighted directed graph with n vertices. Let the vertices be $x[1], \ldots x[n]$. Let $w[i, j]$ be the given weight of the arc from $x[i]$ to $x[j]$, which is ∞ if there is no such arc. The algorithm should output arrays v and b, where $v[i, j]$ is the minimum weight of any path from $x[i]$ to $x[j]$, and $b[i, j]$ is the backpointer of that path.

5. Write pseudocode for the Bellman-Ford algorithm on a weighted directed graph with n vertices and m edges. Let the vertices be $x[1], \ldots x[n]$, let $x[1]$ be the source vertex. and let the edges be $e[1], \ldots e[m]$, where $e[j]$ is an arc from a vertex $s[j]$ to a vertex $t[j]$, and $e[j]$ has weight $w[j]$. The output consist of values $v[1], \ldots v[n]$, where $v[i]$ is the least weight of any path from $x[1]$ to $x[i]$, as well as backpointers $b[2], \ldots b[n]$. Your code should include the shortcut which terminates the execution when the correct values of the $v[i]$ have been computed.

6. Find a dynamic programming algorithm for the following coin-row problem. There is a row of n coins, each of which has some value, and the algorithm needs to find a set of coins of maximum total value, such that there are no three consecutive coins in the set.

7. Work problems 1 and 5 of the complex number assignment.