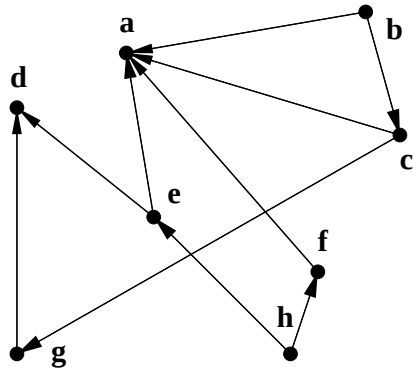
University of Nevada, Las Vegas Computer Science 477/677 Fall 2021

Practice for the Examination November 15, 2021

The entire practice examination is 250 points.

1. [20 points] Write the array of in-neighbor lists and the array of out-neighbor lists for the directed graph shown below.



2. [20 points] Explain how to implement a sparse array as a search structure of ordered pairs.

3. Consider the following recursive C++ function.

```
int f(int n)
 {
  if(n > 0) return f(n/2)+f(n/4)+f(n/4 + 1)+n;
  else return 0;
 }
```

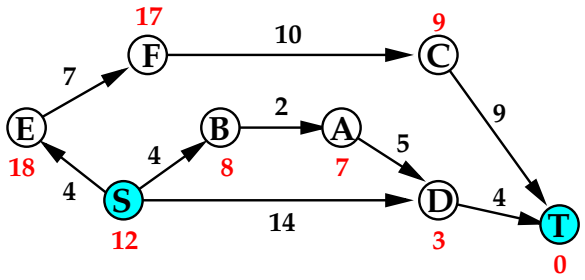
   (a) [10 points] What is the asymptotic complexity of f as a function of n, using Θ notation? using Θ notation?

(b) [10 points] What is the asymptotic time complexity of this code as a function of n, using Θ notation?

(c) [10 points] Write pseudo-code for a dynamic programming algorithm to compute $f(n)$ for a given n. What is the asymptotic time complexity of your code as a function of n, using Θ notation?

(d) [20 points] Write pseudo-code for a memoization algorithm to compute $f(n)$ for a given n. What is the asymptotic complexity of the algorithm in terms of n, using Θ notation?

4. [20 points] Walk through the A^* algorithm for the weighted directed graph shown below, where the pair is (S, T). The heuristic is shown as red numerals.


17
9
F
10
C
7
2
9
E
B
A
5
18
4
8
7
4
S
D
4
14
T
12
3
0

.

5. [20 points] Find the Levenshtein edit distance from the word "mennoover" to the word "maneuver." Show the matrix.

6. (a) [0 points] Find the longest strictly monotone increasing subsequence of the sequence 1,5,2,2,4,8,7. The answer might not be unique. If there are choices, give just one answer.

   (b) [20 points] Write pseudocode for finding the length of the longest strictly monotone increasing subsequence of any given sequence of integers. (Hint: Use dynamic programming.)

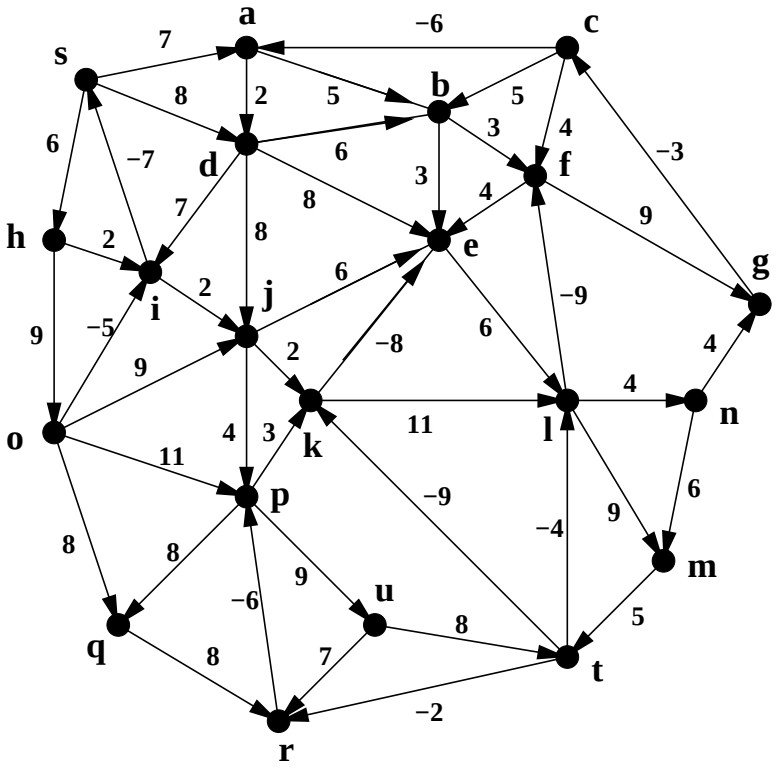
7. [20 points] Write pseudocode for the Bellmain-Ford algorithm. What is its asymptotic time complexity?

8. [20 points] Write pseudocode for the Floyd-Warshal algorithm. What is its asymptotic time complexity?

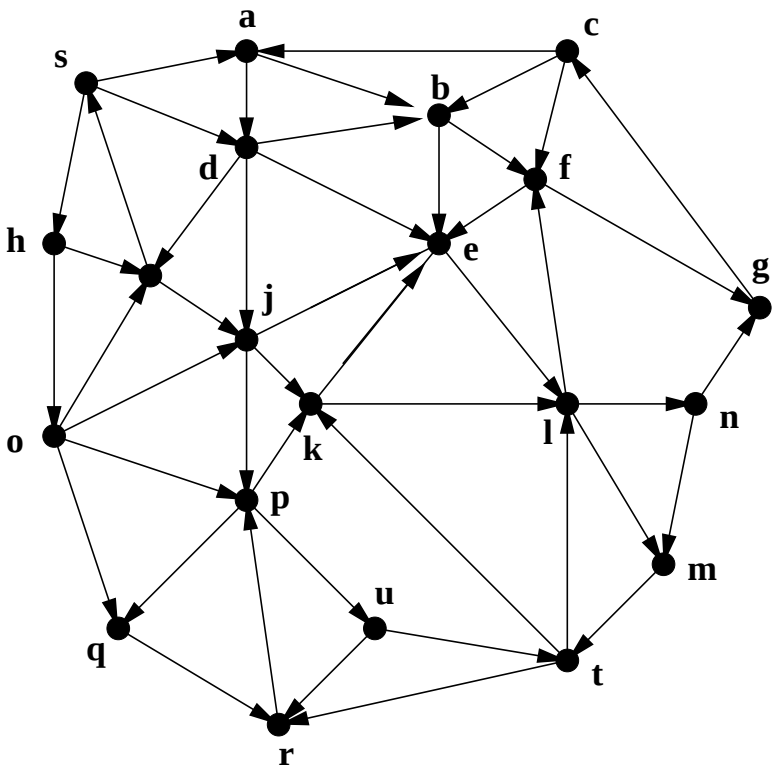
9. [20 points] Write pseudocode for a DP algorithm which finds the maximum sum of any subsequence of a given sequence of positive numbers, where the subsequence cannot have two consecutive terms of the original sequence.

10. [40 points]

The first step of Johnson's algorithm is to compute the heuristic function On the weighted directed graph (a) below, label each node of (a) with the correct heuristic. (You do not have to show the steps of the algorithm for this. The example is small enough that you can simply compute the values in your head.) The next step is to adjust the arc weights. Label the arcs of (b) with the adjusted weights.



(a)



(b)