

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

Assignment 5: Due Monday October 11, 2021 11:59 pm

Name: _____

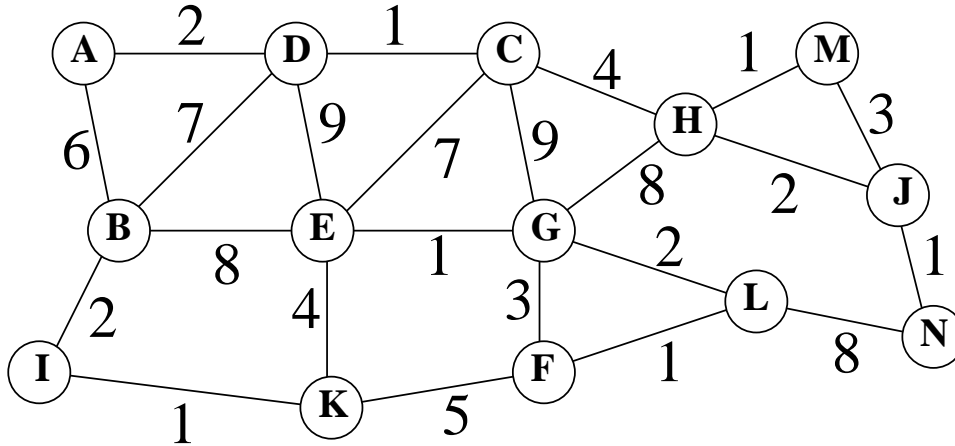
You are permitted to work in groups, get help from others, read books, and use the internet. Turn in the completed assignment on canvas, using instructions given to you by the grader, Mr. Heerdt, by 11:59 PM October 4.

1. Fill in the blanks.
 - (a) In _____ hashing, no two data have the same hash value.
 - (b) Using _____ coding, the codons for the different symbols of a message may be written consecutively without spaces.
2. Write a recurrence for the time complexity of this function, then solve the recurrence.

```
void george(int n)
{if(n > 0)
  {for(int i = 0; i < n; i++) cout << "hello" << endl;
  george(n/2); george(n/3); george(n/6);}}
```

3. A hash table with of size $m = 200$ is used to store 400 data items, using a pseudo-random hash function. The average number of items in a cell (“bucket”) is clearly $\frac{400}{200} = 2$, but there could be empty cells. Approximately how many empty cells will there be, on the average? Pick the answer you think is closest.
 - (a) 0
 - (b) 5
 - (c) 11
 - (d) 27
 - (e) 43
 - (f) 84

4. Walk through Kruskal's algorithm to find the minimum spanning tree of the weighted graph shown below. Show the evolution of the union/find structure at several intermediate steps. Whenever there is choice between two edges of equal weight, choose the edge which has the alphabetically largest vertex. Whenever there is a union of two trees of equal weight, choose the alphabetically larger root to be the root of the combined tree. Indicate path compression when it occurs.



5. Insert the letters B, A, Y, H, P, D into an empty treap, where the “random” keys are given in the following table. Show the treap after each insertion and indicate all rotations.

| | |
|---|----|
| A | 8 |
| B | 4 |
| D | 10 |
| H | 2 |
| P | 5 |
| Y | 9 |

6. Find an optimal Huffman code on the alphabet A,B,C,D,E,F where frequencies are given in the following table.

| | |
|---|----|
| A | 8 |
| B | 6 |
| C | 3 |
| D | 11 |
| E | 14 |
| F | 2 |

7. A 3-dimensional $9 \times 7 \times 10$ rectangular array A is stored in main memory in row major order, and its base address is 8192. Each item of A takes one word of main memory, that is, one addressed location. Find the address of A[4][5][2].

8. You are trying to construct a cuckoo hash table of size 10, where each of the 9 names listed below has the two possible hash values, indicated in the array. Can you construct that table? Construct the table, or show that it can't be done by using Hall's marriage theorem.

| | h1 | h2 |
|-----|----|----|
| Ann | 0 | 3 |
| Bob | 1 | 3 |
| Ted | 6 | 8 |
| Sue | 3 | 6 |
| Gus | 2 | 7 |
| Cal | 4 | 7 |
| Dan | 1 | 9 |
| Sal | 6 | 9 |
| Eve | 5 | 8 |

9. Give the asymptotic time complexity in terms of n , using Θ , O , or Ω , whichever is most appropriate.

(a) $F(n) \geq 2F(\sqrt{n}) + 1$

(b) $G(n) = 3(G(2n/3) + 3G(n/3)) + n^3$