COP 3503
Test 2 Practice

1) List one of an Algorithmic Techniques mentioned in class for each of the following discussed algorithms.
    a. (5 pts) Prim's MST

    b. (5 pts) Huffman Coding

    c. (5 pts) Skip List Insertion

    d. (5 pts) Merge Sort

    e. (5 pts) Sudoku Solver

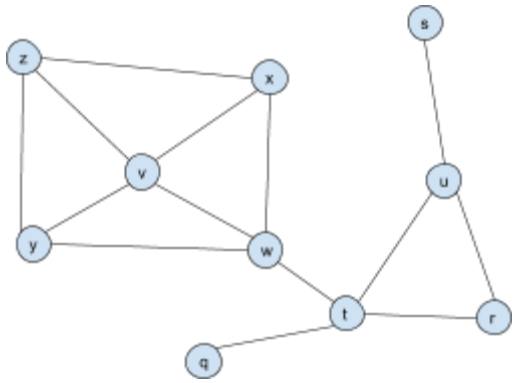
2) (15 pts) Determine a Greedy solution (and prove it) for the following problem. Travis needs to punch holes in some number of groups of papers. Since Travis is a teacher, he was only able to afford a hole-punch that can work on at most 3 pieces of paper at once. Travis' papers comes in groups and each group needs to be punched all at once otherwise the groups might not fit in his binder properly. Luckily Travis' groups contain at most 3 pieces of paper. Additionally Travis can punch two or more groups at the same time if the sum of the pieces of papers across the punched groups is no more than 3. Travis will give you the sizes for each group of papers you must determine the minimum number of times Travis needs to use his terrible hole-punch.

3) (20 pts) Determine a Greedy solution (and prove it) for the following problem. Travis is going to give out gifts on 10/24 to his friends. He has an assortment of 2n potential gifts for his n friends. Since his friends can be easily offended Travis needs to make sure that his friends feel like they have been treated equally. Travis found out that as long as each friend receives an equal number of gifts each set of which has the same sum value they will be happy. Assuming that Travis (and unfortunately his friends) knows the value of each gift determine, if Travis can distribute gifts without upsetting anyone.

4) (15 pts) What is the Huffman tree for the following String? Assume that nodes with lower frequencies will be to the left when merged (Hint: there is 5 characters).

String: "an_ad_ban_abba_and_nab_a_baba_and_a_bad_banana"

5) (15 pts) List the order in which nodes are visited by a DFS (Staring at Vertex r) in the following graph. Assume that ties are broken alphabetically with “a” occurring first.

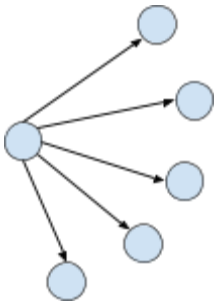


6) (20 points) In class a Topological sort was coded two ways. For this problem you must complete the following topological sort the order of which will be stored in the integer array topo_elements.

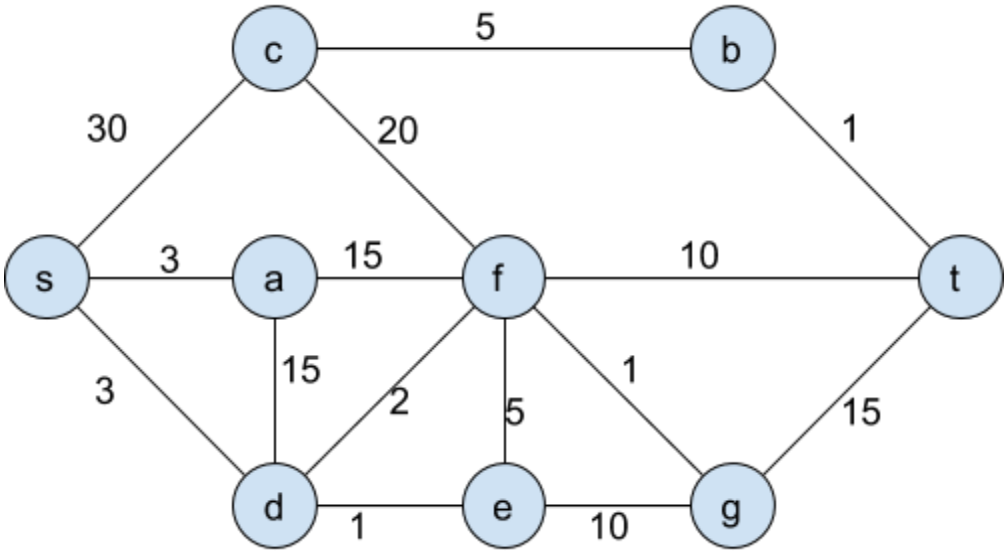
```
public static int position = 0;
public static int[] topo_elements;
public static class Edge {
    int st, en, w;
    Edge rev;
}
public static class Graph {

    ArrayList<ArrayList<Edge>> adj_list;
    ArrayList<ArrayList<Edge>> rev_adj;
    int n;
}

public static void DFSTopo(int cur, Graph g, boolean[] visited, int[] inDeg) {

    _____________________________ = _____________________________;

    for (Edge e : g.adj_list.get(cur)) {

        _____________________________;

        if ((____________________ == ____________________) && ____________________) {

            _____________________________;

            DFSTopo(_____________________________________);
        }
    }
}
```

7) (15 pts) Prove or disprove: Graphs with negative edge weights will always produce invalid results by running Dijkstra's.

8) (20 pts) How many topological orderings are there for the following graph?



9) (25 pts) What is the min cut from ***s*** to ***t*** for the following graph?



10) Mr. Cheese is having a party for his friends. However, Mr. Cheese is lazy and does not want to spend too much effort preparing the party. Each guest has a certain set of criteria the party must have for a good party. If any of their criteria for a guest is not met, then that guest will not find the party to be enjoyable, and if a guest does not find the party enjoyable, Mr. Cheese will spend some time the next day apologizing to them. Sadly for Mr. Cheese, implementing each criteria takes some amount of time. Mr. Cheese wants to find the minimum total time between party preparing and apologizing.

As an example, suppose AJ wants criteria 1, Percy wants criteria 2, and Tyler wants criteria 1 and 2. If Mr. Cheese implements only criteria 2, then Mr. Cheese will apologize to AJ and Tyler the following day. The sum of Mr. Cheese's total time for such a party will be apology time for Tyler and AJ plus implementation time for criteria 2.

a. (15 pts) In general, how would you construct a flow graph for solving Mr. Cheese's problem, if the amount of time for implementing a party criteria was equal to the amount of time it takes for Mr. Cheese to apologize to a guest?

b. (20 pts) What additional changes would need to be done, if the amount of time for apologizing was not equal to the time to implement some party criteria?

c. (10 pts) Construct a graph for the following party criteria and guests.

Name	Criteria	Apology time
Ray	1, 2, 3	5 minutes
Percy	3	30 minutes
AJ	2	10 minutes
Tyler	2, 3	5 minutes

Criteria	Time to Implement
1	50 minutes
2	10 minutes
3	4 minutes