Combinatorial Optimization: First midterm exam
## 2018.03.22.

Please indicate your name and Neptun code on top of your test! Every problem is worth 10 points, the minimum number of points required for passing is 24. You can work for 90 minutes. You are not allowed to use written or printed materials, a calculator or any other aid when writing the test. Please make sure to justify your answers - unjustified results are worth no points. I wish you all the success!

1. Prove that the following problem is in NP: Input: S; where $S=\{x_1, x_2, \ldots, x_n\}$ is a set of positive integers. Output: True if there exist I and J two different subsets of $\{1, 2, \ldots, n\}$, so that

$$\sum_{i \in I} x_i = \sum_{j \in J} x_j$$

2. Assume that A is a decision problem in NP, and B is an NP complete decision problem. Show that if there exists a polynomial time algorithm for solving B, then there exists an other also polynomial method for solving A.

3. Run the BFS method in the graph on the right from C to decide whether the graph is binary or not. (Indicate the levels of the tree)
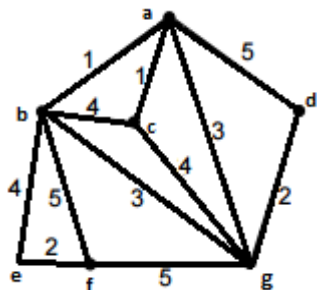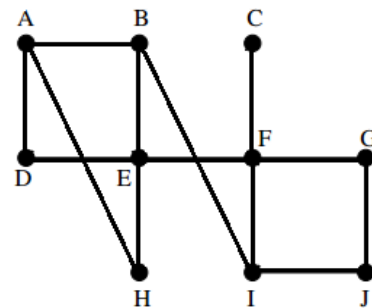
4. Run the Kruskal method to find a minimum spanning tree in the graph on the left. (Indicate the order of the decisions)

5. Find a maximum flow and a minimum cut with the Ford-Fulkerson method in the graph on the right. (It starts from s and the target is t)
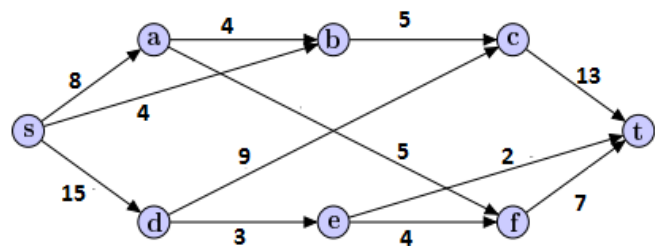
6. Solve the following knapsack problem with dynamic programming: Size = 6, Objects (weight-value): 2-3, 4-7, 5-9, 1-1, 3-6, 2-5