Name(last, first): _____

U C L A Computer Science Department

CS 180 **Algorithms & Complexity** **UID : _____**

Midterm **Total Time: 90 minutes** **April 25, 2022**

Each problem has 20 points: 5 problems, 5 pages

All algorithm should be described in bullet format (<u>with justification/proof</u>).
You cannot quote any time complexity proofs we have done in class: you need to prove it yourself.

Problem 1: Consider **m** candidates **n** votes. A majority is the person with more than **n/2** votes. Design an algorithm for finding a majority. Prove its correctness. Analyze its complexity.

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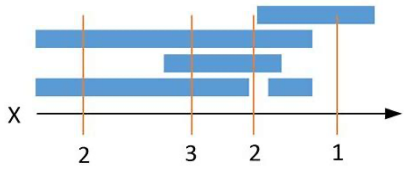
Problem 2: Consider a set of intervals/tasks.
A. Design an algorithm that finds the maximum number of mutually overlapping intervals/tasks.
B. Analyze the time complexity of your algorithm. In the example below the answer is 4.



Problem 3

Give an algorithm for determining if a graph is two-colorable, i.e. if it is possible to color every vertex red or blue so that no two vertices of the same color have an edge between them. Your algorithm should run in time O(V + E), where V is the number of vertices and E is the number of edges in the graph. You should assume that the graph is undirected and that the input is presented in adjacency-list form.

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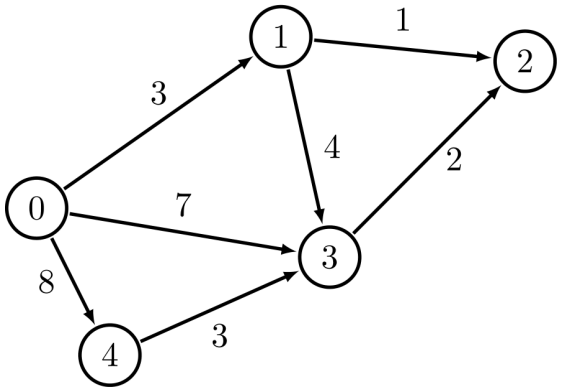
Problem 4: What is the shortest weighted path (sum of the weights on the edges has to be minimized) between vertex 0 and vertex 2? Design an O(V+E) algorithm that finds the shortest path between two vertices in a connected DAG, where V is the number of vertices and E is the number of edges.



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Problem 5: **Prove** that the Breadth first tree starting from a vertex **s**, gives you the distance between **s** and all other vertices.