



CS 180

UCLA Computer Science Department

Midterm

Algorithms & Complexity



Total Time: 1.5 hours

February 2016

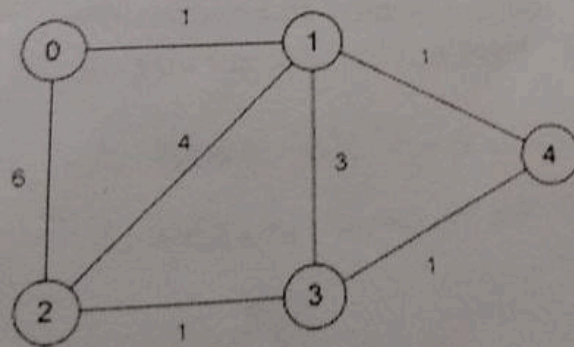


Each problem has 25 points.

1 A. Describe Topological Sort (in English, bullet by bullet) on a DAG B. Analyze its time complexity and justify your answer. C. What will happen when there is a cycle? Prove your answer.



2. **A.** Use Kruskal's MST algorithm to find a an MST in this graph. Show each step.
B. If some edges were negative would the algorithm still find an MST. Prove your answer.



3. A graph is two-colorable if we can color its vertices with RED & BLUE such that no two adjacent vertices have the same color. **A.** Are all graphs two-colorable. Prove your answer **B.** Design an efficient algorithm for two coloring a graph. Prove the correctness of your algorithm. **C.** Analyze its time complexity. **D.** How many colors do you need to color a tree?

4. Consider a sequence x_1, x_2, \dots, x_n of (positive and negative) integers. We want to find two indices i and j such that $x_i + \dots + x_j$ is maximized.

A. Describe in English (bullet by bullet) an $O(n)$ time algorithm (using constant extra space) for solving this problem. For example, if the input is $(-2, -2, 5, 7, -3, 4, -4)$ then $i=3$ and $j=6$ (and the sum $x_i + \dots + x_j$ is equal to 13). **B.** Prove the correctness of your algorithm.