

**Assignment 1**

Due January 17 at the beginning of lecture

*The work you submit must be your own.* You may discuss problems with each others; however, you should prepare written solutions alone. Copying assignments is a serious academic offense, and will be dealt with accordingly.

**Question 1** Give a polytime algorithm for the following problem, analyze its running time, and prove that it is correct.

**Problem 2-COL:**

- Input: An undirected graph.
- Accept if the vertices can be colored by two colors Red and Blue, so that each vertex is colored with exactly one color, and if no two adjacent vertices have the same color.

State the running time clearly as a function of the input size. (For this purpose you can assume that the graph is represented either as a 0-1 adjacency matrix or using the linked list structure, but clearly indicate which one you use.)

**Question 2** Give a nondeterministic polytime algorithm for the following problem. The input consists of two undirected graphs  $G_1 = (V_1, E_1)$  and  $G_2 = (V_2, E_2)$ . It is accepted if and only if there is a mapping  $f$  from  $V_1$  to  $V_2$  such that  $(v_1, v_2) \in E_1$  implies  $(f(v_1), f(v_2)) \in E_2$ . Describe your algorithm by clearly specifying the certificate and the verifier. Argue that the running time is a polynomial in the size of the input. Prove its correctness.