Advanced Analysis of Algorithms - Homework III

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1 Instructions

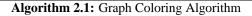
- 1. The homework is due on November 17, in class. Each question is worth 4 points.
- 2. Attempt as many problems as you can. You will be given partial credit, as per the policy discussed in class.

2 Problems

- 1. Is there a problem in the complexity class P, such that all problems in P can be polynomially transformed to this problem?
- 2. Show that a language L can be *verified* in deterministic polynomial time if and only if it can be decided by a nondeterministic algorithm in polynomial time.
- 3. Design a backtracking algorithm for the 3SAT problem.
- 4. Consider an instance of the Subset-Sum problem, where $S = \{2, 10, 13, 17, 22, 42\}$ and B = 52. Solve this instance using backtracking, showing all the steps.
- 5. Consider the following graph coloring algorithm for coloring the vertices of a graph using the fewest number of colors:

Function FIND-OPTIMAL-COLOR(**G=**<**V**,**E**>)

- 1: Let $V_{un} = V$ and $C_u = \{1, 2, \dots, n\}$.
- 2: while $(V_{un} \neq \phi)$ do
- 3: c_{cur} is the smallest indexed color in C.
- 4: Assign c_{cur} to as many vertices as possible in V_{un} making sure that a vertex with index number k is considered before a vertex with index number k + 1.
- 5: Delete all the colored vertices from V_{un} .
- 6: Delete c_{cur} from C.
- 7: end while



 V_{un} is the set of uncolored vertices and C_u is the set of unassigned colors. Is Algorithm (2.1) optimal? Justify your answer with a proof or a counterexample.