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 non-deterministic 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 $C_u = \{1, 2, \ldots, n\}$.
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**

Algorithm 2.1: Graph Coloring Algorithm

V_{un} is the set of uncolored vertices and C_u is the set of unasssigned colors.

Is Algorithm (2.1) optimal? Justify your answer with a proof or a counterexample.