Interview Questions: Intractability

3/3 points earned (100%)

Excellent!

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1 / 1 points

1.

Graph 3-colorability. An undirected graph is 3-colorable if the vertices can be colored red, green, or blue in such a way that no edge connects two vertices with the same color. Prove that 3COLOR is $\mathcal{NP}$-complete.

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Thank you for your response.

Hint: give a polynomial-time reduction from 3SAT to 3COLOR by creating three vertices for each clause.

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1 / 1 points

2.

Decision problems. Traditionally, the complexity classes $\mathcal{P}$ and $\mathcal{NP}$ are defined in terms of *decision problems* with yes/no answers instead of *search problems*, e.g., instead of Prove that the search problem version of SAT (*find a binary solution to a given system of boolean equations?*) polynomial-time reduces to the decision version of SAT (*does there exists a binary solution to a given system of boolean equations.*).

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Thank you for your response.

Hint: to determine whether to set x_1 to true, set it to true; simplify the resulting system of boolean equations; and check whether there exists a solution to the simplified system.

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1 / 1 points

3.

Optimization problems. Given an undirected graph with positive edge weights, the traveling salesperson problem is to find a simple cycle that visits every vertex and has minimum total weight. The search problem version of the problem is, given a parameter L, find a tour of length at most L. Prove that the optimization version of the problem polynomial-time reduces to the search version of the problem.

Remark: for many problems such as this one, the optimization version of the problem (which is not known to be in $\mathcal{NP}$) is solvable in polynomial time if and only if the search version of the problem (which is easily seen to be in $\mathcal{NP}$) is.

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Thank you for your response.

Hint: use binary search.