W4D1 Assignment

1. Suppose Prob1, Prob2, and Prob3 are decision problems and Prob1 is polynomial reducible to Prob2, and Prob2 is polynomial reducible to Prob3. Explain why Prob1 must be polynomial reducible to Prob3.

By applying the law of transitivity to Prob1, Prob2, and Prob3, since Prob1 is polynomial reducible to Prob2, and Prob2 is polynomial reducible to Prob3, we can conclude that Prob1 is polynomial reducible to Prob3.

2. Illustrate the proof that the HamiltonianCycle problem is polynomial reducible to TSP by considering the following Hamiltonian graph—an instance of HamiltonianCycle—and transforming it to a TSP instance in polynomial time so that a solution to the HC problem yields a solution to the TSP problem, and conversely.



Is there HC in this graph? YES

0

0 1 1 0 Is there simple cycle of total cost less than 0? YES



0

A-B-D-C-A = 0+0+0+0 = 0. Total cost <= 0. This solution implies that every edge of C also is an edge in G. Therefore HC --poly---> TSP

Question 3

To show that TSP is NP-Complete

1. Show TSP is in NP
2. Show TSP is in NP-hard

To show that TSP is in NP, we can show that given a solution (path) to the TSP problem we can verify the solution using a non-deterministic algorithm in polynomial time. This is true.

To show that TSP is NP-hard, we use the given NP-complete problem, i.e. Hamiltonian Cycle problem is NP-Complete.

For the Hamiltonian Cycle problem to be NP-complete, it is true that the Hamiltonian Cycle problem is in NP and it is NP-hard.

From the reducibility theorem we know that HC is polynomial reducible to TSP, which makes TSP NP-hard.

Therefore, TSP is NP-complete.