University of Colombo School of Computing
SCS 1308 - Foundations of Algorithms
Tutorial - 04

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1. Prove that the Hamiltonian Cycle problem is NP-Complete, including the reduction from a known NP-Complete problem.

2. Explain why the Traveling Salesman Problem (TSP) is NP-Complete. Provide the details of its reduction from the Hamiltonian Cycle problem.

3. Discuss the importance of the Cook-Levin theorem in establishing the foundation of NP-Completeness and its implications for modern computational theory.

4. Prove that the Graph Coloring problem with k colors is NP-Complete. Outline the steps involved in the reduction from 3-SAT.

5. Provide a detailed proof that TSP belongs to the NP class. Include details about the certificate, the verification algorithm, and its polynomial-time complexity.

6. Discuss the implications of P = NP on NP-Hard problems like the Halting Problem. Why does this result not directly apply to undecidable problems?

7. Given a new optimization problem, describe the steps to convert it into a decision problem and prove it belongs to NP.

8. Consider the following distances between five distribution centers (in km)

a. A to B: 10
b. A to C: 15
c. A to D: 20
d. A to E: 25
e. B to C: 35
f. B to D: 30
g. B to E: 20
h. C to D: 25
i. C to E: 30
j. D to E: 15

I. Determine if there exists a Hamiltonian cycle (a tour visiting all centers once) with a total distance of 85 km or less. If so, provide a valid cycle.

II. Provide a step-by-step proof that TSP belongs to the NP class. Include details about the certificate, the verification algorithm, and its polynomial-time complexity.