

Lesson Plan: Tackling the Travelling Salesman Problem in DP Mathematics

Overview

This lesson plan is devised for International Baccalaureate (IB) Diploma Programme (DP) students exploring the Travelling Salesman Problem (TSP) in Graph Theory, a pivotal concept in optimization and computational mathematics. It will delve into the problem's definition, its significance, and various approaches to solving it, with a focus on the nearest neighbor algorithm and the vertex deletion method.

Objectives

- Understand the Travelling Salesman Problem and its place in graph theory and optimization.
- Explore the nearest neighbor algorithm as a heuristic method for solving the TSP.
- Investigate the vertex deletion method for addressing the TSP.
- Evaluate the efficiency and practicality of different TSP solving algorithms.

Materials

- Whiteboard and markers
- Projector for video demonstrations and algorithm visualizations
- Handouts detailing the steps of the nearest neighbor and vertex deletion algorithms
- Computers with internet access for interactive TSP simulation

Lesson Duration

60 minutes

Lesson Structure

1. Introduction to the Travelling Salesman Problem (10 minutes)
 - Briefly explain the TSP and its importance in fields like logistics, optimization, and computer science.
 - Discuss the challenge of finding the shortest Hamiltonian cycle that visits each vertex exactly once and returns to the start.
2. Exploring the Nearest Neighbor Algorithm (15 minutes)
 - Describe the nearest neighbor algorithm and demonstrate its approach to solving the TSP through a worked example or video.
 - Highlight the strengths and weaknesses of the algorithm.
3. Investigating the Vertex Deletion Method (15 minutes)
 - Explain the vertex deletion method, providing a step-by-step guide on how it attempts to solve the TSP.
 - Compare its efficiency and accuracy against the nearest neighbor algorithm.

4. Hands-on Activity: Solving the TSP (15 minutes)

- Split students into small groups and assign each group a simple TSP challenge.
- Allow students to apply the nearest neighbor and vertex deletion methods to find solutions, using graph paper or interactive online simulations.

5. Discussion and Comparative Analysis (5 minutes)

- Regroup and discuss the outcomes of the hands-on activity. Reflect on the applicability, efficiency, and limitations of each method.
- Encourage students to consider why the TSP is categorized as NP-hard and what implications this has for solving real-world problems.

Assessment

- Evaluate students' understanding through their participation in the discussion and their ability to apply algorithms during the hands-on activity.
- Assess the correctness of the solutions and the rationale behind choosing a particular method for solving the TSP.

Extensions

- Assign homework where students research real-world applications of the TSP and present their findings.
- Encourage students to explore more advanced algorithms for the TSP and compare them to the nearest neighbor and vertex deletion methods.

Resources

- Videos demonstrating the nearest neighbor algorithm and the vertex deletion method.
- Interactive TSP simulation tools or software for practical application.

This lesson plan aims to provide students with a comprehensive understanding of the Travelling Salesman Problem, fostering critical thinking and problem-solving skills in the context of DP Mathematics.