Homework–1A Sudoku Video
Fall 2024: CS 313: Computational Complexity Theory

Due: Thursday, September 19, 2023. Total Marks: 50

This homework can be attempted individually or in groups of two.

Introduction and Motivation

In the first part of the assignment, you will be exploring the complexity of a familiar puzzle: Sudoku. But instead of writing a traditional proof, you will create a short instructional video explaining why generalized Sudoku on an $n \times n$ grid is NP-Complete. The goal is to help you learn not just by writing formal proofs, but by explaining complex concepts in an engaging and creative way.

Creating a video engages different cognitive processes, helping you solidify your understanding of the material. You will need to:

- Break down complex concepts into clear and understandable components.
- Use visual aids (like diagrams or animations) to communicate ideas more effectively.
- Structure and narrate your thoughts in a logical and coherent manner, a valuable skill for both academic and professional settings.
- Develop your ability to explain theoretical concepts in a way that others can follow, a critical skill in research, teaching, and many technical professions.

By the end of this project, you will have a deeper understanding of NP-completeness, problem reductions, and time complexity, while also enhancing your communication skills.

Assignment Prompt

Your task is to create a **5 minute instructional video** explaining why generalized Sudoku on an $n \times n$ grid is NP-Complete. Your video should be clear, engaging, and accurate. Make sure to cover the following key points:

1. Problem Definition

- Define the generalized Sudoku problem for an $n \times n$ grid clearly.
- Explain the rules of Sudoku as they apply to this problem .
- Formulate the problem as a decision problem and show how it fits into the NP class.

2. Reduction from Another NP-Complete Problem

- Choose an appropriate NP-Complete problem for reduction.
- Clearly define the chosen problem and outline its rules.
- Explain how you will reduce this problem to generalized Sudoku.
- Use diagrams or images where helpful to show how the reduction is performed step by step.

3. Correctness of the Reduction

- Provide a clear and detailed explanation of why your reduction is valid.
- Demonstrate the mathematical or logical relation between the two problems, ensuring you explain why a solution to Sudoku would also solve the NP-complete problem you reduced from.

4. Time Complexity Analysis

- Analyze the time complexity of your algorithm and reduction, considering the data structures or representations you used.

5. Explanation of NP-Completeness

- Summarize why generalized Sudoku is NP-complete, emphasizing that it belongs to NP and that you have shown a reduction from another NP-complete problem.

6. Video Presentation, Audio and Visual Aids

- The video can be in any format of your choice. This is your chance to be creative! I will post a few video samples on the course LMS for creative ideas.
- You should use audio and visual aids such as diagrams, charts, or animations to enhance your explanation. This of course is dependent on your chosen format of presentation.
- Ensure your video is logically structured and flows smoothly from one concept to the next, just like an engaging video on YouTube would.

Submission Guidelines

- The video should be between 5 minutes long.
- Ensure your explanation is accessible and free from excessive jargon, but still rigorous in its use of formal definitions and reasoning.
- Submit your **video link** via the course platform by the due date. The link should be freely accessible without the need to login.
- You are urged, but not required, to make the video publicly available.

Good Luck!

Category	Points	Criteria for Full Points
Problem Definition	10	- Correctly defines the generalized Sudoku problem on an $n \times n$ grid. - Explains the rules of Sudoku clearly and precisely. - Formulates the problem as a decision problem and shows how it fits into NP.
Reduction from NP-Complete Problem	10	- Selects an appropriate NP-Complete problem for reduction. - Clearly and accurately explains the rules of the chosen problem. - Demonstrates a clear, logical, and valid reduction from the NP-Complete problem to Sudoku.
Correctness of the Reduction	10	- Provides a clear and detailed explanation of why the reduction is valid. - Demonstrates the mathematical or logical connection between the two problems. - Correctly shows that solving Sudoku implies solving the reduced problem.
Time Complexity Analysis	5	- Accurately analyzes the time complexity of the reduction. - Considers appropriate data structures and representations for the analysis.
Explanation of NP-Completeness	5	- Correctly explains why generalized Sudoku is NP-complete. - Emphasizes that the problem belongs to NP and that a reduction from an NP-complete problem has been provided.
Visual Aids and Presentation	5	- Effectively uses diagrams, charts, or animations to explain complex concepts (e.g., the reduction and time complexity). - Visual aids are well-integrated into the explanation and enhance understanding.
Clarity and Structure	5	- The video is logically structured and easy to follow. - Concepts are presented clearly, without excessive jargon, and flow smoothly from one point to the next.
Engagement and Creativity	5	- The video is engaging, with creative and thoughtful presentation techniques. - The narration and presentation style hold the viewer's interest while explaining complex material.

AI Declaration

ChatGPT has been used to help modify the text of this prompt.