

Coursework1 Report

F29AI - Artificial Intelligence

Keqin ZHANG (H00460395) Yuwei ZHAO (H00460398)

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Abstract

This report involves the solutions to the tasks outlined in Coursework 1 for the *F29AI - Artificial Intelligence course*. The main objective of the coursework is to search algorithms and automated planning using *PDDL*.

1 Introduction

2 Procedure

2.1 Part 1 - Solving and Analyzing Sudoku with Search Algorithms

2.1.1 Part 1A

Solution:

A CSP(constraint satisfaction problem) should involves the following three components: Variables, Domains and Constraints. Therefore, we can define the Sudoku problem as follows:

$$\text{Sudoku} = \langle V, D, C \rangle$$

where

1. V : The set of 81 variables, $V = \{V_{i,j} \mid i, j \in \{1, 2, \dots, 9\}\}$.
2. D : The domain $D_{i,j}$ for each variable $V_{i,j}$ is defined as:
 - $D_{i,j} = \{k\}$, if $V_{i,j}$ is a given cell with value k .
 - $D_{i,j} = \{1, 2, \dots, 9\}$, if $V_{i,j}$ is an empty cell.
3. C : The set of 27 "All-Different" constraints:
 - C_{row} : For each row i , all variables $V_{i,1}, V_{i,2}, \dots, V_{i,9}$ must have different values.
 - C_{col} : For each column j , all variables $V_{1,j}, V_{2,j}, \dots, V_{9,j}$ must have different values.

- $C_{subgrid}$: For each 3×3 subgrid, all 9 variables within that subgrid must have different values.

Time Complexity Analysis:

- Brute-force Search Algorithm:

For each of the k spaces, there are 9 possible choices of numbers. This results in a total of $9 \times 9 \times \dots \times 9$ (k times) combinations. Therefore, the time complexity of the brute-force search algorithm is $O(9^k)$. When the worst-case scenario occurs, the algorithm needs to explore all possible combinations, leading to the $O(9^{81})$ time complexity.

- Backtracking Search Algorithm:

2.1.2 Part 1B

2.2 Part 2 - Automated Planning

2.2.1 Part 2A: Modelling the Domain

2.2.2 Part 2B: Modelling the Problems

2.2.3 Part 2C: Extension

3 Reflection and Analysis

4 Conclusion