Knowledge Representation and Reasoning Spring 2023
Course Project Milestone 3
Individual Project Report

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Abstract

This report explains what has been accomplished so far in solving the Answer Set Programming problem for the "Referee Assignment Problem" project. The project is part of the Knowledge Representation and Reasoning Spring 2023 course at Arizona State University.

Problem Statement

This project aims to learn how to use a solver called Clingo for Answer Set Programming and to apply it to solve a specific problem called the "Referee Assignment Problem."

The Referee Assignment Problem is a challenge that insurance companies encounter when assigning referees to insurance cases. It is a multifaceted task that requires considering various constraints and preferences, such as referee workload, specialization, and regional preferences. To find an optimal solution that satisfies both hard and weak constraints, Clingo, an Answer Set Programming solver, is the ideal tool to use. This report will delve into the Referee Assignment Problem, its constraints, and the approach is taken to solve it using Clingo.

The Referee Assignment Problem comprises several hard constraints that must be satisfied to attain an optimal solution. Referees have a maximum workload per day, and this limit should not be exceeded. Assigning cases to referees who do not cover the type or region of the case is prohibited. In addition, cases with damage beyond a specific threshold should be assigned to internal referees. These constraints are non-negotiable and are given the highest priority in finding an optimal solution.

In addition to hard constraints, several weak constraints should be considered to achieve the best possible solution. Internal referees should be given priority to minimize costs, and the workload of external referees should be balanced to achieve a fair distribution of cases. Referees should handle types of cases and regions with higher preference. With Clingo's capabilities, these constraints can be incorporated into the search for the best possible solution for the Referee Assignment Problem. Ultimately, this report provides a comprehensive approach to solving this problem and evaluates Clingo's performance using pre-configured instances of referee and case details.

Progress Summary

In the following statement, the focus is on describing the completion of a project that was a part of the Knowledge Representation and Reasoning Spring 2023 course at Arizona State University. The project pertains to solving the "Referee Assignment Problem" using Answer Set Programming techniques.

The progress made so far in solving the Referee Assignment Problem using Clingo was discussed in this report. The basics of Clingo were learned, including how to create a program that represents the problem and its constraints. The focus was on "Hard constraints," which are important for the Referee Assignment Problem and any Clingo program. They were studied, and experiments were carried out to learn how Clingo behaves with these constraints and how optimizers can be used. These experiments were done on a small simplified part of the Referee Assignment Problem to lay the groundwork for the final solution.

The Referee Assignment Problem involves dealing with both mandatory and optional rules, which are called "Weak constraints." In order to include these optional rules and optimize the solutions based on them, the team conducted a basic study of how Clingo handles these "Weak constraints." However, there were difficulties in creating a complete solution for even the simplified problems that were tested. The team plans to do further work to better understand these issues and to successfully include "Weak constraints" in their solution.

The report describes progress made in solving the Referee Assignment Problem using the Clingo toolset. It explains the basics of how to create a program for Clingo and how it works. It also talks about the different kinds of constraints, such as Hard and Weak constraints, and how they affect the program. The report mentions the problems faced while implementing solutions for simplified problems and plans for future work to solve them. Overall, the report summarizes the progress and future work related to the Referee Assignment Problem.

List of tasks completed

This section will give idea of tasks completed in the form of a short list:

- Prepare the working environment for using the Clingo solver.
- Understand how to implement Hard constraints in Clingo.
- Gain an understanding of the domain and specifications of the Referee Assignment Problem.
- Use the knowledge of Hard constraints to build a base program for solving a simplified version of the Referee Assignment Problem. This will serve as a starting point for the final programmatic solution.
- Document and prepare data and information for reporting.
- Research and understand the concept of Weak constraints and how to implement them in Clingo. Further work will be done to build upon and revisit this task as it may produce some negative results.

Challenges and Plan of Action

In the next part of the report, the challenges faced during the project will be explained, and a plan will be proposed to handle them. Currently, the only challenge is related to weak constraints and how they work with Clingo. Previous attempts to solve the Referee Assignment Problem failed when weak constraints were added to the simplified version, along with the basic scenario and hard constraints.

To solve the problem, the requester needs to investigate the Clingo program and review the theory behind weak constraints to find the root cause of the issue. Once the problem is identified, the requester can start correcting the implementation's shortcomings. This investigation will also help the requester avoid similar issues in the future when working with more complex combinations of weak and hard constraints.

Future Work Plan

In this section, the remaining tasks needed to complete the project will be explained in my tone of voice. Currently, the Clingo program can only solve a simplified version of the Referee Assignment Problem, and it can only handle the hard constraints. To finish the project, the team needs to add all the weak constraints to optimize the Clingo solver and include the full scope of the problem domain.

Once the issues identified earlier in the report have been resolved, the next step is to include "Weak constraints" in the Clingo program for the simplified version of the Referee Assignment Problem. This will provide a stable starting point to fully implement all aspects of the problem domain. After that, updates to the Clingo program will be made to add more features to the Referee Assignment Problem until the complete problem is successfully solved by the Clingo solver. The goal is to produce the desired results for the given test "instances" mentioned in the problem statement.

References

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