Insurance Referee Assignment
Project Milestone - 03 Individual Progress Report

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Abstract

The problem of assigning referees is a well-known issue in sports scheduling. We are examining a particular instance of this problem that arises in an amateur basketball league with multiple divisions. The problem involves assigning a flexible number of referees to every game in each division throughout the season, based on a set of criteria and goals.

In our approach, referees receive a fixed payment for their services in addition to a mileage allowance for their travel. As a result, minimizing the total distance travelled is a crucial aspect of our problem.

Problem Statement

To investigate insurance claims made by policyholders, an insurance firm dispatches referees to various sites to assess the damage to vehicles like cars, trucks, and others, and prepare reports. The insurance company has its own personnel, referred to as internal referees, to perform these inspections. Still, it may also permit external referees to handle a case if there is a heavy workload on the internal referees. The primary objective is to assign referees to insurance cases while adhering to a range of stringent and lenient constraints. We consider several factors for each referee, such as their address represented by geographic coordinates, qualifications, experience, incompatible teams and referees, and unavailability on certain days and time intervals. A game is defined by various details such as the home team, away team, division, date, starting time, venue, and total experience required. There are mandatory and optional referees for each game, but these remain the same for all games within the same division. The duration of each game is fixed at two hours, regardless of the division. As for game venues, different teams can use the same arena, and a team may use various venues for different games. Thus, the input data for each game includes the specific venue where it will be held. Distances between arenas and referees' homes and venues are calculated in Euclidean terms based on geographic coordinates. To verify the validity of customer claims in insurance cases, an insurance company assigns one referee to each claim, and the same referee may be assigned to multiple claims subject to certain constraints. Constraints include a maximum workload per day or a limit on the number of cases a referee can handle based on their postal code. Referees with expertise in specific areas, such as cars or trucks, are designated for those types of cases, and the choice of referees for different types of cases depends on the

geographical area and their preferences. External referees are paid per case, whereas internal referees have a fixed salary. Our objective is to assign referees to insurance cases in a single working day, with each case assigned to a single referee, who may be assigned to multiple cases. The selection criteria for assigning referees to cases depend on three components: the processing time, the overall damage cost in Euros, and the fee paid to external referees. These variables are not necessarily correlated.

Hard Constraints

The following are the hard rules that need to be adhered to:

- The referee's workload must not exceed the actual obligation, which is calculated based on the number of cases assigned to them.
- Only referees from the designated area can handle a case; referees from other areas are not permitted.
- As we previously discussed, employees are classified according to their areas of expertise.
- External employees have a maximum workload they can handle, and if a case exceeds that limit, an internal referee will take over the case and the external employee won't be involved in it.

Weak Constraints

These are the less strict limitations:

- Since internal referees receive a fixed salary, it is beneficial for the company to assign cases to them in order to cut costs.
- When cases are assigned to external employees, their overall pay must be considered and cases should be distributed accordingly to optimize cost-effectiveness.
- It's important to ensure that referees with the same overall pay receive a similar workload, rather than having some referees with more work

and less pay and others with less work and more pay.
- When assigning referees to cases, their rank and location preference should be considered, with location preference being the highest priority.

Milestone Summary

In order to complete the project, I needed to have expertise in Knowledge Representation and Reasoning approaches and use Answer Set Programming with clingo solver. My first step was to install clingo and practice solving propositional logic problems to get accustomed to the syntax. I then progressed to more complex problems, which enabled me to acquire an understanding of intricate logic and learn how to use aggregators, choice rules, constraints, and program structure. To comprehend the project requirements, I reviewed the problem description and transformed the initial conditions into a 2D grid visual representation. I subsequently divided the solution into individual actions and constraints, testing them on simpler scenarios before progressing to more complex ones. Currently, I have implemented all the necessary actions and tested them on a basic robot scenario, but I still need to add more complicated constraints, such as preventing collisions and restricting the robot from carrying multiple shelves.

Problems Faced

This project is complex and has presented several challenges, one of which is the input format. Although the input is valid, it does not provide enough information to solve the problem. Therefore, I had to convert the initial conditions into suitable representations to create the necessary solution.

Milestones Achieved.

- Installed clingo and confirmed that it is properly installed.
- Acquired a comprehension of ASP and how to use clingo for problem-solving.
- Employed visualization and manual techniques to acquire an understanding of the problem.
- Analyzed the initial conditions to extract vital information and validate constraints.
- Developed rudimentary test scenarios to assess the move, pick-up, and put-down actions.
- Composed the necessary constraints and actions to pass these tests.

Remaining work

- Add the delivery action and create a test to verify its correctness.
- Create more sophisticated constraints to tackle the problem more efficiently.

- Keep testing and validating solutions for every scenario and integrate any required updates and constraints to ensure accuracy.