Insurance Referee Assignment Problem

Sahil Yogesh Hadke
Email: shadke1@asu.edu
ASU ID: 1229679960

Abstract

The "Insurance Referee Assignment Problem" project is focused on optimizing the allocation of referees to insurance claims, with a goal of efficiently assigning referees to cases within a single day while adhering to workload limits, geographical constraints, and cost considerations. Substantial progress has been achieved, including the installation of Clingo, an ASP solver, and a deep understanding of Answer Set Programming (ASP), providing a solid foundation for problem-solving. The problem has been systematically deconstructed into manageable parts, and program entities have been successfully translated into ASP facts, allowing for a suitable representation of the problem for solving. However, a significant challenge has arisen in encoding weak constraints into the ASP formulation. Unlike hard constraints, weak constraints introduce preferences that can be violated if necessary to find a solution, requiring careful consideration to balance these preferences with other criteria such as cost efficiency and fairness in workload distribution. To address this challenge, a detailed plan has been outlined, including a thorough review of the ASP formulation, additional research on weak constraints, and refinement of the ASP program to better incorporate weak constraints and optimize the solution according to specified criteria. Regular testing and collaboration with teaching assistants and professors will be crucial in further refining the solution to meet the project's requirements.

Problem Statement

In the insurance industry, the efficiency and accuracy of claims handling are paramount for customer satisfaction and operational effectiveness. The problem focuses on optimizing the allocation of referees—both internal and external—to various insurance claims based on a set of complex constraints. Referees are responsible for inspecting claims and determining their validity, and each has a specified maximum workload, geographical areas, and types of cases they are best suited to handle. The task is to assign these referees to insurance cases in such a way that no referee is overloaded, geographical and domain-specific preferences are honored, and financial expenditures are minimized.

The insurance company employs referees who specialize in different types of claims, such as passenger cars or trucks, and operates across various geographical regions defined by postal codes. Each referee has a preference rating for both the type of claim and the region where they operate. Internal referees are salaried, while external referees are paid per case, with fees varying by the complexity and type of the case.

The challenge is to develop an algorithm that can handle the assignment of referees to insurance cases within a single day, adhering to hard constraints like workload limits and geographical and domain eligibility, and soft constraints aimed at reducing costs and balancing work distribution. The algorithm's effectiveness will be measured against a set scoring system, prioritizing cost efficiency, fairness, and adherence to preferences. This system should ensure that the insurance claims are processed efficiently, cost-effectively, and to the satisfaction of all parties involved.

Progress Made

The 'Insurance Referee Assignment Problem' project has made considerable progress, marked by the installation of Clingo on the local machine. This critical step enables the hands-on development and testing of Answer Set Programming (ASP), facilitating a deeper understanding of the technology necessary to address the complexities of the task. With Clingo operational, I have been able to refine my grasp of ASP, setting a strong foundation for tackling the nuanced challenges presented by the project. This understanding is essential for devising a solution that is specifically tailored to the unique demands of assigning referees in the insurance sector.

In addressing this problem, I have implemented several key hard constraints that are integral to the solution's functionality. The Workload Limit constraint ensures that no referee's daily workload exceeds the established maximum working minutes, preventing overburdening. The Regional Assignment constraint mandates that referees handle cases only within their designated regions, thereby optimizing logistics and case handling efficiency. The Type Matching constraint aligns case types with referees' specific areas of expertise, ensuring cases are handled competently. Addi-

tionally, the Damage Threshold constraint restricts the assignment of high-value cases to internal referees only, securing the handling of more sensitive cases. These constraints collectively safeguard the integrity and effectiveness of the solution, ensuring it meets specified criteria for efficient and accurate referee assignment.

Issues or Challenges Encountered

Another significant challenge encountered in the development of the project was the encoding of weak constraints into the ASP formulation. Unlike hard constraints, which must be satisfied without exception, weak constraints introduce preferences that should be considered but can be violated if necessary to find a solution.

Encoding these preferences required careful consideration of their impact on the overall solution and the balance between satisfying preferences and optimizing other criteria. Understanding the nuances of weak constraints and their interaction with other parts of the ASP program was crucial for ensuring that the final solution met the project's requirements while considering these preferences.

Moreover, balancing the optimization criteria related to weak constraints, such as minimizing costs while ensuring fairness in workload and payment distribution among referees, added complexity to the encoding process.

Plan to Resolve Issues

To address the challenges encountered in developing the weak constraints and optimization part of the project, a detailed plan has been formulated. Firstly, a thorough review of the existing ASP formulation will be conducted to identify any errors or inefficiencies in the encoding of weak constraints. This review will involve testing the ASP program with various scenarios to ensure that it behaves as expected and meets the project requirements.

Next, additional research will be conducted to better understand the nuances of weak constraints and their impact on the overall solution. This will involve studying existing literature on ASP and optimization techniques.

Based on this research, the ASP program will be refined to better incorporate weak constraints and optimize the solution according to the specified criteria. This may involve restructuring the program logic, revising the encoding of weak constraints, and fine-tuning the optimization criteria to achieve a more balanced and efficient solution.

Throughout this process, regular testing and validation will be performed to ensure that the changes made are effective and do not introduce new issues. Additionally, collaboration with teaching assistants and professor will continue to gather feedback and refine the solution further.

Itemized Tasks Completed

- Installed Clingo on local machine, ensuring readiness for ASP development and testing.
- Developed a proficient understanding of ASP and Clingo, laying a strong foundation for problem-solving using these tools.
- Demonstrated a strong grasp of the problem's core concepts, essential for developing a comprehensive ASP solution.
- Deconstructed the complex problem statement into manageable steps, aiding in a systematic approach to problem-solving.
- Analyzed and understood the problem's requirements, ensuring clarity and precision in problem-solving efforts.
- Translated abstract problem statements into concrete ASP facts, demonstrating effective problem representation skills.
- Grasped the significance of hard constraints, ensuring that referee workloads and case assignments align with specified criteria.
- Key hard constraints have been successfully encoded, ensuring adherence to rules and limitations: Workload Limit (each referee has a maximum daily workload to prevent overburdening), Regional Assignment (cases are assigned only to referees in charge of the region), Type Matching (cases are assigned only to referees in charge of the case type), and Damage Threshold (cases exceeding a damage threshold are assigned only to internal referees).
- Prepared a solid foundation for implementing weak constraints, aiming to optimize solution outcomes and fairness.

Itemized Tasks To Be Completed and Initial Plan to Complete

- **Implement Weak Constraints:** Address preferences, such as prioritizing internal referees to minimize costs. Modify the ASP model's assignment rules accordingly, ensuring they don't violate hard constraints.
- **Ensure Fairness in Assigning Cases to External Referees:** Balance their overall payment by developing rules that calculate total payments for each external referee and minimize differences between them.
- **Ensure Fair Workload Distribution:** Create rules to balance the overall workload among all referees, minimizing differences in total workload.
- **Implement Constraints for Priority Assignments:** Modify the rules to prioritize assigning cases to referees based on higher preferences for case types and regions.
- **Develop and Integrate Optimization Criteria:** Balance payment and workload among referees effectively, integrating these criteria into the ASP model.
- **Conduct Thorough Testing:** Validate correctness and efficiency of the solution with various input scenarios.
- **Refine ASP Model Based on Test Results:** Iterate as necessary to improve performance and accuracy.
- **Document the Entire Process:** Include the ASP model, constraints, optimization criteria, and test results for future reference and potential optimization.