Insurance Referee Assignment Problem

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Abstract

The project focuses on developing an optimization system for assigning internal and external referees to insurance cases. Each referee is bound by a set maximum workload and has specific geographical and domain preferences. The goal is to ensure that these assignments do not surpass the referees' capacities and are in line with their preferences and areas of expertise. The assignment mechanism must adhere to constraints such as geographical and domain compatibility and workload caps, while also aiming to minimize costs, ensure equitable payment among external referees, and distribute workload evenly among all referees. This system encapsulates a multifaceted optimization challenge that integrates multiple weighted objectives, represented through a detailed scoring system. The outcomes of this system are expressed as relational atoms that detail the optimal assignments of referees to cases, focusing on cost reduction and adherence to all constraints. The effectiveness of the system is measured using a scoring system that evaluates the solutions' closeness to an ideal state, taking into account various cost elements and preference alignments. This method offers a robust framework for managing the intricacies involved in assigning referees to insurance cases, ensuring optimal and fair utilization of resources in daily operations.

Problem Statement

In the insurance industry, the efficiency and accuracy of claims handling are paramount for customer satisfaction and operational effectiveness. The "Insurance Referee Assignment 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

In my project tackling the "Insurance Referee Assignment Problem," I've made substantial progress. I installed Clingo, an ASP solver, on my local machine, which is crucial for implementing the solution. Additionally, I've delved deep into the concepts of Answer Set Programming (ASP), ensuring a solid grasp of the methodology. Breaking down the problem statement into manageable parts has provided a clear roadmap for development.

Translating program entities into ASP facts was a key step, enabling the representation of the problem in a format suitable for ASP solving. Moreover, I've successfully encoded the hard constraints into the ASP formulation, ensuring that the solution adheres strictly to the specified rules and limitations. These achievements mark significant progress in the project and set a strong foundation for its successful implementation and further refinement.

Issues or Challenges Encountered

Another significant challenge encountered in the development of the "Insurance Referee Assignment Problem" project was the encoding of weak constraints into the ASP formulation. Unlike hard constraints, which must be satisfied without exception, weak constraints introduce prefer-

ences 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 "Insurance Referee Assignment Problem" 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, as well as consulting with experts in the field to gain insights and best practices.

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 peers and experts 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.

- Deconstructed the complex problem statement into manageable steps, aiding in a systematic approach to problem-solving.

- 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.

- Analyzed and understood the problem's requirements, ensuring clarity and precision in problem-solving efforts.

- Prepared a solid foundation for implementing weak constraints, aiming to optimize solution outcomes and fairness.

- Demonstrated a strong grasp of the problem's core concepts, essential for developing a comprehensive ASP solution.

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.