Milestone 4: Insurance Referee Assignment

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Problem Statement

In the insurance industry, it's crucial to have a fair and efficient system for processing claims. One aspect of this process is verifying the legitimacy of the claims before deciding on the compensation payout. This is where the assignment of referees comes in.When a customer files an insurance claim, the insurance company assigns a referee to evaluate the claim. The referee is responsible for verifying the details of the claim, including the cause and extent of the damage and the cost of repairs or replacement. Based on their assessment, the referee makes a recommendation on the payout amount that the insurance company should offer to the customer.Assigning referees to claims can be a complex process. There are several factors that need to be considered, such as workload, geographic location, and area of expertise. The workload of referees is managed carefully to ensure that each referee can handle a manageable number of cases in a day, without compromising the quality of their assessment. Geographic location is also taken into account to reduce the travel time for referees and make the process more efficient.Furthermore, referees are assigned based on their area of expertise.Referees can be internal employees of the insurance company or external contractors. Internal referees receive a fixed salary and are responsible for assessing claims within their area of expertise. External referees are paid per case, and their fees are typically higher than those of internal referees. Proper allocation of referees also helps to minimize the risk of fraud. Therefore, insurance companies use various selection criteria, such as the time required to process the case, damage cost, and fee paid to external referees, to allocate referees to claims. By doing this, they can ensure that the process is transparent and unbiased, and that customers receive the payouts they deserve. [1]

Background

Identifying suitable tasks in popular coding languages that use imperative programming can be a challenging process. This is because it often involves implementing constraints and performing an effective search space enumeration, which can be time-consuming and complex. However, using a declarative language such as Prolog can simplify this process by reducing the amount of code required for search space traversal and allowing for greater focus on encoding constraints.Despite the benefits of using Prolog, there are some drawbacks. One of the main disadvantages of Prolog is that it may not terminate eventually, which can lead to problems when working with large search spaces. Additionally, efficient search space traversal in Prolog requires a deep understanding of complex operators, such as the branch cut operator, which can be difficult for programmers who are new to the language.As an alternative to Prolog, I chose to use Clingo for my project for several reasons. One of the main advantages of Clingo is that it terminates eventually, which means that it will always find a solution if one exists. This is important because it ensures that the program will not get stuck in an infinite loop, even when working with large search spaces.Another advantage of Clingo is that it requires less knowledge of complex operators than Prolog. This is because Clingo utilizes Answer Set Programming and stable model semantics, which are helpful in implementing constraints. These features allow for a more intuitive and streamlined approach to constraint programming, which makes it easier to write and debug code.Overall, using Clingo for my project allowed me to simplify the process of identifying suitable tasks by reducing the amount of code required for search space traversal and allowing for greater focus on encoding constraints. It also provided me with several advantages over Prolog, including eventual termination and a more intuitive approach to constraint programming. [2]

Approach

Answer Set Programming (ASP) is a programming paradigm that is based on declarative logic. It allows users to specify a set of rules and constraints that define a problem, rather than specifying how the solution should be found. ASP can be used to solve a wide range of problems, including those with complex restrictions or constraints.One of the main advantages of using ASP is that it requires less preparation compared to other methods when it comes to dealing with restriction-related problems. This is because ASP allows users to specify constraints and rules in a declarative way, without needing to specify how the constraints should be enforced. Instead, ASP solvers automatically generate solutions that satisfy the specified constraints.Another ad-

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vantage of ASP is that it provides a powerful and flexible way to represent and reason about knowledge. ASP allows users to express complex relationships and dependencies between objects and events in a concise and natural way, which makes it easier to understand and modify the problem specification.ASP is also efficient and scalable, making it suitable for solving large-scale problems. ASP solvers use sophisticated algorithms to search for solutions that satisfy the constraints specified in the problem description. These algorithms can be customized and optimized to take advantage of the specific structure of the problem at hand.

Testing

During the testing phase of a model, it is evaluated based on two types of constraints: rigid and flexible. The rigid constraint is a strict rule that must be met in order for a model to be considered a viable option. Any model that fails to meet this constraint is immediately disqualified.On the other hand, the flexible constraint is a guideline that allows for some flexibility. However, there is a penalty for each violation of the flexible constraint. The more violations a model has, the higher the penalty will be. This penalty is used to determine which model is the best option, even if all the models satisfy the rigid constraint.Ultimately, the best model is the one that meets all the rigid constraints and has the fewest penalties for any flexible constraint breaches. This ensures that the chosen model is both accurate and flexible, while still adhering to the company's defined criteria.To evaluate the accuracy of their implementation, the company has defined nine constraints and developed ten hypothetical scenarios. These scenarios are used to test the model's ability to meet the constraints and to identify any weaknesses in the implementation. By carefully testing the model in a variety of scenarios, the company can ensure that it is reliable and effective in real-world situations. [3]

Types of Constraints

Hard Constraints

The allocation of cases to referees should be done in a way that ensures their workload does not exceed a specified maximum limit, as this could lead to referees becoming overwhelmed and making mistakes. It is important to manage the allocation process carefully to ensure that referees have a manageable workload and are able to provide high-quality and accurate assessments of the cases assigned to them.Referees may indicate their preferences for specific regions or types of cases. This means that referees who express a preference level of 0 for a particular region will not be assigned cases from that area. Similarly, referees who have not stated a preference for a specific type of case will not be assigned to handle it. This ensures that referees are assigned cases that they are comfortable with and have relevant knowledge of.The assignment of cases will be based on a predetermined damage threshold, meaning that referees with relevant expertise and experience will be assigned to handle cases that fall within their area of expertise. This ensures that cases are handled by referees who are most qualified to assess the case and provide an accurate and unbiased assessment.Overall, managing the allocation of cases to referees is crucial to ensure that referees are not overwhelmed and can provide high-quality assessments. By taking into account referees' preferences and expertise, the allocation process can be optimized to provide the best possible outcomes. [4]

Weak Constraints

To reduce expenses, organizations may prefer to use internal referees instead of external referees who are paid per case. However, it is important to ensure that external referees are compensated fairly for the cases they handle. To ensure fairness in the assignment of cases, every external referee should have the opportunity to receive cases, and their overall compensation should be equal to that of internal referees.To ensure that cases are assigned equitably, both internal and external referees should have an equal number of cases assigned to them. Priority should be given to referees who are preferred for higher priority cases. For example, if a case requires a specific area of expertise that an external referee possesses, they should be assigned the case, regardless of their preference for that type of case.Referees' preferences should also be considered when assigning cases to them. This means that if an external referee has expressed a preference for a specific type of case, they should be assigned cases that fall within that category. However, if an external referee has not expressed a preference for a specific type of case, they should still have the opportunity to receive cases that fall within their area of expertise.In summary, to ensure fairness in the assignment of cases, organizations should strive to assign an equal number of cases to both internal and external referees, while taking into account referees' preferences and expertise. By doing so, external referees can be compensated fairly for their work, while still reducing overall expenses for the organization. [5]

Explanation of Hard and Weak Constraints

Maximum Working Time

Referees' workload in terms of working minutes should not exceed their capacity, which is determined by the total time required for all their assigned tasks. The number of cases assigned to each referee is linked to their ID, indicating their ability to handle them.

:- referee(rid, type, max_overload, prev_workload, prev_payment)
#sum { effort, cid : case(cid, type,effort,damage, postc, payment),
assign(cid, rid)} $\geq max\_workload.$

Region

Referees are allocated to particular areas based on their preference level, which ranges from 0 to 3, where 0 indicates their inability to work in that area and 3 is their highest preference. Referees who do not express any preference are considered to have a preference level of 0 for that region. Two protocols must be established to ensure this.

Rule 1: :- assign(cid, rid),
case(cid, type,effort, damage, postc,payment), not prefRegion(rid, postc, pref).

Rule 2: :- assign(cid, rid),
case(cid, type,effort, damage, postc,payment), prefRegion(rid, postc, pref).

Work Preference

The Region Hard Constraint is a rule that is put in place to ensure that a referee is assigned only to cases that fall within their area of expertise. This is an important rule to follow, as it ensures that cases are being handled by referees who have the necessary knowledge and experience to make informed decisions.In the past, the rule was enforced through the use of a function called prefRegion, which would assign referees to cases based on their preferred regions. However, there were some issues with this approach, as referees may have preferred certain regions for personal reasons rather than because of their expertise in handling cases in those regions.This rule has two slightly different regulations than the previous ones.; replacing prefRegion(rid, postc, pref) with prefType(rid, caset, pref).

To address these issues, the rule has been updated to use a new function called prefType. This function assigns referees to cases based on their preferred case types, rather than their preferred regions. This ensures that referees are assigned to cases that fall within their area of expertise, rather than just their preferred geographic location.There are two slightly different regulations associated with the prefType function. The first regulation requires referees to specify their preferred case types when they register as a referee. This information is then used to assign them to cases that fall within their area of expertise.

The second regulation requires the organizers of the referee assignment system to ensure that referees are only assigned to cases that fall within their preferred case types. This helps to prevent referees from being assigned to cases that they may not be qualified to handle.
Overall, the Region Hard Constraint is an important rule that helps to ensure that cases are being handled by referees who have the necessary knowledge and experience to make informed decisions. The use of the prefType function is a valuable update to this rule, as it helps to ensure that referees are assigned to cases based on their expertise, rather than just their personal preferences.

Damage

When a company experiences damage or loss, there are different ways to address the situation. One option is to hire external referees or experts to handle the claim. However, there may be limits to the amount of damage that an external referee can handle.To address this issue, a company may introduce a policy that restricts the amount of damage that an external referee can handle. This policy would specify that if the damage exceeds a certain threshold, internal referees must handle the claim.

Internal referees are employees of the company who are trained and authorized to assess and handle damage claims. By introducing this policy, the company can ensure that only experienced and knowledgeable staff are handling severe damage cases.The specific threshold for when internal referees must handle the claim will depend on the company's preferences and capabilities. It may be based on factors such as the complexity of the claim, the amount of potential damages, and the availability of internal staff. [6]
Overall, introducing a policy that requires internal referees to handle damage beyond a certain threshold can help a company manage risk and ensure that claims are handled efficiently and effectively.

:- externalMaxDamage(ExtMaxDamage),
referee(rid, type, max_overload, prev_overload, prev_payment).
case(cid, type, effort, damage, postc, payment)
Damage $\geq ExtMaxDamage, assign(cid, rid)$.

Prefer Internal Referees

In order to minimize costs, the company prefers internal referees instead of external ones. The appropriate weights for each limited rule can be assigned in the following manner:

17CA + 6CB + 10CC + 30CD + 30CE

The weight assigned to a weak constraint, Ci, is represented by the coefficient preceding it, indicating its level of significance.

Balanced Workload

This limitation may not be always attainable. In such cases, resorting to the data can serve as a viable alternative.

Balanced Payment

The method of ensuring equitable compensation for external referees is like the previous requirements. We need to consider two situations where the external referee's scope of work is closely associated.

Type Preference

Each member of the team is given a rating from 0 to 3 based on their preference for a certain type of task. A score of 0 means that the person is disinterested or has the least amount of enthusiasm for the task, while a score of 3 indicates a high level of interest in taking on the job. We must penalize the allocation of low-priority tasks to referees and develop the code in a way that enables the ASP to choose a model that results in the lowest possible penalty while following this guideline.

Results and Analysis

To evaluate the program's trustworthiness, the company provided simulated scenarios, which were successfully executed according to our plan.

Output

Starting test:
Command: clingo scenario_eight.lp scenario_one.lp –quiet=1

clingo version 5.6.1
Reading from scenario_eight.lp ...
Solving...
Answer: 1
assign(14,27)assign(15,27)
Optimization: 227988
OPTIMUM FOUND

Models :1
Optimum :yes Optimization : 227988
Calls :1
Time :0.060s(Solving: 0.01s 1st Model: 0.00s Unsat 0.01s)
CPU Time :0.063s

====TEST RESULTS====
TEST PASSED!
EXPECTED: assign(14,27)assign(15,27)
ACTUAL: assign(14,27) assign(15,27)

Final Assessment

The weights applied to the penalties in both rigorous and casual regulations by the organization are chosen haphazardly. Upon further investigation, it was found that the model could be more effective if consistent weights of punishments are established. This would allow for more accurate and consistent outcomes when enforcing regulations.At first, establishing consistent weights of punishments may have presented some complications. However, with continued learning through lectures and online materials, the individual was able to make headway. Specifically, they utilized Clingo, a software tool for solving logic programs, to aid in this task.

Clingo provides a platform for modeling and solving problems using answer set programming. This means that the individual was able to create a model of the problem and use Clingo to generate possible solutions based on that model. By doing so, they were able to test different weights of punishments and see how they would impact the outcomes of the regulations.Once consistent weights of punishments were established, the organization could enforce regulations more effectively. With consistent weights, penalties for violating regulations would be applied fairly and predictably. This would discourage violations and encourage compliance, leading to a more stable and efficient regulatory system. In conclusion, establishing consistent weights of punishments can be a challenging task, but with the right tools and continued learning, it is possible to make headway. By utilizing Clingo, the individual was able to model the problem and test different weights, ultimately leading to a more effective regulatory system.

Future Work

With the advancement of machine learning models, the benefits of using these models in predicting punishment weights have become apparent. The statement highlights the precision of using classification algorithms to categorize data into specific groups or classes, allowing for accurate predictions based on historical data. This approach is superior to relying on random selection or manual adjustments, as it provides more accurate results and reduces the chances of errors.

Additionally, the statement highlights the use of Clingo on distributed memory, which is a technique used to utilize memory across multiple clusters. This approach results in faster processing times for even complex scenarios, as the data can be divided and processed simultaneously across different nodes, reducing the time required for computation. Despite scenario six taking longer to execute, the use of distributed memory allowed for efficient utilization of resources and faster processing times.

In summary, the use of advanced machine learning models and distributed memory techniques has opened up the possibility of achieving more accurate and efficient predictions, even in complex scenarios. This advancement can lead to significant improvements in decision-making and policy formulation across various domains, including law enforcement, finance, and healthcare.

References

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