Project Milestone 3
Automated Warehouse Scenario

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Problem Statement

This project is based on a problem statement from 2019 ASP (Answer Set Programming) challenge. The main purpose of this project is to deliver the packages by robots located inside warehouses. Robots need to pick up the shelves which contains the products which needs to be delivered, make it available at the warehouse, and then later drop it at the picking station. The parcel should be available as soon as possible, based on the given orders. This represents a real time warehouse scenario.

A warehouse is represented as a rectangular grid and the robots can move vertically and horizontally but never diagonally. The robots are flat and can move underneath the shelves and pick them up. The robots do their work of picking up shelves, putting down the shelves, deliver shelves or deliver products. While they do the work there must not be any crashes, that is, no robot should move into or switch its shell with another one from one step to next. If two robots are on the same cell, then it is termed as collision. We need to avoid collision during the transfer of packages. Highways are cells where no shelves can be put down. All robots don't need to be always active. Each order is mapped to one pickup station.

The goal is to fulfill the orders in as little time as possible. Time taken to complete the order is counted in terms of steps.

Summary of Progress made

As from the problem statement, we need to understand the basics and terminologies used in ASP and Clingo. There are certain actions which a robot performs which needs to be represented in form of objects and relations. So, I first watched and understood the concepts taught in module 3, module 4 and module 5. Various topics such as arithmetic, clingo directives, pooling, negation etc. has been taught in these modules which are helpful in designing Automated warehouse scenario. Based on the concepts I was able to identify and define the states of robot in the warehouse problem.

I have gone through the automated-warehouse-scenario package which was provided by the professor in canvas. The description.pdf file has helped in understanding how input and output works. The example provided helps in visualizing the working of a robot in Realtime scenario.

Challenges faced

The challenges faced during designing and working on Automated Warehouse Scenario are:

1. Understand the hard and weak constraints.
2. Understand the test cases given, find out their working.
3. Identify the objects in the project.
4. How to represent warehouse and robot in clingo.
5. Understand the complex output given in the problem.
6. How to represent common sense law of inertia in clingo.

How to resolve the issues?

The issues can be resolved by:

1. Making a list of all the actions performed by the robot inside a warehouse.
2. Illustrate and understand the edge case scenarios.
3. Research and read more to understand the working of robots in a warehouse.

Tasks Completed

The tasks that have been completed are:

1. Read description.pdf and understand the flow of problem statement.
2. Identify the objects in warehouse
3. Understand the given test cases in simpleInstances folder.
4. Define robot and its movements.
5. Define grid control.
6. Identify actions performed inside a warehouse.
7. Understood the hard and weak constraints in fulfilling the orders.
8. Learn more about common sense law of inertia for warehouse world.
9. Code common sense law of inertia.
10. Identify the required constraints for a robot – Robot move, pickup, dropoff, shelf picking station, delivery, highway, idle.
11. Code robot's movements and the constraints.
12. Code for shelf constraints.

Future tasks

The tasks that need to be completed are:

1. Code for robot to pick up the shelf.
2. Code for robot to drop the shelf.
3. Code for highway constraint.
4. Code for picking station.
5. Code for delivery.
6. Deliver the package.
7. Find out the time taken for the whole process.

References

1. Nguyen, V., Obermeier, P., Son, T. C., Schaub, T., & Yeoh, W. (2017), *Generalized Target Assignment and Path Finding Using Answer Set Programming*, IJCAI (pp. 1216-1223). ijcai.org.
2. https://sites.sju.edu/plw/files/2019/06/slides.pdf
3. Marcello Balduccini. *Representing Constraint Satisfaction Problems in Answer Set Programming.*