Individual Progress Report- Milestone 3
Project- Automated Warehouse Scenario

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Problem Statement

An automated warehouse is a logistic facility where automated equipment's are used to optimize the operations. This project also demonstrates one of the ideas where robots are used to fulfill orders in timely manner. Whenever order is placed, robots which are flat in size carry shelves with the ordered product and take them to matching picking stations.

An Automated warehouse is represented as a rectangular grid where robots can move horizontally and vertically in adjacent cell. Note that we have a constraint that a robot cannot move diagonally in the warehouse. As mentioned above robots are flat in size and can move underneath shelves and pick them up. Another constraint here is when robot carries a shelf it cannot fit under another shelf until it moves away from the current shelf.

The goal is to fulfill all the orders in timely manner in addition to fulfilling all the constraints. Robots must be prevented from having collision in any state be it Idle, moving, pickup, put down, deliver etc. This also implies that robots cannot switch cells in any step. Steps here is counted in terms of time (t1, t2, t3 etc.).

Summary of Progress

To solve this complex problem statement, I am using clingo with ASP language. ASP is a declarative programming language oriented to solve difficult search problems. Goal is to find stable models through answer set solvers. I am also using python to run the scripts which in turn look for .asp files given as part of this project. Module 3,4,5 of the project have discussed couple of complex ASP problems like – N-Queens problem, Monkey-banana, Block's world, Serializable etc. which has helped a lot in making progress for this project. The guidelines described in description file has provided help in understanding nature of the problem. I have setup visual studio code with Python and clingo and have made progress in writing constraints and actions for this project.

The visual example provided in the description file has helped me in understanding and writing actions. As part of the Project development, I will include a python file, running this python script will ask for an input for ASP file present in simple Instance's folder of the project. Once ASP file references is provided it will redirect the program to a clingo file which will include all the actions, constraints, effects, axioms, Law of inertia and predicates. As I am making progress on the project, I have faced couple of challenges which are highlighted in next section.

Challenges Faced

I have faced some challenges in designing and writing constraint for different scenarios and setting up python to execute script. While I have solved issues related to python and I am still making progress in solving the challenges related to constraints. To highlight some of the scenarios here which I faced with constraints are: 1) Robot cannot move outside the grid 2) Robots cannot swap places 3) Making sure the order delivered to picking station is for the right product and quantity, which in turn translate to effect of delivering a product. 4) Writing commonsense law of inertia 5). A robot can pick up the shelf only when it is on the node containing the shelf 6) I was also unclear as to what value to provide in time steps and have solved that by adding a const directive which can be provided a value 6) Go through each test cases and formulate a plan which works for all the test data.

Though some of these challenges are fixed and helped in solving complexity for other scenarios, there are still some corner and edge cases which are pending and I am working

on to resolve those. I am highlighting summary of work which have been completed so far in the next section.

Summary of completed tasks.

Following tasks have been completed so far as part of project progress:

1. Setting up clingo and python.
2. Going through basic answer set programming and understanding different predicate, commands etc.
3. Understanding the details through project walkthrough video and description file.
4. Identifying project objectives and plan to execute the task.
5. Understanding test cases given as part of the project.
6. Identifying the constraint for different scenarios.
7. Identifying the action performed by robots in warehouse.
8. Identifying the effects and commonsense law of Inertia.
9. Identifying state constraints and Action effects.
10. Coding python script file to intake given test case file in simple instances folder
11. Coding to generate the actions
12. Coding Actions constraint- Robot moving, picking shelf, putting down.
13. Coding state constraint- Picking station cannot be a highway, Shelf cannot be on highway
14. Coding effects: Effect of moving a robot, Effect of picking and putting down a shelf
15. Coding Law of Inertia and also using minimize to find the optimal solution

Considering progress made so far on the project I am optimistic of completing the remaining part in the given time frame. There are still significant chunk of coding needs to be completed which I am highlighting in next section.

Tasks to complete & plan

Some of the pending tasks for the project are highlighted as below:

1. Formulate a plan to divide clingo file in to multiple parts/files and include them in the main file. This will make file easy to maintain and would be good for readability purpose.
2. Organize the input to understandable format.
3. Coding to generate the outputs.
4. Coding for remaining actions and effects.
5. Coding pending part for picking up and putting down shelf.
6. Coding for delivering product to picking station.
7. Coding for some of the Robot constraints – Robots cannot be on the same nodes, Robots cannot swap places.
8. Coding for the shelf constraints- No two shelves on the same node, No two shelves on same robot, No shelf on two locations.
9. Coding for Effect of delivering a product.
10. Goal state declaration.
11. Declaring show predicates for numerous objects- node, robot, shelf, product etc.

I have spent some time to understand the pending scenarios and have revised some part of module 5 which has helped in formulating the pending constraints. I am also planning to divided the clingo file in multiple chunk and include the remaining files using include directive in the main file.

References

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