Course Project: Milestone 3 - Individual Progress Report

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Abstract

The project aims to develop a simplified version of automated warehouse scenario done in Amazon warehouses where robots are used to deliver the products to the pickup stations to fulfil orders. This report gives a clear picture of problem description, summary of progress till now, issues encountered and an overview of the tasks I still need to complete.

Problem Statement

In this project I am working on a robot automated warehouse to deliver products to the pickup stations where warehouse is a rectangular grid of any size whereas robots can move horizontally and vertically through adjacent cells. Our main goal is to deliver the products in little time as possible. To achieve this the robots should cover the least number of cells to reach the desired destination. Here time calculated to deliver the products is nothing but the number of moves that a robot takes.

Progress Summary

First after clearly understanding the problem statement I went on internet and researched on how this current amazon warehouses are functioning. This gave me a clear picture on how products are delivered, then I wrote what are the features we need to add.

Understanding the problem statement and writing what will be the inputs and given the constraints like

- Robots can only move horizontally or vertically but not diagonally.
- Robot is a flat surface which can carry one shelve at a time and robots cannot swap shelves.
- A warehouse is divided into rectangular grids of which each cell has x and y co-ordinates.

Input predicates

- **init(object(node,'n'),value(at,pair('x','y')))** – The term 'n' in the predicate represents a point on a rectangular grid where 'x' and 'y' are the co-ordinates of the node 'n'.
- **init(object(highway,'h'),value(at,pair('x','y')))** – The term 'h' in the predicate represents a highway cell located at 'x' and 'y' co-ordinates.

The rectangular grid's highway cells are a subset of those cells and have the same coordinates as the regular cells. Given that a corresponding fact of the first kind exists and identifies the grid cell in question as a highway cell, it may be assumed that the highway cells have some extra information or functionality that sets them apart from normal cells.

In the same we should write input statements for robots' shelf, pickup station, product. Given neither a robot nor a shelf can be originally carried by another robot or placed in a cell that has been classified as a highway.

Output predicates

Robots must supply the precise number of units necessary for each product in an order, even if the delivery is made in many portions. At time steps 't' denoted by positive integers beginning at 1, actions may be carried out.
Further criteria are stated along with the form of atoms for actions in the following: Each robot specified by an instance may, but need not, do one action each time step:

- **occurs(object(robot,'r'),move('dx','dy'),'t')** - At time t, the robot is moving shelves from position (X,Y) to position (X+dy, Y+dy), where dx and dy correspond to movement (0,1), (1,0), and (0,1). (1, 0).
- **occurs(object(robot,'r'),pickup,'t')** - At time t, the robot "r" picks up the shelf at coordinates "X" and "Y."

Then I acquired some mandatory knowledge on Knowledge Representation topics so that I will be able to write some hard constraints in this project.

Issues Encountered

- In this project we should use **dynamic programming** because the status of each object changes over time. Translating the inputs into object declarations is the first issue I faced.
- Understanding the problem statement and obtaining special constraints, translating the English statements to input, and output clingo statements are the next minor issues I faced.
- **Implementing the solution** (working on this currently): Till now I got all the necessary knowledge on the given problem, formulating the code from statements. I need to implement the code test it for correctness with the given test-cases.
- **Acquiring the abilities** required to complete the project.

  I studied Answer Set Programming in addition to the readings, assignments, and tests from the course. Being familiar with all the clingo programs and that too this problem is like block word problems.

Tasks Completed

- The project package which contains the problem description and sample instances has been downloaded and I have investigated the sample cases included in the package and have learned about the input and output formats.
- From the given problem statement identifying the objects - node, highway, robot, product, shelf, orders, etc. Mapping these objects with distinctive labels and positions.
- Started writing hard constraints: You have started to write hard constraints to find the plan to fulfill all orders. You have learned how to write more complex hard constraints in Week 4 and Week 5 of the course and are applying this knowledge to the project.

Tasks need to be done

- Implementing the dynamic programming approach to handle the changing status of input over time.
- Coding and testing are to be done to make sure the project's goals is met and the code is functioning correctly. Once if I finish writing the code, I can check the code with the given sample test cases.
- Further developing my skills in Answer Set Programming and clingo and techniques that can help me with writing hard constraints and finish this project.

Plans to resolve issues

- It could be useful to generate a list or map of objects with their attributes, such as their present position, status, and other details, before converting the inputs into object declarations which is useful in changing the status of input over time.
- While implementing the solution I think it will be wise to use test-driven development approach where I am writing tests for each piece of code and ensure that it passes moving on to next one.