Question 6 [BONUS PART]

We need to create an intelligent shopping Robot which will operate in large single-story shopping mall to facilitate the customers.

The shopping mall is divided into a number of regions and each region contains a range of products. Some of the regions are adjacent to each other and the Robot can directly go to any of the neighboring/adjacent region of a given region.

The whole map of the shopping mall can be represented as a graph with the nodes as regions and there is an undirected edge between neighboring regions.

As programmer of the shopping robot we can use a simple command MOVE_To(R_ID) move to region R_ID that is adjacent to the present region and the Command PICK_UP(ITEM_ID) to pick the item using the ITEM_ID.

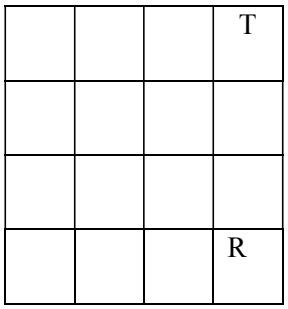
The user of our Robot will provide it the ITEM_ID of a single item to be purchased and the main job of our shopping Robot will be to identify the target region that contains the item by using a database and then go to the appropriate part of the store and bring the requested item by using minimum number of steps. You can assume that we can query the database by using the interface function R_ID = QUERY(ITEM_ID); It has been decided to formulate the problem of finding the shortest path from the Robots initial position to the destination region and hence your first job is to formulate this problem as a search problem.

Part a) **[3 + 2 Points]**

- Completely specifying a minimal set of items needed to keep the state of the problem.
- Which algorithm(s) could be used to find a shortest path from the starting position to goal region if each **MOVE-TO** command has a constant cost.

Part b) **[3 + 2 Points]**

Now assume that each floor of the mall is divided into n x n square regions. The robot is in the right-bottom corner and the target region is in the upper-right corner where the Robot can only move either horizontally or vertically. Such a floor is shown in the figure below.



- How many regions would be expanded, in the best and worst case, by BFS algorithms. (Assume Graph Search Versions)
- How many regions would be expanded by the A* search algorithms if the City-block-Distance is used as a heuristic function. (Assume Graph Search Versions). The City-Block-Distance is defined as the sum of horizontal and vertical distances.

Good Luck!