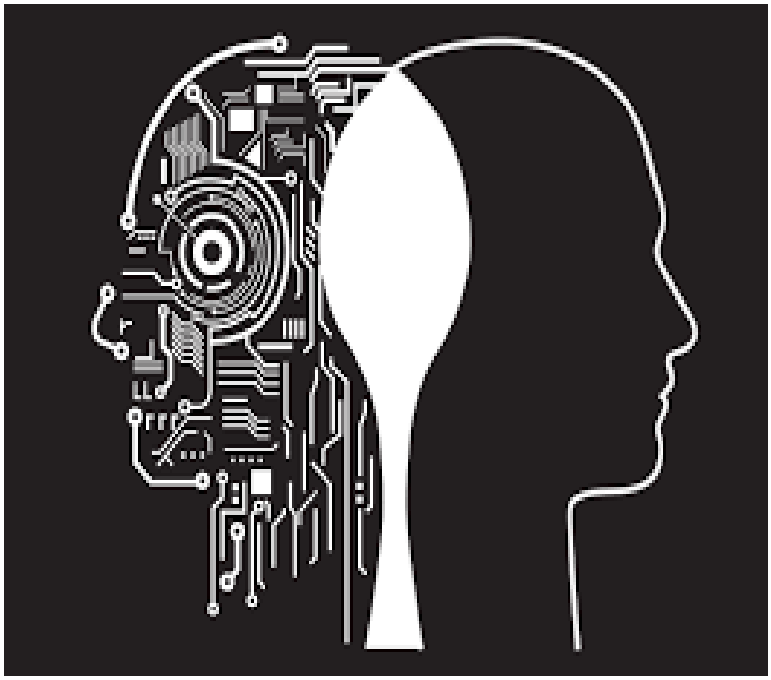

Part I: Programming with A* Search

ARTIFICIAL INTELL & INTELL AGENTS

Team Members: Saarah Huda (H00232155), Fahad Mostafa (H00203962), Daniyar (H00204990)

F29AI | 31st October 2017

Solution

The robot starts at the delivery truck and looks for either a small or a large package to carry them to Warehouse A or Warehouse B respectively and vice versa using an optimal path found via A* search which uses either Manhattan or Euclidian heuristic.

State Space

- Matrix
- Warehouse A, Warehouse B and truck are statically placed on the matrix at a considerable distance between each other.

The matrix was selected as state space because it is easier to represent the problem. It is like a GUI representation.
The packages present in the truck and the warehouses are randomly initialized.

Heuristics

When the program runs, user is given choices to select either Manhattan or Euclidian heuristic.

These heuristics were preferred because they were taught to us in lectures. Therefore, it was easier to understand and implement.

How Manhattan was implemented

The co-ordinates of A (warehouse) was subtracted from the co-ordinates of T (truck). Then the absolute value was taken as the heuristic. The following formula was used:

$H = (x2 – x1) + (y2 – y1)$

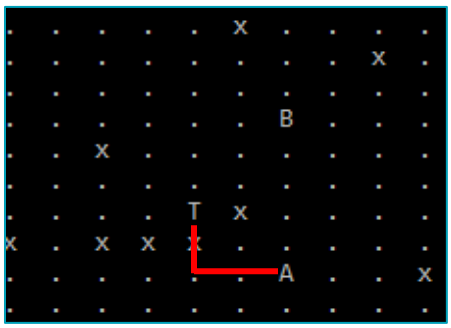

Fig 1. Shows how Manhattan heuristic is calculated from T to A.

T has co-ordinates (6,4) and A has co-ordinates (8,6) and applying the formula gives H = (8-6) + (6-4) = 4. Therefore, 4 is the heuristics of T from A.

How Euclidian was implemented

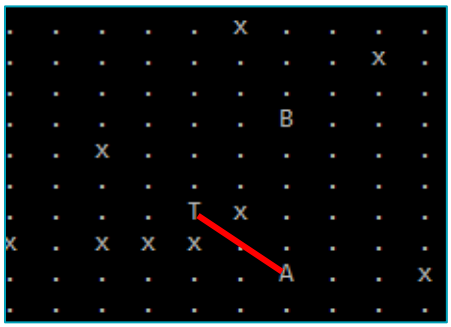

Fig 2. Shows how Euclidian is calculated from T to A.

Formula is $H = \sqrt{[(x2 - x1)^2 + (y2 - y1)^2]}$
$H = \sqrt{[(8 - 6)^2 + (6 - 4)^2]} = 2.8284271247461903$ is the heuristic value.

Extra Notes:

1. Download both python files (a_star.py and main.py).
2. Open the files in Python 3 IDLE.
3. Run the main.py

A* search:
- Sample code from https://www.redblobgames.com/pathfinding/a-star/

Part 2: Knowledge Representation and Automated Planning

Solution

All properties, objects, actions and operations described in the problem description has been implemented. The three missions specified are properly planned by the planner using the domain and problem PDDL files and give no errors. Moreover, either the missions could be run as three different plans or as one single plan.

Usually in first-contact missions, the security personnel are present with the captain but if for some reason the security personnel are not present then the captain gets injured which then requires the medical personnel to attend the captain to heal the injury to be able to complete the mission successfully. The ship, after completing all missions does successfully return to the Earth as well.

Features

- Have used types that are grouped into 3 categories: static, personnel and equipment.
- All personnel can move through the static types e.g. engineer (personnel type) moves through lift (static type).
- One static is connected to another static type.
- Equipment can only be moved by the personnel type.

```
(:types

bridge engineering sickbay transporter-room shuttle-bay science-lab cargo-bay lift hall planet - static

captain engineer science-officer navigator medical-personnel security-staff transporter-chief robot - personnel

plasma light heavy - equipment

ship
)
```

- Missions are defined as actions in the domain.
- Example of a mission (relief mission) shown below.

```
(:action mission-relief
    :parameters
        (?p - planet ?medic - medical-personnel ?supplies - light)
    :precondition
        (and
            (ship-at ?p)
            (medical-supplies ?supplies)
            (relief-mission ?p)
            (at ?medic ?p)
            (equipment-location ?supplies ?p)
        )
    :effect
    (and
        (not (relief-mission ?p))
        (not (pickable ?supplies))
    )
)
```

- All other operations are also defined in the domain.
- Heavy equipment can only be carried by a robot.

```
(:action pick-up-robot
    :parameters
        (?x - robot ?y - (either heavy plasma) ?room - static)
    :precondition
        (and
```

- Any personnel can pick light equipment.

```
    (:action pick-up
        :parameters
            (?x - personnel ?y - light ?room - static)
        :precondition
            (and
```

- All missions are in a single goal.
- Disable missions by commenting.
- It is possible to complete all missions in one plan.
- Goal is as shown below.

```
  (:goal
  (and

   (forall (?x - planet)
     (and
       ;(not (relief-mission ?x))
       (not (exploratory-mission ?x))
       ;(not (first-contact-mission ?x))
       )
  )
  (ship-at earth)
    )
  )

)
```

Extra notes:

1. Use a text editor like Sublime Text or Notepad++ to open plans as the default notepad does not align the text properly.