Homework 3

CMU 16-782 : Planning and Decision Making in Robotics

1 Compilation Instructions

Compile using : g++ planner.cpp in terminal
Run using : ./a.out filename.txt
Replace filename.txt with :

1. **Blocks world** : example.txt
2. **Triangles and Blocks world** : example_triangle.txt
3. **Fire Extinguisher world** : example_fire.txt

Type of heuristic can be changed by changing the definition of the constant HEURISTIC. The values to be used for different types of heurisitcs are :

1. No heuristic : **0**
2. Inadmissible heuristic : **1**
3. Admissible heuristic : **2**

2 General Instructions

Following are the different heuristics cases which I tried:

1. **No heuristic** : Simple A-star search with no heuristic.
2. **In admissible heuristic** : Counts the difference in number of true conditions between current state and the goal state.
3. **Admissible heuristic** : Does another A-star search from each newly discovered state. This A-star search does not consider negative effects of the actions. The heuristic assigned in such a case is the number of steps required to reach goal state with the mentioned A-star search.

3 Blocks Environment

3.1 Explanation of Environment

1. **Symbols** : A, B, C, Table
2. **Conditions**:
   (a) On(x,y) : Block x is on y.
   (b) Block(x) : x is a block.
   (c) Clear(x) : x has no block on top of it.
3. **Actions**:
   (a) MoveToTable(b,x) : Move block b which is on block x to table.
   (b) Move(b,x,y) : Move block b from block x to block y.

3.2 Performance

	Number of Expansions	**Time Taken(in seconds)**
No heuristic	13	1
Inadmissible Heuristic	16	1
Admissible Heuristic	4	1

4 Triangles and Blocks Environment

4.1 Explanation of Environment

1. **Symbols** : B0, B1, B2, B3, B4, T0, T1, Table
2. **Conditions**:
   (a) On(x,y) : x is on y.
   (b) Block(x) : x is a block.
   (c) Clear(x) : x has no block/triangle on top of it.
   (d) Triangle(x) : x is a triangle.
   (e) NotTable(x) : x is not a table.
3. **Actions**:
   (a) MoveToTable(b,x) : Move block/triangle b which is on block x to table.
   (b) Move(b,x,y) : Move block/triangle b from block x to block y.

4.2 Performance

	Number of Expansions	**Time Taken(in seconds)**
No heuristic	648	8
Inadmissible Heuristic	297	3
Admissible Heuristic	24	874

5 Fire Extinguisher Environment

5.1 Explanation of Environment

1. **Symbols** : A, B, C, D, E, F, W, Q
2. **Conditions**:
   (a) Atrobot(x) : Robot is at x.
   (b) Atquad(x) : Quadcopter is at x.
   (c) Isflying(x) : x is flying.
   (d) Uav(x) : x is a Quadcopter.
   (e) Hascharge(x) : Quadcopter has charge.
   (f) Batterylow(x) : Quadcopter has low battery.
   (g) Haswater(x) : Quadcopter has water.
   (h) Firealpha(x) : Fire in the initial stage.
   (i) Firebeta(x) : Fire after being extinguished once.
   (j) Firegamma(x) : Fire after being extinguished twice.
   (k) Firedelta(x) : Fire after being extinguished thrice.
   (l) Loc(x) : x is a location.
3. **Actions**:
   (a) Land(b,c) : Land quadcopter on robot at location c.
   (b) Fly(b) : Fly quadcopter.
   (c) Charge(b) : Charge quadcopter.
   (d) Move(n,m) : Move the robot from location m to location n.
   (e) Movewithquad(n,m) : Move the robot with the quadcopter from location m to location n.
   (f) Fillwater(b) : Fill quadcopter with water.
   (g) Extinguishalpha(b) : First round of extinguishing.
   (h) Extinguishbeta(b) : Second round of extinguishing.
   (i) Extinguishgamma(b) : Third round of extinguishing.

5.2 Performance

	Number of Expansions	**Time Taken(in seconds)**
No heuristic	773	3
Inadmissible Heuristic	777	3
Admissible Heuristic	552	1143