**Artificial Intelligence for Robotics 2**

**Assignment 1**

**Output problem 4**

**Problem 4 – standard configuration:**

Domain parsed  
Problem parsed  
Grounding..  
Light Validation Completed  
Simplification..  
(Pre Simplification) - |A|+|P|+|E|: 421  
(After Easy Simplification) - |A|+|P|+|E|: 166  
(After AIBR):166  
(Pre Simplification) - |A|+|P|+|E|: 421  
(After Easy Simplification) - |A|+|P|+|E|: 166  
(After AIBR):166  
Grounding and Simplification finished  
|A|:82  
|P|:42  
|E|:42  
Size(X):26  
Size(F):72  
Delta time heuristic model:1.0  
Delta time planning model:1.0  
Delta time search-execution model:1.0  
Delta time validation model:1  
Setting horizon to:NaN  
Running WA-STAR  
Reachable actions and processes: |A U P U E|:166  
h(n = s\_0)=1188.0  
f(n) = 1188.0 (Expanded Nodes: 0, Evaluated States: 0, Time: 0.013)  
f(n) = 1386.0 (Expanded Nodes: 1, Evaluated States: 4, Time: 0.041)  
f(n) = 1391.0 (Expanded Nodes: 22, Evaluated States: 29, Time: 0.157)  
f(n) = 1402.0 (Expanded Nodes: 42, Evaluated States: 53, Time: 0.217)  
Starting Validation  
(Pre Simplification) - |A|+|P|+|E|: 421  
(After Easy Simplification) - |A|+|P|+|E|: 166  
(After AIBR):166  
Epsilon set to be:0.0  
Resolution for validation:1.0  
(Pddl+ semantics) Plan is valid:true  
Problem Solved  
0.00000: (m-move\_to\_crate-A crate2 m2 )  
0.00000: (m-move\_to\_crate-A crate2 m1 )  
(0.00000,2.00000)------>waiting  
2.00000: (m-at\_crates-A crate2 m1 )  
2.00000: (m-at\_crates-A crate2 m2 )  
2.00000: (m-load-F\_A crate2 m1 m2 )  
2.00000: (m-move\_create\_to\_loading\_bay-L\_F crate2 m1 m2 )  
(2.00000,5.00000)------>waiting  
5.00000: (crate\_at\_loading\_bay-L\_F crate2 m1 m2 )  
5.00000: (m-download-F crate2 m1 m2 )  
5.00000: (l-load-F crate2 l )  
5.00000: (m-charging m2 )  
(5.00000,10.00000)------>waiting  
10.00000: (m-move\_to\_crate-A crate1 m2 )  
(10.00000,11.00000)------>waiting  
11.00000: (crate\_on\_conveyor\_belt\_fragile-F crate2 l )  
(11.00000,12.00000)------>waiting  
12.00000: (m-at\_crates-A crate1 m2 )  
12.00000: (m-load-A crate1 m2 )  
12.00000: (m-move\_create\_to\_loading\_bay crate1 m2 )  
(12.00000,13.00000)------>waiting  
13.00000: (m-charging m1 )  
13.00000: (m-move\_to\_crate-B crate5 m1 )  
(13.00000,16.00000)------>waiting  
16.00000: (m-at\_crates-B crate5 m1 )  
(16.00000,19.00000)------>waiting  
19.00000: (crate\_at\_loading\_bay crate1 m2 )  
19.00000: (m-download crate1 m2 )  
19.00000: (l-load crate1 l )  
19.00000: (m-charging m2 )  
19.00000: (m-move\_to\_crate-B crate5 m2 )  
(19.00000,22.00000)------>waiting  
22.00000: (m-at\_crates-B crate5 m2 )  
22.00000: (m-load-F\_B crate5 m1 m2 )  
22.00000: (m-move\_create\_to\_loading\_bay-L\_F crate5 m1 m2 )  
(22.00000,23.00000)------>waiting  
23.00000: (crate\_on\_conveyor\_belt crate1 l )  
(23.00000,28.00000)------>waiting  
28.00000: (crate\_at\_loading\_bay-L\_F crate5 m1 m2 )  
28.00000: (m-download-F crate5 m1 m2 )  
28.00000: (l-load-F crate5 l )  
28.00000: (m-charging m1 )  
28.00000: (m-charging m2 )  
28.00000: (m-move\_to\_crate-B crate3 m1 )  
(28.00000,29.00000)------>waiting  
29.00000: (m-at\_crates-B crate3 m1 )  
(29.00000,34.00000)------>waiting  
34.00000: (crate\_on\_conveyor\_belt\_fragile-F crate5 l )  
34.00000: (m-move\_to\_crate-B crate3 m2 )  
(34.00000,35.00000)------>waiting  
35.00000: (m-at\_crates-B crate3 m2 )  
35.00000: (m-load-F\_B crate3 m1 m2 )  
35.00000: (m-move\_create\_to\_loading\_bay-L\_F crate3 m1 m2 )  
(35.00000,37.00000)------>waiting  
37.00000: (crate\_at\_loading\_bay-L\_F crate3 m1 m2 )  
37.00000: (m-download-F crate3 m1 m2 )  
37.00000: (l-load-F crate3 l )  
37.00000: (m-charging m1 )  
37.00000: (m-charging m2 )  
37.00000: (m-move\_to\_crate-B crate4 m2 )  
37.00000: (m-move\_to\_crate-B crate4 m1 )  
(37.00000,39.00000)------>waiting  
39.00000: (m-at\_crates-B crate4 m1 )  
39.00000: (m-at\_crates-B crate4 m2 )  
39.00000: (m-load-F\_B crate4 m1 m2 )  
39.00000: (m-move\_create\_to\_loading\_bay-L\_F crate4 m1 m2 )  
(39.00000,42.00000)------>waiting  
42.00000: (crate\_at\_loading\_bay-L\_F crate4 m1 m2 )  
(42.00000,43.00000)------>waiting  
43.00000: (crate\_on\_conveyor\_belt\_fragile-F crate3 l )  
43.00000: (m-download-F crate4 m1 m2 )  
43.00000: (l-load-F crate4 l )  
43.00000: (m-charging m1 )  
43.00000: (m-move\_to\_crate crate6 m1 )  
43.00000: (m-charging m2 )  
(43.00000,44.00000)------>waiting  
44.00000: (m-at\_crates crate6 m1 )  
44.00000: (m-load crate6 m1 )  
44.00000: (m-move\_create\_to\_loading\_bay crate6 m1 )  
(44.00000,46.00000)------>waiting  
46.00000: (crate\_at\_loading\_bay crate6 m1 )  
46.00000: (m-download crate6 m1 )  
46.00000: (l-load\_cheap-L crate6 ll )  
46.00000: (m-charging m1 )  
(46.00000,49.00000)------>waiting  
49.00000: (crate\_on\_conveyor\_belt\_fragile-F crate4 l )  
(49.00000,50.00000)------>waiting  
50.00000: (crate\_on\_conveyor\_belt\_cheap-L crate6 ll )  
  
Plan-Length:116  
Duration:50.0  
Metric (Plan):0.0  
Metric (Search):94.0  
Planning Time:2240  
Heuristic Time:1938  
Search Time:2030  
Expanded Nodes:942  
States Evaluated:1530  
Fixed constraint violations during search (zero-crossing):0  
Number of Dead-Ends detected:283  
Number of Duplicates detected:753

**Problem 4 – opt-hmax configuration:**

Domain parsed  
Problem parsed  
Grounding..  
Light Validation Completed  
A\* with numeric hrmax  
Simplification..  
(Pre Simplification) - |A|+|P|+|E|: 421  
(After Easy Simplification) - |A|+|P|+|E|: 166  
(After AIBR):166  
(Pre Simplification) - |A|+|P|+|E|: 421  
(After Easy Simplification) - |A|+|P|+|E|: 166  
(After AIBR):166  
Grounding and Simplification finished  
|A|:82  
|P|:42  
|E|:42  
Size(X):26  
Size(F):72  
Delta time heuristic model:1.0  
Delta time planning model:1.0  
Delta time search-execution model:1.0  
Delta time validation model:1  
w\_h set to be 1  
g\_h set to be 1  
Setting horizon to:NaN  
Running WA-STAR  
Hard Conditions: 12  
Simple Conditions: 100  
Reachable actions and processes: |A U P U E|:166  
h(n = s\_0)=17.0  
f(n) = 17.0 (Expanded Nodes: 0, Evaluated States: 0, Time: 0.022)  
f(n) = 20.0 (Expanded Nodes: 1, Evaluated States: 4, Time: 0.025)  
f(n) = 22.0 (Expanded Nodes: 3, Evaluated States: 9, Time: 0.027)  
f(n) = 24.0 (Expanded Nodes: 5, Evaluated States: 15, Time: 0.03)  
f(n) = 25.0 (Expanded Nodes: 7, Evaluated States: 21, Time: 0.032)  
f(n) = 26.0 (Expanded Nodes: 10, Evaluated States: 25, Time: 0.033)  
f(n) = 27.0 (Expanded Nodes: 13, Evaluated States: 28, Time: 0.034)  
f(n) = 28.0 (Expanded Nodes: 19, Evaluated States: 44, Time: 0.037)  
f(n) = 29.0 (Expanded Nodes: 60, Evaluated States: 120, Time: 0.055)  
f(n) = 30.0 (Expanded Nodes: 74, Evaluated States: 150, Time: 0.061)  
f(n) = 31.0 (Expanded Nodes: 92, Evaluated States: 186, Time: 0.067)  
f(n) = 32.0 (Expanded Nodes: 116, Evaluated States: 230, Time: 0.076)  
f(n) = 33.0 (Expanded Nodes: 148, Evaluated States: 278, Time: 0.085)  
f(n) = 34.0 (Expanded Nodes: 170, Evaluated States: 315, Time: 0.093)  
f(n) = 35.0 (Expanded Nodes: 206, Evaluated States: 364, Time: 0.105)  
f(n) = 36.0 (Expanded Nodes: 253, Evaluated States: 433, Time: 0.117)  
f(n) = 37.0 (Expanded Nodes: 316, Evaluated States: 539, Time: 0.133)  
f(n) = 38.0 (Expanded Nodes: 415, Evaluated States: 737, Time: 0.164)  
f(n) = 39.0 (Expanded Nodes: 721, Evaluated States: 1337, Time: 0.295)  
f(n) = 40.0 (Expanded Nodes: 1175, Evaluated States: 2671, Time: 0.421)  
f(n) = 41.0 (Expanded Nodes: 1681, Evaluated States: 4099, Time: 0.515)  
f(n) = 42.0 (Expanded Nodes: 1989, Evaluated States: 5091, Time: 0.571)  
f(n) = 43.0 (Expanded Nodes: 2239, Evaluated States: 5997, Time: 0.621)  
f(n) = 44.0 (Expanded Nodes: 2465, Evaluated States: 6837, Time: 0.676)  
f(n) = 45.0 (Expanded Nodes: 2615, Evaluated States: 7434, Time: 0.707)  
f(n) = 46.0 (Expanded Nodes: 2767, Evaluated States: 7888, Time: 0.73)  
f(n) = 47.0 (Expanded Nodes: 3282, Evaluated States: 8774, Time: 0.774)  
f(n) = 48.0 (Expanded Nodes: 4498, Evaluated States: 10946, Time: 0.884)  
f(n) = 49.0 (Expanded Nodes: 6654, Evaluated States: 15526, Time: 1.107)  
f(n) = 50.0 (Expanded Nodes: 10376, Evaluated States: 24159, Time: 1.489)  
f(n) = 51.0 (Expanded Nodes: 15568, Evaluated States: 35732, Time: 2.002)  
f(n) = 52.0 (Expanded Nodes: 21308, Evaluated States: 48466, Time: 2.543)  
f(n) = 53.0 (Expanded Nodes: 28494, Evaluated States: 63463, Time: 3.18)  
f(n) = 54.0 (Expanded Nodes: 34326, Evaluated States: 74787, Time: 3.636)  
f(n) = 55.0 (Expanded Nodes: 40092, Evaluated States: 85099, Time: 4.08)  
f(n) = 56.0 (Expanded Nodes: 44390, Evaluated States: 94709, Time: 4.491)  
f(n) = 57.0 (Expanded Nodes: 47598, Evaluated States: 102569, Time: 4.82)  
f(n) = 58.0 (Expanded Nodes: 50724, Evaluated States: 109791, Time: 5.124)  
f(n) = 59.0 (Expanded Nodes: 56152, Evaluated States: 120409, Time: 5.577)  
f(n) = 60.0 (Expanded Nodes: 64658, Evaluated States: 137191, Time: 6.304)  
f(n) = 61.0 (Expanded Nodes: 78844, Evaluated States: 165468, Time: 7.601)  
f(n) = 62.0 (Expanded Nodes: 101996, Evaluated States: 215147, Time: 9.749)  
-------------Time: 10s ; Expanded Nodes: 104926; Evaluated States: 221565  
f(n) = 63.0 (Expanded Nodes: 144718, Evaluated States: 295575, Time: 13.186)  
f(n) = 64.0 (Expanded Nodes: 197478, Evaluated States: 385233, Time: 16.915)  
-------------Time: 20s ; Expanded Nodes: 238731; Evaluated States: 457403  
f(n) = 65.0 (Expanded Nodes: 258932, Evaluated States: 487907, Time: 21.274)  
f(n) = 66.0 (Expanded Nodes: 330590, Evaluated States: 595972, Time: 26.13)  
-------------Time: 30s ; Expanded Nodes: 387742; Evaluated States: 690988  
f(n) = 67.0 (Expanded Nodes: 400586, Evaluated States: 708126, Time: 30.633)  
f(n) = 68.0 (Expanded Nodes: 488522, Evaluated States: 848650, Time: 36.043)  
-------------Time: 40s ; Expanded Nodes: 542769; Evaluated States: 935994  
f(n) = 69.0 (Expanded Nodes: 572130, Evaluated States: 975957, Time: 42.132)  
f(n) = 70.0 (Expanded Nodes: 636098, Evaluated States: 1066184, Time: 46.372)  
-------------Time: 50s ; Expanded Nodes: 687896; Evaluated States: 1138138  
f(n) = 71.0 (Expanded Nodes: 695478, Evaluated States: 1145030, Time: 50.301)  
f(n) = 72.0 (Expanded Nodes: 758152, Evaluated States: 1231948, Time: 53.89)  
f(n) = 73.0 (Expanded Nodes: 821959, Evaluated States: 1318752, Time: 57.654)  
-------------Time: 60s ; Expanded Nodes: 855903; Evaluated States: 1386553  
f(n) = 74.0 (Expanded Nodes: 891131, Evaluated States: 1439338, Time: 62.192)  
-------------Time: 70s ; Expanded Nodes: 984475; Evaluated States: 1604241  
f(n) = 75.0 (Expanded Nodes: 1014099, Evaluated States: 1644338, Time: 72.798)  
-------------Time: 80s ; Expanded Nodes: 1067891; Evaluated States: 1742081  
f(n) = 76.0 (Expanded Nodes: 1159263, Evaluated States: 1865002, Time: 89.77)  
-------------Time: 90s ; Expanded Nodes: 1161065; Evaluated States: 1869393  
-------------Time: 100s ; Expanded Nodes: 1229338; Evaluated States: 1980579  
f(n) = 77.0 (Expanded Nodes: 1280547, Evaluated States: 2040794, Time: 105.419)  
-------------Time: 110s ; Expanded Nodes: 1304295; Evaluated States: 2083014  
-------------Time: 120s ; Expanded Nodes: 1371806; Evaluated States: 2176714  
f(n) = 78.0 (Expanded Nodes: 1408435, Evaluated States: 2220237, Time: 125.263)  
-------------Time: 130s ; Expanded Nodes: 1447540; Evaluated States: 2285684  
f(n) = 79.0 (Expanded Nodes: 1566451, Evaluated States: 2440997, Time: 138.259)  
-------------Time: 140s ; Expanded Nodes: 1611712; Evaluated States: 2515127  
f(n) = 80.0 (Expanded Nodes: 1796827, Evaluated States: 2748000, Time: 147.728)  
-------------Time: 150s ; Expanded Nodes: 1861310; Evaluated States: 2840550  
f(n) = 81.0 (Expanded Nodes: 2065050, Evaluated States: 3084120, Time: 157.89)  
Starting Validation  
(Pre Simplification) - |A|+|P|+|E|: 421  
(After Easy Simplification) - |A|+|P|+|E|: 166  
(After AIBR):166  
Epsilon set to be:0.0  
Resolution for validation:1.0  
(Pddl+ semantics) Plan is valid:true  
Problem Solved  
0.00000: (m-move\_to\_crate-A crate2 m1 )  
0.00000: (m-move\_to\_crate-A crate2 m2 )  
(0.00000,2.00000)------>waiting  
2.00000: (m-at\_crates-A crate2 m1 )  
2.00000: (m-at\_crates-A crate2 m2 )  
2.00000: (m-load-F\_A crate2 m1 m2 )  
2.00000: (m-move\_create\_to\_loading\_bay-L\_F crate2 m1 m2 )  
(2.00000,5.00000)------>waiting  
5.00000: (crate\_at\_loading\_bay-L\_F crate2 m1 m2 )  
5.00000: (m-download-F crate2 m1 m2 )  
5.00000: (m-charging m1 )  
5.00000: (m-move\_to\_crate-A crate1 m1 )  
(5.00000,7.00000)------>waiting  
7.00000: (m-at\_crates-A crate1 m1 )  
7.00000: (m-load-A crate1 m1 )  
7.00000: (m-move\_create\_to\_loading\_bay crate1 m1 )  
(7.00000,14.00000)------>waiting  
14.00000: (crate\_at\_loading\_bay crate1 m1 )  
14.00000: (m-charging m2 )  
14.00000: (m-download crate1 m1 )  
14.00000: (m-charging m1 )  
14.00000: (m-move\_to\_crate-B crate3 m2 )  
14.00000: (m-move\_to\_crate-B crate3 m1 )  
(14.00000,15.00000)------>waiting  
15.00000: (m-at\_crates-B crate3 m2 )  
15.00000: (m-at\_crates-B crate3 m1 )  
15.00000: (m-load-F\_B crate3 m1 m2 )  
15.00000: (m-move\_create\_to\_loading\_bay-L\_F crate3 m1 m2 )  
(15.00000,17.00000)------>waiting  
17.00000: (crate\_at\_loading\_bay-L\_F crate3 m1 m2 )  
17.00000: (m-download-F crate3 m1 m2 )  
17.00000: (m-charging m2 )  
17.00000: (m-charging m1 )  
17.00000: (m-move\_to\_crate-B crate5 m2 )  
17.00000: (m-move\_to\_crate-B crate5 m1 )  
(17.00000,20.00000)------>waiting  
20.00000: (m-at\_crates-B crate5 m1 )  
20.00000: (m-at\_crates-B crate5 m2 )  
20.00000: (m-load-F\_B crate5 m1 m2 )  
20.00000: (m-move\_create\_to\_loading\_bay-L\_F crate5 m1 m2 )  
20.00000: (l-load-F crate3 l )  
(20.00000,24.00000)------>waiting  
24.00000: (l-load\_cheap-L\_F crate2 ll )  
(24.00000,26.00000)------>waiting  
26.00000: (crate\_at\_loading\_bay-L\_F crate5 m1 m2 )  
26.00000: (crate\_on\_conveyor\_belt\_fragile-F crate3 l )  
26.00000: (m-download-F crate5 m1 m2 )  
26.00000: (m-charging m2 )  
26.00000: (l-load-F crate5 l )  
26.00000: (m-move\_to\_crate-B crate4 m2 )  
26.00000: (m-charging m1 )  
26.00000: (m-move\_to\_crate-B crate4 m1 )  
(26.00000,28.00000)------>waiting  
28.00000: (m-at\_crates-B crate4 m1 )  
28.00000: (m-at\_crates-B crate4 m2 )  
28.00000: (m-load-F\_B crate4 m1 m2 )  
28.00000: (m-move\_create\_to\_loading\_bay-L\_F crate4 m1 m2 )  
(28.00000,30.00000)------>waiting  
30.00000: (crate\_on\_conveyor\_belt\_cheap-L\_F crate2 ll )  
30.00000: (l-load\_cheap-L crate1 ll )  
(30.00000,31.00000)------>waiting  
31.00000: (crate\_at\_loading\_bay-L\_F crate4 m1 m2 )  
31.00000: (m-download-F crate4 m1 m2 )  
31.00000: (m-charging m1 )  
31.00000: (m-move\_to\_crate crate6 m1 )  
(31.00000,32.00000)------>waiting  
32.00000: (m-at\_crates crate6 m1 )  
32.00000: (crate\_on\_conveyor\_belt\_fragile-F crate5 l )  
32.00000: (l-load-F crate4 l )  
32.00000: (m-load crate6 m1 )  
32.00000: (m-move\_create\_to\_loading\_bay crate6 m1 )

(32.00000,34.00000)------>waiting  
34.00000: (crate\_on\_conveyor\_belt\_cheap-L crate1 ll )  
34.00000: (crate\_at\_loading\_bay crate6 m1 )  
34.00000: (m-download crate6 m1 )  
34.00000: (l-load\_cheap-L crate6 ll )  
(34.00000,38.00000)------>waiting  
38.00000: (crate\_on\_conveyor\_belt\_fragile-F crate4 l )  
38.00000: (crate\_on\_conveyor\_belt\_cheap-L crate6 ll )

Plan-Length:102  
Duration:38.0  
Metric (Plan):0.0  
Metric (Search):80.0  
Planning Time:158745  
Heuristic Time:95392  
Search Time:158529  
Expanded Nodes:2087017  
States Evaluated:3107755  
Fixed constraint violations during search (zero-crossing):0  
Number of Dead-Ends detected:462944  
Number of Duplicates detected:2574846

**Problem 4 – opt-blind configuration:**

Domain parsed  
Problem parsed  
Grounding..  
Light Validation Completed  
A\* with 0-1 goal heuristic  
Simplification..  
(Pre Simplification) - |A|+|P|+|E|: 421  
(After Easy Simplification) - |A|+|P|+|E|: 166  
(Pre Simplification) - |A|+|P|+|E|: 421  
(After Easy Simplification) - |A|+|P|+|E|: 166  
(After AIBR):166  
Grounding and Simplification finished  
|A|:82  
|P|:42  
|E|:42  
Size(X):26  
Size(F):72  
Delta time heuristic model:1.0  
Delta time planning model:1.0  
Delta time search-execution model:1.0  
Delta time validation model:1  
w\_h set to be 1  
g\_h set to be 1  
Setting horizon to:NaN  
Running WA-STAR  
Reachable actions and processes: |A U P U E|:166  
h(n = s\_0)=1.0  
f(n) = 1.0 (Expanded Nodes: 0, Evaluated States: 0, Time: 0.002)  
f(n) = 2.0 (Expanded Nodes: 1, Evaluated States: 4, Time: 0.003)  
f(n) = 3.0 (Expanded Nodes: 5, Evaluated States: 12, Time: 0.003)  
f(n) = 4.0 (Expanded Nodes: 13, Evaluated States: 28, Time: 0.005)  
f(n) = 5.0 (Expanded Nodes: 29, Evaluated States: 52, Time: 0.006)  
f(n) = 6.0 (Expanded Nodes: 53, Evaluated States: 79, Time: 0.007)  
f(n) = 7.0 (Expanded Nodes: 80, Evaluated States: 96, Time: 0.009)  
f(n) = 8.0 (Expanded Nodes: 97, Evaluated States: 111, Time: 0.01)  
f(n) = 9.0 (Expanded Nodes: 112, Evaluated States: 126, Time: 0.01)  
f(n) = 10.0 (Expanded Nodes: 127, Evaluated States: 143, Time: 0.011)  
f(n) = 11.0 (Expanded Nodes: 144, Evaluated States: 162, Time: 0.012)  
f(n) = 12.0 (Expanded Nodes: 163, Evaluated States: 186, Time: 0.012)  
f(n) = 13.0 (Expanded Nodes: 187, Evaluated States: 217, Time: 0.013)  
f(n) = 14.0 (Expanded Nodes: 218, Evaluated States: 257, Time: 0.014)  
f(n) = 15.0 (Expanded Nodes: 258, Evaluated States: 316, Time: 0.015)  
f(n) = 16.0 (Expanded Nodes: 317, Evaluated States: 415, Time: 0.018)  
f(n) = 17.0 (Expanded Nodes: 416, Evaluated States: 592, Time: 0.021)  
f(n) = 18.0 (Expanded Nodes: 593, Evaluated States: 897, Time: 0.026)  
f(n) = 19.0 (Expanded Nodes: 898, Evaluated States: 1407, Time: 0.037)  
f(n) = 20.0 (Expanded Nodes: 1408, Evaluated States: 2238, Time: 0.055)  
f(n) = 21.0 (Expanded Nodes: 2239, Evaluated States: 3400, Time: 0.088)  
f(n) = 22.0 (Expanded Nodes: 3401, Evaluated States: 4703, Time: 0.13)  
f(n) = 23.0 (Expanded Nodes: 4704, Evaluated States: 5881, Time: 0.184)  
f(n) = 24.0 (Expanded Nodes: 5882, Evaluated States: 6661, Time: 0.216)  
f(n) = 25.0 (Expanded Nodes: 6662, Evaluated States: 7199, Time: 0.239)  
f(n) = 26.0 (Expanded Nodes: 7200, Evaluated States: 7705, Time: 0.252)  
f(n) = 27.0 (Expanded Nodes: 7706, Evaluated States: 8307, Time: 0.266)  
f(n) = 28.0 (Expanded Nodes: 8308, Evaluated States: 9253, Time: 0.282)  
f(n) = 29.0 (Expanded Nodes: 9254, Evaluated States: 11163, Time: 0.311)  
f(n) = 30.0 (Expanded Nodes: 11164, Evaluated States: 15255, Time: 0.363)  
f(n) = 31.0 (Expanded Nodes: 15256, Evaluated States: 22419, Time: 0.446)  
f(n) = 32.0 (Expanded Nodes: 22420, Evaluated States: 34105, Time: 0.586)  
f(n) = 33.0 (Expanded Nodes: 34106, Evaluated States: 49399, Time: 0.789)  
f(n) = 34.0 (Expanded Nodes: 49400, Evaluated States: 65165, Time: 1.027)  
f(n) = 35.0 (Expanded Nodes: 65166, Evaluated States: 78347, Time: 1.261)  
f(n) = 36.0 (Expanded Nodes: 78348, Evaluated States: 85529, Time: 1.484)  
f(n) = 37.0 (Expanded Nodes: 85530, Evaluated States: 90087, Time: 1.588)  
f(n) = 38.0 (Expanded Nodes: 90088, Evaluated States: 93345, Time: 1.661)  
f(n) = 39.0 (Expanded Nodes: 93346, Evaluated States: 97353, Time: 1.71)  
f(n) = 40.0 (Expanded Nodes: 97354, Evaluated States: 104789, Time: 1.796)  
f(n) = 41.0 (Expanded Nodes: 104790, Evaluated States: 118963, Time: 1.904)  
f(n) = 42.0 (Expanded Nodes: 118964, Evaluated States: 144651, Time: 2.127)  
f(n) = 43.0 (Expanded Nodes: 144652, Evaluated States: 185669, Time: 2.55)  
f(n) = 44.0 (Expanded Nodes: 185670, Evaluated States: 243111, Time: 3.256)  
f(n) = 45.0 (Expanded Nodes: 243112, Evaluated States: 309349, Time: 4.167)  
f(n) = 46.0 (Expanded Nodes: 309350, Evaluated States: 374243, Time: 5.197)  
f(n) = 47.0 (Expanded Nodes: 374244, Evaluated States: 439895, Time: 6.399)  
f(n) = 48.0 (Expanded Nodes: 439896, Evaluated States: 503007, Time: 7.385)  
f(n) = 49.0 (Expanded Nodes: 503008, Evaluated States: 559579, Time: 8.458)  
f(n) = 50.0 (Expanded Nodes: 559580, Evaluated States: 611823, Time: 9.443)  
-------------Time: 10s ; Expanded Nodes: 596350; Evaluated States: 645989  
f(n) = 51.0 (Expanded Nodes: 611824, Evaluated States: 657283, Time: 10.236)  
f(n) = 52.0 (Expanded Nodes: 657284, Evaluated States: 701027, Time: 10.912)  
f(n) = 53.0 (Expanded Nodes: 701028, Evaluated States: 750043, Time: 11.595)  
f(n) = 54.0 (Expanded Nodes: 750044, Evaluated States: 811259, Time: 12.72)  
f(n) = 55.0 (Expanded Nodes: 811260, Evaluated States: 889671, Time: 13.67)  
f(n) = 56.0 (Expanded Nodes: 889672, Evaluated States: 986635, Time: 14.912)  
f(n) = 57.0 (Expanded Nodes: 986636, Evaluated States: 1106111, Time: 16.596)  
f(n) = 58.0 (Expanded Nodes: 1106112, Evaluated States: 1237403, Time: 18.422)  
-------------Time: 20s ; Expanded Nodes: 1209572; Evaluated States: 1347214  
f(n) = 59.0 (Expanded Nodes: 1237404, Evaluated States: 1367967, Time: 20.451)  
f(n) = 60.0 (Expanded Nodes: 1367968, Evaluated States: 1501459, Time: 22.482)  
f(n) = 61.0 (Expanded Nodes: 1501460, Evaluated States: 1633055, Time: 25.22)  
f(n) = 62.0 (Expanded Nodes: 1633056, Evaluated States: 1751759, Time: 27.183)  
f(n) = 63.0 (Expanded Nodes: 1751760, Evaluated States: 1858963, Time: 29.121)  
-------------Time: 30s ; Expanded Nodes: 1798958; Evaluated States: 1906107  
f(n) = 64.0 (Expanded Nodes: 1858964, Evaluated States: 1959995, Time: 31.496)  
f(n) = 65.0 (Expanded Nodes: 1959996, Evaluated States: 2053363, Time: 33.498)  
f(n) = 66.0 (Expanded Nodes: 2053364, Evaluated States: 2143503, Time: 35.505)  
f(n) = 67.0 (Expanded Nodes: 2143504, Evaluated States: 2245043, Time: 37.404)  
f(n) = 68.0 (Expanded Nodes: 2245044, Evaluated States: 2365599, Time: 39.244)  
-------------Time: 40s ; Expanded Nodes: 2290193; Evaluated States: 2426378  
f(n) = 69.0 (Expanded Nodes: 2365600, Evaluated States: 2506483, Time: 41.509)  
f(n) = 70.0 (Expanded Nodes: 2506484, Evaluated States: 2674015, Time: 44.001)  
f(n) = 71.0 (Expanded Nodes: 2674016, Evaluated States: 2878407, Time: 46.946)  
-------------Time: 50s ; Expanded Nodes: 2839369; Evaluated States: 3085225  
f(n) = 72.0 (Expanded Nodes: 2878408, Evaluated States: 3122223, Time: 50.818)  
f(n) = 73.0 (Expanded Nodes: 3122224, Evaluated States: 3392767, Time: 56.641)  
-------------Time: 60s ; Expanded Nodes: 3266300; Evaluated States: 3566844  
f(n) = 74.0 (Expanded Nodes: 3392768, Evaluated States: 3676239, Time: 64.476)  
-------------Time: 70s ; Expanded Nodes: 3549117; Evaluated States: 3853846  
f(n) = 75.0 (Expanded Nodes: 3676240, Evaluated States: 3958095, Time: 76.451)  
-------------Time: 80s ; Expanded Nodes: 3775671; Evaluated States: 4075089  
f(n) = 76.0 (Expanded Nodes: 3958096, Evaluated States: 4215755, Time: 88.196)  
-------------Time: 90s ; Expanded Nodes: 3996413; Evaluated States: 4264291  
f(n) = 77.0 (Expanded Nodes: 4215756, Evaluated States: 4435099, Time: 99.671)  
-------------Time: 100s ; Expanded Nodes: 4223277; Evaluated States: 4443952  
-------------Time: 110s ; Expanded Nodes: 4425362; Evaluated States: 4611305  
f(n) = 78.0 (Expanded Nodes: 4435100, Evaluated States: 4616787, Time: 110.494)  
f(n) = 79.0 (Expanded Nodes: 4616788, Evaluated States: 4778235, Time: 119.602)  
-------------Time: 120s ; Expanded Nodes: 4628248; Evaluated States: 4789470  
f(n) = 80.0 (Expanded Nodes: 4778236, Evaluated States: 4930099, Time: 127.387)  
Starting Validation  
(Pre Simplification) - |A|+|P|+|E|: 421  
(After Easy Simplification) - |A|+|P|+|E|: 166  
(After AIBR):166  
Epsilon set to be:0.0  
Resolution for validation:1.0  
(Pddl+ semantics) Plan is valid:true  
Problem Solved  
0.00000: (m-move\_to\_crate-A crate1 m1 )  
(0.00000,2.00000)------>waiting  
2.00000: (m-at\_crates-A crate1 m1 )  
2.00000: (m-load-A crate1 m1 )  
2.00000: (m-move\_create\_to\_loading\_bay crate1 m1 )  
(2.00000,9.00000)------>waiting  
9.00000: (crate\_at\_loading\_bay crate1 m1 )  
9.00000: (m-download crate1 m1 )  
9.00000: (m-charging m1 )  
9.00000: (m-move\_to\_crate-A crate2 m1 )  
9.00000: (m-move\_to\_crate-A crate2 m2 )  
(9.00000,11.00000)------>waiting  
11.00000: (m-at\_crates-A crate2 m1 )  
11.00000: (m-at\_crates-A crate2 m2 )  
11.00000: (m-load-F\_A crate2 m1 m2 )  
11.00000: (m-move\_create\_to\_loading\_bay-L\_F crate2 m1 m2 )  
(11.00000,14.00000)------>waiting  
14.00000: (crate\_at\_loading\_bay-L\_F crate2 m1 m2 )  
14.00000: (m-download-F crate2 m1 m2 )  
14.00000: (m-charging m1 )  
14.00000: (m-move\_to\_crate-B crate4 m1 )  
14.00000: (m-charging m2 )  
14.00000: (m-move\_to\_crate-B crate4 m2 )  
(14.00000,16.00000)------>waiting  
16.00000: (m-at\_crates-B crate4 m1 )  
16.00000: (m-at\_crates-B crate4 m2 )  
16.00000: (m-load-F\_B crate4 m1 m2 )  
16.00000: (m-move\_create\_to\_loading\_bay-L\_F crate4 m1 m2 )  
(16.00000,19.00000)------>waiting  
19.00000: (crate\_at\_loading\_bay-L\_F crate4 m1 m2 )  
19.00000: (m-download-F crate4 m1 m2 )  
19.00000: (m-charging m2 )  
19.00000: (m-charging m1 )  
19.00000: (l-load-F crate2 l )  
19.00000: (l-load\_cheap-L crate1 ll )  
19.00000: (m-move\_to\_crate-B crate3 m1 )  
19.00000: (m-move\_to\_crate-B crate3 m2 )  
(19.00000,20.00000)------>waiting  
20.00000: (m-at\_crates-B crate3 m1 )  
20.00000: (m-at\_crates-B crate3 m2 )  
20.00000: (m-load-F\_B crate3 m1 m2 )  
20.00000: (m-move\_create\_to\_loading\_bay-L\_F crate3 m1 m2 )  
(20.00000,22.00000)------>waiting  
22.00000: (crate\_at\_loading\_bay-L\_F crate3 m1 m2 )  
22.00000: (m-download-F crate3 m1 m2 )  
22.00000: (m-charging m1 )  
22.00000: (m-charging m2 )  
22.00000: (m-move\_to\_crate-B crate5 m2 )  
22.00000: (m-move\_to\_crate-B crate5 m1 )  
(22.00000,23.00000)------>waiting  
23.00000: (crate\_on\_conveyor\_belt\_cheap-L crate1 ll )  
23.00000: (l-load\_cheap-L\_F crate4 ll )  
(23.00000,25.00000)------>waiting  
25.00000: (m-at\_crates-B crate5 m1 )  
25.00000: (m-at\_crates-B crate5 m2 )  
25.00000: (crate\_on\_conveyor\_belt\_fragile-F crate2 l )  
25.00000: (m-load-F\_B crate5 m1 m2 )  
25.00000: (m-move\_create\_to\_loading\_bay-L\_F crate5 m1 m2 )  
(25.00000,27.00000)------>waiting  
27.00000: (l-load-F crate3 l )  
(27.00000,29.00000)------>waiting  
29.00000: (crate\_on\_conveyor\_belt\_cheap-L\_F crate4 ll )  
(29.00000,31.00000)------>waiting  
31.00000: (crate\_at\_loading\_bay-L\_F crate5 m1 m2 )  
31.00000: (m-download-F crate5 m1 m2 )  
31.00000: (m-charging m1 )  
31.00000: (m-move\_to\_crate crate6 m1 )  
(31.00000,32.00000)------>waiting  
32.00000: (m-at\_crates crate6 m1 )  
32.00000: (m-load crate6 m1 )  
32.00000: (m-move\_create\_to\_loading\_bay crate6 m1 )  
32.00000: (l-load\_cheap-L\_F crate5 ll )  
(32.00000,33.00000)------>waiting  
33.00000: (crate\_on\_conveyor\_belt\_fragile-F crate3 l )  
(33.00000,34.00000)------>waiting  
34.00000: (crate\_at\_loading\_bay crate6 m1 )  
34.00000: (m-download crate6 m1 )  
34.00000: (l-load crate6 l )  
(34.00000,38.00000)------>waiting  
38.00000: (crate\_on\_conveyor\_belt crate6 l )  
38.00000: (crate\_on\_conveyor\_belt\_cheap-L\_F crate5 ll )

Plan-Length:102  
Duration:38.0  
Metric (Plan):0.0  
Metric (Search):80.0  
Planning Time:128125  
Heuristic Time:226  
Search Time:127878  
Expanded Nodes:4786003  
States Evaluated:4937399  
Fixed constraint violations during search (zero-crossing):0  
Number of Dead-Ends detected:0  
Number of Duplicates detected:6588249

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Vaselli Alessandro 5320822