School of Data and Computer Science, Sun Yat-sen University

E08 FF Planner(2)

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Contents

1 Boxman Game

If you don't know how to play the boxman game, you should open `BoxMan.zip` and click `BoxMan.exe` to have a try. You can also choose the level of the game to challenge yourselves. There are five cases choosed from level 1, 10, 30, 40, 50 in the following figures.

You can model the location information based on rectangular coordinates as mapped out in Figure 3. For example, we denote by P13 the position (1,3). The calculated action sequence can be like this: `MOVE P12 P13, PUSH BOX1 P14 P15...`,which means the guy runs from position (1,2) to position (1,3), and push the box1 from position (1,4) to position (1,5). However, this is only a very simple and intuitive approach to representing the actions and positions. If you have any other better methods, you can have a try.

Please solve the boxman game by using FF planner. You should hand in 2 files, including a domain file (`boxman_domain.pddl`) and data file (`boxman5.pddl`).

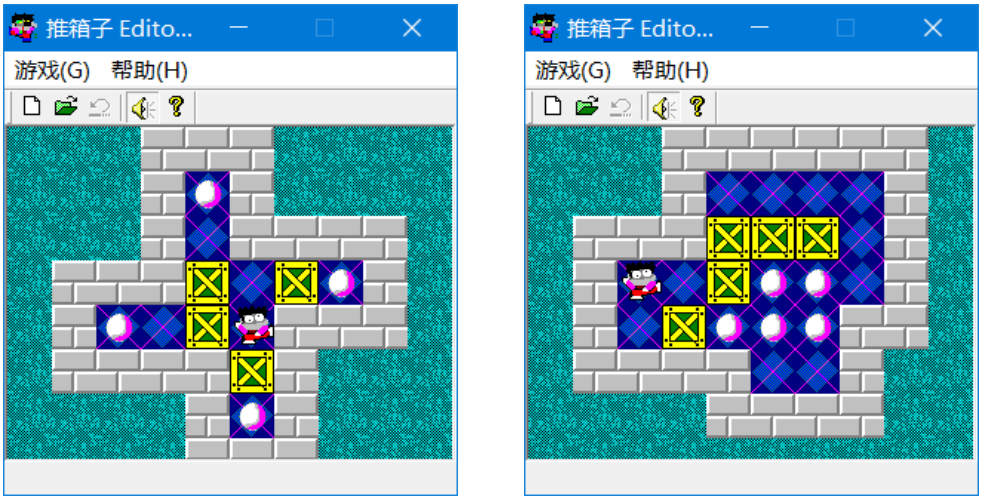

Figure 1: Boxman case1 (level 1) and case2 (level 10)

2 Notes

Please send **E08__YourNumber.zip** which should contain the codes(**ai__2020@foxmail.com**).

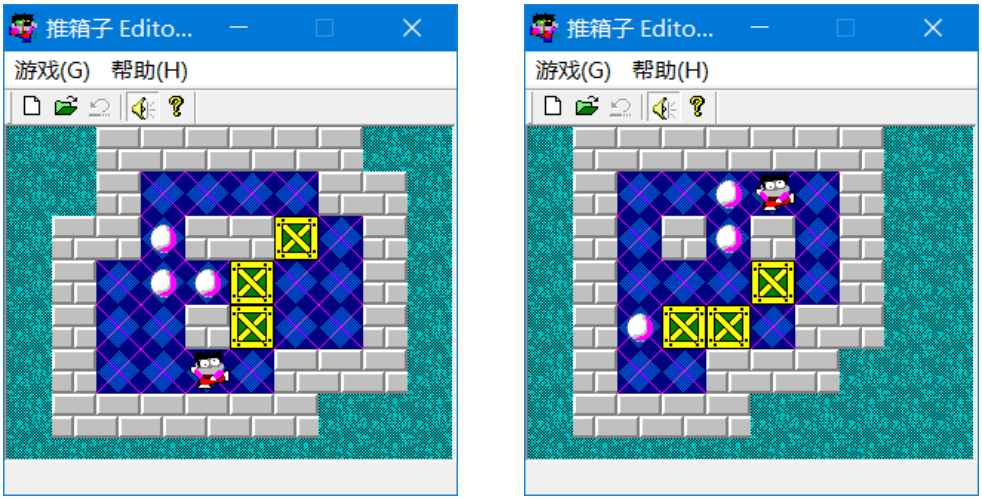

Figure 2: Boxman case3 (level 30) and case4 (level 40)

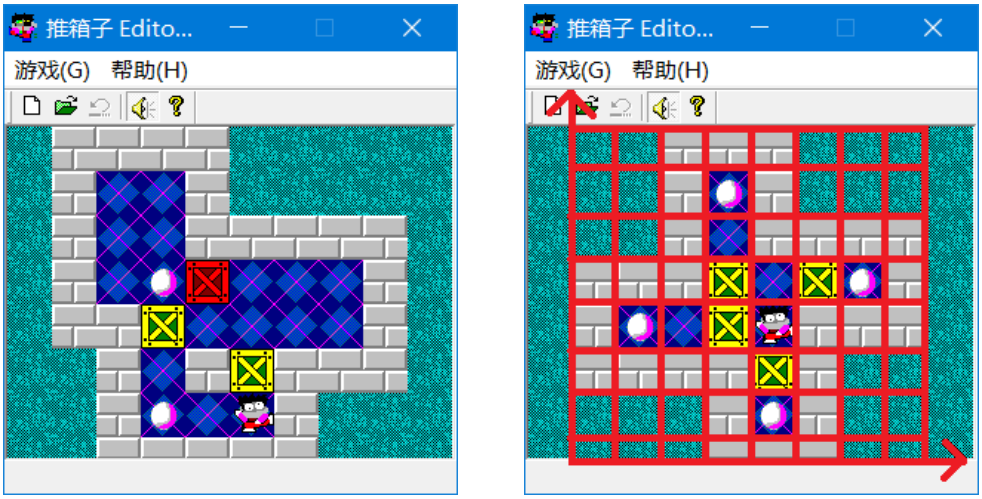

Figure 3: Boxman case5 (level 50) and modelling

3 Code

boxman domain.pddl

```
(define (domain boxman)

    (:requirements :strips :typing :equality :universal-preconditions :
        conditional-effects)
    (:types box loc)

    (:predicates
        (clear ?l - loc) ; nothing in location
```

```
        (boxat ?b - box ?l - loc) ; box in location
        (roleat ?l - loc) ; role in location
        (access ?l1 - loc ?l2 - loc) ; loc1 to loc2 accessible
        (rowcol ?l1 - loc ?l2 - loc) ; loc1 and loc2 in the same row or
            col
    )

    (:action move ; blank to blank
        :parameters (?l1 - loc ?l2 - loc)
        :precondition (and (roleat ?l1) (access ?l1 ?l2) (clear ?l2))
        :effect (and (not (roleat ?l1)) (not (clear ?l2)) (clear ?l1) (
            roleat ?l2))
    )

    (:action push ; push box to blank
        :parameters (?b - box ?l1 - loc ?l2 - loc ?l3 - loc)
        :precondition (and (roleat ?l1) (boxat ?b ?l2) (clear ?l3) (
            access ?l1 ?l2) (access ?l2 ?l3) (rowcol ?l1 ?l3))
        :effect (and (not (roleat ?l1)) (not (boxat ?b ?l2)) (not (clear
            ?l3)) (roleat ?l2) (boxat ?b ?l3) (clear ?l1))
    )


)
```

boxman.pddl

```
(define (problem boxman5) (:domain boxman)

(:objects
    b1 b2 b3 - box
    l16 l15 l14 l21 l22 l23 l24 l25 l26 l31 l33 l34 l41 l42 l43 l44 l53
        l54 l63 l64 - loc
```

```
)

(:init
    (clear l16) (clear l15) (clear l14) (clear l21) (clear l22)
    (clear l24) (clear l25) (clear l26) (clear l31) (clear l33)
    (clear l43) (clear l44) (clear l53) (clear l54) (clear l63)
    (clear l64)

    (roleat l41)
    (boxat b1 l23) (boxat b2 l34) (boxat b3 l42)

    (access l16 l26) (access l16 l15) (access l15 l16)
    (access l15 l25) (access l15 l14) (access l14 l15)
    (access l14 l24) (access l26 l16) (access l26 l25)
    (access l25 l26) (access l25 l15) (access l25 l24)
    (access l24 l25) (access l24 l23) (access l24 l14)
    (access l24 l34) (access l23 l24) (access l23 l22)
    (access l23 l33) (access l22 l21) (access l22 l23)
    (access l21 l22) (access l21 l31) (access l34 l24)
    (access l34 l44) (access l34 l33) (access l33 l23)
    (access l33 l34) (access l33 l43) (access l31 l21)
    (access l31 l41) (access l44 l34) (access l44 l54)
    (access l44 l43) (access l43 l44) (access l43 l42)
    (access l43 l33) (access l43 l53) (access l42 l41)
    (access l42 l43) (access l41 l31) (access l41 l42)
    (access l54 l44) (access l54 l64) (access l54 l53)
    (access l53 l43) (access l53 l63) (access l53 l54)
    (access l64 l54) (access l64 l63) (access l63 l53)
    (access l63 l64)

    (rowcol l16 l15) (rowcol l16 l14) (rowcol l16 l26)
    (rowcol l15 l16) (rowcol l15 l14) (rowcol l15 l25)
    (rowcol l14 l16) (rowcol l14 l15) (rowcol l14 l24)
```

```
40      (rowcol l14 l34) (rowcol l14 l44) (rowcol l14 l54)
41      (rowcol l14 l64) (rowcol l21 l22) (rowcol l21 l23)
42      (rowcol l21 l24) (rowcol l21 l25) (rowcol l21 l26)
43      (rowcol l21 l31) (rowcol l21 l41) (rowcol l22 l21)
44      (rowcol l22 l23) (rowcol l22 l24) (rowcol l22 l25)
45      (rowcol l22 l26) (rowcol l22 l42) (rowcol l23 l21)
46      (rowcol l23 l22) (rowcol l23 l24) (rowcol l23 l25)
47      (rowcol l23 l26) (rowcol l23 l33) (rowcol l23 l43)
48      (rowcol l23 l53) (rowcol l23 l63) (rowcol l24 l14)
49      (rowcol l24 l21) (rowcol l24 l22) (rowcol l24 l23)
50      (rowcol l24 l25) (rowcol l24 l26) (rowcol l24 l34)
51      (rowcol l24 l44) (rowcol l24 l54) (rowcol l24 l64)
52      (rowcol l25 l15) (rowcol l25 l21) (rowcol l25 l22)
53      (rowcol l25 l23) (rowcol l25 l24) (rowcol l25 l26)
54      (rowcol l26 l16) (rowcol l26 l21) (rowcol l26 l22)
55      (rowcol l26 l23) (rowcol l26 l24) (rowcol l26 l25)
56      (rowcol l31 l21) (rowcol l31 l33) (rowcol l31 l34)
57      (rowcol l31 l41) (rowcol l33 l23) (rowcol l33 l31)
58      (rowcol l33 l34) (rowcol l33 l43) (rowcol l33 l53)
59      (rowcol l33 l63) (rowcol l34 l14) (rowcol l34 l24)
60      (rowcol l34 l31) (rowcol l34 l33) (rowcol l34 l44)
61      (rowcol l34 l54) (rowcol l34 l64) (rowcol l41 l21)
62      (rowcol l41 l31) (rowcol l41 l42) (rowcol l41 l43)
63      (rowcol l41 l44) (rowcol l42 l22) (rowcol l42 l41)
64      (rowcol l42 l43) (rowcol l42 l44) (rowcol l43 l23)
65      (rowcol l43 l33) (rowcol l43 l41) (rowcol l43 l42)
66      (rowcol l43 l44) (rowcol l43 l53) (rowcol l43 l63)
67      (rowcol l44 l14) (rowcol l44 l24) (rowcol l44 l34)
68      (rowcol l44 l41) (rowcol l44 l42) (rowcol l44 l43)
69      (rowcol l44 l54) (rowcol l44 l64) (rowcol l53 l23)
70      (rowcol l53 l33) (rowcol l53 l43) (rowcol l53 l54)
71      (rowcol l53 l63) (rowcol l54 l14) (rowcol l54 l24)
72      (rowcol l54 l34) (rowcol l54 l44) (rowcol l54 l53)
```

```
    (rowcol l54 l64) (rowcol l63 l23) (rowcol l63 l33)
    (rowcol l63 l43) (rowcol l63 l53) (rowcol l63 l64)
    (rowcol l64 l14) (rowcol l64 l24) (rowcol l64 l34)
    (rowcol l64 l44) (rowcol l64 l54) (rowcol l64 l63)
)

(:goal
    ; (and (boxat b1 l21) (boxat b2 l24) (boxat b3 l34))
    ; (and (boxat b1 l21) (boxat b2 l34) (boxat b3 l24))
    ; (and (boxat b1 l24) (boxat b2 l21) (boxat b3 l34))
    (and (boxat b1 l24) (boxat b2 l34) (boxat b3 l21))
    ; (and (boxat b1 l34) (boxat b2 l21) (boxat b3 l24))
    ; (and (boxat b1 l34) (boxat b2 l24) (boxat b3 l21))
)

)
```

4 Results

Plan.txt

```
(push b3 l41 l42 l43)
(move l42 l41)
(move l41 l31)
(move l31 l21)
(move l21 l22)
(push b1 l22 l23 l24)
(move l23 l33)
(push b3 l33 l43 l53)
(move l43 l44)
(move l44 l54)
(move l54 l64)
(move l64 l63)
```

```
13 (push b3 l63 l53 l43)
14 (push b3 l53 l43 l33)
15 (move l43 l42)
16 (move l42 l41)
17 (move l41 l31)
18 (move l31 l21)
19 (move l21 l22)
20 (move l22 l23)
21 (push b1 l23 l24 l25)
22 (push b2 l24 l34 l44)
23 (push b2 l34 l44 l54)
24 (move l44 l43)
25 (push b3 l43 l33 l23)
26 (move l33 l34)
27 (move l34 l24)
28 (push b3 l24 l23 l22)
29 (push b3 l23 l22 l21)
30 (move l22 l23)
31 (move l23 l24)
32 (move l24 l34)
33 (move l34 l44)
34 (move l44 l43)
35 (move l43 l53)
36 (move l53 l63)
37 (move l63 l64)
38 (push b2 l64 l54 l44)
39 (push b2 l54 l44 l34)
40 (move l44 l43)
41 (move l43 l33)
42 (move l33 l23)
43 (move l23 l24)
44 (move l24 l14)
45 (move l14 l15)
```

```
(move l15 l16)
(move l16 l26)
(push b1 l26 l25 l24)
```

本次实验的关键在于解析推箱子游戏的步骤，并且用 PDDL 语法来描述这些动作，我使用了两种 types 分别是 box 和 loc 分别指示箱子的 ID 以及游戏棋盘的位置，以及五个 predicates 分别指示位置是否为空、箱子是否在位置上、角色当前位置、两个位置是否相邻可行、两个位置是否同行或同列，还使用了两个 action 分别是 move 和 push 指示移动和推箱子两个动作。最后用 FF 规划器得到的结果比较理想，共 48 步，具体步骤如上列表所示。