Innopolis University
Introduction to Practical Artificial Intelligence
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Assignment 1

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1   Task description

Harry has decided to use his invisibility cloak to hide from unexpected guests and go to the library during the night. However, he has lost his invisibility cloak somewhere in the library while looking for a book. At that time, Argus Filch and his cat Mrs Norris began inspecting the library. Harry has to find the book and leave the library without being caught.

2   Project structure

The code has been written on Java (JDK 1.8), trying to follow the principles of SOLID and OOP.

To comply with the rules all classes has been placed in one file. For your comfort, the main code repository (with separate classes) could be accessed by link (https://github.com/bart02/Introduction_To_AI).

3   PEAS description

3.1   Actors

Harry Potter, Argus Filch, Mrs Norris

3.2   Performance measure

Harry Potter is looking for a book and grab it. After taking the book he is looking for an exit and win the game.

3.3   Environment

The environment is a 9*9 square map. Harry Potter is looking for the book and the exit, sometimes looking for the invisibility cloak.

3.4   Actuator

Harry Potter chooses one of eights possible directions and move. Also he grabs the book and the Invisibility cloak.

3.5   Sensor

Harry Potter has an ability to perceive inspectors and their zones and the Invisibility cloak if Harry Potter is in the same sell. We choose the case Harry can see the cells(Scenario 1 or Scenario 2)

3.6   Environment classification

- Partially Observable
- Dynamic

- Discrete

- Deterministic

- Multi-agent

- Sequential

- Known

4 Algorithms

4.1 Backtracking search

I have used standard backtracking, that deletes dead ends from the path. It works so bad on scenario 2, because diagonal moves must have other priority in this case.

4.2 A*

First of all I scan field, then go.

5 Statistical Analysis

Now we compare the algorithms based on test maps generated. So, our comparison for each tests are:

5.1 Backtracking (scenario 1)

Average winrate: 99%

Execution time: 4.384E-4 s

Average length: 50 steps

5.2 Backtracking (scenario 2)

Average winrate: 10%

Execution time: 3.03852E-4 s

Average length: 30 steps

5.3 A* (scenario 1)

Average winrate: 99%

Execution time: 0.007926839 s.

Average length: 12 steps

5.4   A* (scenario 2)

Average winrate: 80%

Execution time: 0.009949873 s

Average length: 13 steps

6   Impossible cases

Since we don't have restriction about always winning the game, we have some variants that are impossible to do. Now we have 3 lose-variants that we can't solve.

First of all, let's have a look at our map:

- "0" - Empty cells, so Harry moves to them without losing the game

- "1" - Harry Potter's position

- "2" - Invisibility cloak's position

- "3" - Book's position

- "4" - Exit's position

- "-1" - Enemy's zone

- "-2" - Enemy's position

6.1   First variant

In first variant (Fig.1) we have impossible variant, because Harry Potter can't go through the inspectors zones without Invisibility cloak. And Harry Potter can't reach the Invisibility cloak because Harry Potter can't go through the inspectors zones. Therefore, it's impossible variant.

6.2   Second variant

In second variant (Fig.2) we have impossible variant, because Harry Potter can't go through the inspectors zones without Invisibility cloak. Harry Potter can grab the book, but he can't reach the exit because Harry Potter can't go through the inspectors zones without Invisibility cloak. And Harry Potter can't reach the Invisibility cloak because Harry Potter can't go through the inspectors zones.Therefore, it's impossible variant.

6.3   Third variant

In second variant (Fig.3) we have impossible variant, because Harry Potter appears in inspector's zone, so he dies immediately. Therefore, it's impossible variant.

```
2    0    0    0    0    0    0    0    0
-1   -1   -1   0    0    4    0    0    0
-1   -2   -1   0    0    0    0    0    0
-1   -1   -1   0    0    0    0    0    0
0    0    -1   -1   -1   -1   -1   3    0
0    0    -1   -1   -1   -1   -1   0    0
0    0    -1   -1   -2   -1   -1   0    0
0    0    -1   -1   -1   -1   -1   0    0
1    0    -1   -1   -1   -1   -1   0    0
```

Figure 1:

```
0    0    0    0    0    0    0    0    0
0    0    0    0    0    0    -1   -1   -1
0    0    0    0    0    0    -1   -2   -1
0    0    0    0    0    0    -1   -1   -1
0    3    -1   -1   -1   -1   -1   4    0
0    0    -1   -1   -1   -1   -1   0    0
0    0    -1   -1   -2   -1   -1   0    0
0    0    -1   -1   -1   -1   -1   0    0
1    0    -1   -1   -1   -1   -1   0    2
```

Figure 2:

```
0    0    0    0    0    0    0    0    0
0    0    0    0    0    0    -1   -1   -1
0    3    0    0    0    0    -1   -2   -1
0    0    0    0    0    0    -1   -1   -1
-1   -1   -1   -1   0    0    0    4    0
-1   -1   -1   -1   0    0    0    0    0
-1   -2   -1   -1   0    0    0    0    0
-1   -1   -1   -1   0    0    0    0    0
1    -1   -1   -1   0    0    0    0    2
```

Figure 3: