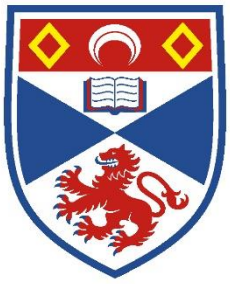
CS5011 Artificial Intelligence Practice

Assignment 3 – Logical Agents- Nettle sweeper



University of
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Contents

The ongoing research program of showing Searle's Chinese Room Argument to be false

1. Finishing Part

In this assignment, the parts I have done as follows:

- All tasks in part1
- All tasks in part2

2. Design

2.1 The whole structure

The steps of how I implement transition between different strategies

(1) Free all neighbors of the cells with value of 0

(2) Implement single point reasoning strategy(SPS)

a) Once a cell with value of 0 is uncovered, free all neighbors until no cells can be free.

b) If the value of new uncovered cell is not equal to 0, go back to (2) and continue doing the next steps.

c) Go out of from SPS when the environment do not change.

(3) Implement easy equation strategy (EES)

a) Once a cell with value of 0 is uncovered, free all neighbors until no cells can be free.

b) If the value of new uncovered cell is not equal to 0, go back to (3) and continue doing the next steps.

c) When the environment do not change, go back to (4) and continue and continue doing the next steps.

(4) Implement random guess strategy (RGS)

a) Once uncover a cell with value of -1, the agent will lose.

b) If the uncovered cell is equal to 0, go back to (1) and continue doing the next steps.

c) If the uncovered cell is neither 0 nor -1, go back to (2) and continue doing the next steps.

Note: For every step as above, once the number of whole cells minus the number of flagged cells is equal to the number of uncovered cells, the agent will win.

2.2 The implementation of free all neighbors

- When the current cell is equal to 0, free all neighbors(i.e. invoke “beforeSPS” method from Game class). To free all neighbors, it need to go invoke “uncoverCells” method from Agent.
- To realize “uncoverCells” method, I choose to uncover (i.e. assign true to “isFlagged” variable) the neighbors of the current cell from 8 directions (i.e. South, Southeast, East, Northeast, North, Northwest, West, Southwest).
- Add all neighbors with value of 0 into “zerolist”, continue free all neighbors of those neighbors in order.

2.3 The implementation of single point reasoning strategy

- Use frontier to store those cells which are still covered, not flagged and has no less than uncovered neighbors.
- To use SPS to decide which cells can be flagged or uncovered:
    a) The current cell is the cell from the frontier.
    b) Add neighbor candidates of the current cell into a queue.
    c) Choose the head neighbor candidate of the current node.
    d) If the value of the head neighbor candidate of the current node is equal to the number of its cover neighbors (including flagged neighbors), flag the current cell.
    e) If the value of the head neighbor candidate of the current node is equal to the number of its flagged neighbors, uncover the current cell.
    f) If the uncover the current cell is 0, free all neighbors until no cell can be free (i.e. go to execute 3.2.1)
    g) If the uncover the current cell is not 0, continue doing SPS.
    h) After of the step f), some of cells which is included in the original frontier may be uncovered now, therefore the frontier should be updated.
    i) Finish SPS until the frontier is empty or the environment will not change.

2.4 The implementation of easy equation strategy

- Use frontier to store those cells which are uncovered and has no less than covered but not flagged neighbors.

- Create 2 pair lists. Those cells are in same position in different pair lists are pairs. Pairs are those that both are in frontier and adjacent cells.
- Create 2 children lists which is used to store children of pairs respectively. Here children means neighbors
- Remove repeated children from two children lists
- To use EES to decide which cells can be flagged or uncovered:
    a) Only if there is one children list and another children list not empty, EES works.
    b) Calculate the difference between p1 and p2. P1 is the value of the first cell in the first pair list minus the number of its flagged cells. P2 is the value of the first cell in the second pair list minus the number of its flagged cells
    c) If p1-p2 equal to 0, uncover all neighbors in not empty children list.
    d) If the uncover the current cell is 0, free all neighbors until no cell can be free (i.e. go to execute 3.2.1)
    e) If p1-p2 is no less than the size of not empty children list, Flagged all neighbors in not empty children list.
    f) Finish EES until the frontier is empty.

2.5 The implementation of random guess strategy

To realize this strategy, probe a cell randomly. If randomly probe a flagged or uncovered cell, probe a cell again until finding a covered and not flagged cell.

3. Examples and Testing

To ensure my program run properly, I need ensure output the action of a cell every time. The console shows “uncover: (x, y)” when the agent uncover (x, y); The console shows “Flag: (x, y)” when the agent mark (x, y); When the agent wins, the console shows “Game won!”; When the agent lost, the console shows “Game lost!”;

3.1 Part 1

3.1.1 Easy difficulty level, nworld1

0	0	0	2	%
0	0	0	2	%
1	2	1	2	1
%	3	%	2	0
1	3	%	2	0

Game won!

3.1.2 Medium difficulty level, nworld2

0	0	0	0	0	0	1	1	1
0	0	0	0	1	1	3	%	2
0	0	0	0	2	%	6	%	4
0	0	0	0	2	%	%	%	%
0	0	0	0	1	3	%	5	3
0	0	0	0	0	1	2	%	1
0	0	0	0	0	0	1	1	1
0	0	0	0	1	1	1	0	0
0	0	0	0	1	%	1	0	0

Game won!

3.1.3 Hard difficulty level, nworld3

4. In the first time, the agent won because the agent is lucky when uncovers a random cell.

0	0	0	0	1	3	%	2	0	0
1	1	1	0	1	%	%	3	2	2
1	%	1	0	1	2	2	2	%	%
1	1	1	0	0	1	1	2	3	%
1	1	0	0	0	1	%	1	2	2
%	2	0	0	0	1	1	1	1	%
%	4	1	0	0	0	0	1	2	2
%	%	3	2	2	2	1	2	%	1
%	%	3	%	%	2	%	2	1	1
%	3	2	2	2	2	1	1	0	0

Game won!

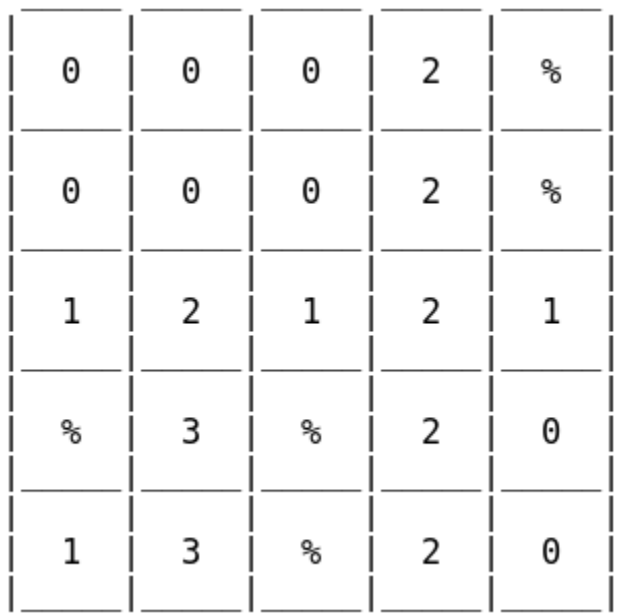
In the second time, the agent won because the agent is lucky when uncovers a random cell.

0	0	0	0	1	3	%	2	0	0
1	1	1	0	1	%	%	3	2	2
1	%	1	0	1	2	2	2	%	%
1	1	1	0	0	1	1	2	3	#
1	1	0	0	0	1	%	1	2	#
%	2	0	0	0	1	1	1	1	#
%	4	1	0	0	0	0	1	2	#
%	%	3	2	2	2	1	2	%	#
#	#	#	-1	#	#	#	#	#	#
#	#	#	#	#	#	#	#	#	#

Game lost!

4.1 Part 2

4.1.1 Easy difficulty level, nworld1



4.1.2 Medium difficulty level, nworld2

0	0	0	0	0	0	1	1	1
0	0	0	0	1	1	3	%	2
0	0	0	0	2	%	6	%	4
0	0	0	0	2	%	%	%	%
0	0	0	0	1	3	%	5	3
0	0	0	0	0	1	2	%	1
0	0	0	0	0	0	1	1	1
0	0	0	0	1	1	1	0	0
0	0	0	0	1	%	1	0	0

Game won!

4.1.3 Hard difficulty level, nworld3

0	0	0	0	1	3	%	2	0	0
1	1	1	0	1	%	%	3	2	2
1	%	1	0	1	2	2	2	%	%
1	1	1	0	0	1	1	2	3	%
1	1	0	0	0	1	%	1	2	2
%	2	0	0	0	1	1	1	1	%
%	4	1	0	0	0	0	1	2	2
%	%	3	2	2	2	1	2	%	1
%	%	3	%	%	2	%	2	1	1
%	3	2	2	2	2	1	1	0	0

Game won!

5. PEAS Model

Performance measure:

- Uncover nettles: game lost;
- Flag successfully all nettles and uncover the other cells: game won.

Environment

- -1 means that the cell contains a mine
- 0–8 is the number of nettles in the 8 adjacent neighbours
- Easy level: in which N=5, M=5, indicating a board of 5x5 with 5 nettles
- Medium level: in which N=9, M=10, indicating a board of 9x9 with 10 nettles

- Hard level: in which N=10, M=20, indicating a board of 10x10 with 20 nettles

Actuators: uncover cell, mark cell
Sensors: When the agent uncover a cell, it can get the value of the cell from the environment.

6. Evaluation

6.1 Part1 Evaluation

The first step is Free all neighbors of cells with value of 0. After executing this step, in general, many cells can be uncovered because of chain reaction. However it also depend on the start probed cell. If the agent is lucky, it may uncovered a large number of cells. If the agent is not lucky, it may can only uncovered a few cells. If the number of uncovered cells are big, it will be helpful to do the next strategy and vice versa. The next strategy, SPS, focus on detail and more uncovered cells means more useful information for doing SPS.

- The advantage of this strategy includes:

a) When use single point strategy, only one probed cell and its neighbors' information need to be consider. However, when using easy equation strategy, a pair of cells and its neighbors' information need to be consider.

b) It can flag or uncover some cells by calculating the difference between the value of probed cell and the number of flagged cells.

c) In this assignment, Since SPS is used after freeing all neighbors of the cells with value of 0 and the shape of grids. Therefore, every covered but not flagged cell usually have more than one uncovered neighbors, which means it can improve the possibility of the role of a covered cell being determined because a covered cell can be determined by more than one time.

d) Although sometimes, the role of a covered cell cannot be determined immediately, its role may can be determined after other cell being uncovered.

e) The formulation is very simple, so it is common used in Minesweeper game.

- The disadvantage of this strategy includes:

a) This strategy seriously obey specific equation relationship, therefore, sometimes a covered cell cannot be decided immediately. Sometimes this strategy need to be looped many times until environment will not change.

b) When almost all determined cell in one direction in the map before doing SPS, the possibility of predicting covered cells are relatively low unless cells with value of 0 are opened in that process.

After do that, if there is still undetermined cells, do randomly guess. The risk of doing randomly guess is really big. If the agent is lucky, it may win the game. But if the agent is unlucky, it may lose immediately.

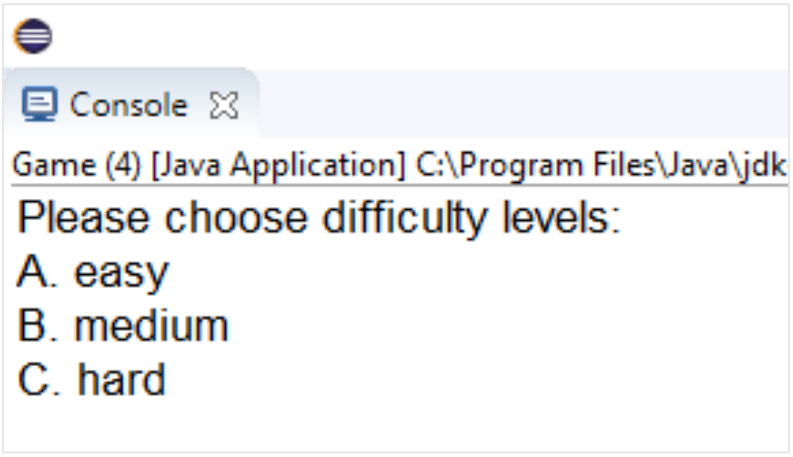
6.2 Part2 Evaluation

In this part 2, a new strategy called easy equation strategy have been add between SPS and RGS. After do SPS, if there is still some cells cannot be determined. You may find, mostly, they concentrate on a certain part in a map. It will not do any prediction based on find relationship singularly. The relationship between adjacent uncovered cells and their covered neighbors should be found and a new strategy is required. Easy equation strategy can help to solve these kind of problems. This strategy is more complicated than SPS because every time a pair of cells need to be compared. This strategy is very ingenious and it usually can determined more than

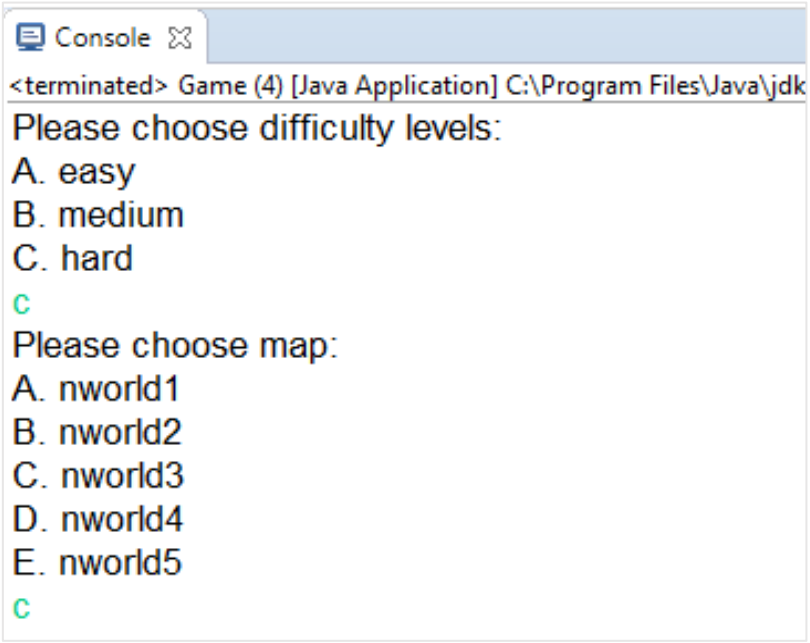
one cell each time. After combining this strategy with other strategies and converting in different strategies, the agent can always win without doing RGS in this assignment.

7. Running

(1) When run the program, a user should choose a difficulty level for agent.



(2) A user should choose a map for agent.



(3) Please use Linux to run this program because to ensure the environment can be shown properly.

8. Bibliography

1. Tu.
2. H.
3. Mac.
4. Goert.
5. Robert S.
6. Searle.
7. Se
8. Ha