# USER MANUAL

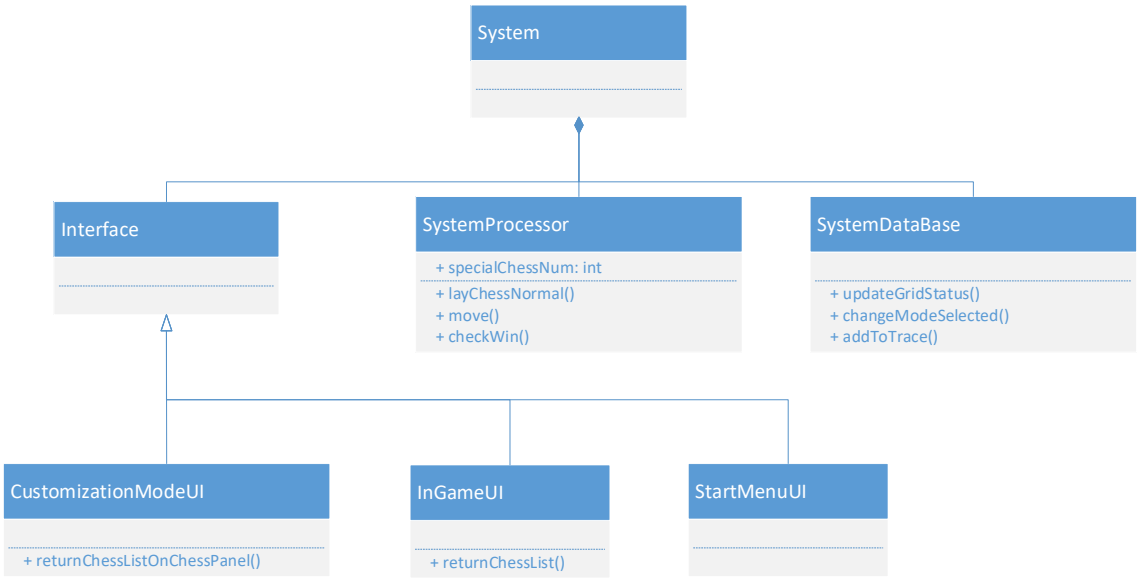
Huarong Path System

Group X
Author

# 目录

## System Architecture

The system architecture is shown below:



# Player Manual

## Main menu

The player will be first shown with a game main menu (Figure 1):

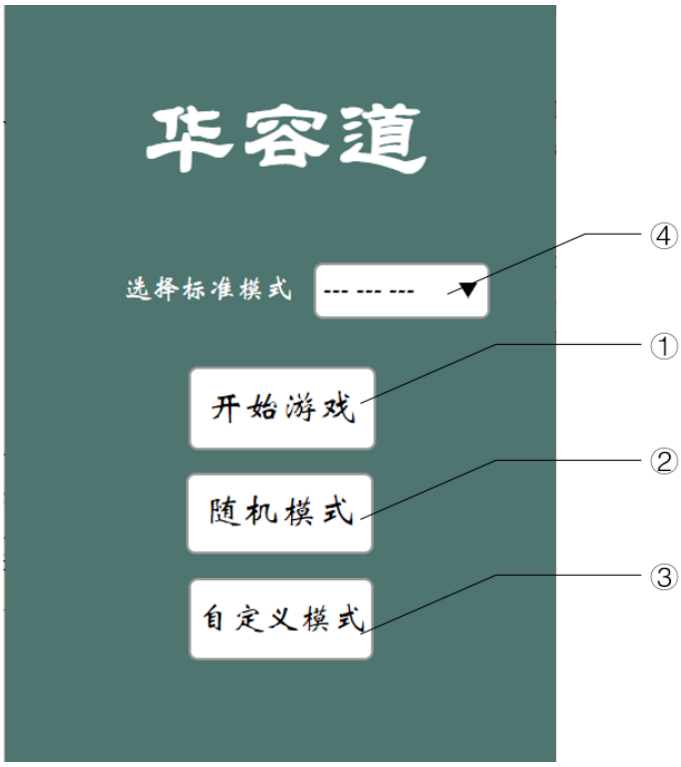



Figure 1

### *Main Menu Components*

- ①“开始游戏”. Clicking on this button will start a game with standard mode (if player has already chosen a mode(④) ). The game starting state will be fixed as the mode player selects.
- ②“随机模式”. Clicking on this button will start a game with random mode. The game starting state will be randomly chosen from the pre-defined states.
- ③“自定义模式”. Clicking on this button will firstly open the customize board, which allows player to place the chess on board as he/she wishes. Then play the game as usual.
- ④“选择标准模式”. Select the standard mode starting state (Figure 2). There are 10 modes available to select in total, which are “横刀立马”，“齐头并进”，“兵分三路”，“屯兵东路”，“插翅难飞”，“近在咫尺”，“层层设防”，“水泄不通”，“过五关”，“小燕出巢”. Once player select the starting state he wants, he can click the “开始游戏”(①) button to start the game in standard mode.

> Tips: If “选择标准模式”(④) is not selected (i.e. “--- --- ---” is chosen), player will be unable to start a standard game!


Figure 2

## Standard Mode

After clicking “开始游戏” in main menu (Figure 1 - ①), player should be able to open the main game board (Figure 3).

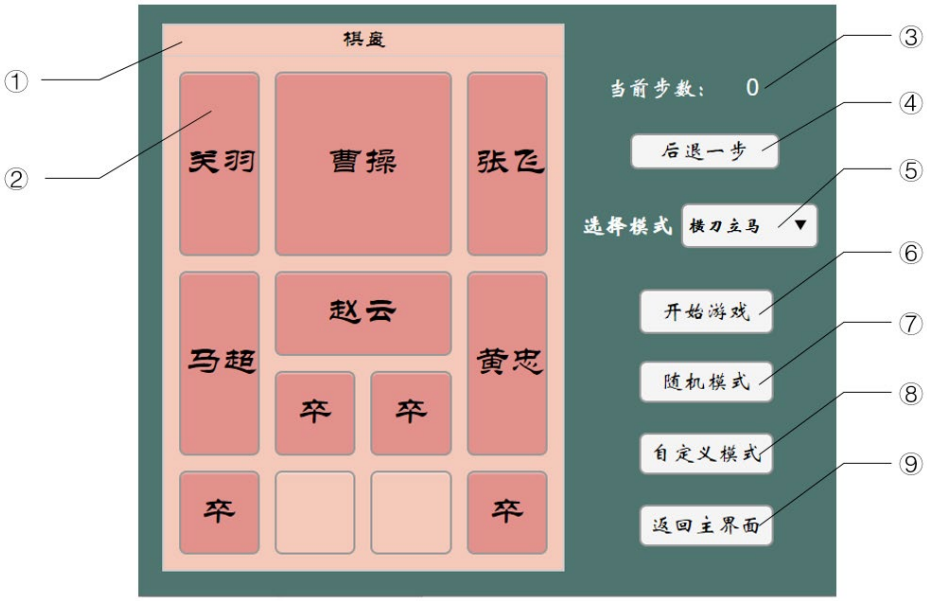



Figure 3

*Game Board Components*

- ①“棋盘”. This is the Huarong Path game chessboard.
- ② Chess. These are the chesses consist of the chessboard.
- ③“当前步数”. This is a record of the current number of moves from starting state.
- ④“后退一步”. Click on this button, and the player will be able to take back a move.
- ⑤“选择模式”. Select the mode (starting state). Later on the player can press button “开始游戏”(⑥) to start another standard mode game with selected starting state.
- ⑥“开始游戏”. Clicking on this button will quit current game and start a game with standard mode. The game starting state will the selected starting state on “选择模式”(⑤).
- ⑦“随机模式”. Clicking on this button will quit current game and start a game with random mode. The game starting state will be randomly chosen from the pre-defined states.
- ⑧“自定义模式”. Clicking on this button will quit current game and open the customize board, which allows player to place the chess on board as he/she wishes. Then play the game as usual.
- ⑨“返回主界面”. Clicking on this button will quit current game and back to the main menu.

> Warning: If any one of the right side buttons (⑥-⑨) is clicked while the game running, the current game will stop immediately and cannot be recovered!

*How to play the game*

1. The game target is to move chess “曹操” to the exit, which is shown in the orange box in Figure 4.

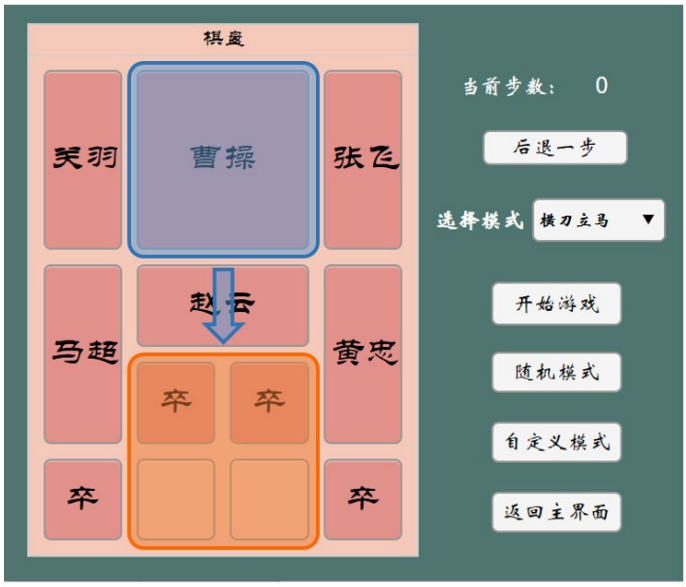



Figure 4

2. However, player cannot move the chess arbitrarily. At each step, player can move one chess to the adjacent space if and only if the adjacent space is big enough to carry out this move. For example, in Figure 5, “卒”is able to move downwards, but “赵云”is not able to move rightwards since one “卒”is on its way.

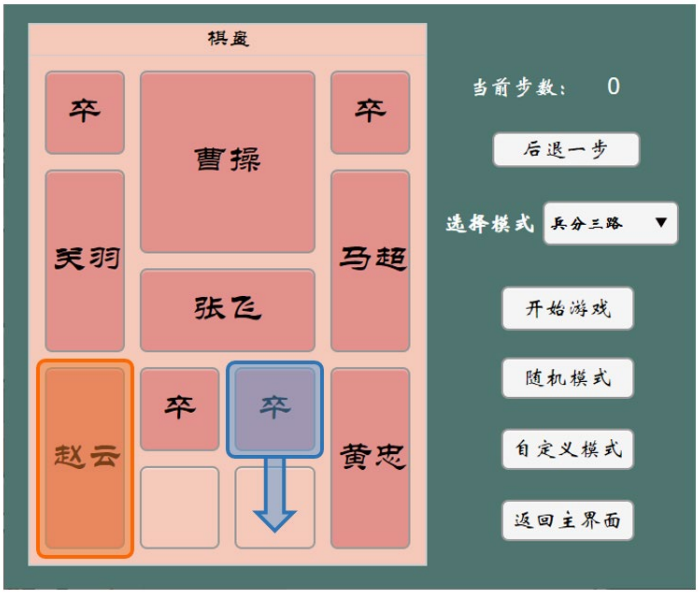



Figure 5

3. To move a chess, the player should first select the chess, then select the space block that he/she wants it to move to. If multiple space blocks are available, click any of them is fine. For example, in Figure 6, to move “张飞”downwards, click “张飞” first to activate this chess, then click any of the blank space, and “张飞” will move to the space below.

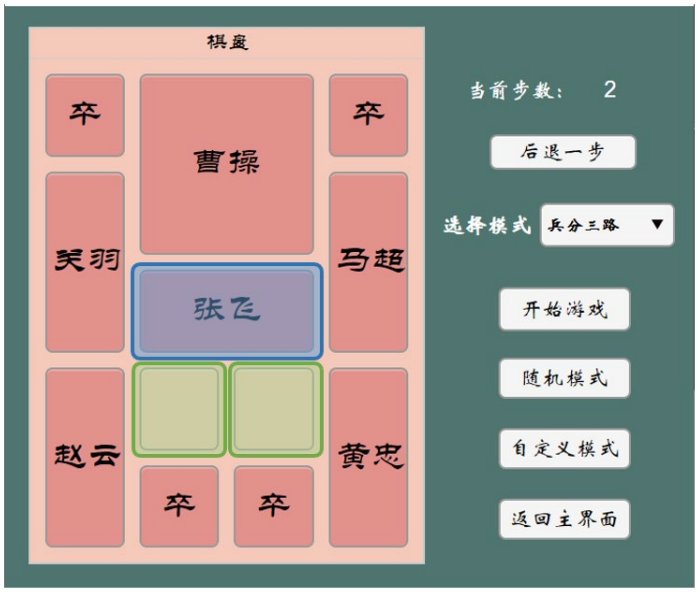



Figure 6

4. If the player need to take back a move, he/she can press “后退一步”.

5. Finally, if “曹操” is moved to the target place, then a winning massage will be displayed (Figure 7). The player can choose to start a new game or back to the main menu.


Figure 7

## Random Mode

After clicking “随机模式” in main menu (Figure 1 - ②), the player should expect a random start state on the game board. The start state is ensured to have a solution, which allows the player to win the game. The game board and playing method is exactly the same as those in standard mode. For detail information, please refer to Standard Mode.

## Customize Mode

After clicking “自定义模式” in main menu (Figure 1 - ③), the player will be shown a customize board (Figure 8), which allows the player to place the chess onto the chessboard by himself.

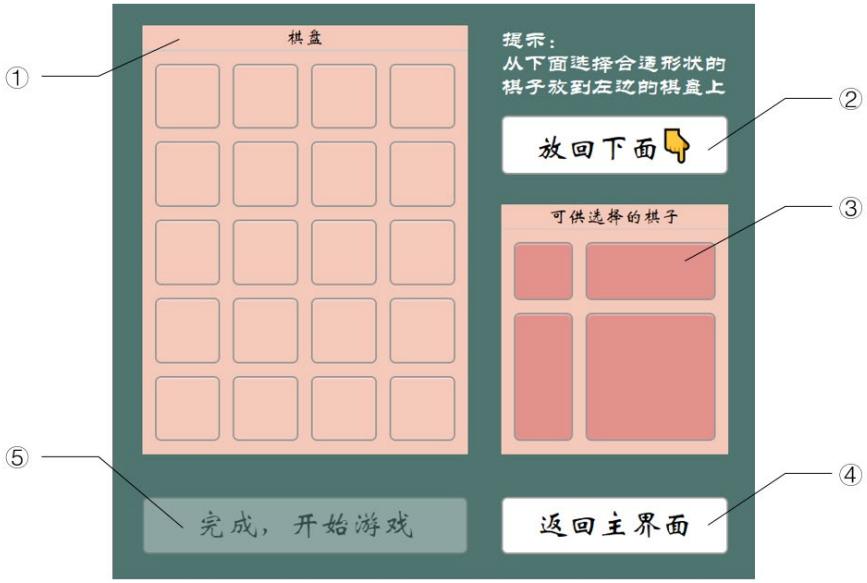



Figure 8

### *Customize Board Components*

- ①“棋盘”. This is the Huarong Path game chessboard. The player will place the chesses on this board.
- ②“放回下面”. This button allows the player to place back the chess off the chessboard.
- ③“可供选择的棋子”. All kinds of the chesses that the player needs to put onto the chessboard.
- ④“返回主界面”. Clicking on this button will quit customize mode and back to the main menu.
- ⑤“完成，开始游戏”. Clicking on the button will start a game with start state same as current setting.

> Warning: If “返回主界面”(④) is clicked, the chess status on the game board will get lost immediately and cannot be recovered!

### *How to customize the chess board*

1. To place the chess onto the chess board, the player need to ① click the chess he/she wants on the right small box “可供选择的棋子”, then ② click the place he/she wants to put this chess on the left large chess board “棋盘”. The left up corner block of the chess will be aligned to the place the player clicks. See Figure 9, 10.

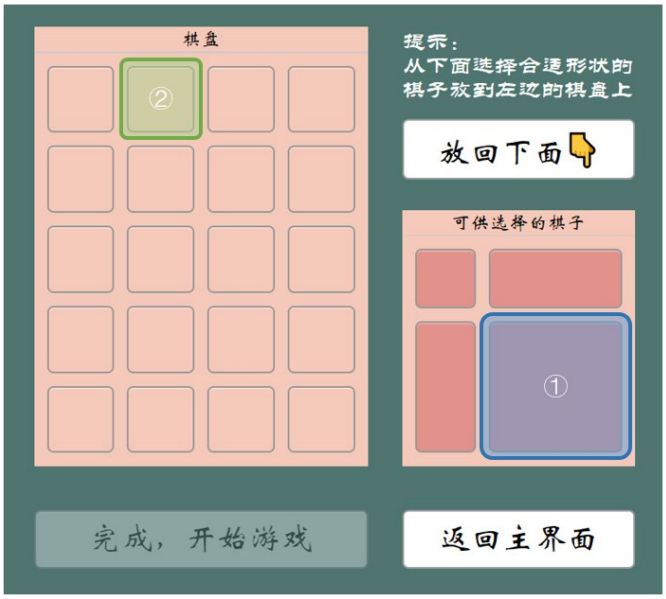



Figure 9

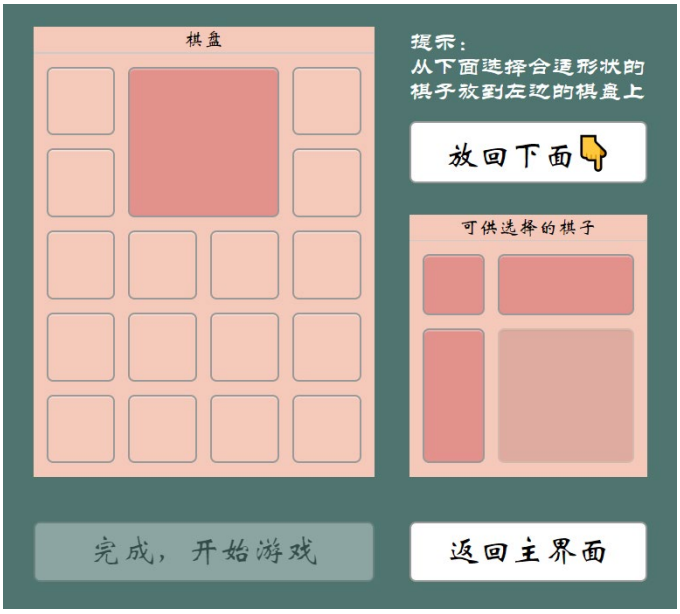



Figure 10

2. If the player mistakenly placed one chess, he/she can ① click on the chess placed on the wrong place, then ② click the button “放回下面👇”. The chess will be put back to the available chess box on the right “可供选择的棋子”. See Figure 11.

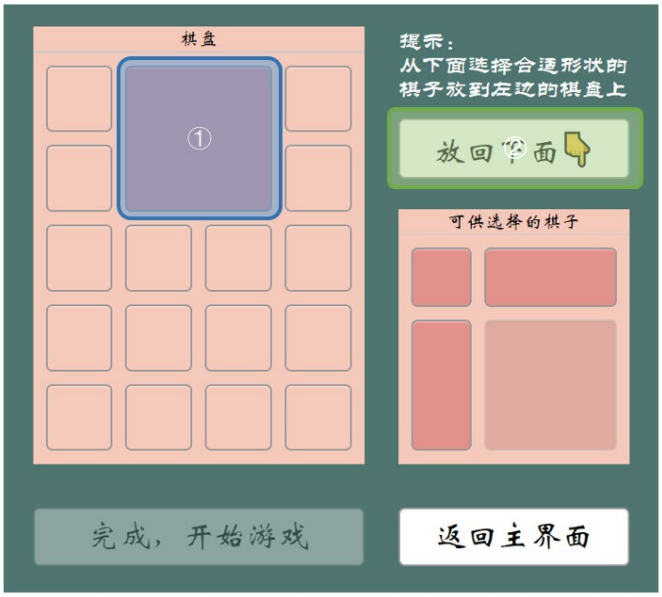



Figure 11

3. The player must place exactly 4 1*1 chesses, 5 1*2 or 2*1 chesses, and 1 2*2 chess onto the chessboard. Chesses exceeded required amount is not allowed. Once the required amount of chesses are placed onto the chessboard, player can choose to click “完成，开始游戏” to start a game with start state same as the current setting (Figure 12).

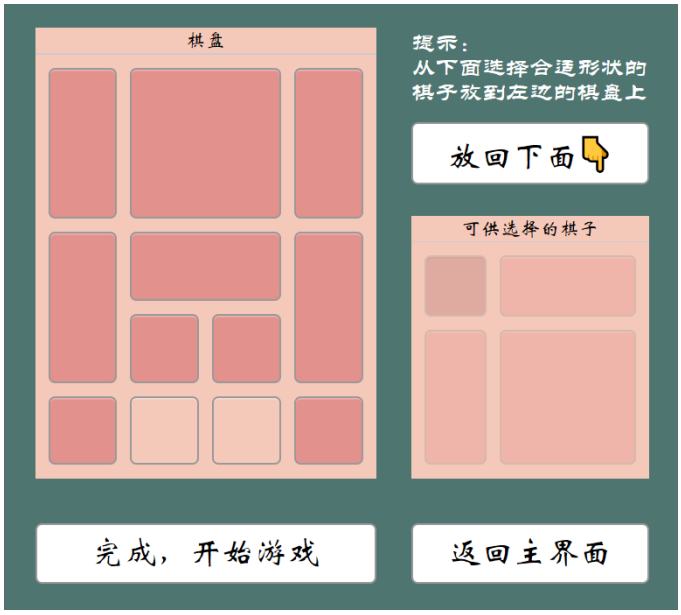



Figure 12

4. The player can play the game on game board with the same rule in standard mode. For detail information, please refer to Standard Mode.

## Check Solution

Player can check the solution of any start state of Huarong Path game using the UPPAAL model provided.

### *How to generate UPPAAL chessboard code*

After clicking “完成，开始游戏”in customize mode (Figure 12), player is expected to find a series of code in Matlab console.

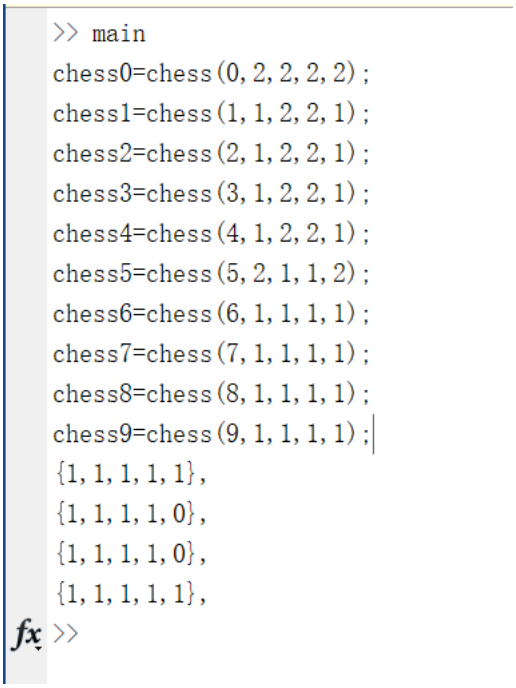



Figure 13

As is shown in Figure 13, the codes consist of 2 parts: one is the chess axis (former 10 rows), the other is the chessboard (latter 4 rows). In this example, the chess axis codes are:

```
chess0=chess(0,2,2,2,2);
chess1=chess(1,1,2,2,1);
chess2=chess(2,1,2,2,1);
chess3=chess(3,1,2,2,1);
chess4=chess(4,1,2,2,1);
chess5=chess(5,2,1,1,2);
chess6=chess(6,1,1,1,1);
chess7=chess(7,1,1,1,1);
chess8=chess(8,1,1,1,1);
chess9=chess(9,1,1,1,1);
```

The chessboard codes are:

```
{1,1,1,1,1},
{1,1,1,1,0},
{1,1,1,1,0},
```

```
{1,1,1,1,1},
```

*How to put the code into UPPAAL model*

1. Open the UPPAAL model named “checkSolution.xml”;
2. Copy the chess axis codes to the template declaration part of the model (Figure 14). Replace original chess information (See Figure 15, codes before System declaration);


Figure 14


Figure 15

3. Copy the chessboard code to the declaration part of the model (Figure 16). Replace the lines between the instruction comments (Figure 17).

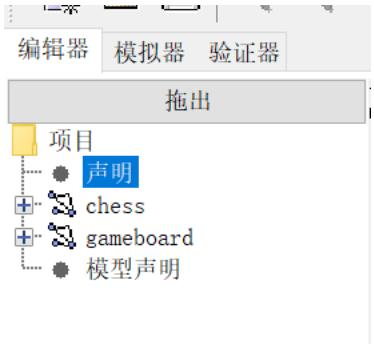



Figure 16

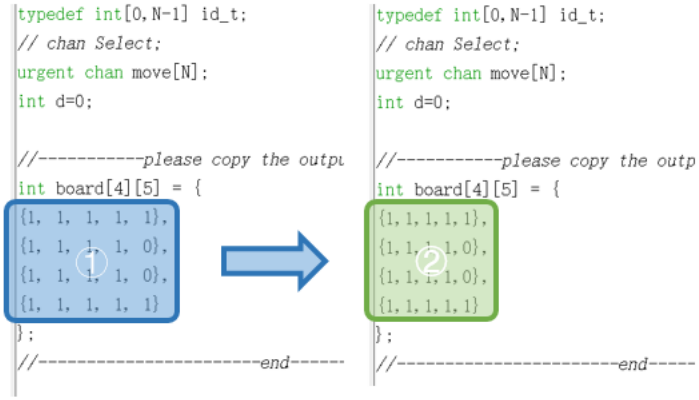



Figure 17

> Warning: Some UPPAAL versions may lead to unexpected problems here. If you encounter problems like invalid syntax, please delete the last comma (,) in the code (there are 20 commas in total, only delete the last one) and have another try.

### *How to examine the solution*

1. Load the properties in file “property.q”;
2. Verify the last property: “E<>(chess0.x==1&&chess0.y==3)”. This property means that check whether Caocao can get to the final position within valid moves.

Tips: To find the solution in reasonable time, you are highly recommended to use “random depth first search” mode (Figure 18) to search for the solutions.

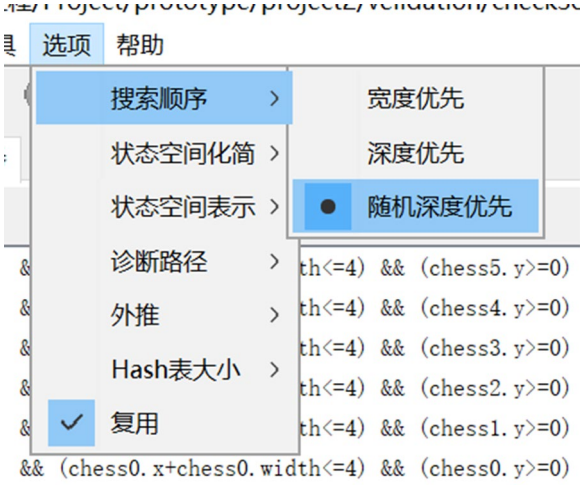



Figure 18

Also, in some UPPAAL versions, you need to set the path to “Some Path” to obtain the solution path if the game state has a solution (Figure 19).

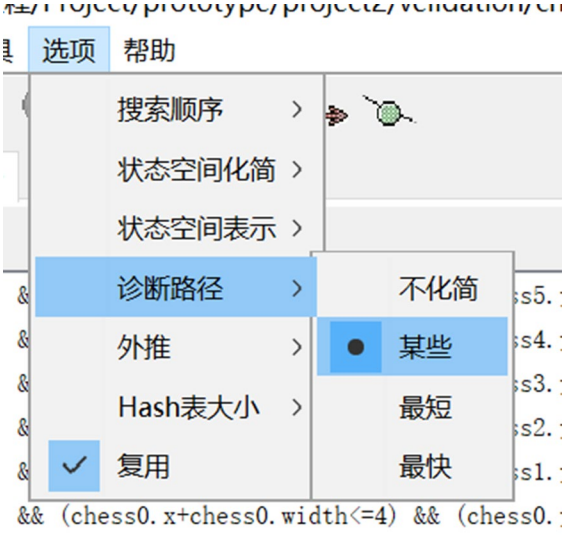



Figure 19

The verification may fail and raise error from time to time. Please try another several times if it complains about some wired errors.

3. If this property holds, that means this start game state has at least one solution. You can view the solution in “Trace” block.
4. In the right down corner, you can easily read the solution moves to the start game state (Figure 20). Each chess number represent one chess, chess0 is Caocao. From up to down is the solution.

For example, in figure 20, first select proper chess to move left, then select proper chess to move down…

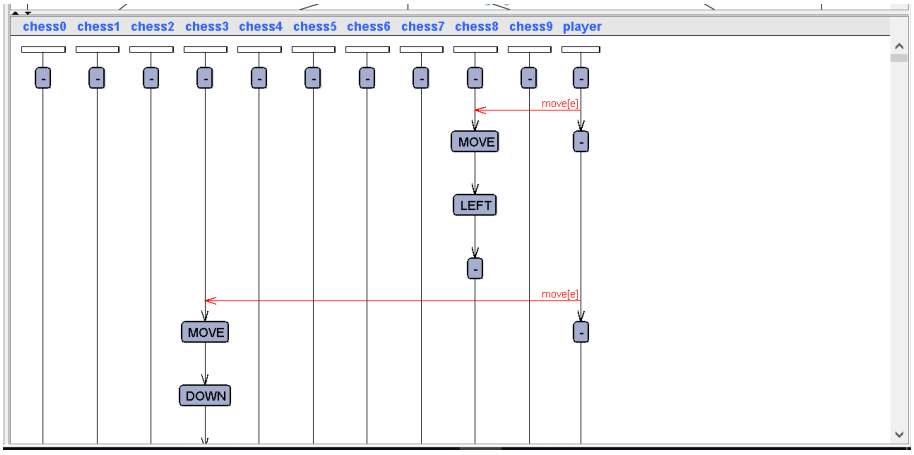



Figure 20

5. If this property fails, that means this start game state has no solution.