README

Name : Tushar Kumar
NetId : tusharku
Collaborators : None

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1 Introduction

This project, which was implemented by myself, and **did not have any collaboration from anybody else**, implements three variants of TicTacToe (Basic TTT played on 3*3 board, NineBoard TTT played on 9*9 board, Ultimate TTT played on 9*9 board). The game is implemented using Minimax algorithms with alpha beta pruning and also has heuristics to cut off search at any depth. This project was undertaken as part of the graduate course(CSC 442) at University Of Rochester.

2 Technology Used

- Java as the programming language (Java 10.0.2) with no external libraries
- Eclipse used as IDE
- Draw.io for creating design artifacts

3 Building the project

- Download the **TicTacToe-tusharku.zip** file(which you would have if you are reading this file.
- Unzip the file to get the TicTacToe-tusharku folder
- Run the following commands in sequence once you are in the location where you downloaded the zip file: Please mind the line break created because the command being of greater length than width of the page. Like below command would be: "javac -d executable -sourcepath src -cp . src/com/uofr/course/csc442/hw/hw1/tictactoe/gameplay/Game.java"

```
cd TicTacToe-tusharku

javac -d executable -sourcepath src -cp .
 ↪  src/com/uofr/course/csc442/hw/hw1/tictactoe/gameplay/Game.java
```

In case , you were not able to compile this, not to worry, I have provided the already compiled binaries of classes in the bin folder. So you can use that straight away to run the application

4 Running the application

- Run the following command to play TicTacToe

```
cd TicTacToe-tusharku
java -cp executable
 ↪  com.uofr.course.csc442.hw.hw1.tictactoe.gameplay.Game
```

This, by default would play one game of Basic TTT. For actually playing the game with all the options please read the next section

5 Playing the Game

These are the commandline arguments with their description and possible values that can be provided in order to play the game.

- **board** : This represents the board type that you want to play the game on.
  Possible Values : three(for Basic TTT), nine(for NineBoard), ultimate for UltimateTTT
  Default Value : three

- **iter** : This represents the number of iterations of game you want to play.
  Possible Values : Integer ≥ 1
  Default Value : 1

- **auto** : Whether you want to automate the game play by having the opponent of minimax pick moves randomly, or you want to select the moves yourself.
  Possible Values : true or false
  Default Value : false

- **alphabeta** : Whether alpha beta pruning should be enabled or not
  Possible Values : true or false
  Default Value : true

- **depth** : What depth you want to restrict the minimax search to
  Possible Values : Integer ≥ 1
  Default Value : 10 for BasicTTT, 6 otherwise

- **firstx** : If X should always be the piece that moves first, if not, it will be randomly decided whether X or O will play first.
  Possible Values : true or false
  Default Value : true

5.1 Playing Basic TTT Game

Here are some sample scenarios with their commands provided:

- **Playing 1 BasicTTT Game**

```
java -cp executable
↪  com.uofr.course.csc442.hw.hw1.tictactoe.gameplay.Game
```

- **Playing 10 BasicTTT Game**

```
java -cp executable
↪  com.uofr.course.csc442.hw.hw1.tictactoe.gameplay.Game -iter 10
```

- **Playing 10 BasicTTT Game restricting Minimax to depth 4**

```
java -cp executable
↪  com.uofr.course.csc442.hw.hw1.tictactoe.gameplay.Game -iter 10
↪  -depth 4
```

- **Playing 10 BasicTTT Game restricting Minimax to depth 4 and disabling alphaBeta pruning**

```
java -cp executable
↪  com.uofr.course.csc442.hw.hw1.tictactoe.gameplay.Game -iter 10
↪  -depth 4 -alphabeta false
```

- **Playing 10 BasicTTT Game with X/O both having equal chance of moving first**

```
java -cp executable
↪  com.uofr.course.csc442.hw.hw1.tictactoe.gameplay.Game -iter 10
↪  -firstx false
```

- **Playing 10 BasicTTT Game with user moves being picked up randomly**

```
java -cp executable
↪  com.uofr.course.csc442.hw.hw1.tictactoe.gameplay.Game -iter 10
↪  -auto true
```

5.2 Playing NineBoard TTT Game

Here are some sample scenarios with their commands provided:

- **Playing 1 NineBoard Game**

```
java -cp executable
↪  com.uofr.course.csc442.hw.hw1.tictactoe.gameplay.Game -board nine
```

- **Playing 10 NineBoard Game**

```
java -cp executable
↪  com.uofr.course.csc442.hw.hw1.tictactoe.gameplay.Game -board nine
↪  -iter 10
```

- **Playing 10 NineBoard Game restricting Minimax to depth 4**

```
java -cp executable
↪  com.uofr.course.csc442.hw.hw1.tictactoe.gameplay.Game -board nine
↪  -iter 10 -depth 4
```

- **Playing 10 NineBoard Game with user moves being picked up randomly**

```
java -cp executable
↪  com.uofr.course.csc442.hw.hw1.tictactoe.gameplay.Game -board nine
↪  -iter 10 -auto true
```

5.3 Playing UltimateTTT Game

Here are some sample scenarios with their commands provided:

- **Playing 1 UltimateTTT Game**

```
java -cp executable
↪  com.uofr.course.csc442.hw.hw1.tictactoe.gameplay.Game -board
↪  ultimate
```

- **Playing 10 UltimateTTT Game**

```
java -cp executable
↪  com.uofr.course.csc442.hw.hw1.tictactoe.gameplay.Game -board
↪  ultimate -iter 10
```

- **Playing 10 UltimateTTT Game restricting Minimax to depth 4**

```
java -cp executable
↪  com.uofr.course.csc442.hw.hw1.tictactoe.gameplay.Game -board
↪  ultimate -iter 10 -depth 4
```

- **Playing 10 UltimateTTT Game with user moves being picked up randomly**

```
java -cp executable
↪  com.uofr.course.csc442.hw.hw1.tictactoe.gameplay.Game -board
↪  ultimate -iter 10 -auto true
```