

CS510 HW Assignment 4

Christopher Geib

Due: Feb.27th 11:59pm

Part 1: Programming Assignment (100 points)

In this assignment you will program an agent that uses Minimax to play the game of Othello. You do not need to implement the game of Othello this time if you don't want. You can use the following Java implementation: `java-othello-src.zip`, which is a very simple implementation of the game of Othello. You can test it by running the file `"Test.java"`, which should run a game where both players generate moves at random.

The Othello implementation is structured as follows:

- `OthelloMove.java`: this class contains stores a "move" (which player made the move and the coordinates of the move)
- `OthelloState.java`: this is the core class, which implements most of the functionality of the game. The functions you should be aware of, for implementing minimax are:
 1. `public OthelloState(int a_boardSize)`: the constructor, you can create boards of whatever size you want, as long as it's 2 or bigger (Othello is typically played in a 8x8 board though).
 2. `public boolean gameOver()`: determines whether the game has finished or not.
 3. `public int score()`: returns the score (positive means player O is winning, negative means player X is winning).
 4. `public List generateMoves()`: returns the list of moves for the next player to move.
 5. `public List generateMoves(int player)`: same as before, but you can specify which player you want to generate moves for.
 6. `public OthelloState applyMoveCloning(OthelloMove move)`: creates a new game state that has the result of applying move 'move'
 7. `OthelloPlayer.java`: this is an abstract class defining an agent that player Othello. Your agent should be implemented as a class that extends this one.
- `OthelloRandomPlayer.java`: an example agent that player Othello, but just by choosing moves at random.
- `Test.java`: an example of how to use all the above classes to play a game of Othello.

Specifically, what we are asking you to do is the following:

- Create a new class that extends `OthelloPlayer` (call it something original, to prevent any name clashes with the classes that your classmates will create, since we MAY put all the classes together at some point, to create a tournament!).
- Within this new class, implement an agent that player Othello using the standard minimax algorithm, as we studied it in class.
- As the evaluation function, just use the "score" function that is provided to you in the `OthelloState` class (make sure that your bot can play both as the first or second player).
- Your agent's constructor should accept the depth up to which we want to search.
- To make sure your agent works, make it play against the `OthelloRandomPlayer` we provide. Your agent should defeat it easily!

Part 2: Extra Credit (30 points)

2.A: Alpha-Beta (10 points)

Implement a second agent, which uses alpha-beta search. Compare the times that your two agents take to search up to different depths.

2.B: Tournament (10 points)

Implement another agent, which instead of receiving the depth at which to perform search, it receives a certain amount of time (in milliseconds) that it can use to search. Make sure that your bot returns a solution within this time (you can assume that at least you will have 100 milliseconds)).

Hint: a good way to do this is by making your agent use iterative deepening (i.e. first search at depth 1. Then, if there is still time, search at depth 2. If there is still time, go for depth 3, etc.) Also, make sure that you have code that cancels the search if enough time has passed.

2.C: Lisp (10 points)

Reprogram this assignment in Lisp! You'll have to translate the Java Othello code to Lisp, and then the minimax agent.

What to Submit

All homework for this course must be submitted electronically using Bb Vista. Do not e-mail your assignment to a TA or Instructor! If you are having difficulty with your Bb Vista account, you are responsible for resolving these problems with a TA, an Instructor, or someone from IRT, before the assignment is due. It is suggested you complete your work early so that a TA can help you if you have difficulty with this process.

For this assignment, you must submit: Your C/C++/Java/Lisp/Python/Javascript/... source code, written documentation for your program, and results of your testing. We strongly recommend using a compression utility so that you can compress your files into a single file (with a .zip extension) and just upload it, rather than go through the tedious and error-prone process of uploading each file separately.

Academic Honesty

You must compose all program and written material yourself, including answers to book questions. All material taken from outside sources must be appropriately cited. If you need assistance with this aspect of the assignment, see a consultant during consulting hours.