COMP 4106 - Artificial Intelligence
Winter 2019

Assignment #2

Due date: March 12, 2019

Game Playing with MiniMax

Introduction

In this assignment you will be implementing two versions of the board game "Connect Four".

The Two Versions of "Connect Four"

"Connect Four" is a well-known, simple two-player board game, widely marketed for children. The players take turns dropping disks of their assigned color from the top of a grid. The goal of game is to connect four of your own disks horizontally, vertically or diagonally. A graphical illustration of the game is shown in Figure 1. Here the players have the colors yellow and red. The yellow player is one move away from winning.

The game is played on a variably-sized board (usually 7-by-6, which is the value you should use in this assignment), where, during a player's turn, he or she may place a piece at the "top" and it falls to the "bottom", the lowest unoccupied square. Alternately, he or she may remove a disk from the "bottom". Removing a disk from the bottom shifts every disk above it down one position. This changes the possibilities for a connection for both players. A player can only remove a disk from the bottom if the disk has his or her own color. The first player to construct a line of four pieces in a row (either vertical, horizontal, or diagonal) is considered to have won the game. An informative animation of how the game is played, for those who are unfamiliar with it, is located at its Wikipedia page: http://en.wikipedia.org/wiki/Connect_Four.

Your task is to implement both versions of the game. In the first version, the player is not allowed to remove disks from the "bottom". In the second version, the player is allowed the removal option. At the start of the game, the user must be allowed to choose which option the computer is required to play!
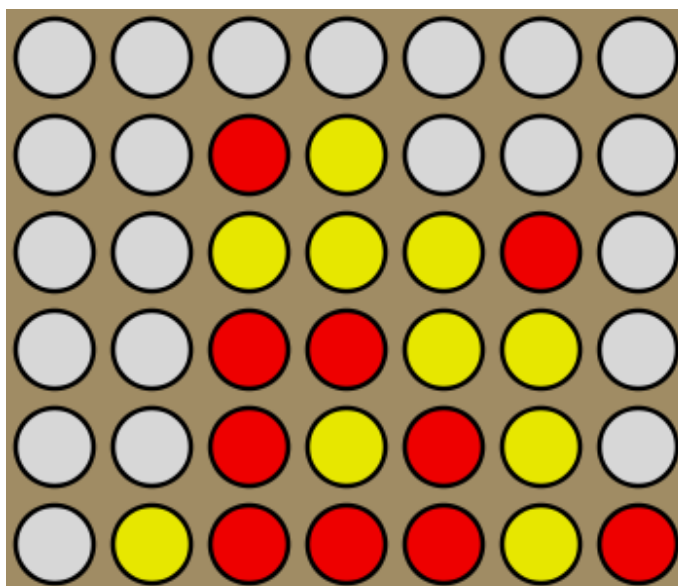

Figure 1: The board associated with "Connect Four".

Assignment Objectives

- Implement MiniMax search with Alpha-Beta pruning for "Connect Four".

  - Implement both the play options.
  - Each option must be implemented with two different heuristics. These heuristics may be the same for both the options.
  - Enable a computer *vs* computer play of the game, where one player uses a heuristic. While this player uses the heuristic, the other one plays random moves.

- Provide a way to bound the depth of the search.

- Code your assignment in such a way as to be able to show every move being made in both of the games.

- Write a short report (no more than two (2) pages) about the state space of the game, the choice of your heuristics, the number of nodes searched and how the players played against each other.

Questions

During the demo you should be prepared to discuss the following questions:

- Explain the heuristics you used for the game(s).

- Does one player always win?

Tips

Don't spend too much time on the graphics. Command-line based graphics is fine.

Bonus

Can you think of a way to improve the number of nodes pruned with Alpha-Beta pruning in "Connect Four"?