Connect-4, originally called “The Captain’s Mistress”, is a two-player game where pieces are dropped onto a grid from above; the goal is to make 4 in a row, vertically, horizontally, or diagonally. With the standard 6x7 board, the player to move first can force a win (the first move is in the center column), a result proved by Victor Allis as part of his Master’s Thesis in 1988.

The first few moves of a Connect-4 game. What can you infer about the search methods employed by the two agents?

(1) Consider a minimax search agent playing standard Connect-4.

(a) What is the branching factor?

(b) What is the size of the state space?:

(c) At 3-ply search (a ply includes one move for each player), will alpha-beta prune any branches when choosing the game’s first move?

(d) In the game shown above, why does ‘x’ move on the far left? Does he think that is his best option?
(2) Consider 3 possible evaluation functions. Describe how to implement each one based on the hint.

(a) The code for a simple function is shown here. What does it do? What is the state.filled business?

```python
def simpleEvalFunction(state, symbol):
    if state.winner == None: return 0
    if state.winner == 'TIE': return 0
    elif state.winner == symbol:
        return 1 + 1.0/state.filled
    elif state.winner != symbol:
        return -1 + -1.0/state.filled
```

(b) Central moves are generally better than edge moves.

(c) It’s good to have 3-in-a-rows. 2-in-a-rows are also good.