COMP30024 Artificial Intelligence
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Project Specification: Rules of the Game of HexiFence

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Board

Our game is played on a *hexagonal* board of dimension *N*, which comprises a grid of hexagonal *cells*. A hexagonal board has dimension *N* in the sense that each edge of the board comprises *N* cells. Your game playing agent will need to be able to cope with different values of *N*, i.e., boards of different sizes. It should be optimised to work on a board with *N=2* or *N=3*.

We number board cells using the notation (row, column), where (0,0) corresponds to the top left-most hexagon as shown below, and (2*N*-2, 2*N*-2) corresponds to the bottom right-most hexagon, i.e., row indices increase as we move down the board, while column indices increase as we move to the right. Below is an example of an *N* = 3 board with the all cells marked.
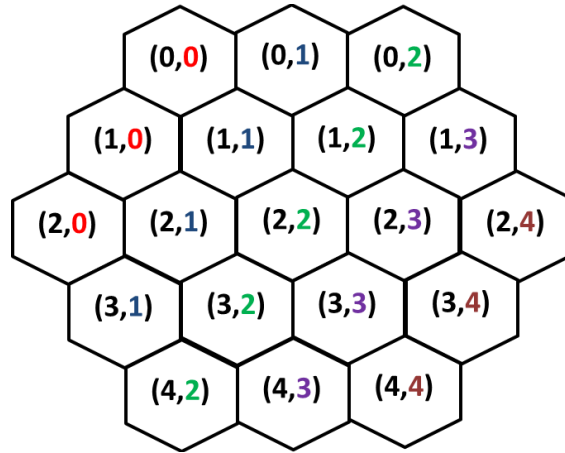

Figure 1. Cell Numbering in a Board with Dimension *N = 3*.

Two cells are *adjacent* if they share a common border (e.g., (1,1) has the adjacent cells (0,0), (0,1), (1,0), (1,2), (2,1) and (2,2), whereas (0,0) has only 3 adjacent cells).

Note that each cell may have up to 6 *adjacent* cells. The edges for each hexagon are determined using the following coordinate system where the blue, red and green lines indicate edges (0, 0), (6, 3) and (7, 6). As you can see some edges do not exist in our board configuration, e.g. (0, 7), (3, 1) and (9, 3). The tuple representing each edge in this problem can vary between (0, 0) and (4N-2, 4N-2).

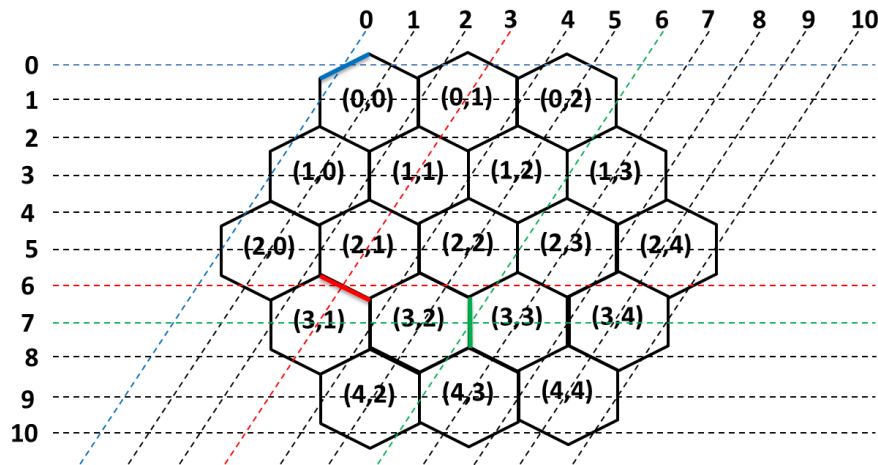Initially, all the edges are empty and no cell is captured on the board.

Figure 2. Edge Alignment in HexiFence board.

Players

There are two players named *Blue* and *Red*. Each player has their own set of pieces that they can place on the board. We will denote a piece for player Blue as *B* (or a blue line), and a piece for player Red as *R* (or a green line).

Example of piece positions

Below is an example of a board with *N=2*. It has three red pieces at the edges of cells (1,0), (1,1) and (2,1), and three blue pieces at (0,1), (1,1) and (1,2). The corresponding edges for the blue pieces are (0,3), (3,4) and (4,6) while the red edges are (4,1), (5,2) and (4,4). Please note that gray edges are empty.
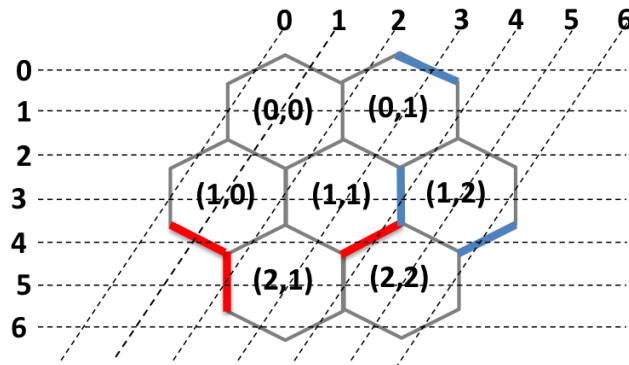

Objective of the game

The objective of each player is to capture as many hexagons as possible. A single hexagonal cell is captured (i.e. completed) by a player when that player has placed his/her piece in the last empty edge of the cell. The player that completes a hexagonal cell has captured that cell.

In the board state below, Blue has made *4* moves and it is Red's turn to make a move. Red can capture the hexagonal cell (1, 2) by putting his/her piece on the last empty edge. As a result Red receives a point as well as an additional move. The following

figure shows the board state before and after Red has made its move:
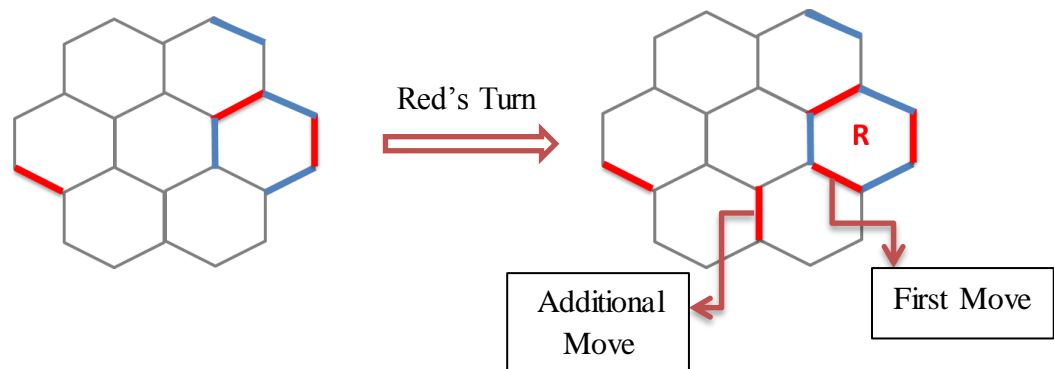
Note that it is possible for a player to capture more than one hexagonal cell with one move. In the following board, you can capture two cells with only one move. Note that although Blue has captured two cells, he/she gets only one additional move.
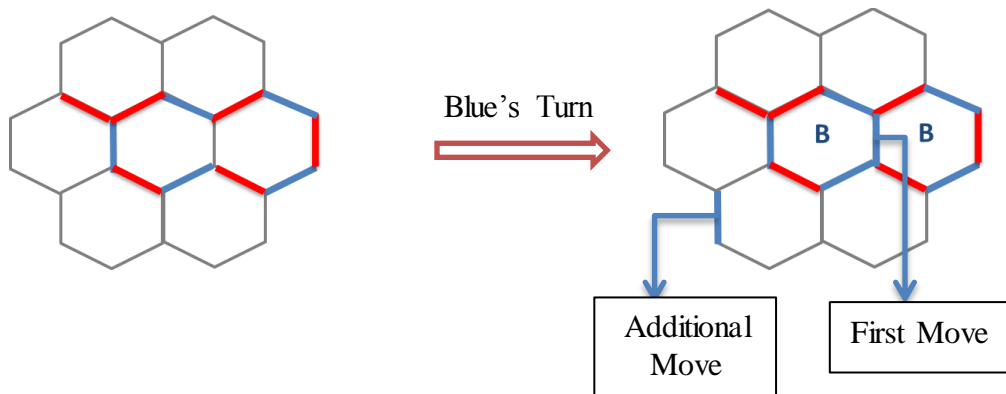
The number of cells that can be captured by one move can be *0, 1* and *2*. In the following board configuration, the number of cells that are *available for capturing* is *4* (demonstrated by C as the captured cells in Figure 3) while the *max number of hexagons that can be captured by a single move* is *2* (demonstrated by B in the captured cells in Figure 4).
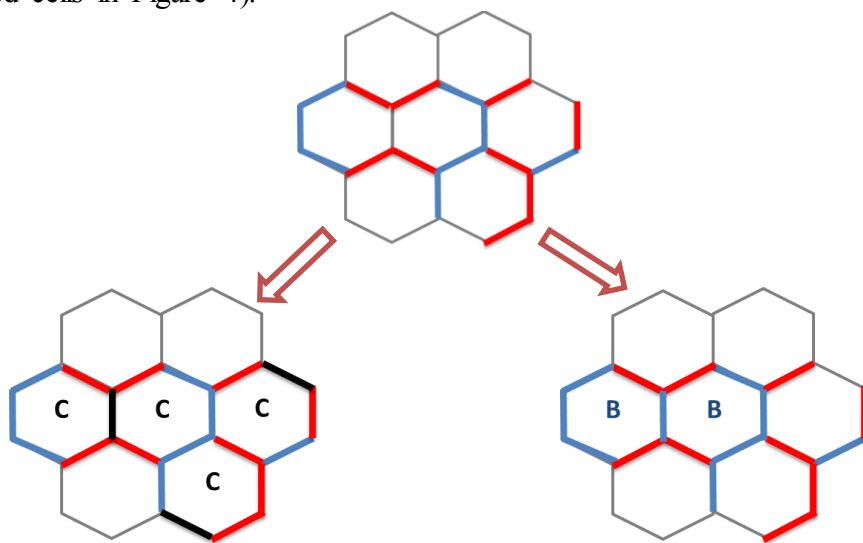

Figure 3. Number of Cells that are Available for Capture.

Figure 4. Maximum Number of Cells that can be Captured by a Single Move.

Rules

- A player is chosen arbitrarily to make the first move.
- Each player takes a turn at placing one of their pieces at any free edge on the board.
- Players cannot move or remove a piece once it has been placed on the board.
- A hexagonal cell is captured once the player places his/her piece on the last empty edge of that cell.
- The player who captures one or more cells with one move receives an additional move.
- A cell is free if one or more of its edges are empty, and it has not been captured.
- The game finishes when there are no free cells left on the board.
- The winner of the game is the player with the most captured cells.
- When a player captures a cell, it may contain pieces of either player on the edges. The player who places his/her piece on the last empty edge of the cell is the player who captures the cell.
- When a player captures a cell, the player is given an additional move. If that additional move also captures a cell, then the player is given another additional move, and so on.