Team Name: RedVelvet
Team Number: 7

Search Algorithms

We plan to use one of the following algorithms:

- Monte Carlo Tree Search (MCTS):
  - MCTS with an Upper Bound Confidence (UCB) function which keeps balance between *exploitation* and *exploration*.
  - For each move, we run some iterations of the algo (around 500) ensuring that a valid move is returned within the time limit.
  - $UCB = w/n + c * \sqrt{lnN/n}$

    w : number of wins with that node as an intermediate

    n : number of simulations with that node as an intermediate

    N : total simulations for current move

    c : a balancing constant

- MiniMax with Alpha-Beta Pruning:
  - Due to time limit of 24 secs, the depth of our search tree will be limited to three.

Heuristics

1. Considering the evaluation criteria (section 5.1) following are the scores assigned to each smallboard type:

- Winning a center small board adds 30 points to the heuristic.
- Winning a corner small board adds 60 points to the heuristic.
- Winning a side small board adds 100 points to the heuristic.

2. Considering the *small_boards_status* of the board, we check for all of the eight possible winning combinations**:**

- ***Scale_Factor*** indicates the importance of winning that small board. Higher the *scale_factor* of a small board, higher are the chances of winning the big board by playing / winning that small board.
- [- - -]
    - In this case, we will try to win any of the small board and initialise the *scale_factor* of each of the small boards to **1**.
- [x - -] adds 250 points to the heuristics.
    - Here, we assign a *scale_factor* of **2** to the empty small boards of this combo. Hence, this will increase the chances of a move being played in one of the empty small boards and increase the chances of winning.
- [x x -] adds 500 points to the heuristics.
    - Here, we assign a *scale_factor* of **3** to the empty small board of this combo. Hence, this will increase the chances of a move being played in the empty small board and increase the chances of winning.
- [x x x] adds 1000 points to the heuristics.

3. Considering the cells of a small board:

- [x - -] adds ***scale_factor * 5*** points to the heuristics.
- [x x -] adds ***scale_factor * 10*** points to the heuristics.
- [x x x] adds ***scale_factor * 20*** points to the heuristics.

4. The above scoring criteria will be followed for the opponent but with negative score (basic minimax approach).