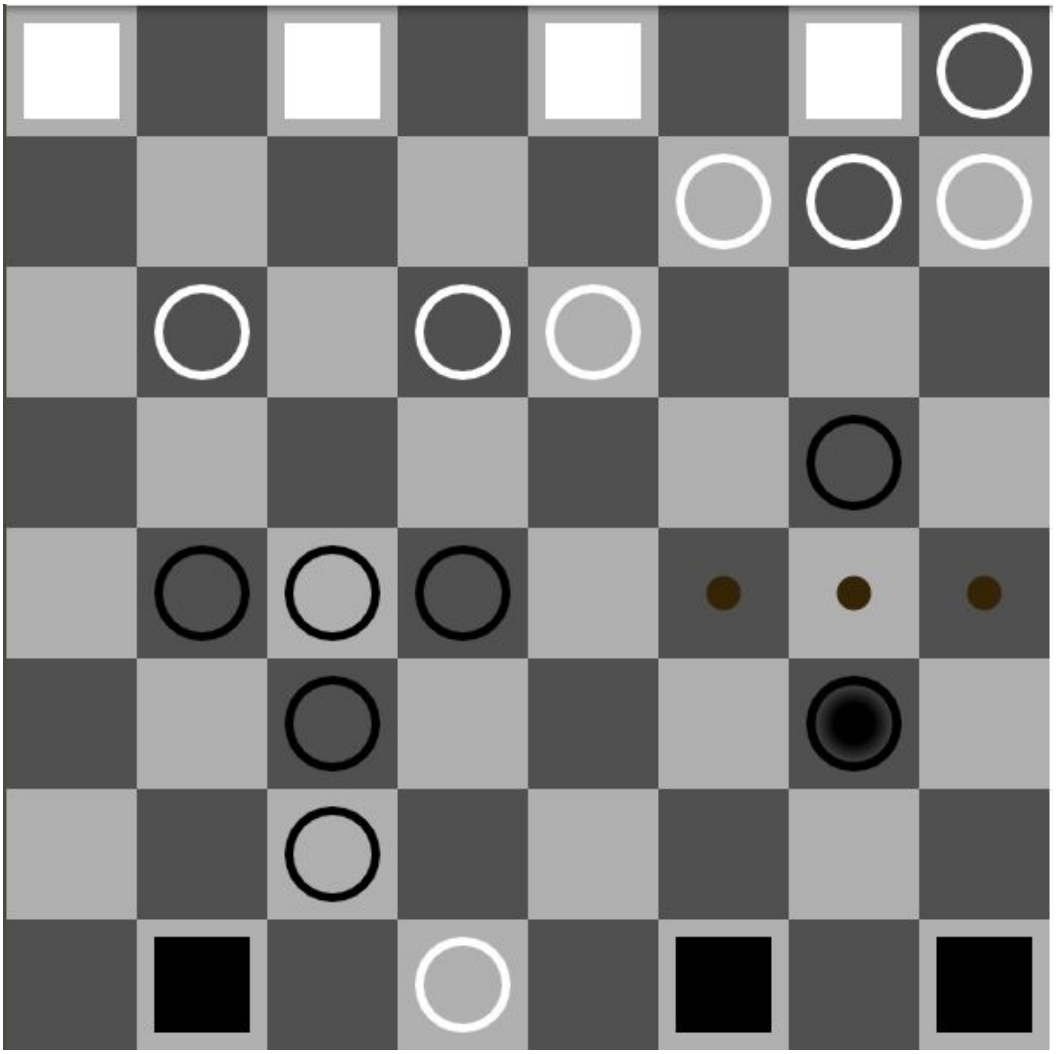
COL 333 - Assignment 5

Wuji - An “intelligent” bot for the Game of Cannon

Kaivalya Subhash Swami (2017CS10339)
Kartik Sharma (2017CS10342)



Highlights

Utility Function : Linear sum of weighted features

Feature	Formula	Weight
Townhall difference	(no. of our townhalls) - (no. of opponent's townhalls)	20
Player difference	(no. of our pieces) - (no. of opponent's pieces)	5
Cannon attackability	(no. of enemy players that can be shot by our cannons) - (no. of our players that enemy cannons can shoot at)	1
Cannon shootability	(no. of empty boxes shootable by our cannons) - (no. of empty boxes shootable by opponent's cannons)	0.5
Average townhall distance	(avg. distance of our pieces to opponent's townhall line) - (avg distance of opponent's pieces to our townhall line)	-1
Minimum townhall distance	(min distance b/w our pieces to opponent's townhall line) - (min distance b/w opponent's pieces to our townhall line)	-0.5

Min Max Search

1. **Alpha Beta Pruning**
    - **Ordering of moves for better pruning :** Moves are ordered in decreasing order of their likelihood to be chosen at each level of the game tree (in particular, "canon shootable" << "cannon attackable << …)
        i. This helps in faster pruning of the tree during alpha-beta pruning
        ii. This allowed the bot to go upto 7 plies in normal game
2. **Quiescent search**
    - Move further deep in the search if a move is of "attack" type
    - In other words, if a move leads to a significant change in the utility of the state (which implies the move involves loss of a player), then it searches for more depth than otherwise (until there is no attack move possible or it has reached a set upper bound).

Challenges

Other than simple debugging tasks, we faced the following challenges:

- **Deciding the weights:** We couldn't use RL so the only way was to play matches & decide
- **Handling stalemate condition:** We couldn't handle this until the very end
- **Free piece attack:** Near the end, it often happens that a piece near our townhall line has a clear path to reach the opponent townhall line. While we couldn't use this situation completely, we tried it by increasing the depth and by adding "min distance" feature

Key takeaways

- Ordering moves based on the likelihood to be chosen can help to go deep in game tree
- A utility function may be a good estimation only on quiescent states and thus, the decisions will be better if utilities of only quiescent states are compared
- Depth should increase as no. of pieces decrease and this number should be well experimented since a change of depth at any point can really improve the game
- The feature "average distance" allows to take a lot of mobile positions on a larger board
- The feature "min distance" can take care of situations where a piece has a clear way forward but the depth is not enough
- The feature "cannon shootability" is one feature that increases the vulnerability of cannons which may make this state a favorable one if we go further deep

---

All in all, we really enjoyed doing this assignment. It is an honor to win the very first tournament. We would like to thank the professor and the TAs who worked so hard for this assignment. Last but not the least, we would also want to thank our fellow peers who, through informal matches, constantly helped us in realizing if there is any scope of improvement.