Connect 4

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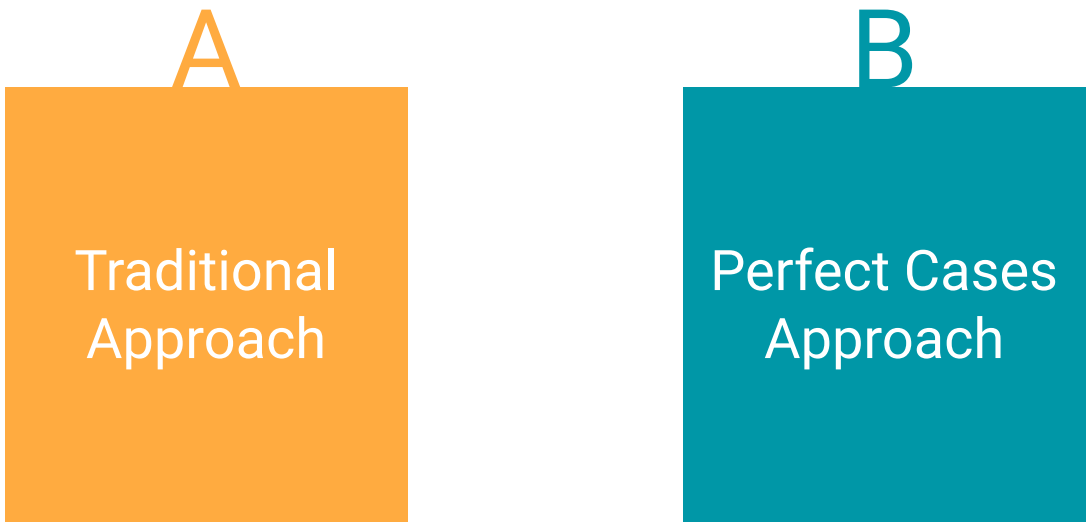
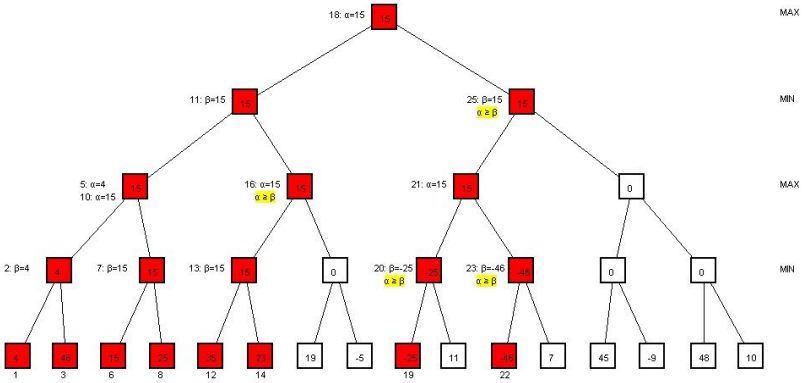
Two approaches



Techniques

1. Minimax
2. Alpha-beta pruning
3. Custom heuristic function
4. Memoization

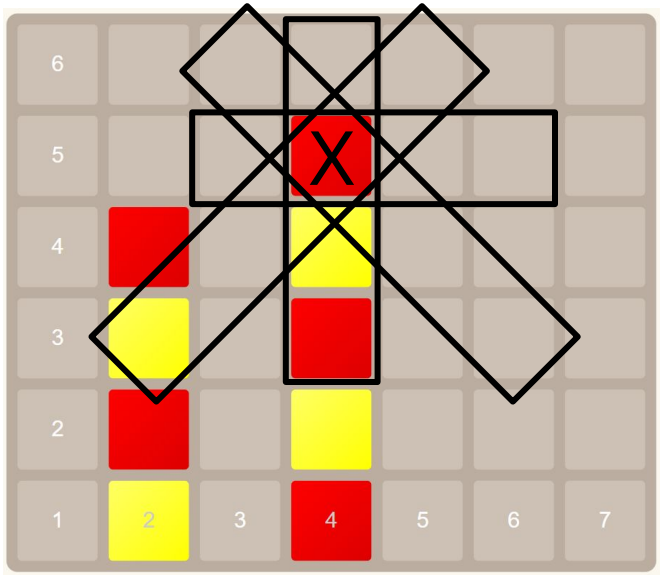


An example of minimax algorithm with alpha-beta pruning

Heuristic function

Patterns to be considered

1. Vertical
2. Horizontal
3. Diagonal (top left)
4. Diagonal (top right)

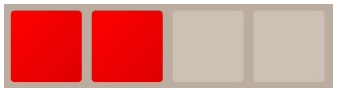


Useful patterns for heuristic calculation

Heuristic function

= 2 ^ (2 ^ n)

= 4



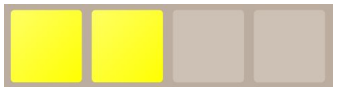
= 16

= 256

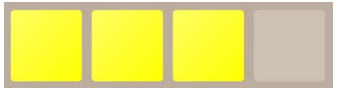
= 1e15

= - 2 ^ (2 ^ n)

= - 4



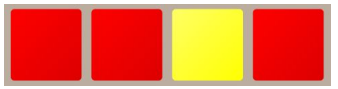
= - 16



= - 256

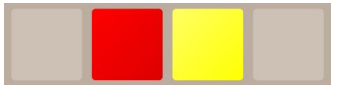
= - 1e15

= 0



= 0

= 0



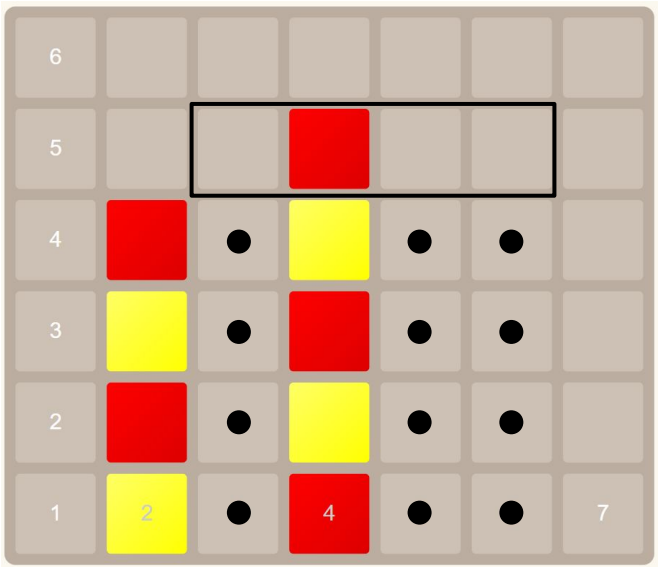
= 0

Heuristic function

There are 12 spaces under the consideration box. So, the score would be

$$2 \wedge (2 \wedge n) - (space * n / 10)$$

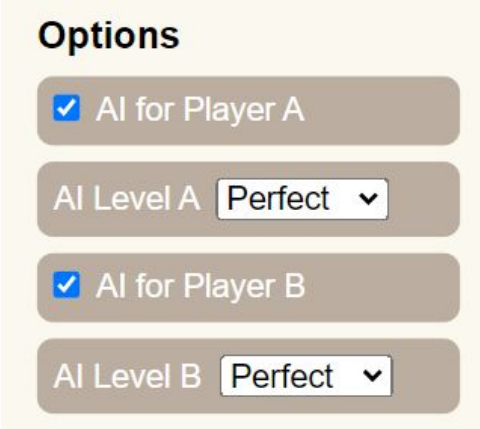
Unfortunately, this method could not counter the perfect bot.



Memoization

In defeating the perfect bot, the player must be the starter and assume that the opponent will select only perfect moves. By doing this, the bot will lose to the player in the turn of 40 from 42.

I let 2 AIs compete to each other, and memorize the states and its decisions which are absolutely perfect moves. Thus, we can overcome the perfect bot!



Working Timeline

1. (2 hours) Board game construction
2. (2 hour) Bot creation with minimax algorithm
3. (1 hour) Applying alpha-beta pruning to the minimax
4. (4 hours) Modifying and tuning the scoring function
5. (1 hour) Getting lost and tried to find a new approach
6. (~10 hours) Collecting the bot's moving decisions
7. (1 hour) Creating the perfect bot beater
8. (1 hour) Building the presentation