

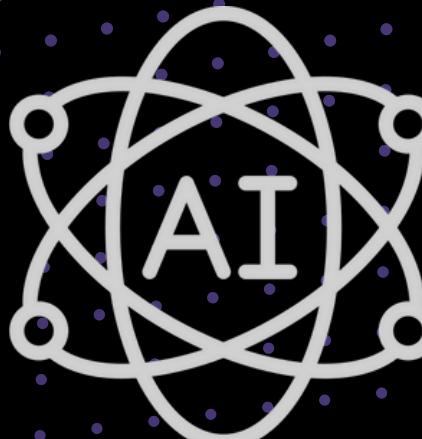
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Winning at Pyrat with AI

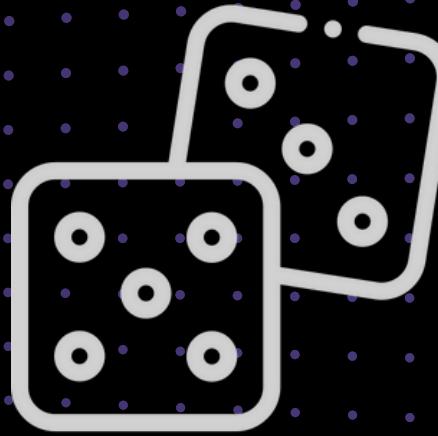
A Reinforcement Learning and combinatorial game theory approach

The idea

The idea is to train a reinforcement learning algorithm and add heuristics through combinatorial game theory.



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WHY DOES IT WORK BETTER ?

RL + Combinatorial

~70% winning rate

Use of heuristics in the ending phase

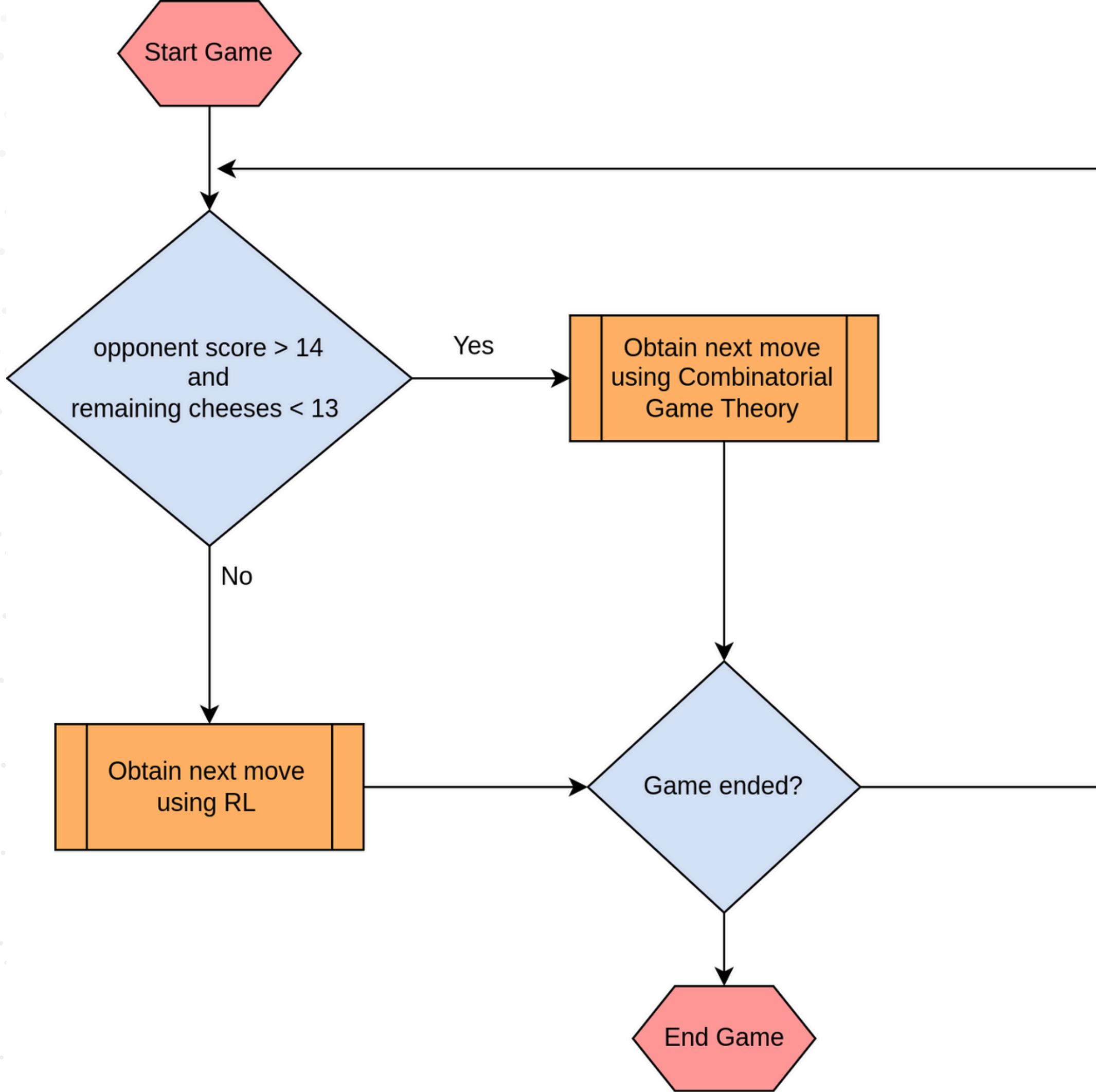
RL

~40% winning rate

Same strategy

Our hypothesis : reinforcement is good at coming up with a global strategy but lacks behind in ending game where strategy is most important.

Logic



Parameter Tuning

```
epoch = 1500 # Total number of epochs that will be done
max_memory = 500 # Maximum number of experiences we are storing
number_of_batches = 8# Number of batches per epoch
batch_size = 32 # Number of experiences we use for training per batch
width = 21 # Size of the playing field
height = 15 # Size of the playing field
cheeses = 40 # Number of cheeses in the game
opponent = manh # AI used for the opponent
discount_factor = 0.95 # Discount factor for the Q-learning algorithm
```

New parameters: the cheese threshold and the cheese limit

```
cheese_thr = 14
comb_cheese_limit = 13
```

70%

Parameter Tuning

method	epoch	max_memory	number_of_batches	batch_size	number_of_games	cheese_thr	winning_rate (%)
reinforcement learning	3000	1000	8	32	100		43
reinforcement learning	1000	2000	8	32	100		50
reinforcement learning	1500	1500	8	32	100		56
Reinforcement + combinatorial	1500	1500	8	32	100	9	79
Reinforcement + combinatorial	1500	3000	8	32	1000	9	73.3
Reinforcement + combinatorial	1500	500	8	32	1000	12	72

Best Results

```
{  
    "miss_python": 0.0  
    "miss_rat": 0.0  
    "moves_python": 80.16  
    "moves_rat": 80.16  
    "prep_time_python": 2.1314620971679686e-06  
    "prep_time_rat": 0.0018941783905029297  
    "score_python": 18.57  
    "score_rat": 20.33  
    "stucks_python": 0.0  
    "stucks_rat": 0.0  
    "turn_time_python": 9.039892250938094e-06  
    "turn_time_rat": 0.00101438053873123  
    "win_python": 0.12  
    "win_rat": 0.8  
}
```

Applying RL Against the AI we have created

GIVEN OUR MIXED AI, WHAT IS THE EXPECTED RESULT OF
USING IT TO TRAIN A NEW AI WITH RL?

```
epoch = 10000 # Total number of epochs that will be done
max_memory = 1000 # Maximum number of experiences we are storing
number_of_batches = 8# Number of batches per epoch
batch_size = 64 # Number of experiences we use for training per batch
width = 21 # Size of the playing field
height = 15 # Size of the playing field
cheeses = 40 # Number of cheeses in the game
opponent = AI # AI used for the opponent
```

60%

Thank you

