Introduction

Monte Carlo tree search (MCTS) is a heuristic search algorithm

Used in in game play.

- MCTS was introduced in 2006 for computer Go
- Used in board games like chess and shogi
- Used in games with incomplete information such as bridge and poker
- Used in real-time video games such as Total War: Rome II's implementation of the high level campaign AI.

Principle of Operation

The focus of MCTS is on the analysis of the most promising moves.

It expands the search tree based on random sampling of the search space.

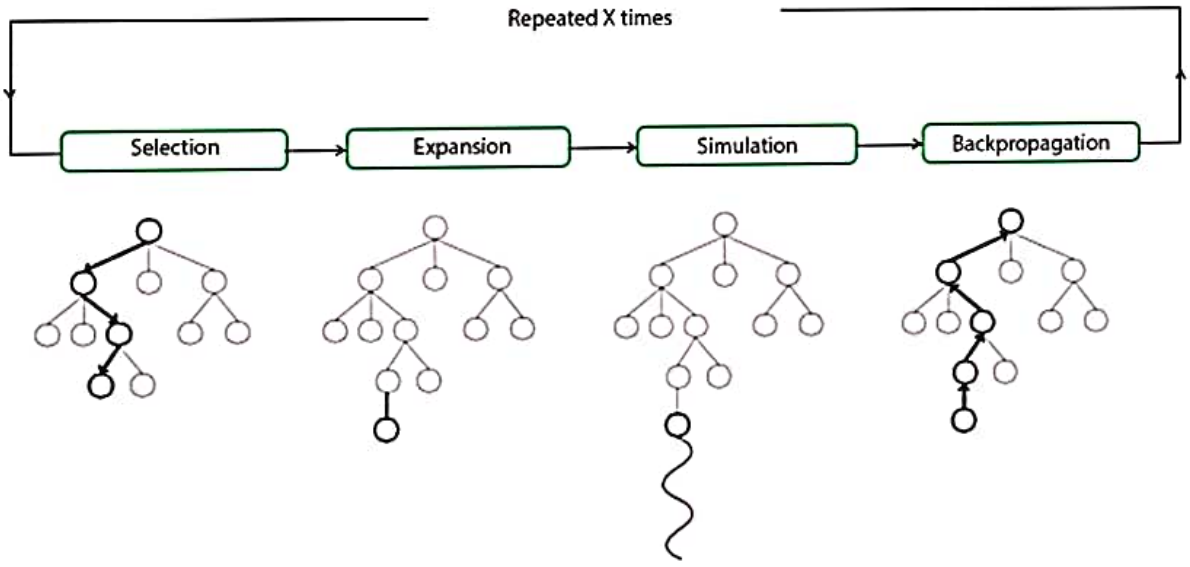
The application of Monte Carlo tree search in games is based on many *playouts* also called *roll-outs*.

In each playout, the game is played out to the very end by selecting moves at random.

The final game result of each playout is then used to weight the nodes in the game tree so that better nodes are more likely to be chosen in future playouts.

Principle of Operation

Each round of Monte Carlo tree search consists of four steps:



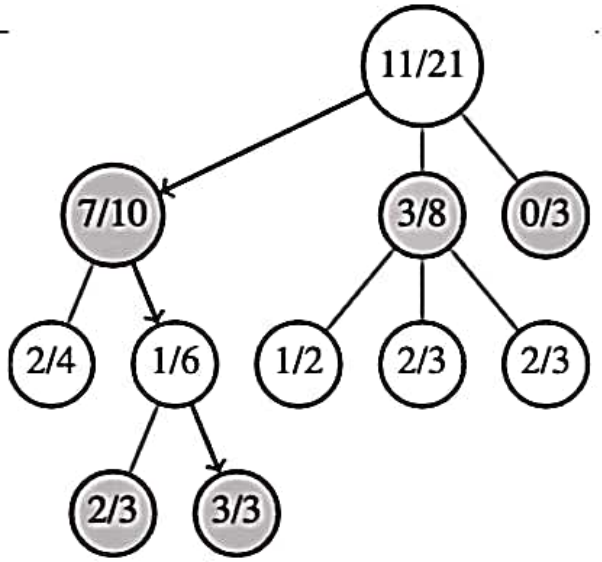
Selection

A selection function is applied recursively until a leaf node is reached.

The function attempts to balance exploitation and exploration.

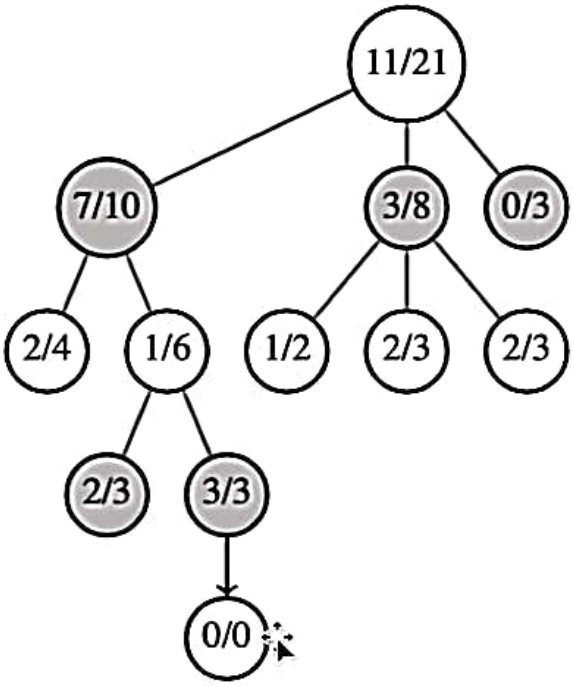
Exploitation: Select moves that lead to the best results so far

Exploration: Select less promising moves to remove uncertainty of them.



Expansion

One or more moves/states are created.

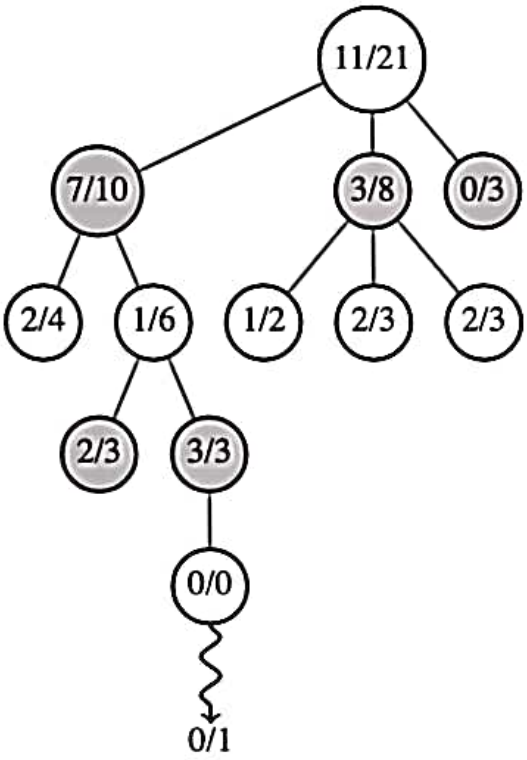


Simulation

One simulation game is played.

Actions are selected at random until game ends.

Use heuristic knowledge to bias selection to actions that look more promising.



Putting it all together