CAP 4053 Artificial Intelligence for Computer Games: Monte Carlo Tree Search

Monte Carlo Tree Search (MCTS)

Overview

Monte Carlo Tree Search (MCTS) is a search algorithm that combines the exploration of Monte Carlo methods with the exploitation of tree search algorithms. It is used in many computer games, such as Go, Chess, and Backgammon, to find the best move for a player. MCTS works by creating a tree of possible moves and then simulating random games from each node in the tree. The algorithm then uses the results of these simulations to select the best move.

Key Concepts

- **Tree Search**: Tree search is a type of search algorithm that explores a tree of possible moves in order to find the best move.

- **Monte Carlo Methods**: Monte Carlo methods are a type of algorithm that uses random sampling to solve problems.

- **Simulation**: Simulation is the process of running a game or other system in order to test it.

Algorithm

The MCTS algorithm works by creating a tree of possible moves and then simulating random games from each node in the tree. The algorithm then uses the results of these simulations to select the best move.

The algorithm begins by selecting a root node in the tree. This node represents the current state of the game. The algorithm then selects a child node from the root node and simulates a game from that node. The algorithm then repeats this process for each child node until it reaches a leaf node (a node with no children).

Once the algorithm has reached a leaf node, it evaluates the node using a heuristic function. This function assigns a score to the node based on how good the move is. The algorithm then backtracks up the tree, updating the scores of each node based on the score of its children.

Once the algorithm has backtracked to the root node, it selects the child node with the highest score and returns it as the best move.

Code Example

```
Start of Code
// Create a root node
Node root = new Node();
// Select a child node from the root
Node child = root.selectChild();
// Simulate a game from the child node
```

```
child.simulateGame();
// Evaluate the child node
child.evaluate();
// Backtrack up the tree, updating the scores of each node
while (child != root) {
       child.updateScore();
       child = child.parent;
}
// Select the child node with the highest score
Node bestMove = root.selectBestChild();
// Return the best move
return bestMove;
End of Code
```

Practice Questions

Q1. What type of search algorithm does MCTS use?

A1. MCTS uses a tree search algorithm.