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Assignment 4 - Instructions

Exploring the minimax Algorithm and Utility Functions

This assignment aims to deepen your understanding of the Minimax algorithm and its application in decision-making processes in games. You will explore how to design a utility function that can evaluate game states and make strategic decisions. The assignment will conclude in a theoretical report and the creation of pseudocode for a utility function tailored to a game of your choice.

1. Introduction to Game Theory and the Minimax Algorithm: Provide a brief overview of game theory and the role of the Minimax algorithm in strategic decision-making for two-player, zero-sum games. Discuss the concept of optimality in moves and how Minimax contributes to achieving it.
2. Understanding Utility Functions: Explain what utility functions are and how they are used in the context of the Minimax algorithm to evaluate the desirability of game states. Discuss factors that might influence the design of a utility function for different types of games.

Simple Example: Tic-Tac-Toe Utility Function

Let's look at a simple example using Tic-Tac-Toe. In Tic-Tac-Toe, a utility function can evaluate the board's state to provide scores such as:

- +1 for a win
- 0 for a draw, and
- -1 for a loss

```
function utility(gameState) -> int:
   if X wins in gameState:
       return +1
   else if O wins in gameState:
       return -1
   else:
       return 0
```

Part 2: Application and Analysis

Selection of a Game: Choose a game (this could be Mancala, chess, or any other game suitable for Minimax analysis). Provide a brief description of the game's rules and objectives.

1. Designing a Utility Function: Create a utility function in pseudocode that could be used by a Minimax algorithm to evaluate game states for your selected game. Explain your reasoning behind the design of the utility function, including any assumptions or considerations you made.
2. Challenges and Strategies: Discuss the challenges you might encounter in implementing the Minimax algorithm and your utility function for the selected game. Propose strategies to overcome these challenges, considering the complexity of the game and computational limitations.

Part 3: Reflection and Conclusion

1. Reflection: Reflect on the process of designing the utility function and how it has deepened your understanding of strategic decision-making in games. Consider the limitations and potential improvements to your approach.
2. Conclusion: Summarize your findings and insights gained from the theoretical exploration of the Minimax algorithm and the practical application of designing a utility function in pseudocode.

Grading of the assignment

Total Points: 100

- Part 1: Theoretical Foundation **(30 Points Total)**
    - Game Theory and the Minimax Algorithm **(15 Points)**: Thoroughly explain game theory and the Minimax algorithm. Assess the optimality and how Minimax achieves strategic decision-making.
    - Utility Functions **(15 Points)**: Graded based on the clarity and depth of explanation on what utility functions are, their role within the Minimax algorithm, and their use in evaluating game states.
- Part 2: Application and Analysis **(50 Points Total)**
    - Selection of a Game **(10 Points)**: Marks are awarded for the selection of an appropriate game for Minimax analysis, including a clear description of the game's rules and objectives.
    - Designing a Utility Function (20 Points): Points reflect creativity and logical reasoning in designing a utility function in pseudocode.
    - Challenges and Strategies **(20 Points)**: Evaluate potential challenges in implementing the Minimax algorithm and utility function for the chosen game. Points will also reflect the quality of proposed strategies to overcome these challenges, considering game complexity and computational limitations.

- Part 3: Reflection and Conclusion **(20 Points Total)**
    - Reflection **(10 Points)**: Points are awarded based on the depth of the your reflection on designing the utility function. Also if you've considered limitations and potential improvements.
    - Conclusion **(10 Points)**: Summarize your findings and insights gained from the theoretical exploration of the Minimax algorithm and the practical application of designing a utility function.

Scores 3-5

- U (Fail): 0-59 points
- 3: 60-74 points
- 4: 75-89 points
- 5: 90-100 points

Scores A-F

- F (Underkänd): 0-59 poäng
- E: 60-69 poäng
- D: 70-79 poäng
- C: 80-89 poäng
- B: 90-94 poäng
- A: 95-100 poäng

◂ Föregående

Nästa ▸