Dameo Project Improvements Summary

Overview of Changes from Version 1 to Version 2

This document summarizes the improvements made between version 1 and version 2 of the Dameo game project. The changes include structural improvements, code refinements, new features, and AI enhancements.

New Files Added

1. **minimax_2.py** - Added a more advanced version of the minimax algorithm with improved heuristics, particularly adding a position-based evaluation factor that rewards pieces moving toward promotion.
2. **minimax_3.py** - Implemented a MinimaxAlphaBeta class that uses alpha-beta pruning to increase search efficiency, allowing for deeper search depths (set to 4 compared to 2 in the other implementations).

Improved AI Implementation

AI Player Enhancements

- **AI Constructor Changes**: Changed the AI initialization to accept a `color` parameter, making it easier to have AIs control either red or blue pieces.
- **Evaluation Functions**: More sophisticated evaluation functions in minimax_2.py that consider:
  - Piece counts
  - King counts
  - Positional advantages (distance to promotion rank)
  - Strategic positioning

AI Architecture

- **Organized AI Hierarchy**: Cleaner separation between different AI implementations with dedicated files.
- **AI vs AI Mode**: Added support for AI vs AI gameplay with different AI algorithms facing each other.
- **AI Difficulty Levels**: Implemented multiple difficulty levels (0-3) with different AI algorithms for each level.

Game Logic Improvements

Capturing Mechanics

- **King Captures**: Improved king capture logic with direction restrictions during multi-captures.
- **Multi-capture Sequences**: Better handling of forced multi-capture sequences.

- **Direction Tracking**: Added tracking for the last direction a king moved, enforcing the rule that kings cannot reverse direction in a capture sequence.

Game Flow

- **Turn Tracking**: Added game_turns counter to track the number of turns played.
- **Game Timing**: Added timing functionality to measure how long games take.

UI Improvements

Interface Elements

- **Instructions**: Added an info button and instructions screen to help players learn the game.
- **Return to Lobby**: Added a return-to-lobby button for better navigation between game states.
- **AI Selection**: Improved UI for selecting AI difficulty in both Player vs AI and AI vs AI modes.
- **Visual Feedback**: Better feedback during AI moves, including showing intermediate steps in multi-captures.

Game States

- **Expanded Game States**:
  - Added "rules" state for displaying game instructions
  - More robust state transitions between menu and gameplay

Performance and Structure

Code Organization

- **Function Refactoring**: Better organization of functions with clearer responsibilities.
- **Parameter Documentation**: Improved comments explaining parameters and return values.
- **Consistent Naming**: More consistent naming conventions across the project.

Performance Optimizations

- **AI Thinking**: Added flags to control AI thinking state to prevent UI lockups.
- **Delay Control**: More configurable delays between AI moves for better visualization.
- **Alpha-Beta Pruning**: Added pruning in minimax_3.py to dramatically improve search efficiency.

Bug Fixes

- **King Promotion**: Fixed issues with king promotion during multi-capture sequences.
- **Game Reset**: Improved reset functionality to properly reset all game state variables.
- **Window Resizing**: Fixed scaling issues with window resizing.

Conclusion

Version 2 represents a significant improvement over version 1 with more robust AI, better UI, cleaner code structure, and enhanced game mechanics. The addition of multiple AI algorithms with different difficulty levels adds replayability, while the improved UI makes the game more accessible to new players.