

Quantum Checkers Game Manual

Introduction

Quantum Checkers is a variant of the classic game of Checkers that incorporates elements of quantum mechanics, adding a layer of probability and uncertainty to the gameplay.

Game Setup

- The board is an 8x8 grid, identical to classical Checkers.
- Each player starts with 12 pieces, placed on the dark squares of the first three rows on their side of the board.
- Each piece begins in a quantum superposition state, with a 50% probability of being on the board.

Piece Representation

- The opacity of each piece represents its probability of being on the board. The actual probabilities can be shown by clicking a button.
- Kings are represented with a yellow border.

Gameplay

Turn Structure

Each turn consists of two phases:

1. Classical Move Phase
2. Quantum Operation Phase

Classical Move Phase

- Players can move their pieces diagonally forward to an adjacent empty square.

- Captures are made by jumping over an opponent's piece to an empty square beyond.
- Multiple captures are not allowed in a single turn.
- Kings can move and capture diagonally in any direction.

Quantum Operation Phase

- After a successful move, the player must apply a rotation gate $R(\pi/6)$ to the moved piece.
- This increases the piece's probability of being on the board by approximately 15%.

Capturing and Measurement

- When a capture is attempted, the game measures the quantum states of both the capturing piece and the target piece.
- If both pieces are measured to be on the board, the capture proceeds as in classical Checkers.
- If either piece is measured to be off the board, the capture fails, and a global measurement occurs:
 - All pieces on the board for both players are measured.
 - Pieces measured to be off the board are removed.
 - The turn ends immediately, and play passes to the other player.

Kinging

- If a piece reaches the opposite end of the board, it becomes a king.
- Kings can move and capture diagonally in any direction.

Winning the Game

The game ends when one player:

- Captures all of their opponent's pieces, or

- Leaves their opponent with no legal moves, or
- Has all of their opponent's pieces measured to be off the board.

User Interface

- Click on a piece to select it.
- Click on a button to show the probabilities of all pieces.
- Valid moves will be highlighted in green.
- Click on a highlighted square to make a move.
- After moving, click on the moved piece to apply the quantum operation.
- Messages at the bottom of the board will provide information about captures and measurements.

Enjoy your game of Quantum Checkers!