

Matchbox Brain

Teach a paper robot to win. Only tell it when it loses.

OBJECTIVE

Play Hexapawn against a robot that starts out knowing nothing. It picks its moves by rolling a die. Whenever it loses, you cross off the last move it made, so it can never make that move again. Nobody tells it why. Score a point every time you beat it. The game ends when the robot wins 4 games in a row (it graduates) or after 30 games.

QUICK START – READ THIS, START PLAYING

- 1 Set up the Play Board: your three pawns on the bottom row, the robot's three on the top row. You move first.
- 2 Pawns move one square straight ahead into an empty square, or one square diagonally ahead to capture. Win by reaching the far row, capturing every enemy pawn, or leaving your opponent with no move.
- 3 Robot's turn: find the tile on the Brain Mat that matches the board. Roll the die to pick one of its moves that isn't crossed off. Play it and write its code in the Learning Log.
- 4 If you win, cross off the robot's last move on the mat. If the robot wins, change nothing. Then play again.

HOW PAWNS MOVE

- 1 The Trainer always moves first. Then take turns.
- 2 A pawn moves one square straight forward into an empty square. It can't capture that way.
- 3 A pawn captures one square diagonally forward. Take the enemy pawn off the board.
- 4 No moving sideways or backward, and no double steps.
- 5 You win when one of your pawns reaches the far row, when you've captured every enemy pawn, or when it's your opponent's turn and they have no legal move.

THE ROBOT'S TURN

- 1 Find the tile that matches the board exactly. Page 1 is the robot's 1st move, page 2 its 2nd, page 3 its 3rd.
- 2 Look only at moves whose box isn't crossed off. If there's just one, play it.
- 3 Otherwise roll the die and count along the live moves in letter order, starting again at the first one, until you reach the number rolled. With four live moves, roll again on a 5 or 6.
- 4 Play that arrow. Write the tile code and letter in the Learning Log, for example 2-07 B.
- 5 If every move on the tile is crossed off, the robot resigns. The Trainer wins.

AFTER EACH GAME

- 1 Trainer wins (or the robot resigns): cross off the last move in this game's row of the Learning Log, on the mat. That's the only way the robot learns.
- 2 Robot wins: change nothing.
- 3 Circle R or T in the Learning Log. The next player becomes Trainer.
- 4 If a 1st-move tile ever has every box crossed off, someone crossed off the wrong move. Erase that tile and keep playing.

HOW TO SCORE

- 1 Beat the robot: +1 point to that game's Trainer.
- 2 The robot graduates after 4 wins in a row. If it hasn't graduated after 30 games, stop there.
- 3 Most points wins. Ties share the win. Everyone signs the robot's diploma on the Learning Log.
- 4 Early games are easy points. Later games are hard ones, and that difference is the whole lesson.

WHAT THE ROBOT TEACHES

- 1 Reward signal: the robot is never told the rules of good play. It's only told when it lost. That's reinforcement learning.
- 2 Mistakes are data: 32 of the 90 moves on the mat lose against a smart Trainer. Every cross-off removes one, for good.
- 3 Exploration: the die makes the robot try moves before it knows which ones work.
- 4 Only what it has seen: tiles that never came up are still untrained. Look at the mat afterward.
- 5 Does it understand Hexapawn? No. It just has fewer bad moves left. Is that thinking?