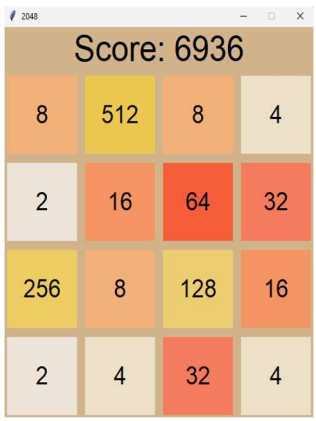
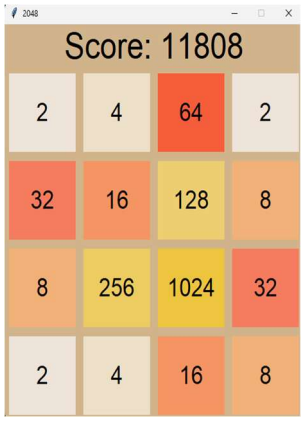
WRITE UP

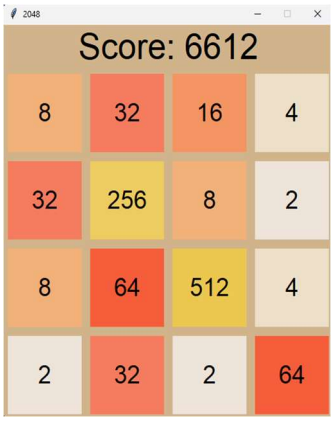
Objective:

Develop a smart 2048 AI agent using Expectimax and heuristics to maximize score and reach high-value tiles efficiently.

MinMax Agent:







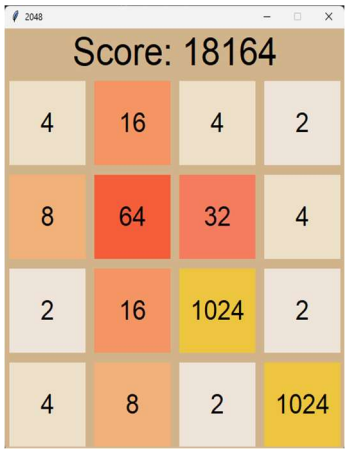
MyAgent(Version 1):

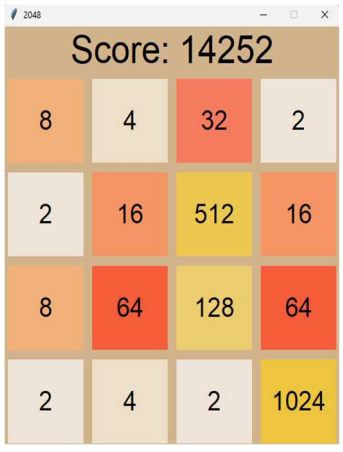
An enhanced version of the MinMax agent, this updated MyAgent uses Expectimax with a refined heuristic focusing on corner anchoring, empty tiles, snake order, and monotonic rows for better 2048 gameplay.

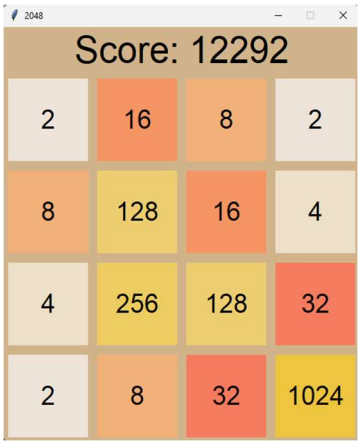
Heuristic improved: From just score to a detailed function considering empty tiles, corner anchoring, snake pattern, monotonicity, and tile disruption.

Move ordering added: Prioritizes moves (D > L > U > R) to help with tile positioning.

minPlayer changed: From minimization to expectimax, using weighted average of outcomes.







MinMax vs MyAgent (v1) Summary:

MyAgent improves MinMax by using Expectimax, adds smart move ordering , and a stronger heuristic focusing on empty tiles, corners, snake pattern, and monotonicity.

Result: Higher scores, better tile control, and more consistent 1024+ tiles.

MyAgent (Version 2):

Adaptive Search Depth

- Old agent used fixed-depth.
- New agent sets depth dynamically: maxDepth = 5 if <4 empty tiles, else 7.

Move Pruning

- Skips moves that don't change the board: if result._board == state._board: continue.

Improved Heuristic Function:

- Empty Tile Bonus: log2(empty_tiles + 1) * 500.
- Anchor Bonus: +8000 if max tile in corner, else -5000.
- Snake Score: Weighted Z-pattern, normalized by max tile.
- Monotonicity: +2000 per monotonic row/column.
- Disruptive Penalty: -10000 for misaligned large tiles.
- Smoothness: Penalizes sharp tile differences.
- Merge Potential: Rewards immediate merges.

Refined Snake Pattern

- Emphasizes top-left stacking in Z-path for better tile control.

Normalized Heuristics

- Snake score scaled by max tile for better generalization.

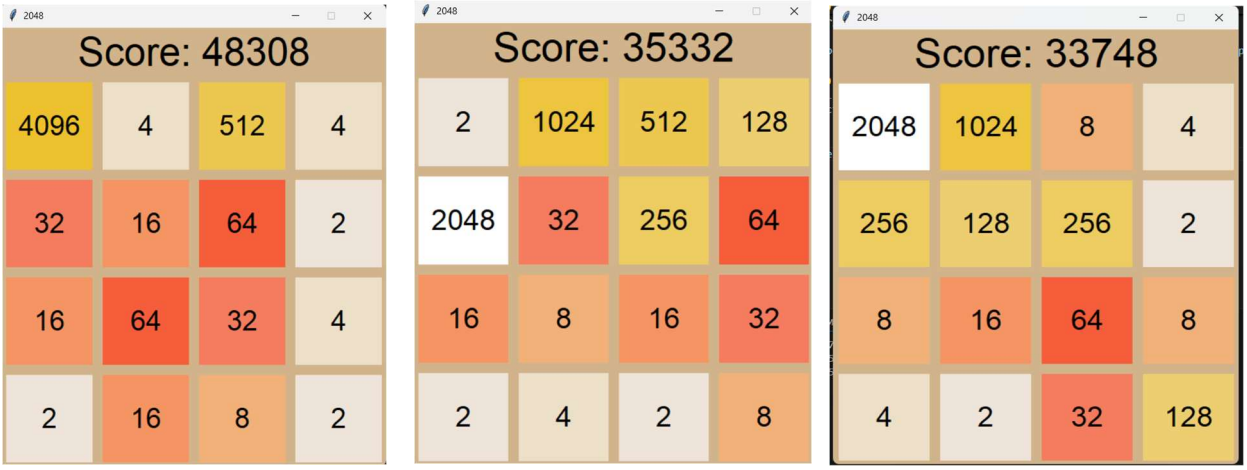
Time-Aware Search

- Exits early if time is low to avoid invalid moves.

Stat Tracking

- Logs average depth and branching factor for tuning.

Observation:



MyAgent(V2) vs MyAgent(V1) vs MinMax Agent:

MyAgent v2 improves upon v1 by introducing adaptive depth search, move pruning, and a more advanced heuristic with smoothness, merge potential, normalized snake score, and disruptive tile penalties, leading to more stable boards.

Result:

MyAgent v2 shows improvement over v1, often reaching 2048 and even 4096 tiles, with much higher scores, sometimes over 48,000. Thanks to smarter pruning, adaptive search depth, and a stronger heuristic, it handles space more efficiently, keeps the board organized, and survives longer. Overall, v2 plays more intelligently and consistently performs better at reaching high-value tiles than Version 1.

Conclusion:

MyAgent v2 outperforms v1 with smarter pruning, adaptive depth, and an improved heuristic. It achieves a median score of around 35,000 and a highest score of 78,308, consistently reaching 2048+ tiles. These results show that v2 is a more reliable and efficient 2048 agent.