

POKER AND MACHINE LEARNING

Applications in game theory

INTRODUCTION

- Michigan State University 2009 – BA Political Science
- Marines – Helicopter pilot almost 10 years
- American University – International Relations and Economics
- Data Scientist



POKER AND GAME THEORY

- Perfect information games – Chess, checkers, tic-tac-toe
- Texas Hold'em is imperfect information
 - No dominant strategy



POKER ENVIRONMENT

- Simplified version of Texas Hold'em
 - Each player gets 2 cards
 - 3 community cards
- Each player makes 2 moves:
 - First is based on their hand cards
 - Second in response to other players' moves
- Possible moves: check/call, raise, or fold
- Winner determined by hand strength

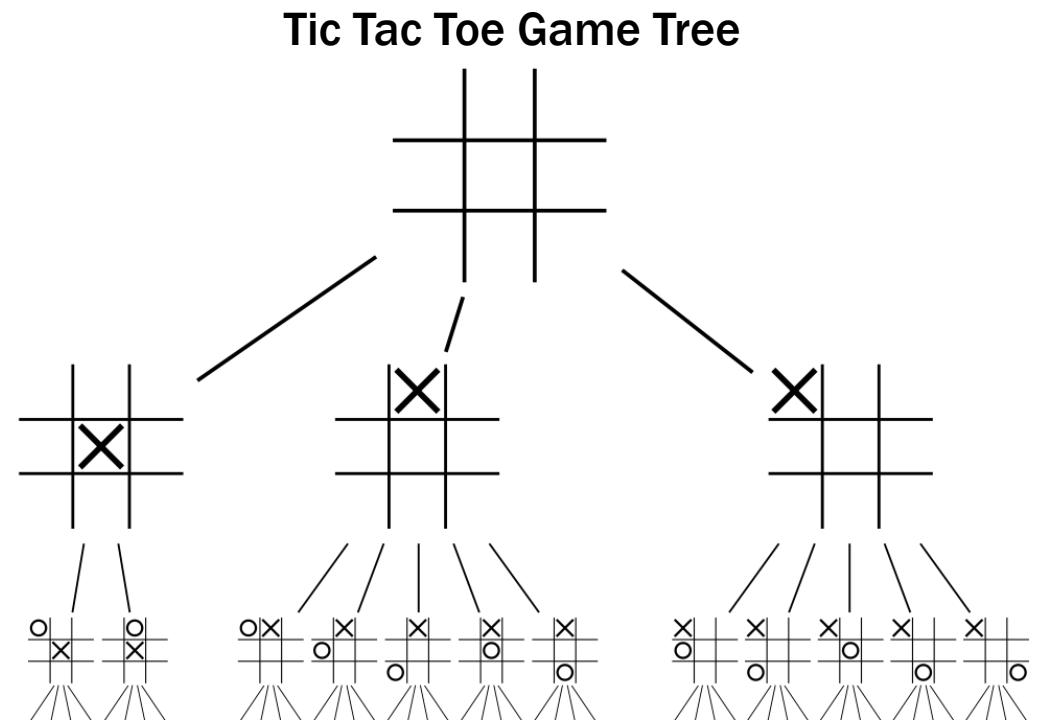


STRATEGY ANALYSIS

- Simulated 3-player games with 10,000 hands:
 - 1 “hawk,” 1 “dove,” and 1 “random” player
 - The ”Hawk” clearly won the 3-player games
- Added complexity – 4 players
 - Duplicated one of the players
 - No clear winner

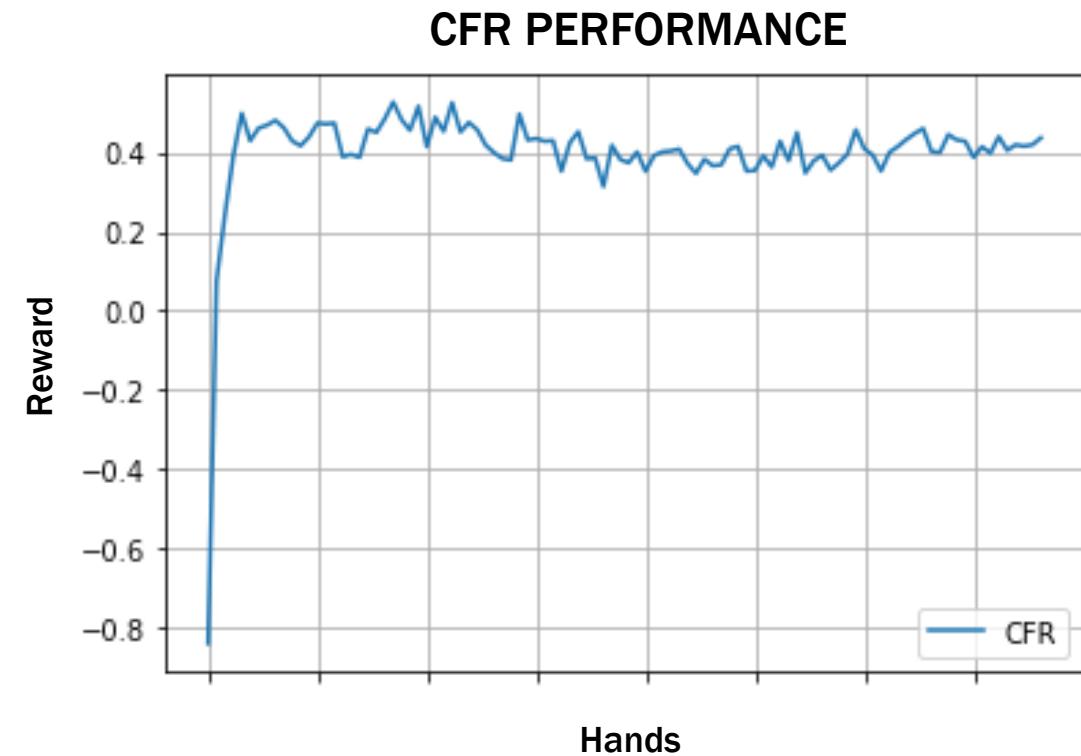
REINFORCEMENT LEARNING

- Deep Counterfactual Regret Minimization (CFR)
 - Starts with game “state”
 - Traverses game tree
 - Determines “reward” – who won
- Minimizes losing



TRAINING CFR AGENT

- Agent trained against other pre-trained agents
- Improved performance over fixed strategies
- Average positive reward per hand
 - Wins more than it loses

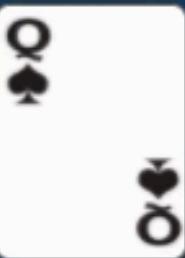




Bet: 1



ID 1



Round: 1



Bet: 2



ID 0



Current Player: 1

Call

Probability 26.28%

Raise

Probability 58.91%

Fold

Probability 14.81%

Check

Illegal

FURTHER APPLICATIONS

- Use real poker hand data from tournaments.
 - Apply LSTM to possibly identify player trends
 - Image recognition to identify “tells” when a player bluffs
- Apply to other real-world imperfect information situations
 - Potentially in international negotiations (business, trade deals, etc.)
- Questions?