AI in Tabletop Games

•••

Team 13
Josh Charnetsky
Zachary Koch
CSE 352 - Professor Anita Wasilewska

Works Cited

- Kurenkov, Andrey. a-Brief-History-of-Game-Ai.png. 18 Apr. 2016, www.andreykurenkov.com/writing/a-brief-history-of-game-ai/
- “A 'Brief' History of Game AI Up To AlphaGo, Part 1.” Andrey Kurenkov's Web World, Apr. 2016, www.andreykurenkov.com/writing/a-brief-history-of-game-ai/.
- Cho, Hwan-gue. "Human Vs. Machine in the Game of Go." Koreana, vol. 30, no. 2, Summer2016, p. 36. EBSCOhost, proxy.library.stonybrook.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=edo&AN=117366011&site=eds-live&scope=site.
- Lien, Tracey. “Artificial Intelligence Has Mastered Board Games; What's the next Test?” The Seattle Times, The Seattle Times Company, 21 Mar. 2016, www.seattletimes.com/business/technology/artificial-intelligence-has-mastered-board-games-whats-the-next-test/.
- Greenemeier, Larry. “20 Years after Deep Blue: How AI Has Advanced Since Conquering Chess.” Scientific American, www.scientificamerican.com/article/20-years-after-deep-blue-how-ai-has-advanced-since-conquering-chess/.
- Wikipedia. “Monte Carlo Tree Search.” Wikipedia, Wikimedia Foundation, 14 Oct. 2017, en.wikipedia.org/wiki/Monte_Carlo_tree_search.

Overview

1. History of AI in Tabletop Games
2. AI in Chess
3. AI in Go
4. Future of AI in tabletop games

Timeline

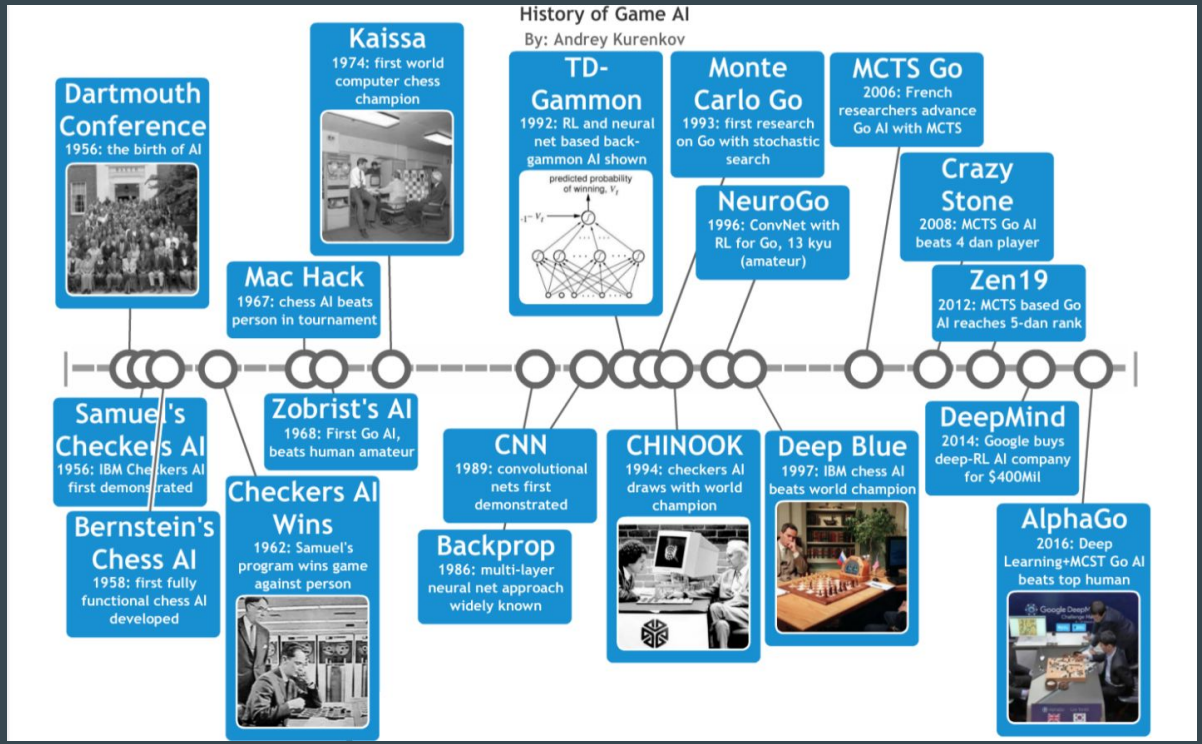


Image source: www.andreykurenkov.com/writing/a-brief-history-of-game-ai/

History

1951 - First chess playing program developed by Alex Turing, before the term AI was used

1956 - Arthur Samuel makes first checkers AI.

1957 - Alex Bernstein makes first chess AI.

1960 - Chess program developed that beats ranked plays in tournament. Go program is able to beat novice players

History

1970’s through 1980’s - The programs improve but the top players still win

1994 - Chinook becomes world champion in checkers

1997 - Deep Blue beats world champion in chess

2006 - Go programs can beat fairly high rated players

2016 - AlphaGo beats world champion Lee Sedol in Go

Minimax

- Developed in 1949 by Claude Shannon
- Works under assumption that opponent plays optimally
- Creates a tree of states then picks a path that leads to the optimal outcome
- Impossible to represent all states to the end of the game
- Not good at punishing mistakes by opponent

Games

Checkers	Chess	Go
8x8 board	8x8 board	19x19 board
10^{20} possible board positions	10^{44} possible board positions	10^{170} possible board positions
40 moves average	60 moves average	200 moves average

Why these games?

Well defined rules

Concise goal

Requires thinking/predicting

Easy to recreate on a computer

All information is present to both players

Chess

- One of the first major goals of AI was to make a program that can win in chess
- Hard to measure AI against human intelligence, so complicated strategy games are one way to compare
- Took around 50 years to get from a program that can beat somebody to a program that can beat everybody

Deep Thought

Developed in 1989 by a team lead by Feng-hsuing Hsu

First chess AI with the ability to challenge grandmaster level players

Used a variety of techniques to calculate moves

More comparisons per second than any other program

How it considers moves

1. Using a database of opening moves
2. Using alpha-beta tree search with evaluation function based on a combination of many handcrafted features
3. Using an endgame database that includes all positions with less than 8 pieces

Evaluation Function

Function that determines what move to make given board position.

Able to search deeper than other chess AI's.

Uses a combination of brute force and selective extension.

Calibrated using a database of games between masters level players.

Still incorporates some encoded knowledge about chess.

Deep Blue

- Deep Thought was able to beat some high level players but the very best.
- Deep Thought 2 began development, later called Deep Blue.
- The same ideas as Deep Thought but much more computational power.
- Uses a custom built supercomputer with 30 processors working with 480 single chip chess search engines allowing 126,000,000 position comparisons per second

Garry Kasparov

Grandmaster level player considered one of the best chess players of all time.

The ultimate test for Deep Blue.

Beat Deep Blue in 1996, but later lost in 1997.

Why Deep Blue was able to win

1. A single chip search engine
2. A massively parallel system with multiple levels of parallelism
3. A strong emphasis on search extensions
4. A complex evaluation function
5. Effective use of a grandmaster game database

Go

- In comparison to chess, Go allows for an incredibly large number of possible moves
- Historically, computer Go players were bad against skilled human players
- AlphaGo, created by a British AI company, beat the Go Champion 4-1
- Moves were wildly different than human strategies
- Humans calculate Go moves at 30/hour while AlphaGo calculates at 1,000,000/hour
- Successful strategies analyzed and added to AlphaGo database

Monte Carlo Tree Search

- Heuristic search algorithm
- Notable implementations: Total War: Rome II, Go, Poker
- Analyzes most promising moves

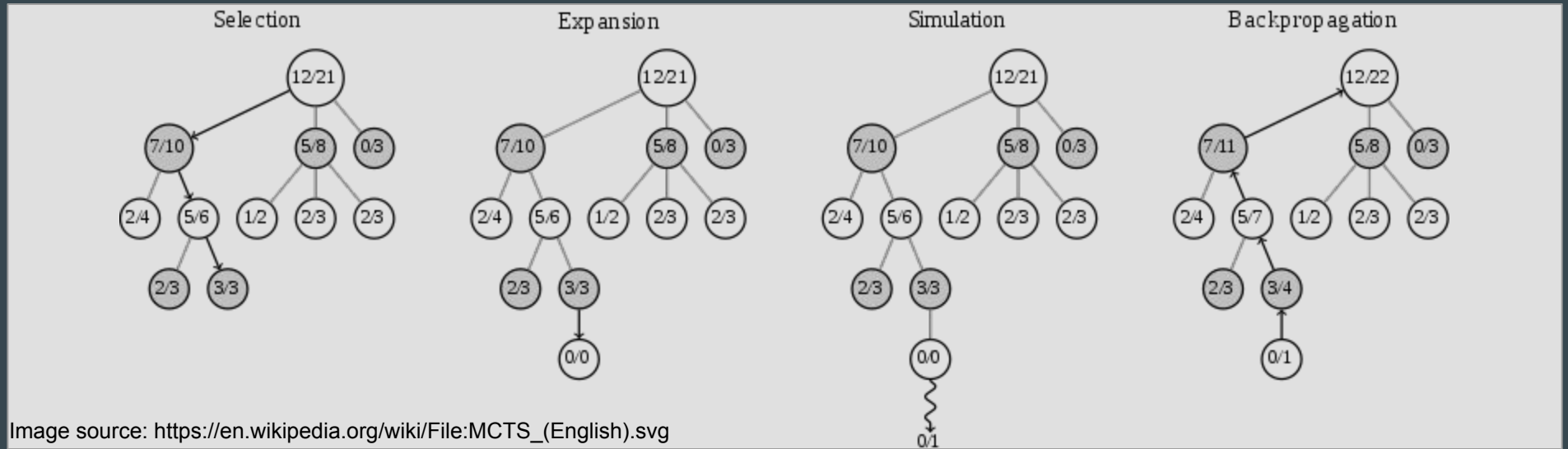
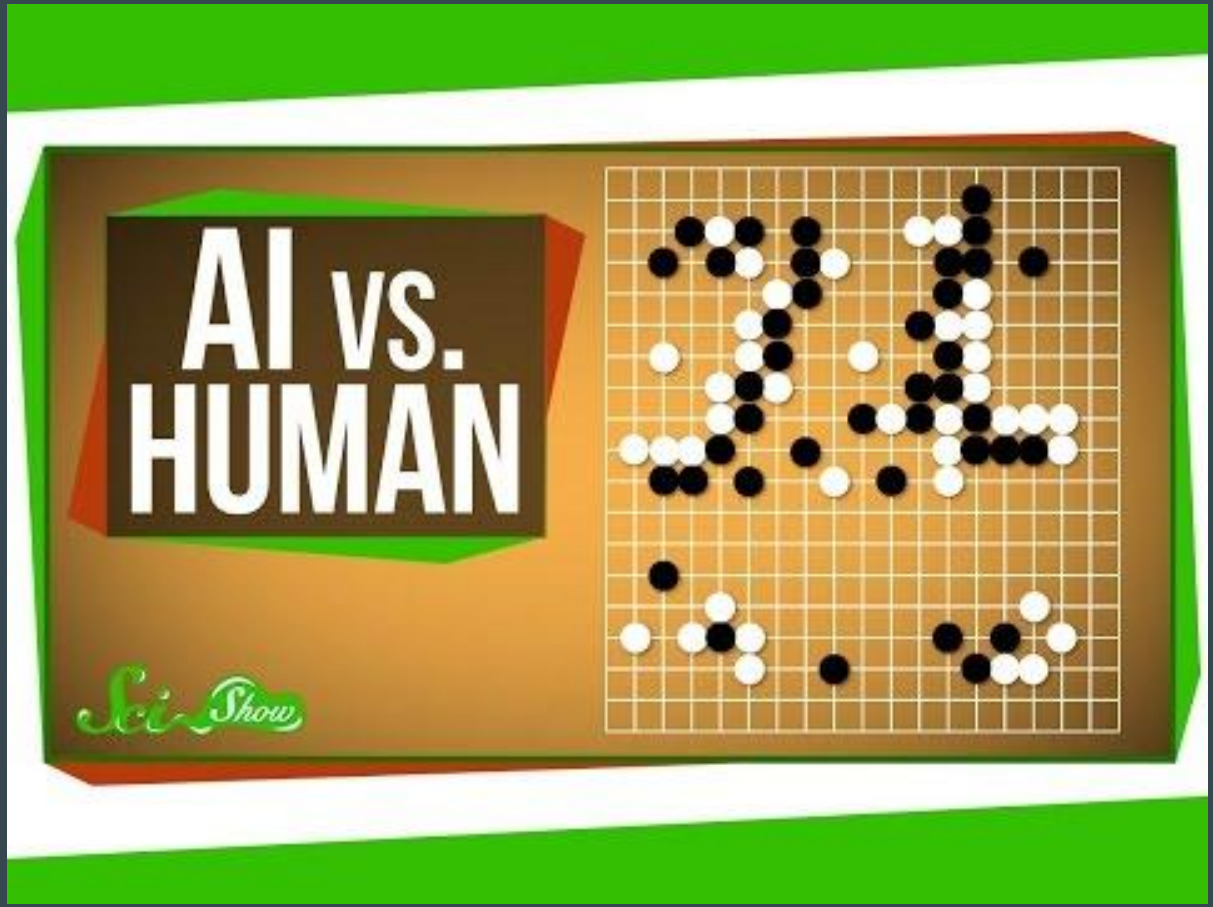


Image source: https://en.wikipedia.org/wiki/File:MCTS_(English).svg

Other Considerations

- Decisions made from past games as well as simulated games against itself
- Set to resign if loss is probable
- Humans typically try to maximize territorial gain while AlphaGo tries to maximize marginal wins


AI vs.
HUMAN
Sci Show

The Future

Board games provide an environment with clear rules and expected results

Other games do not provide the player with all the needed information

Most game-playing AI's specialize in one game

Make AI's that apply knowledge to variety of situations