

Discussion 1: History & Foundation of Artificial Intelligence

Discussion Topic:

Chess strategy has advanced significantly over the years and AI has played a big role in the strategy of the game. Explain the role of computer chess as it relates to AI.

My Post:

Hello Class,

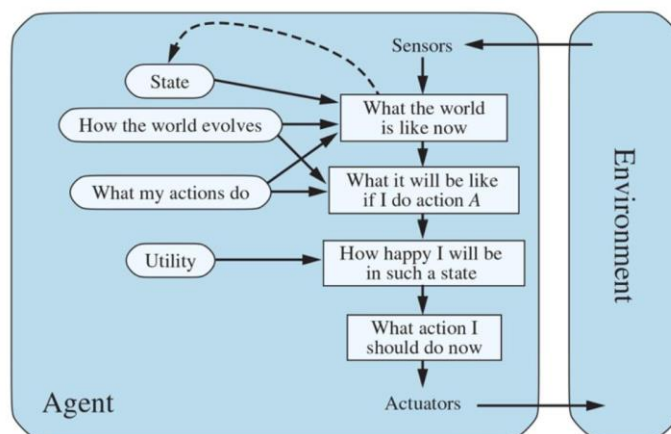
Hello Class,

Artificial Intelligence (AI) and the game of chess have an ongoing relationship that began in 1990s and gained prominence when human chess champions and AI faced each other, notably in 1997 when IBM's Deep Blue defeated chess champion Garry Kasparov, putting AI capabilities into the public spotlight (Martin, 2024). This influenced the evolution of chess strategy over the past few decades by bringing a better understanding of the game (Deverell, 2023). AI is now a tool for game analysis and player training, making chess more popular than ever.

For its part, the game influenced the evolution of AI. The Deep Blue supercomputer was able to evaluate around 200 million chess positions per second, about the capacity to look between 12 to 30 moves ahead, this gave the AI a greater strategic insight than its human counterpart (Cipra, 1996). The Deep Blue supercomputer was an example of good old-fashioned AI which uses heuristic reasoning. In other words, it is an example of symbolic planning AI or narrow AI also called an expert AI which can only play chess and operates based on pre-programmed functions and search algorithms. This AI model can also be defined as a model-based utility-based agent, see Figure 1. A model-based utility-based agent has an internal model of the chess environment and utilizes a utility function(s) to evaluate and choose actions with the goal of winning the game.

Figure 1

Model-based Utility-based Agent

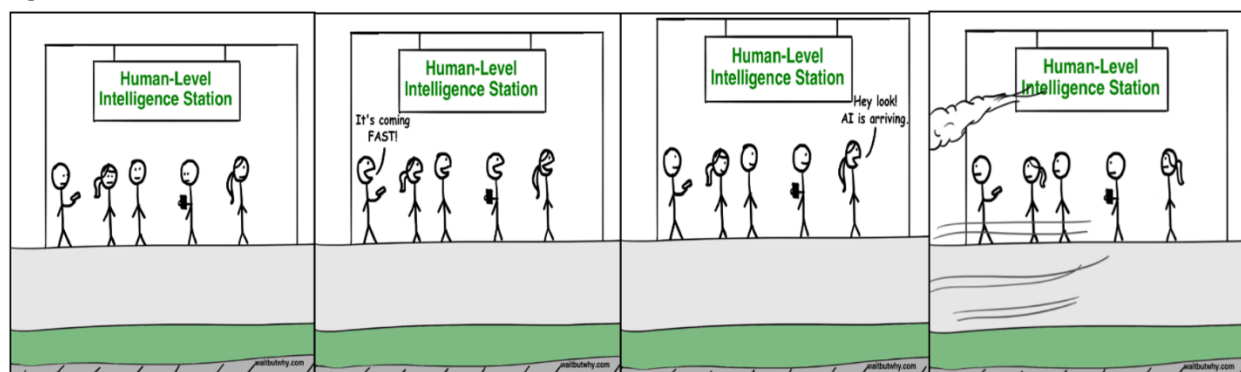


Note: From “2.4 The Structure of Agents. Artificial Intelligence: A Modern Approach” Figure 2.14 by Russell & Norvig (2021, p.55)

More modern AI chess expert models deep neural network use such as Google AlphaZero uses deep neural network model combined with Monte Carlo tree search. A deep neural network is a type of machine learning model that uses an artificial network, a program that tries to mimic the structure of the human brain (Rose, 2023). A machine learning model is a program that learns through supervised, or unsupervised learning or a combination of both. It can be defined as a type of learning agent that improves its performance on a specific task by learning from data, rather than being explicitly programmed with fixed rules (Russell & Norvig, 2021). Google AlphaZero, notably its predecessor AlphaGo, learned to play the game of Go by playing millions of games against itself, using deep neural networks and backpropagation. Backpropagation is a training algorithm used in neural networks that adjusts the weights of the connections between neurons by propagating the error of the output backward through the network. In 2016, AlphaGo beat Lee Sedol Go champion using novel and brilliant moves, such as move 37, “— a move that had a 1 in 10,000 chance of being used. This pivotal and creative move helped AlphaGo win the game and upended centuries of traditional wisdom ” (DeepMind, n.d., p.1). This changes how players play the game of Go and chess, players now study AI-generated strategies and incorporate them into their own gameplay, the expert AIs are now the teachers.

On a side note: Large Language Models such as GPT-4o, o1, Anthropic Claude 3.5 Sonnet 3.5, Gemini 1.5, and Grok 2 are more generalist models with strong language abilities and are not well suited for playing chess and the game of Go. However, based on the Transformers architecture which relies on self-attention, meaning the model weighs the importance of different parts of the input data when making predictions, all that may be needed is scaling in computing power, data, time, and the use of Chain-of-Thought Reasoning for these models to potentially achieve the same levels in chess and Go as the expert AI models. Furthermore, many are predicting that Artificial General Intelligence (AGI), see Figure 2, will be achieved by 2030.

Figure 2



Note: The illustration is a metaphor that depicts the rapid advancement of AI technology, progressing from Artificial Narrow Intelligence (ANI), which is less intelligent than human-level intelligence, to Artificial General Intelligence (AGI), which is equivalent to human-level intelligence, and to Artificial Super-Intelligence (ASI), which surpasses human intelligence. From “The AI revolution: The road to superintelligence Part-2”, by Urban, 2015.

To summarize, AI's relationship with chess has transformed the game itself and made the game more popular than ever, but it has also contributed significantly to the advancement of AI technologies. Deep Blue and more modern models like AlphaZero are the children of this relationship. Moreover, as AI continues to evolve, there is potential for even generalist models, like large language models combined with scaling in computing power, data, time, and the use of Chain-of-Thought Reasoning, to reach the same level of strategic thinking as expert AI not only in strategic games such as chess but also in other fields such as advanced physics and mathematics, potentially surpassing human abilities, if it is not already the case, ultimately opening the door to AGI and subsequently to ASI.

-Alex

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