



Israel National Defense College
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**Strategy - From Theory to Practice: Strategic
Thought and Strategic System**

A challenge at the game of GO, the strategic interaction
between a human player and Artificial Intelligence: the
Lee Sedol-AlphaGo Challenge.

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Introduction

“Go is one of the easiest games to learn but it has an endless array of strategic and tactical possibilities. It has been described as being like four chess games going on together on the same board.” - The Big Book of Rules - 2005

Between the 9th and 15th of March 2016 a unique event took place in Seoul, South Korea. A human player, the 18 time Go world champion Lee Sedol, and AlphaGo, an Artificial Intelligence (AI) computer based on the Google DeepMind AI project, played a five game challenge. AlphaGo won all games but one. The Go world was shocked and viewed AlphaGo's victory as a profound milestone for humanity.

Go is a strategy game in which players take turns placing black and white stones on a 19-by-19 board, with the aim to surround more territory than the opponent. There are more possible Go positions than there are atoms in the observable universe, which means that trying to analyze all interesting sequences of future moves rapidly gets hopeless, even for a computer. Players therefore rely heavily on subconscious intuition to complement their conscious reasoning, with experts developing an almost uncanny feel for which positions are strong and which are weak. Because of its intuitive and creative aspects, Go is viewed more as an art form than just a game. Invented in China over 2500 years ago, it was considered one of the four “essential arts” together with painting, calligraphy and qin music.

It was widely expected that human Go players would be dethroned by machines at some point, as it happened for the game of chess two decades ago. However, most experts predicted that it would take at least another decade. The challenge showed that predictions on AI evolution are difficult and that the future will hold many surprises in the field.

The AI player

AlphaGo is a DeepMind AI system that uses what is called *deep reinforcement learning*. The software learns through routines that provide a positive reward when an outcome is maximized, increasing its tendency to do something again and vice versa. The AI is assigned a goal to achieve and learns to get better and better at achieving it. AlphaGo was provided with a massive database of Go positions from human play and then left playing a clone of itself developing new databases and self-training its *deep neural network* to predict from each position the probability that would ultimately win. Essentially, AlphaGo taught itself the game.

Game 2, Move 37

During the games the AI showed a combination of intuition and logic that gave birth to powerful and creative moves. The normal wisdom, coming from thousand of years of human experience, calls for playing on the third or fourth line from an edge early in the game. With move 37 of the second game, AlphaGo defied every unwritten Go rule by playing on the fifth line.¹ The move proved crucial about 50 moves later,



while the players were fighting in another area of the board, and allowed the AI achieve its second victory in the challenge.

¹ Even the commentators of the live game thought that the move had been displayed on the table by mistake: <https://www.youtube.com/watch?v=HT-UZkiOLv8>

Intelligence Surprise, Relevancy Gap/Strategic Offset (drift)

“Based on its level seen...I think I will win the game by a near landslide.”

- Lee Sedol, October 2015

Lee Sedol was taken completely by surprise by the way the AI played the game. He knew that AlphaGo had played in the past and won, although against lower ranked players, both amateur and professional, and on a smaller board, nevertheless he failed to understand the implications.

The data and information were there, but they were not analyzed effectively. In the end, the model of reality that the human player used before the game, and on which he molded his strategy, had drifted away, becoming inaccurate, and led to failure (strategic offset), not enabling him to anticipate the opponent’s behavior (Figure 1).

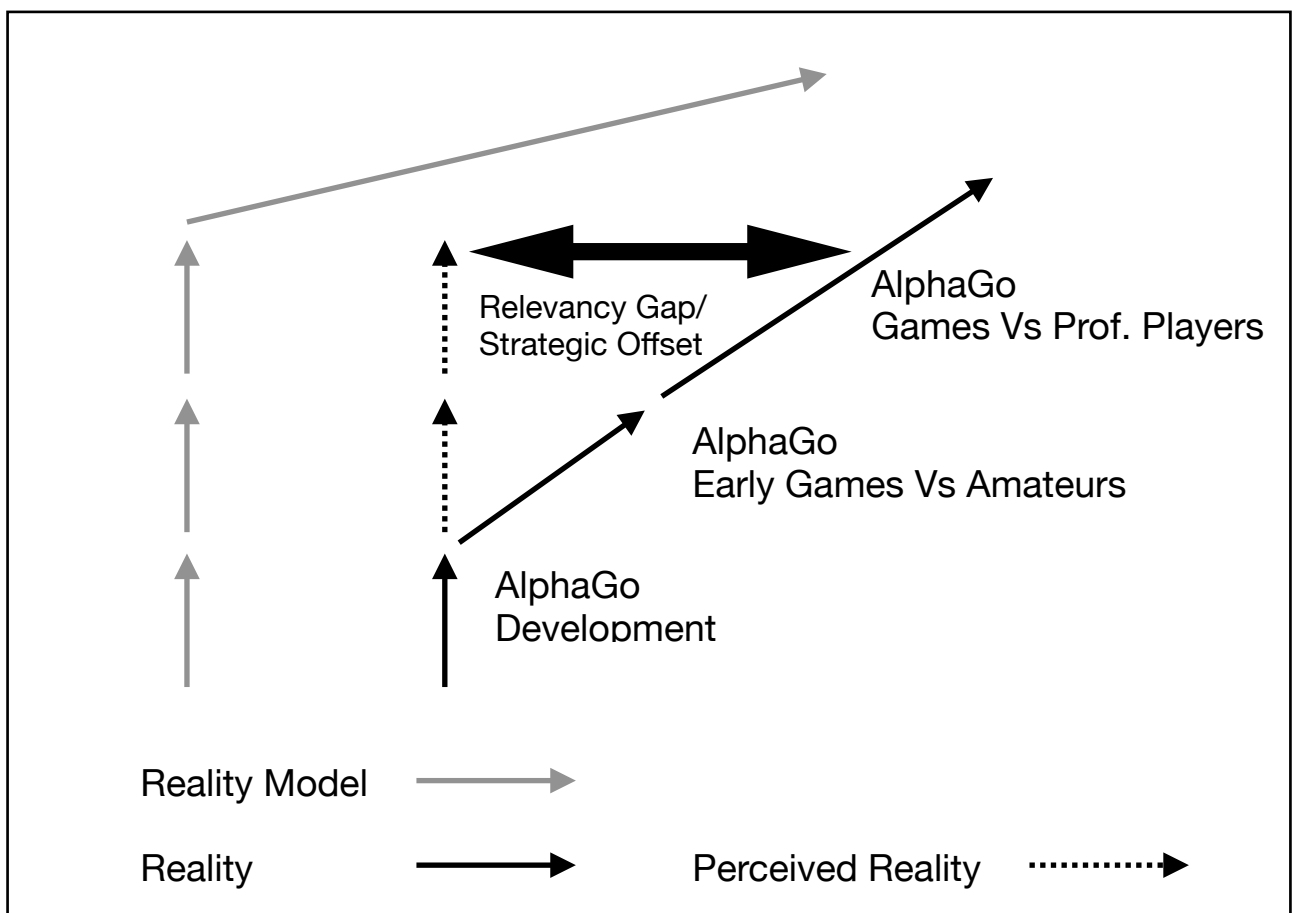


Figure 1 - Relevancy Gap/Strategic Offset

Innovation: Anticipation Vs Adaptation

“AlphaGo’s play makes us feel more free and no move is impossible to play anymore. Now everyone is trying to play in a style that hasn’t been tried before.”

- Zhou Ruiyang, 9 Dan Professional, Go World Champion

The AI, to put it very simply, innovated. “Move 37” was not present in any of the databases from which AlphaGo learned the game and any Go teacher would say that such a crude move cannot possibly be good, and would criticize any student who played it. But AlphaGo does not worry about other people's opinions. Free of biases and preconceptions, the AI did not care about strategy scholars and theorists and acted creating an innovation, seeing a new approach and exploiting it, which ultimately led to victory.

The human player lost the initiative and never regained it, probably shocked by the move. He did not recognize the dangers of an adversary’s innovation, and failed to adapt. Move 37 was not a decisive move, the game was still open at that point, but Lee Sedol did not adjust and, overwhelmed by the unknown, eventually succumbed.

Systemic Thinking, Critical Thinking

AlphaGo showed an extreme capability to do systemic thinking, being able to consider all stones on the board at once, showing a judgment rich in subtlety and precision. Its greatest strength is not any specific move or sequence, but rather the unique perspective that brings to every game. AlphaGo's strategy express flexibility and open-mindedness, which, together with a distinct lack of preconceptions allows it to discover counterintuitive but powerful moves, These abilities allow AlphaGo to convert local regions of influence into coordinated global advantages. Go players

usually do not consider moves which pay a definite price for uncertain profit, but AlphaGo combines a unique sense of risk and reward that make such moves possible. On the other hand, Lee Sedol did not exhibit the capability to critically re-think his approach to the game in the presence of such a sophisticated opponent. The main objective of Critical Thinking should be directed at one's self-certainties, in order to become aware of one's own shortfalls to then try to address them. In this case though, the human player showed no change in its strategic, operational, and tactical patterns. Not capable of "doubting" himself, it became impossible for him to realize that he was progressing on a path that led him to an unavoidable crashing debacle.

"The Architect's Parable" - The Idea of the Middle, Operational Level and Operation

Let's suppose that the programmers of the AI are an like "entrepreneur" providing vision to a "contractor" by stating an end state or final goal, such as "win the challenge Vs Lee Sedol"; then AlphaGo might be considered like the "architect" connecting the entrepreneur to the contractor:

- the programmers/entrepreneur provided a clear strategic objective: win the game;
- based on the strategic objective, and within the provided restraints and constraints represented by the rules of the game, the AI/architect/man in the middle had the freedom to formulate its own operational objectives: achieve territorial superiority;
- the AI/contractor then chose accordingly the tactical steps to achieve it: every single move on the board.

AlphaGo showed the rare ability to effectively link the different levels, from the entrepreneur to the contractor, in order to realize the full potential embodied in the vision.

Deterrence by Punishment

“Even if I become number one, there is an entity that cannot be defeated”

- Lee Sedol - November 2019

Lee Sedol has announced on 29 November 2019 that he is to retire from playing Go professionally, stating that he can no longer hope to become number one due to competition from artificial intelligence.

His decision shows an effective deterrence by punishment is now in force. The human player has the reasonable expectation to pay a higher cost, in terms of personal reputation, than the possible benefits he might gain by further playing against AlphaGo.

Strategic Culture

“AlphaGo's playing style strongly favors greater probability of winning by fewer points over lesser probability of winning by more points. Its strategy of maximizing its probability of winning is distinct from what human players tend to do which is to maximize territorial gains, and explains some of its odd-looking moves.”

- Toby Manning - Match Referee

Is it possible to apply the concept of Strategic Culture to an AI system? One definition for Strategic Culture is “...sum total of ideals, conditional emotional responses, and patterns of habitual behavior that members of the national strategic community have acquired through instruction or imitation and share with each other with regard to [...] strategy”.² Well, if the key words in this definitions are *patterns of habitual behavior, instruction and imitation* than AlphaGo definitely possesses its own, characteristic, Strategic Culture. While humans developed their behavioral

² J. L. Snyder, *The Soviet Strategic Culture: Implications for Limited Nuclear Operations*, RAND 1977

patterns in the course of the millennia through practice, studying, and learning, AlphaGo did it in a few days by running millions of simulations. And it was thanks to this culture, which proved to be superior to the one of the human player, that the AI was capable to gain the strategic advantages that brought to its victory.

Conclusions

The theory of Strategic Thought and Strategic Thinking today is no longer limited to humans players. Concepts such as Deterrence, Systemic Thinking, Strategic Culture, Anticipation vs. Adaptation, and others can effectively be applied to AI systems.

The common assumption is that AI might one day be as “intelligent” as humans, but the reality is that AI is already “more clever” than humans in many fields and that most likely there is no limit to what AI will be capable of in the future.³

The challenge at the game of Go with Lee Sedol provided a glimpse into the capabilities of AI systems, and because Go is the ultimate strategy game, AI now can become a challenge, or help, to the best human strategists in many fields like investment strategy, political strategy and military strategy.

³ Let us just imagine what can happen when AI systems are used to improve AI itself.

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