**Kōan 3:Machine Reasoning  
based on Deep Learning**

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**2020.1.8**

**Abstract**

Machine Reasoning is a kind of actions that learn from available knowledge base and data, try to make conclusions through typical logic method like deduction and induction. Machine Reasoning can be based on symbolic rules or connectionism like neural networks, which is highly developed in rent years. Through the research about rule-based AI Deep Blue and deep learning AI AlphaGo Zero, we can see the two different method to gain knowledge and make reasoning conclusion. Killer applications for Machine Reasoning is coming out with the development of AI and 5G technique, it have potentials and limitations as well.

**What is Machine Reasoning?**

From Wikipedia, Machine Reasoning is a method to generates conclusions from available knowledge using logical techniques such as deduction and induction. Also in another article wrote by Zayan Guedim, Reasoning Machines train on and learn from available data, like Machine Learning systems, but tackle new problems with a deductive and inductive reasoning approach. In our point of view, Machine Reasoning is a kind of actions that learn from available knowledge base and data, try to make conclusions through typical logic method like deduction and induction.

**Difference between Machine Reasoning and Machine Learning**

Machine Learning has its Limit. Machine Learning focus on pre-determined problem and a set of input and expected outputs, if you don’t have many "correct" answers for your problem, Machine Learning is not the best choice. Machine Learning is widely used in knowledge gaining area such as image recognition. On the other hand, Machine Reasoning is useful when we only have limited data or data are highly volatile(不稳定的) so Machine Learning is not reliable. Machine Reasoning try to find the connection between facts, observations and result. Machine Learning focus on solving problems base on the knowledge base, and nowadays we use deep learning as a method to gain this knowledge base.

**From Deep Blue to AlphaGo Zero**

Deep Blue was a chess-playing computer developed by IBM. It is known for being the first computer chess-playing system to win both a chess game and a chess match against a reigning world champion under regular time controls. Deep Blue use traditional search algorithm: alpha-beta search to search for 6-20 moves while playing chess. The whole system is based on evaluation function which includes initialized from and to-be-determined parameters which are determined through thousands of human gameplay. Deep Blue is one of those typical “Good Old-Fashioned Artificial Intelligence”.

AlphaGo is a computer program that plays the board game Go. It was developed by DeepMind Technologies which was later acquired by Google. AlphaGo had three far more powerful successors, called AlphaGo Master, AlphaGo Zero and AlphaZero. AlphaGo and its successors use Monte Carlo tree search and Deep Learning as the key algorithm. With a random heuristic search, AlphaGo don’t need an evaluation search. AlphaGo use neural network to learn over 30 million human gameplay and AlphaGo zero start only with basic rules of go and with no human data. AlphaGo Zero plays 100:0 AlphaGo which proved it’s better.

Deep Blue and AlphaGo Zero shows two different method to implement Machine Reasoning: rule-based method and Machine Learning method. While Machine Learning is more popular in nowadays applications, our human reasoning is actually in the middle.

**Challenging problems for embodied reasoning**

Embodied reasoning is one important aera of Machine Reasoning, but there’re still many challenging. For example, how to distinguish useful information and the environment? The real world is full of random information and many of them are useless for the Machine Reasoning system, it is hard to design an algorithm to distinguish them. It is also difficult to choose the reasoning method base on content, or show the reasoning result because using robot to simulate human is still in development.

**Potentials and Limitations of Machine Reasoning killer application**

In marketing terminology, a killer application is any computer program that is so necessary or desirable that it proves the core value of some larger technology. In other words, consumers would buy the hardware just to run that application. In Machine Reasoning area, with the development of AI and 5G technique, we believed Autonomous vehicles, robots that really speak and learn like human, Express robots and Scientific analysis will be the killer application.

But there’re also many limitations for these killer applications. First is the hardware limit, killer apps are more likely to run on personal devices such as cellphones, smart watches, vehicle media devices. An important problem is to implement Machine Reasoning with few hardware. Second is sensor limit, Machine Reasoning in real world can’t be omniscient, there’re already few accidents happened on autonomous vehicles. It is hard to receive all the information needed to do reasoning. Third is machine limit, Machine Reasoning is running on machines, we’re now not able to figure out how human think by brain and how machine learning works. In order to solve these problems, we still need the development of not only AI and algorithm area, but also material and electronic filed as well.

**Personal contribution**