Toward Self-Aware Machines: Insights of causal reasoning in artificial intelligence

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Topics

- Current issues in AI
- Introduction on causal reasoning
- Current issues in AI
- Conclusion and Future Work

Introduction on causal reasoning

- **Causal reasoning** is the process of identifying causality: the relationship between a cause and its effect

Types of causal reasoning include:

- **Deductive reasoning** starts with the assertion of a general rule and proceeds from there to a guaranteed specific conclusion.

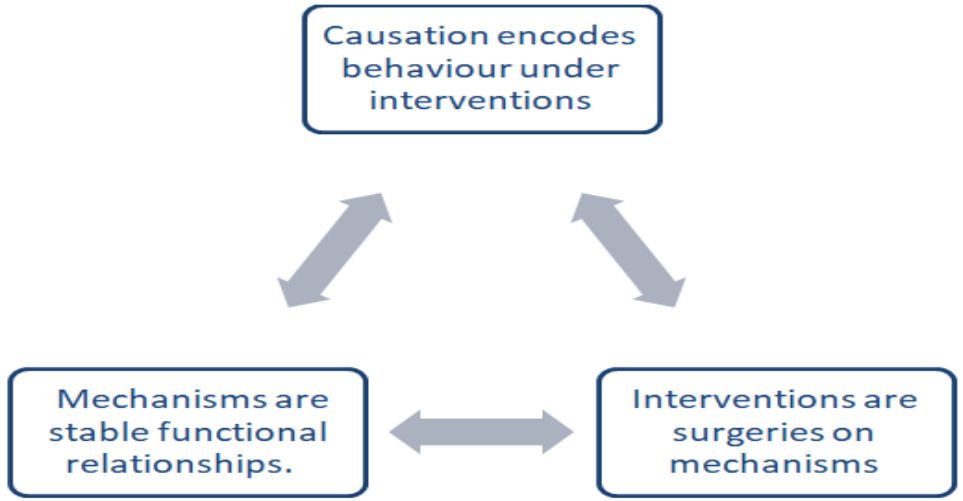
- **Inductive reasoning** is an inference made with uncertainty; the conclusion is likely, but not guaranteed. Induction can be used to speculate about causality

- **Abductive reasoning**, the premises do not guarantee a conclusion. Abduction moves from data description to a hypothesis without a necessary relationship between cause and effect.

Introduction on causal reasoning-cont.

The Causal hierarchy:

- Association (Seeing)- What is?
- Intervention (Doing, Intervening) -What if?
- Counterfactuals (Imaging, Retrospection) –Why?



Principles of Pearl's casual meta-model

Current issues in AI

- There are still limitation of Deep Learning Model.
  - It's a black box.
  - Detect cause and effect to answer different counterfactual questions
- Learn from the user in order to accomplish complex tasks
- Its is very expensive
- Lack of technical knowledge
- Rare and Expensive workforce
- Data acquisition and storage
- Legal/Ethical/Cultural/Social Challenges

Causal reasoning in AI

There are two main approaches to causal reasoning in AI:

- **Rubin Causal Model** (**RCM**) represents an approach to the statistical analysis of cause and effect based on the idea of potential outcomes
- Causal graph models - commonly referred to **Structural Causal Models** (**SCM**) enables us to infer causality using graphs
  - Causation encodes behaviour under interventions
  - Interventions are surgeries on mechanisms
  - Mechanisms are stable functional relationships

Causal reasoning in AI- cont.

- The mathematical tools should be developed in order that AI must undertake and adopt to shift from traditional statistical analysis to causal analysis of multivariate.
- Cause and effect reasoning provides an important approach to advancing our understanding of consciousness and shows an achievable path to ultimately developing a conscious machine
- Applications of Causal AI techniques can enable AI systems to move beyond correlation in order to identify the precise relationships between causes and effects

Conclusion and Future Work

- Causal reasoning provides an important approach to advancing our understanding of artificial consciousness
- Causal reasoning is an indispensable component toward achieving human-level machine intelligence
- Given the strategic importance and widespread, AI usage entails a number of potential risks such as intrusions in our privacy, widening socio-economic inequality, lack of transparency, pressure on the labor market etc.
- Ethical, legal, and social aspects should be taken into consideration to build AI systems of the future.
- Causal inference techniques are used in order to enable AI agents with the ability of identifying underlying web of causes of a behaviour/event and highlight critical insights that predictive models fail to provide.
- It is important to implement causal reasoning in AI systems in order to achieve in the future, a truly intelligent machine.
- Extensive research is needed in the future to validate and evaluate different causal tools for supporting causal reasoning in AI
- Potential optimisation can be reached using different mathematical transformations of the algorithms