ON CAUSAL AND ANTICAUSAL LEARNING

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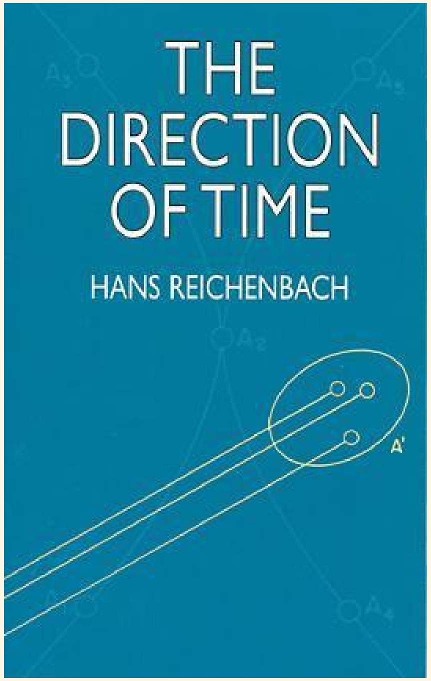
TEST OF TIME HONORABLE MENTION: ICML 2022

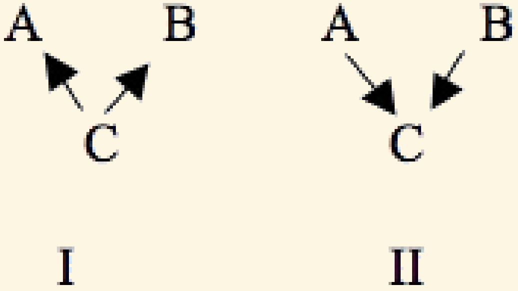
Reichenbach H. The direction of time. Univ of California Press; 1956.

THE DIRECTION OF TIME

hans Reichenbach (1891 - 1953)



1956



The Principle of the Common Cause states that if two events or variables A and B are correlated (i.e., associated), there must be a common cause that explains this correlation.

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STATISTICAL VS CAUSAL POINT OF VIEW

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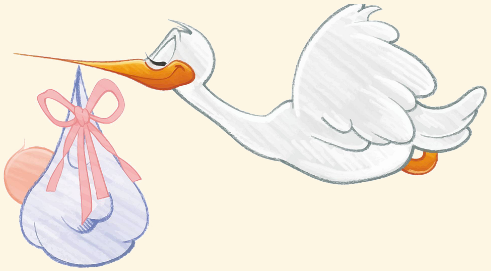

Storks deliver babies: *Highly statistically significant correlation ($p = 0.008$) exists between stork populations and human birth rates across Europe*

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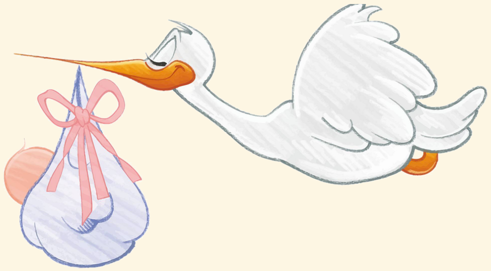

London taxi drivers: *A survey has pointed out a positive and significant correlation between the number of accidents and wearing coats. They concluded that coats could hinder movements of drivers and be the cause of accidents. A new law was prepared to prohibit drivers from wearing coats when driving.*

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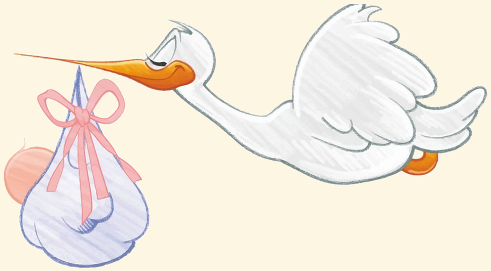

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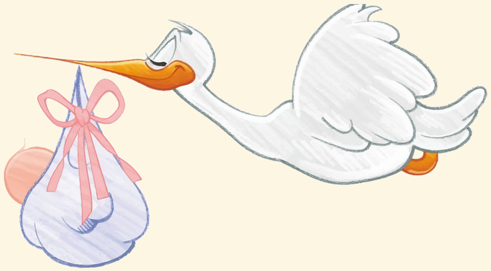

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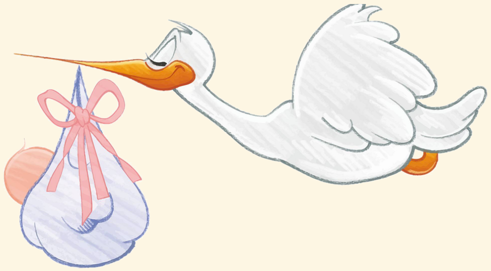

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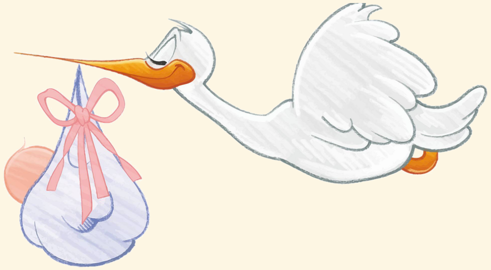

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Causal view takes interest in interventional questions

- Will increasing the number of storks in a country boost its human birth rate?
- Would fewer people smoke if cigarettes were more socially stigmatized?

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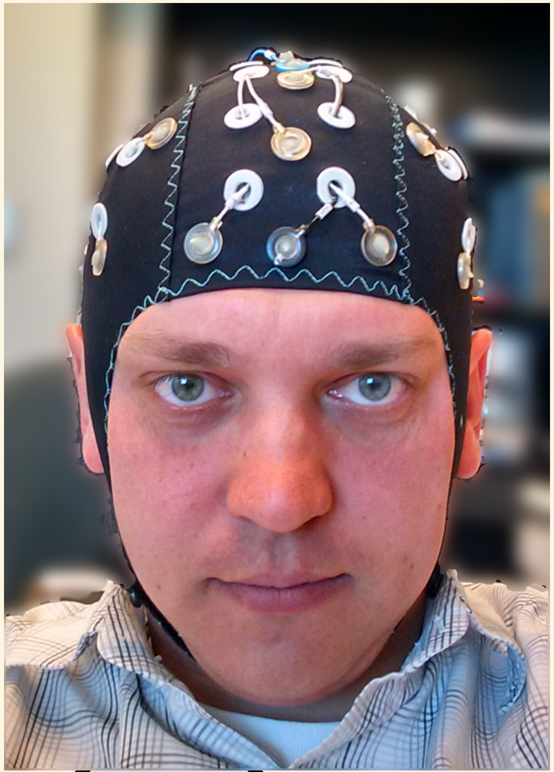

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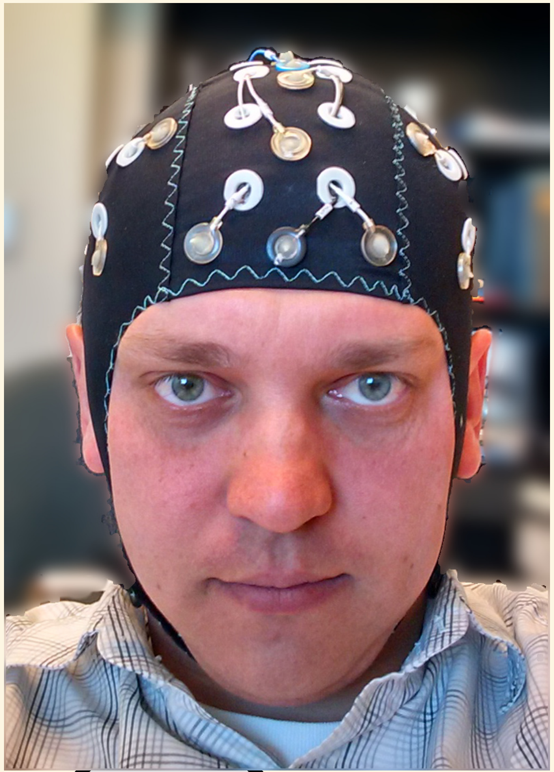

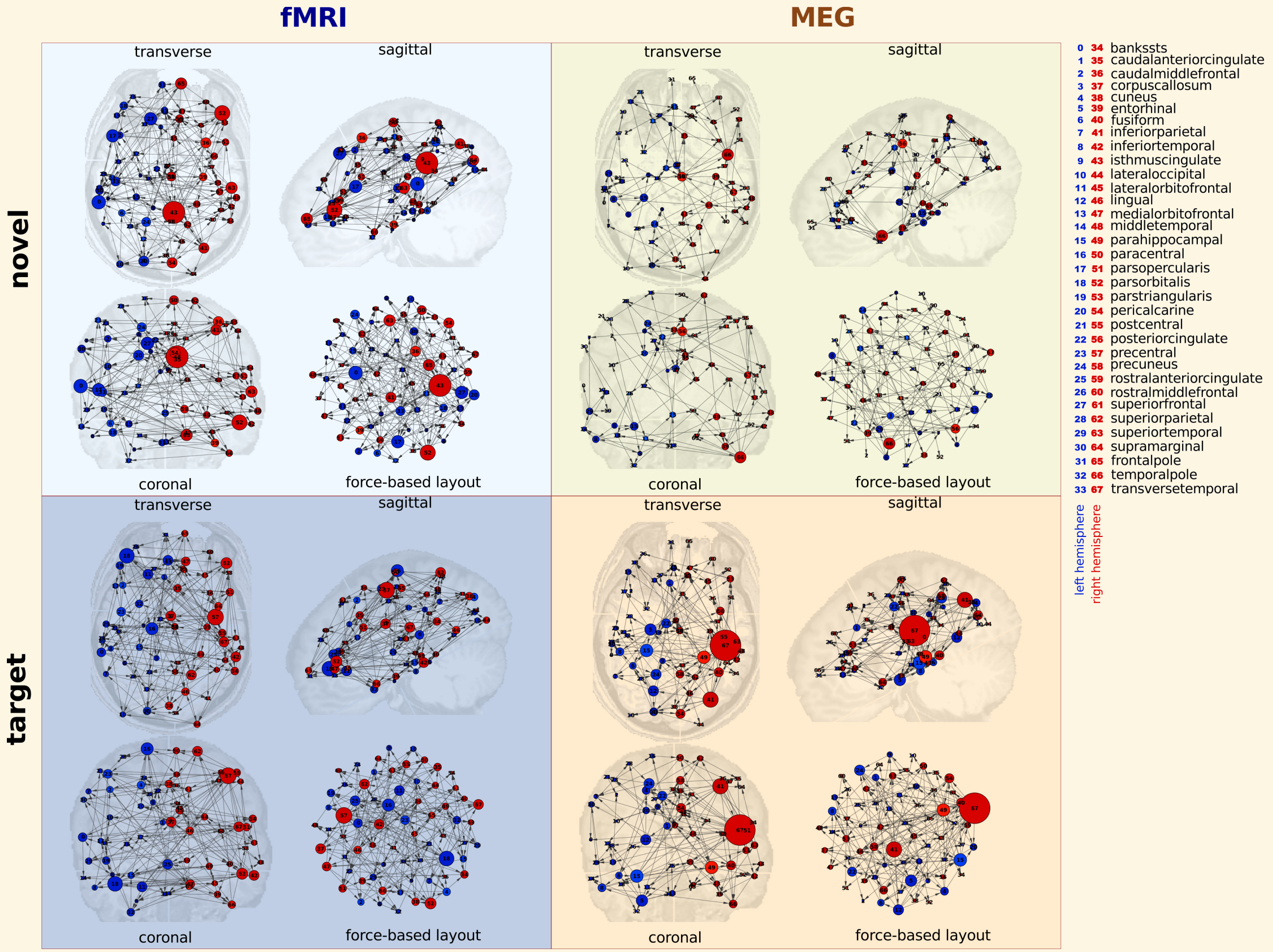

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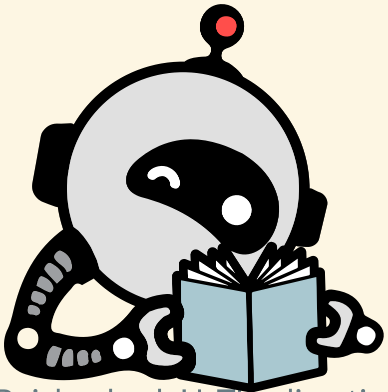

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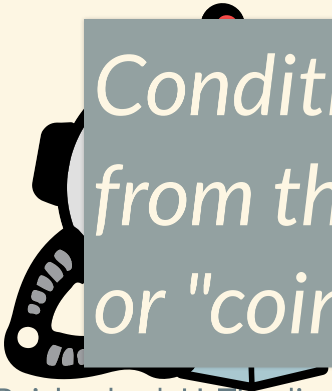

> *Conditional independencies in the data result only from the underlying causal structure (no "fine-tuning" or "coincidental cancellations").*

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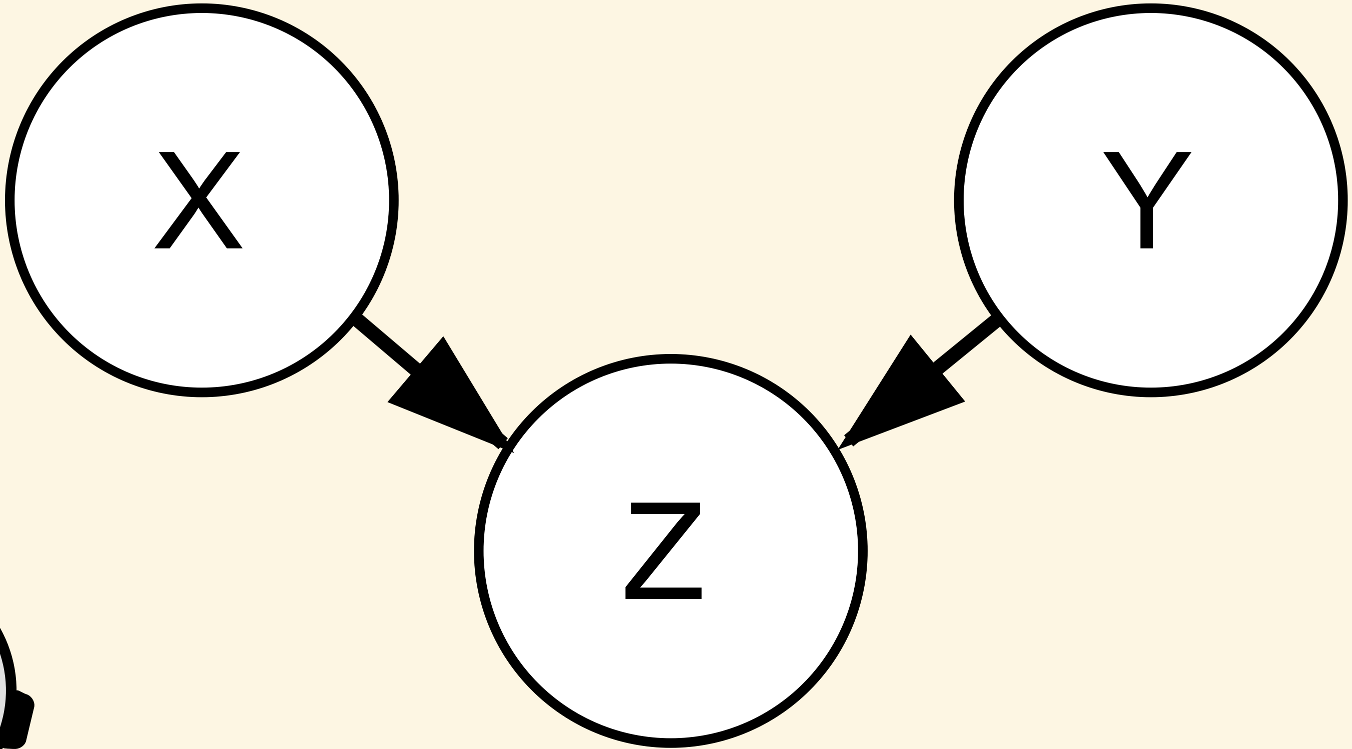
THE COLLIDER



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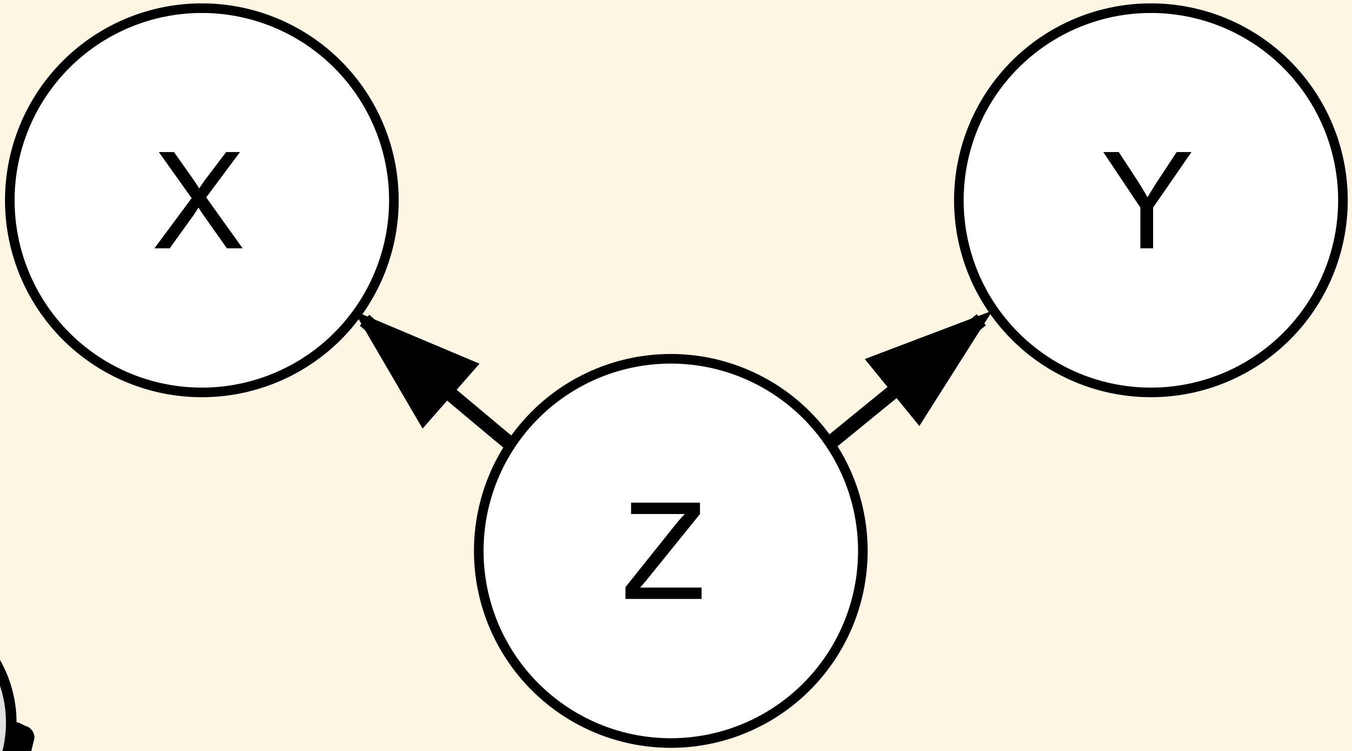
THE COMMON CAUSE



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CAN BE RESOLVED BASED ON INDEPENDENCE TESTS

$$X \perp\!\!\!\perp Y$$
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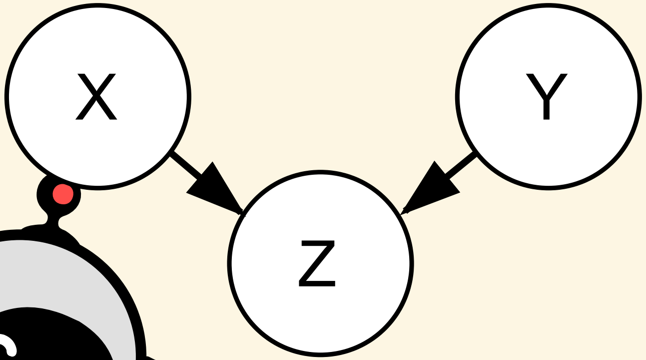

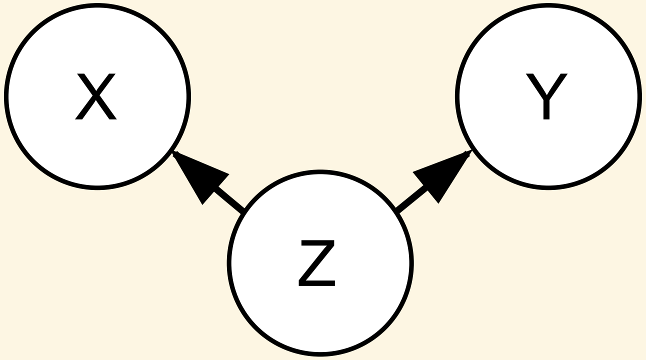

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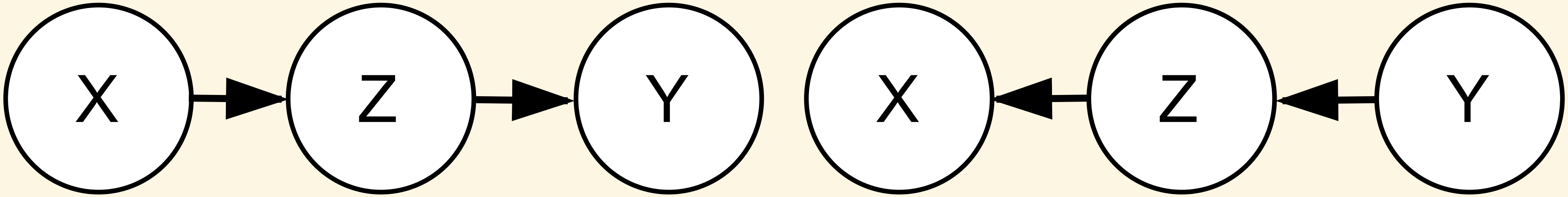

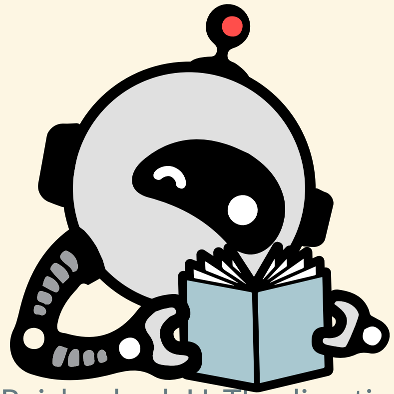

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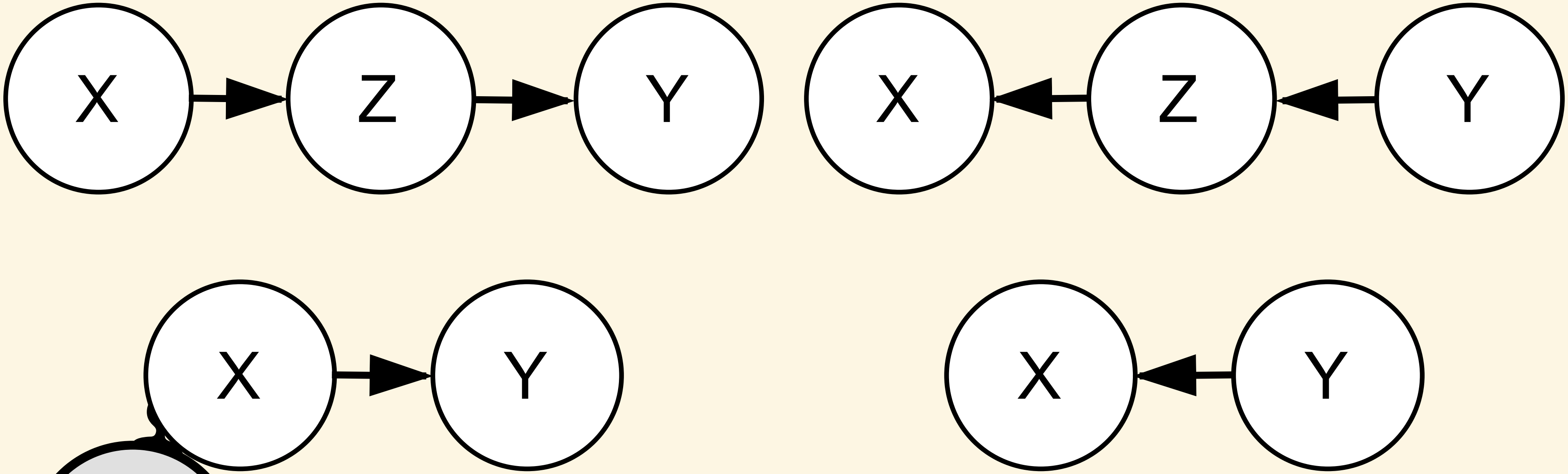

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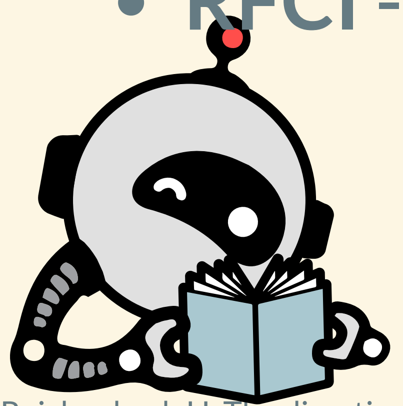
TEST-BASED CAUSAL DISCOVERY ALGORITHMS

- **PC** algorithm (**P**eter Spirtes and **C**lark Glymour)
- **FCI** - Fast Causal Inference
- **TPDA** - Three-Phase Dependency Analysis
- **RFCI** - Really Fast Causal Inference



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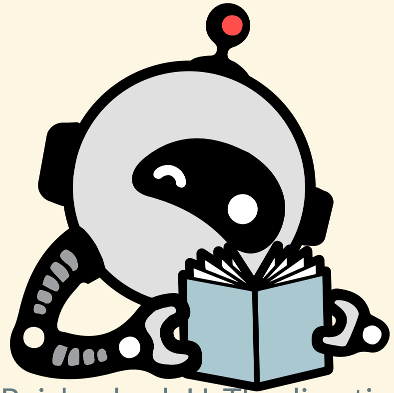

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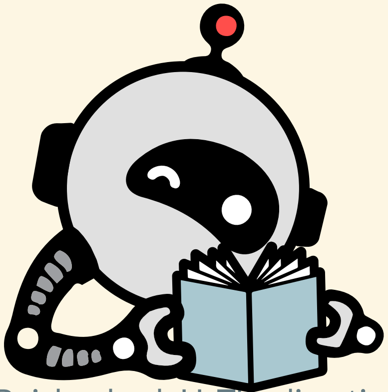

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- The underlying causal structure is important for successful machine learning applications.

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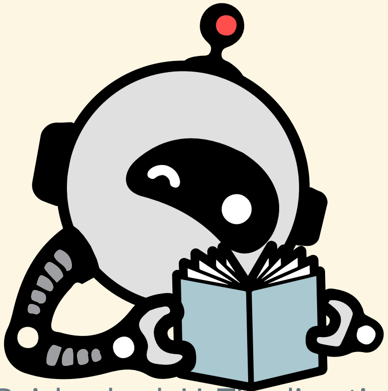

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