Identification of Conditional Causal Effects under Markov Equivalence

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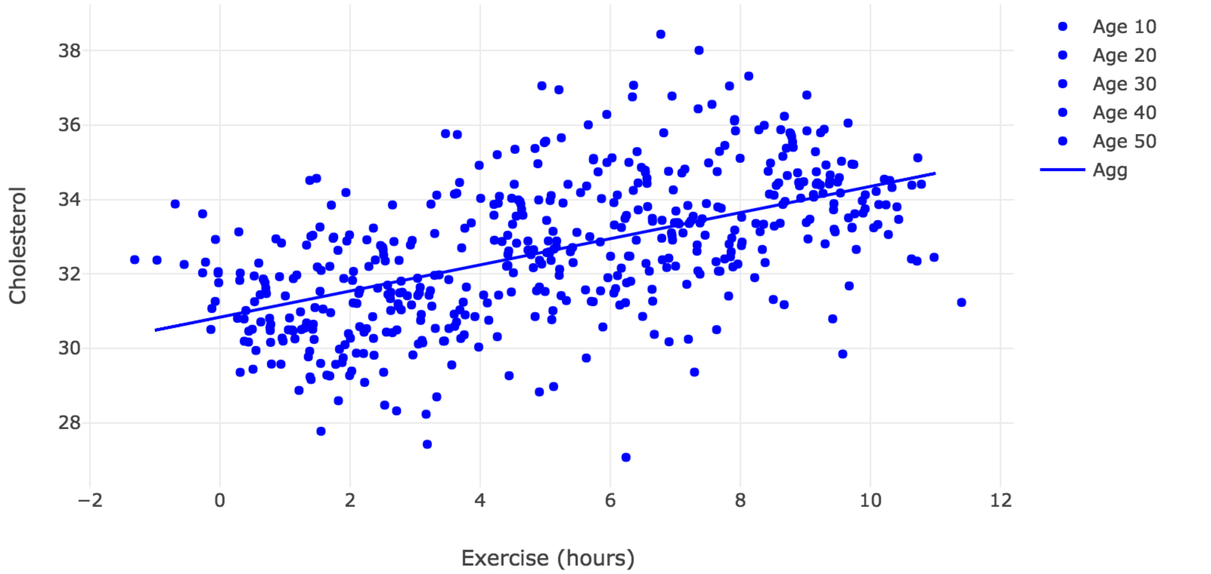
Motivating Example

- What's the effect of exercise on cholesterol?

1



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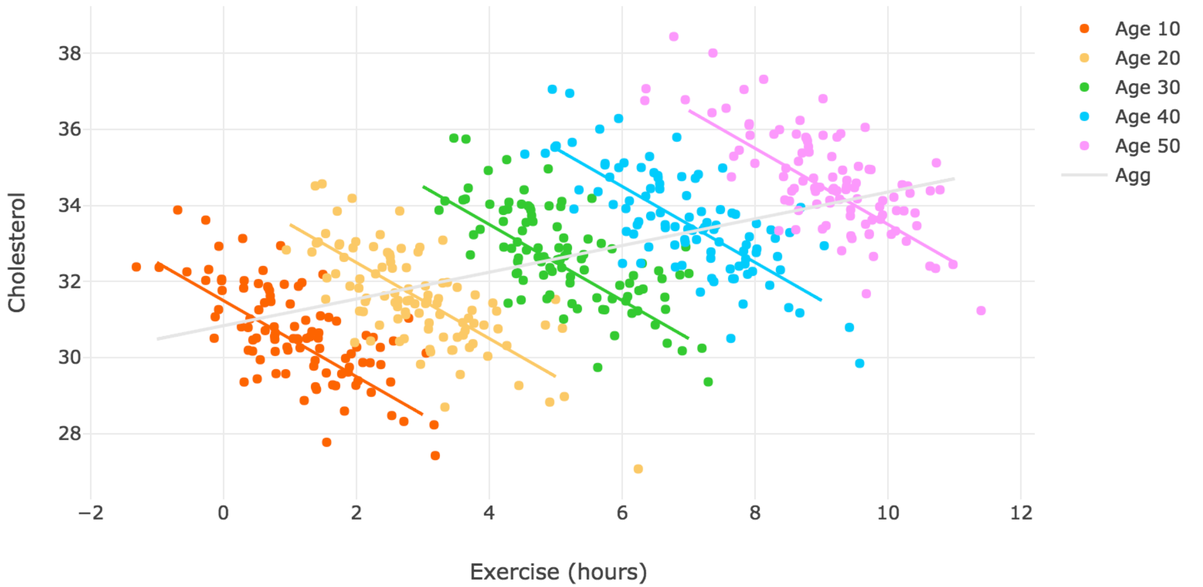

Motivating Examp

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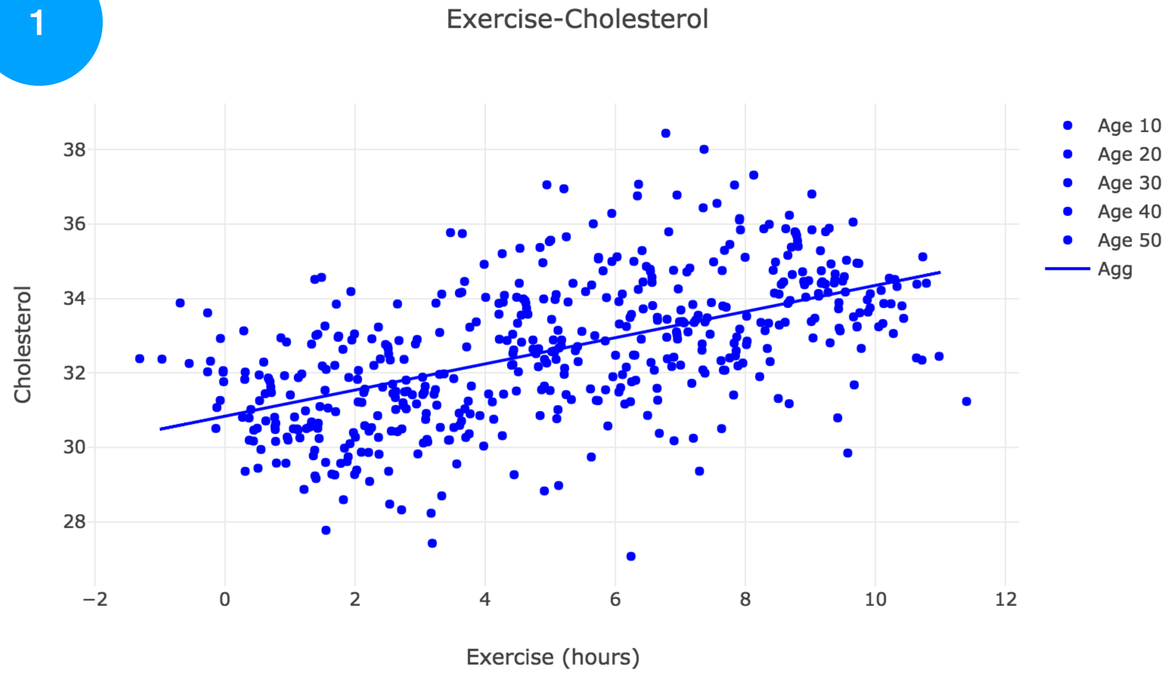

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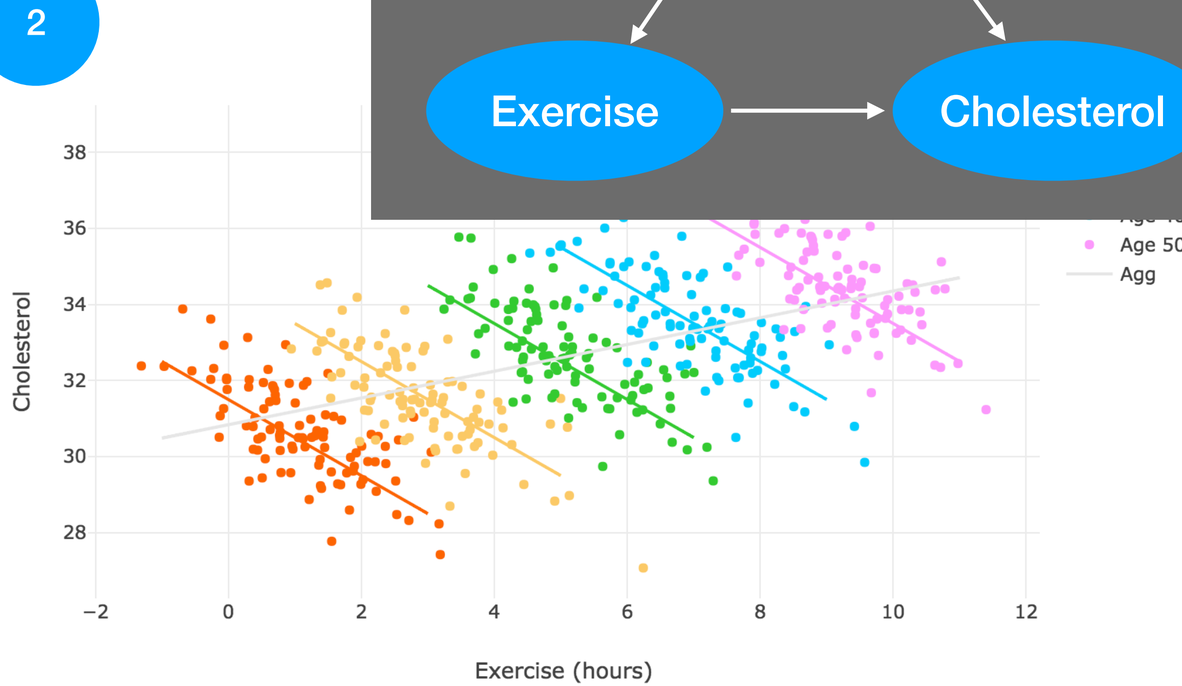
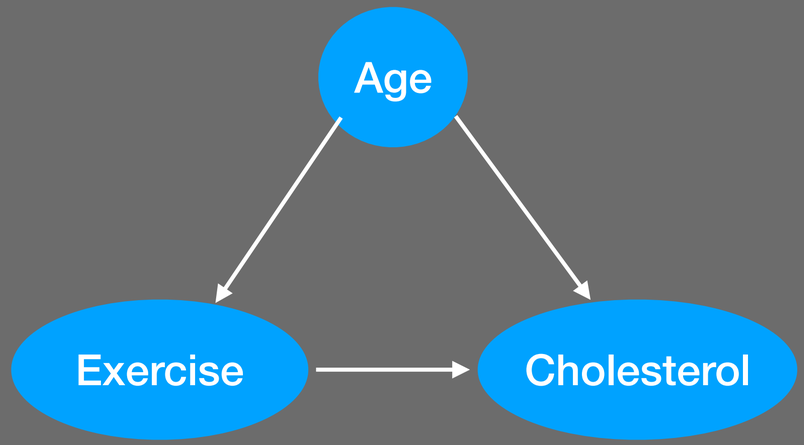


Solution: Causal Diagram



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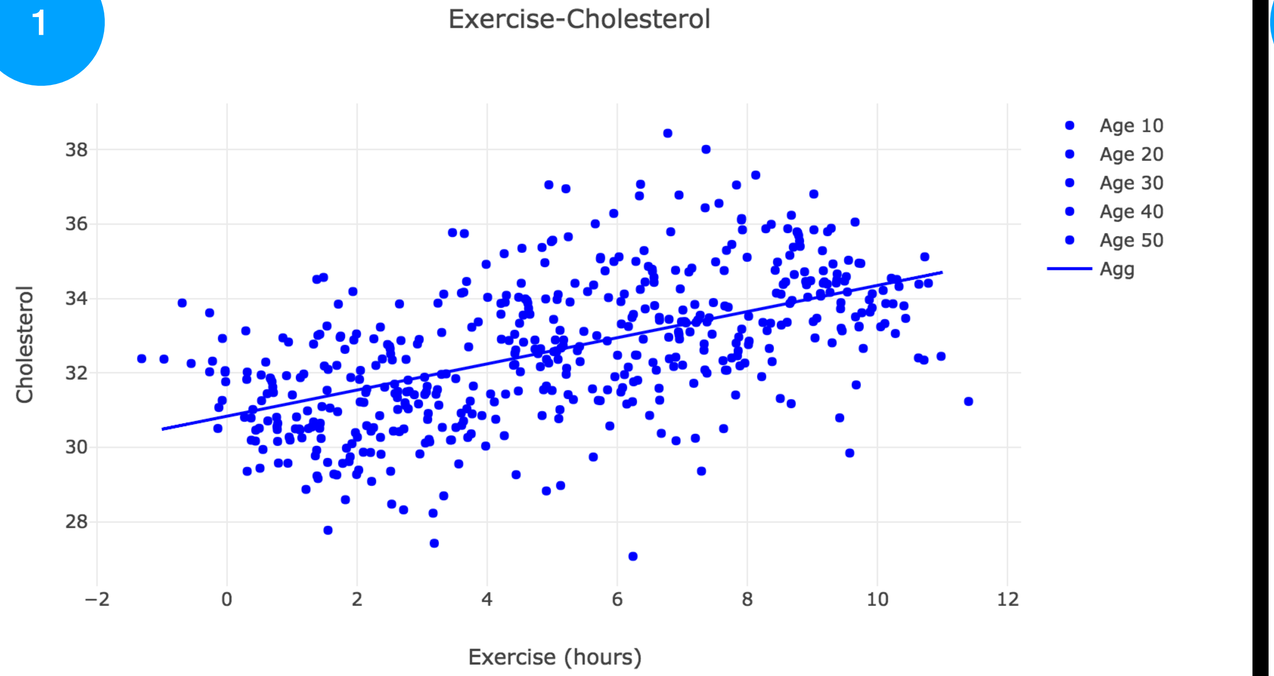

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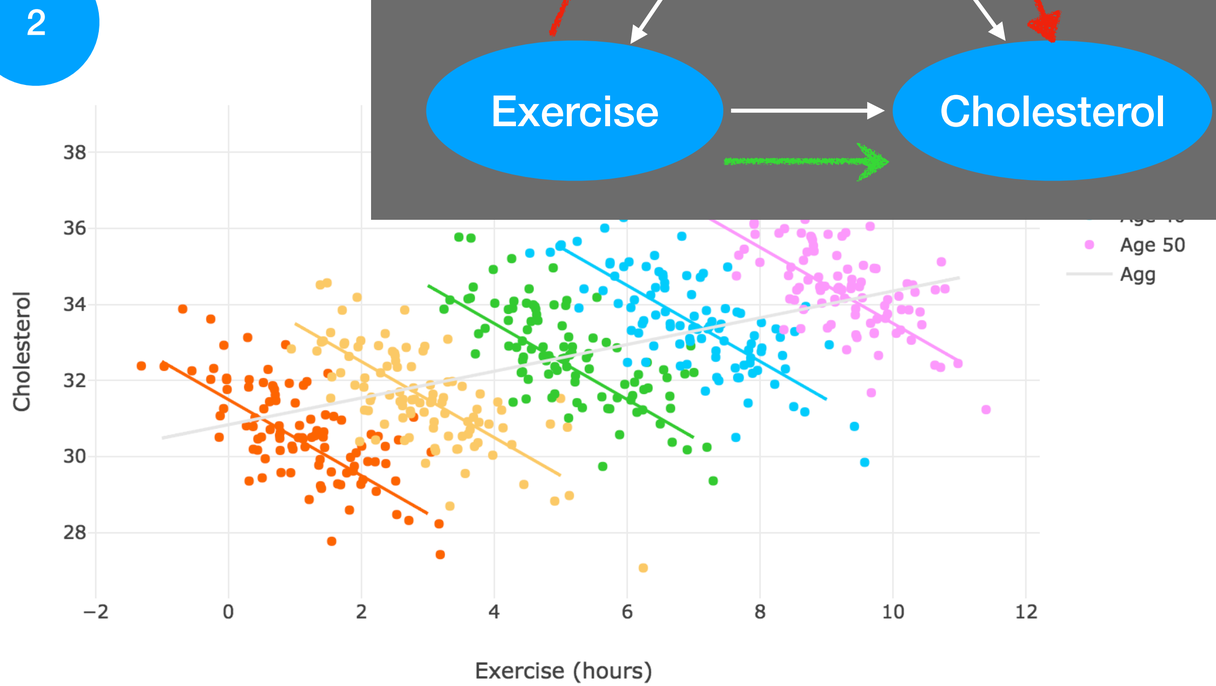

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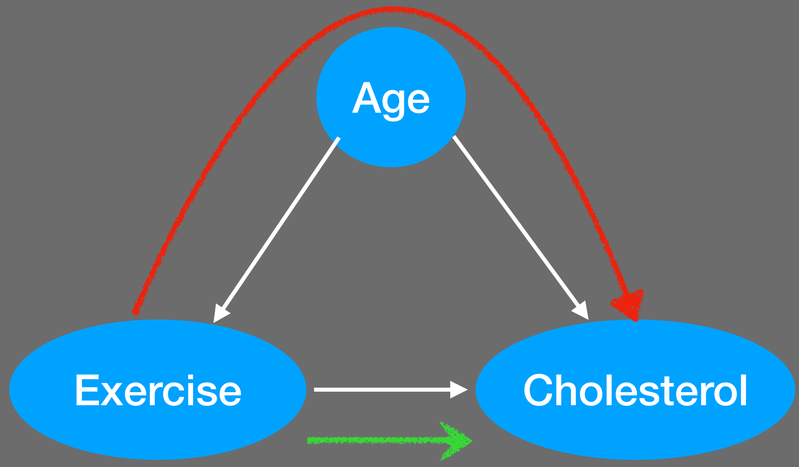

Correlation ✕

More exercise → Higher cholesterol

Motivating Examp

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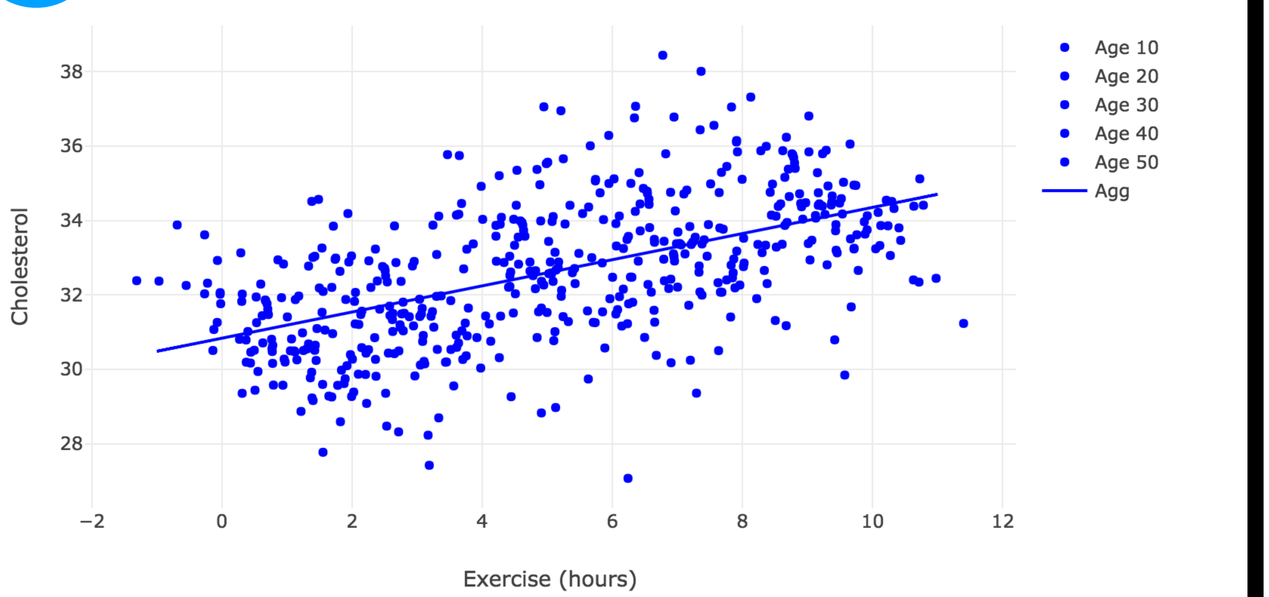

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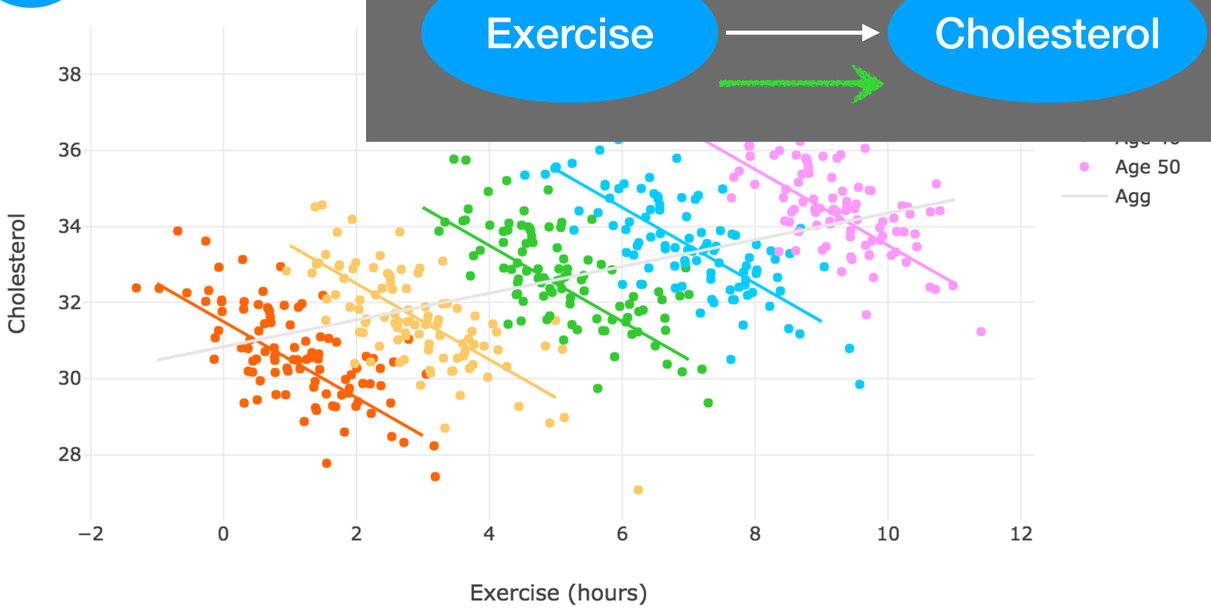

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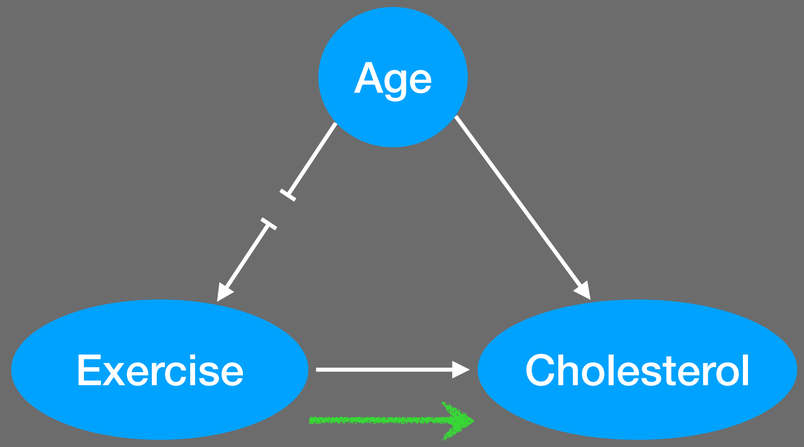

Correlation ✗

More exercise → Higher cholesterol

Causation ✓

More exercise → Lower cholesterol
(for each age group)

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$$Q = P_{\mathbf{x}}(\mathbf{y} \mid \mathbf{z})$$

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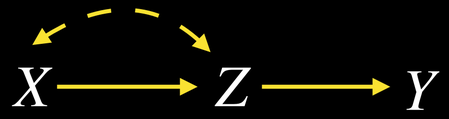

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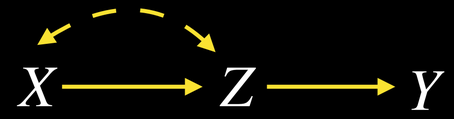

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   $P(x, z, y)$

What is Causal Identification?

Based on the current knowledge about the problem (2) and the available data (3), is the research question (1) identifiable?

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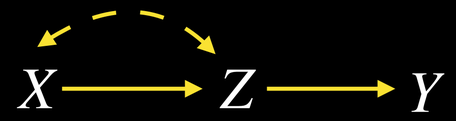

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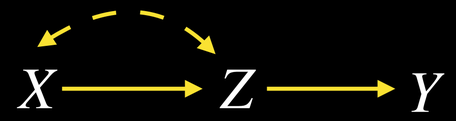

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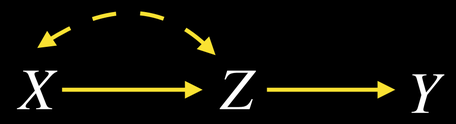

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yes / no?

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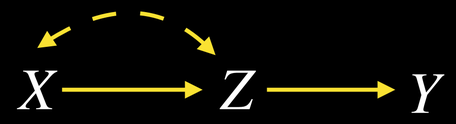

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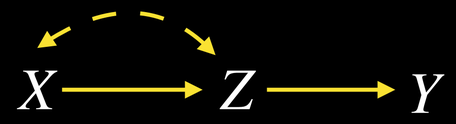

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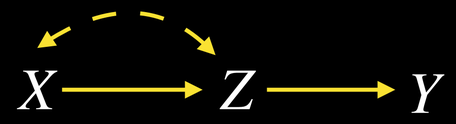

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Great, but…

Can a causal diagram be learned from data?

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Answer: In general, no!

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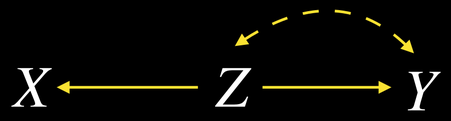
2. 

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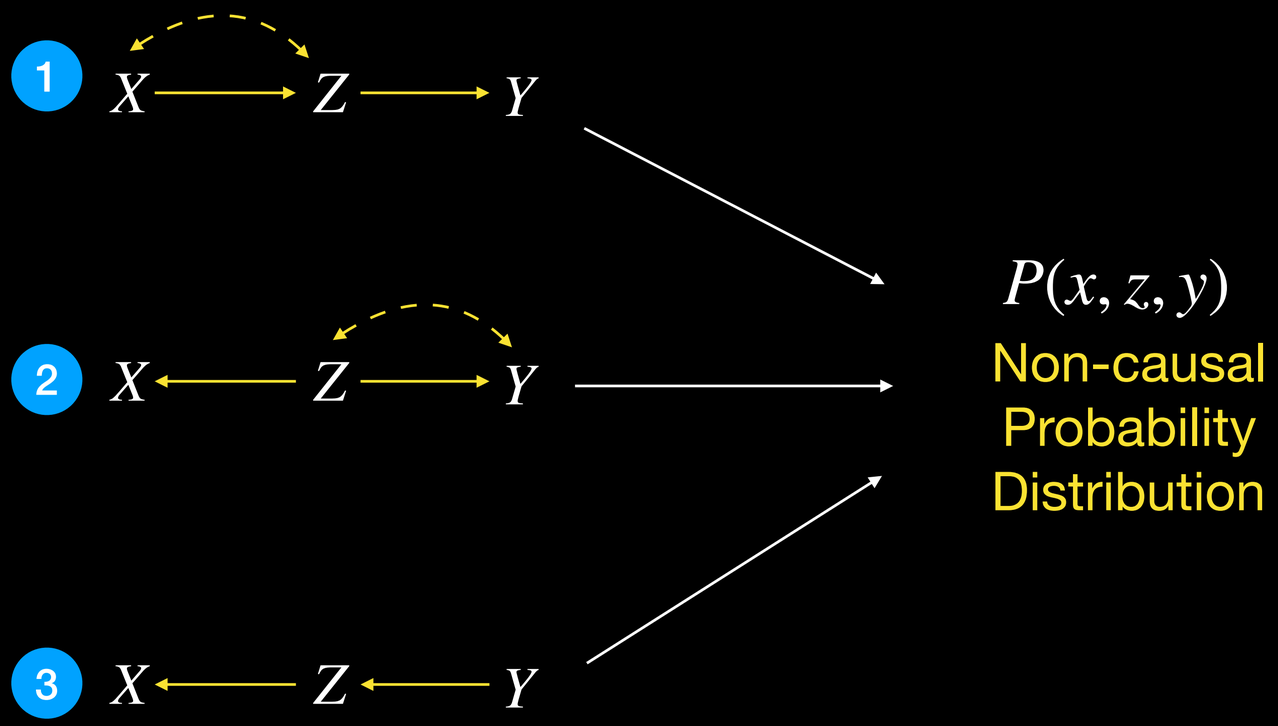

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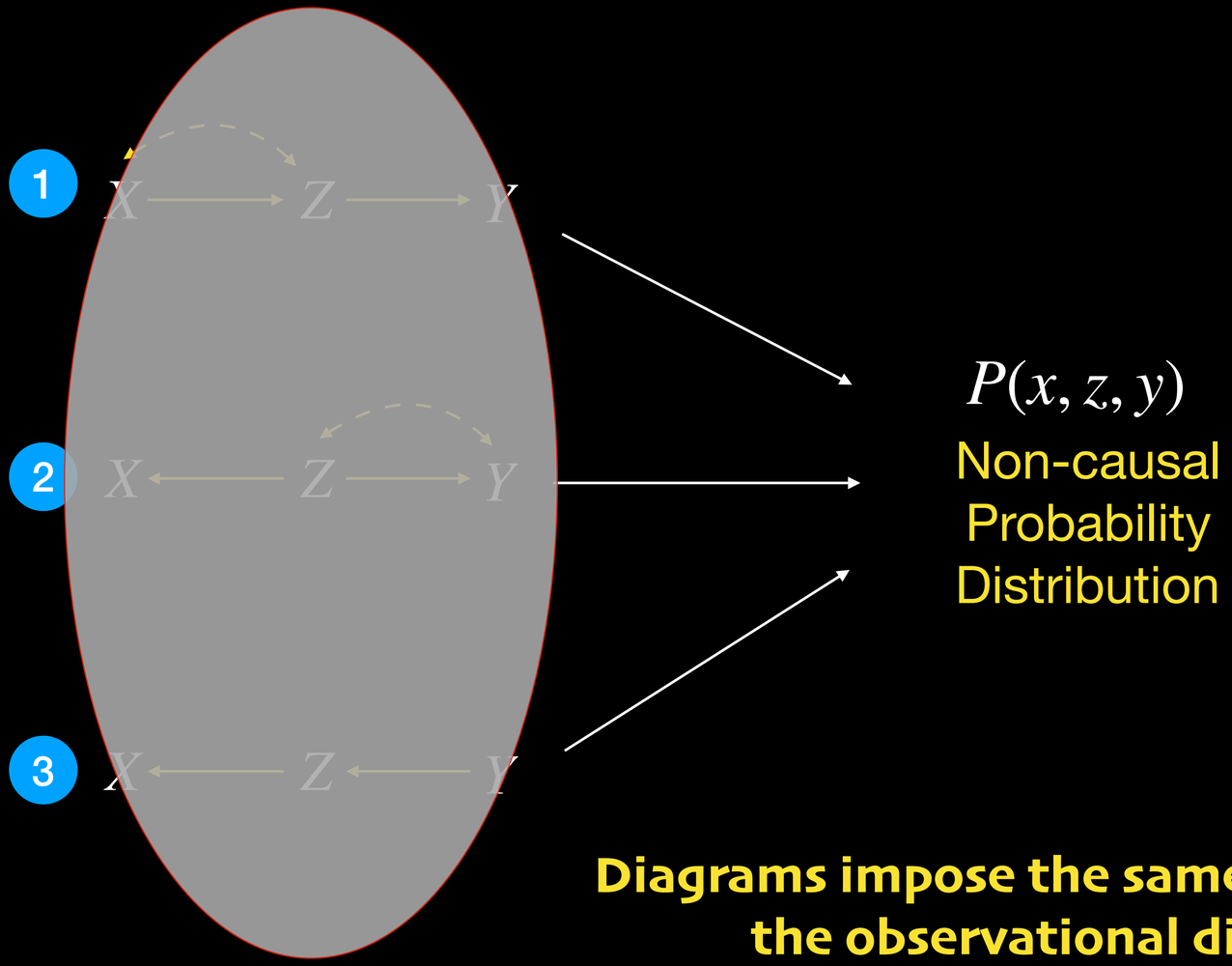

$P(x, z, y)$

Non-causal
Probability
Distribution

Diagrams impose the same constraints over the observational distribution.

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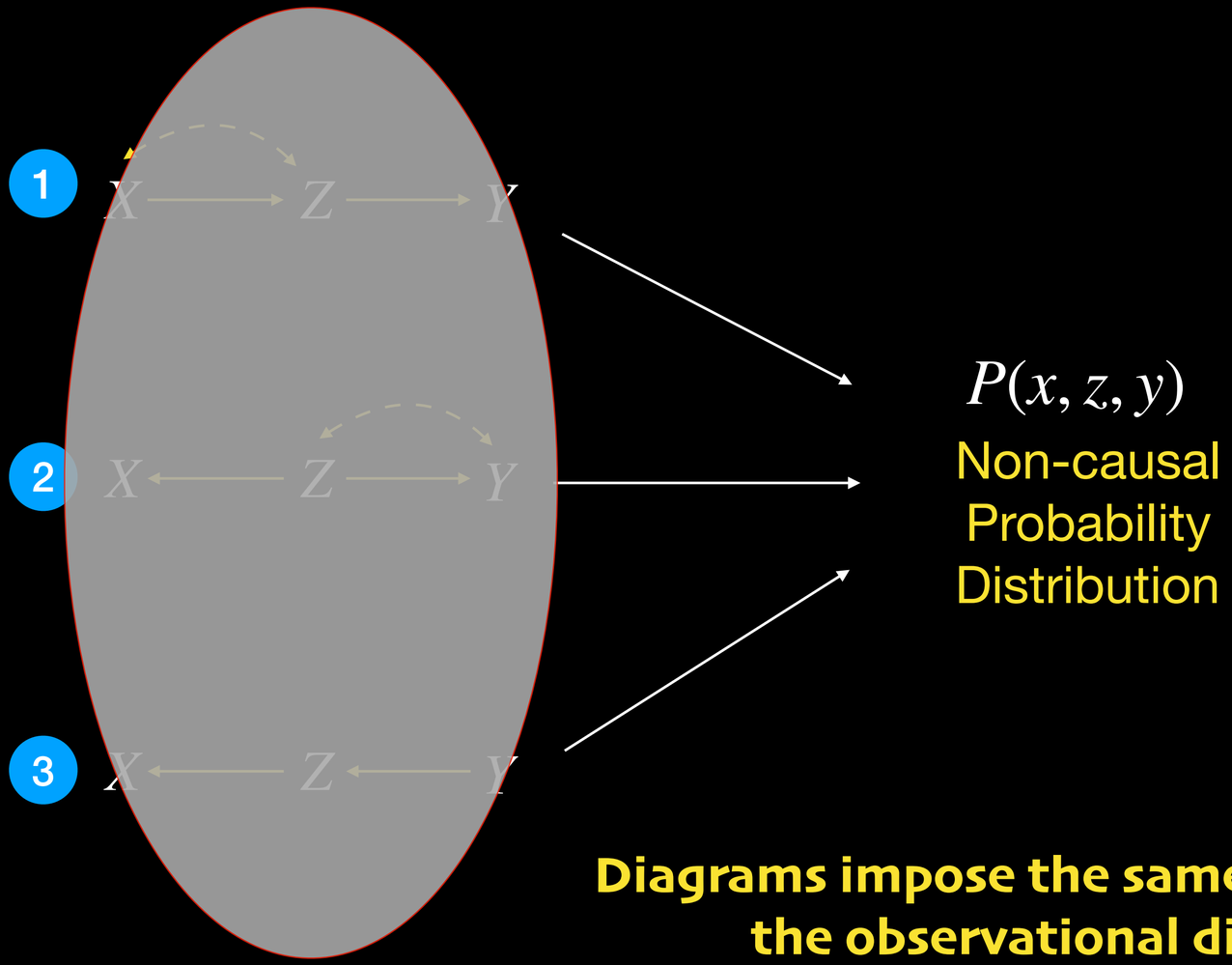

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Markov Equivalence Class

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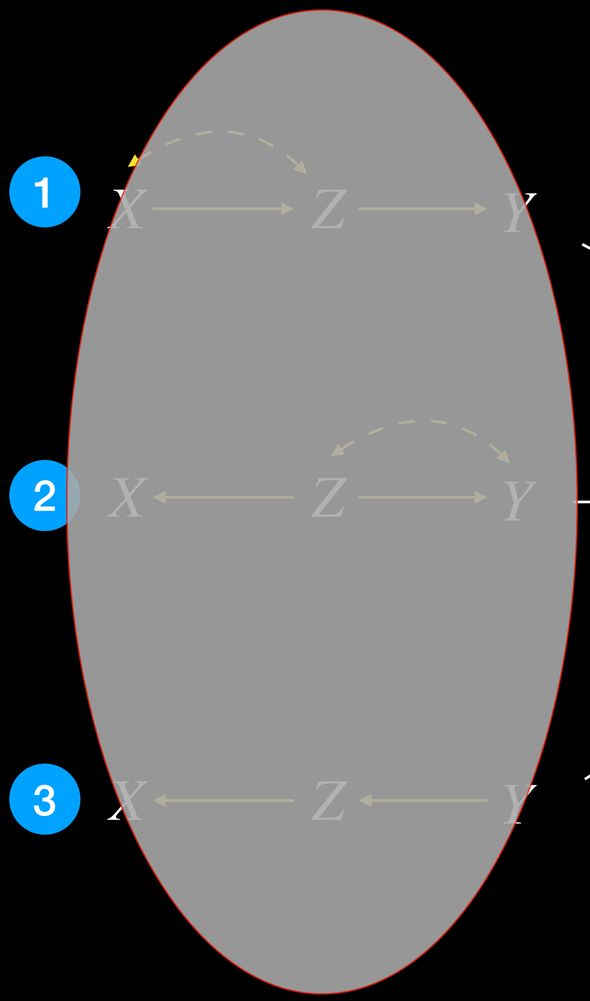

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Non-causal Probability Distribution

Summary Graph

Partial Ancestral Graph (PAG)

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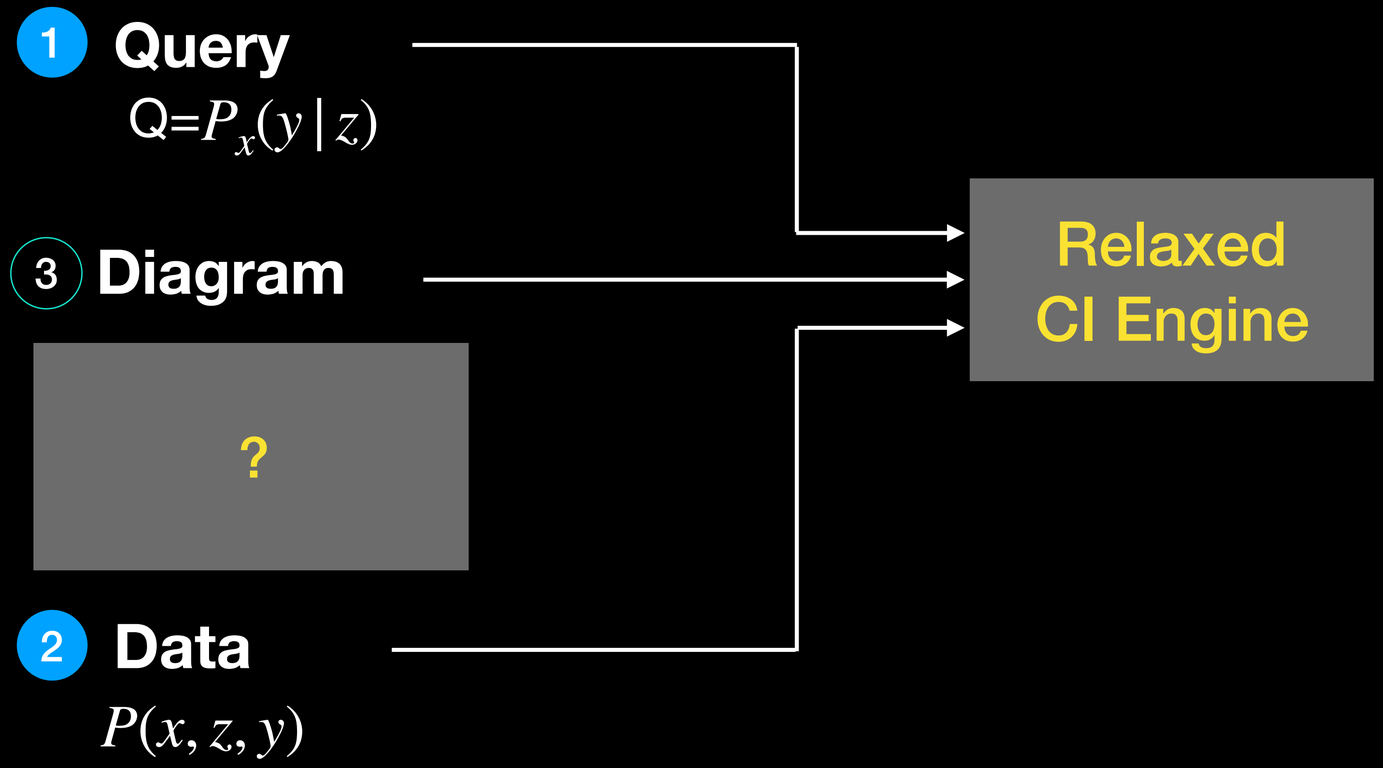
Markov Equivalence Class

Data-Driven Causal Identification



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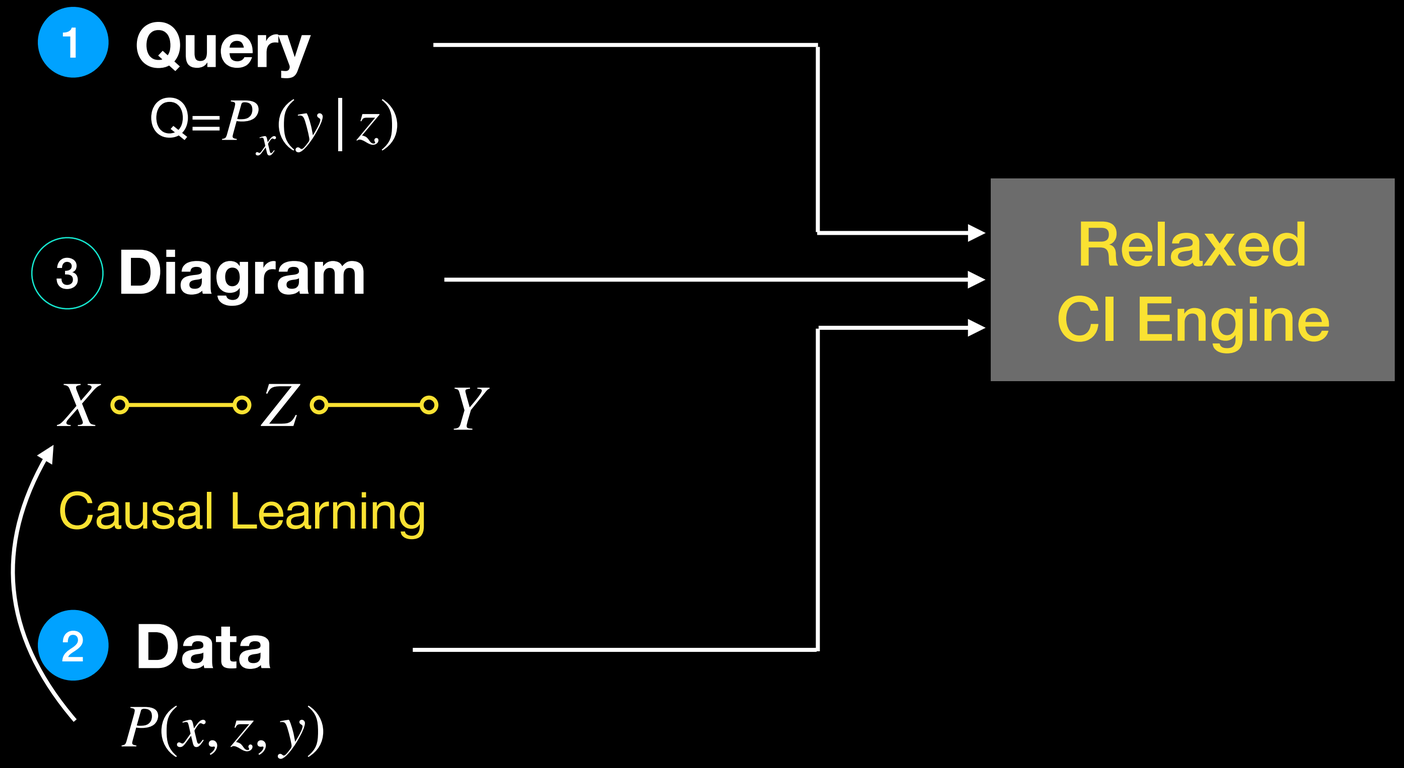

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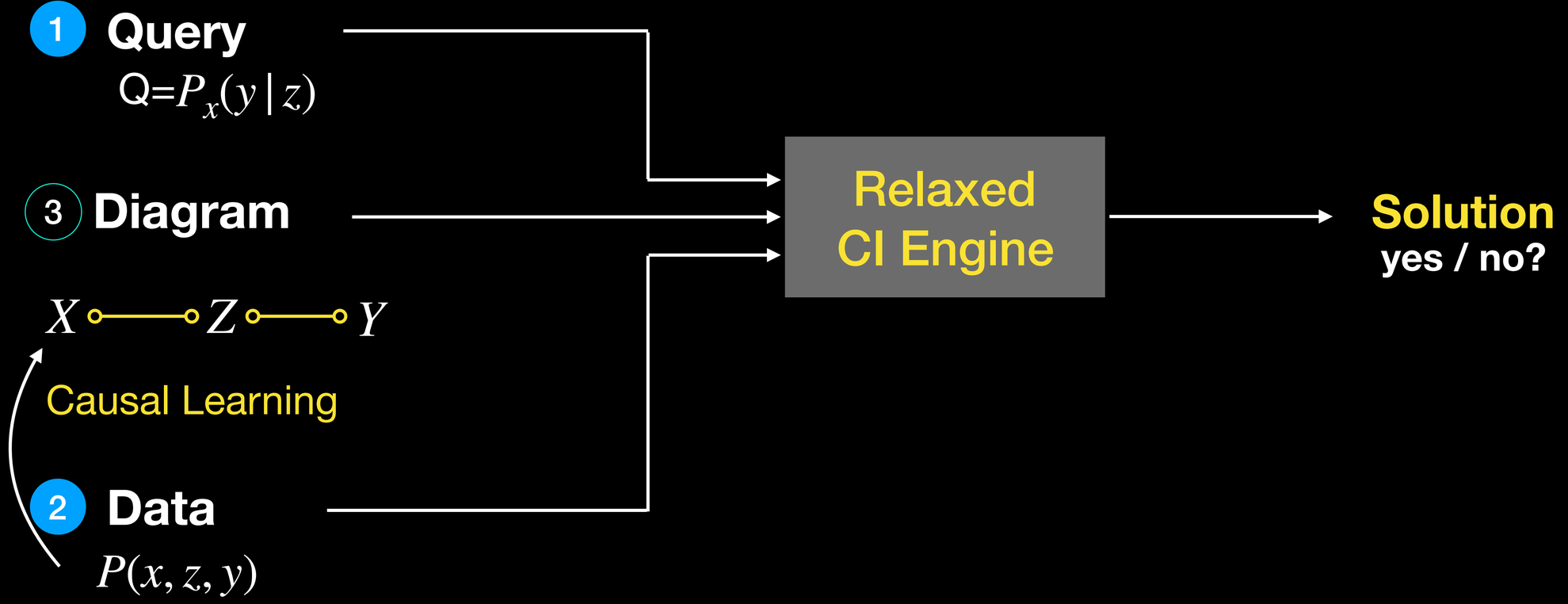

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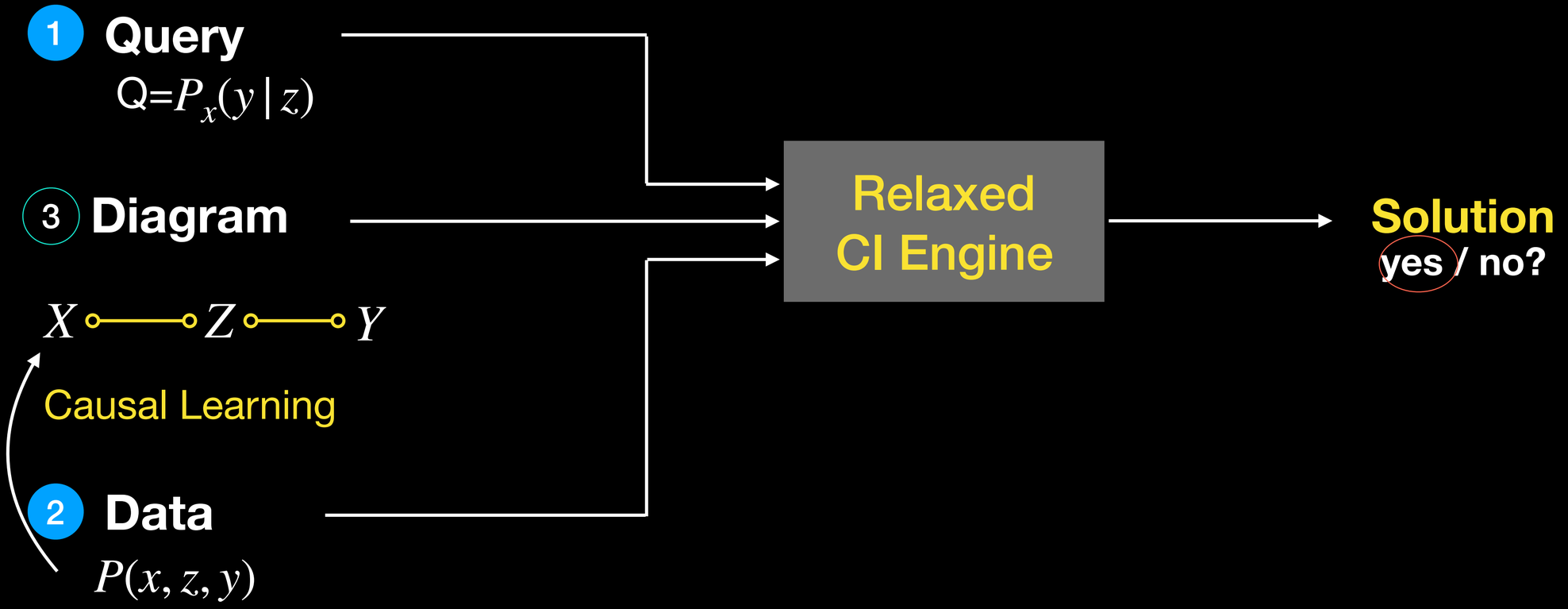

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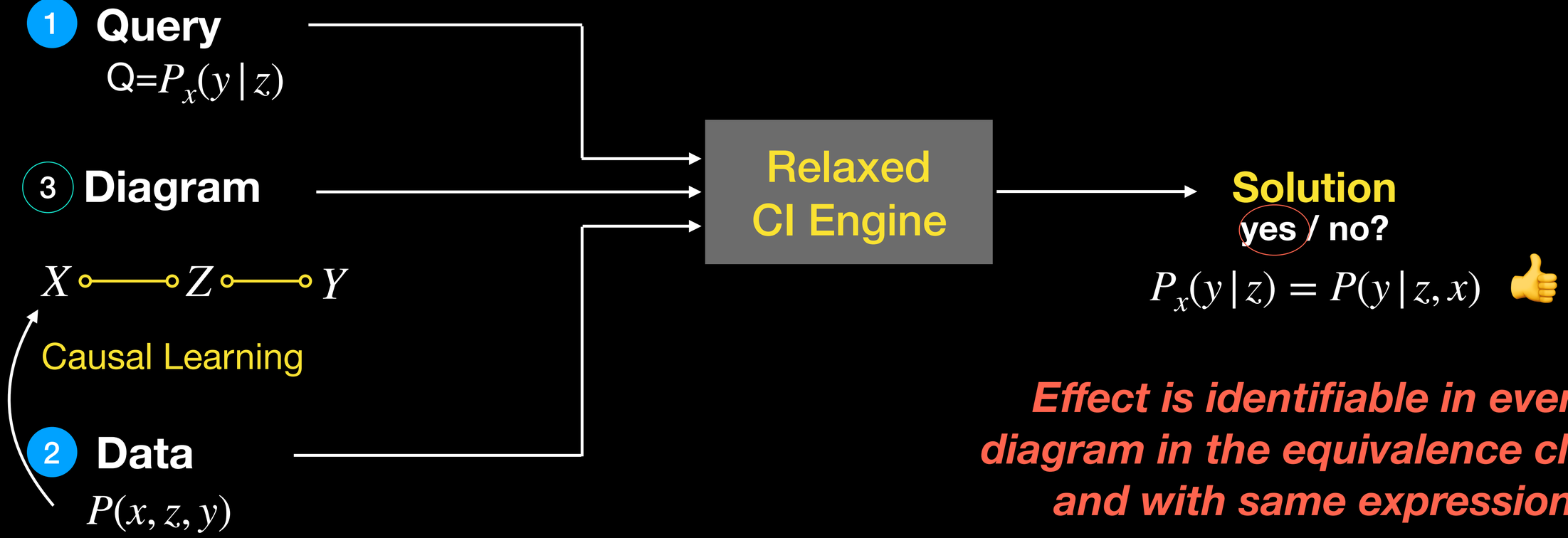

Effect is identifiable in every diagram in the equivalence class, and with same expression!

Conclusions

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Thank you!