

Weakly supervised causal representation learning

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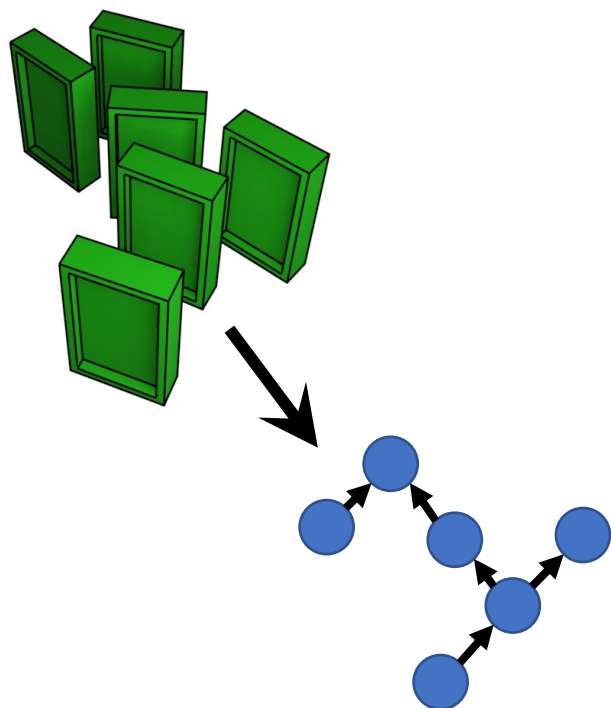
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University of Amsterdam

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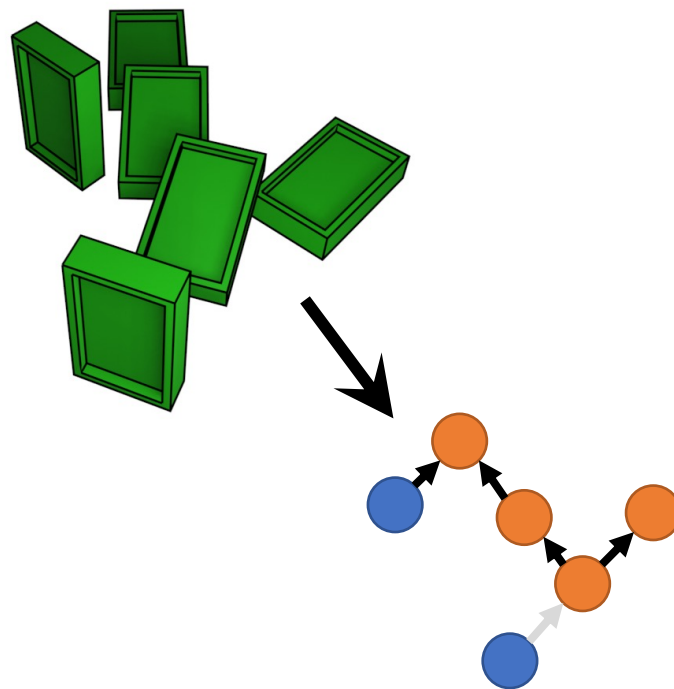
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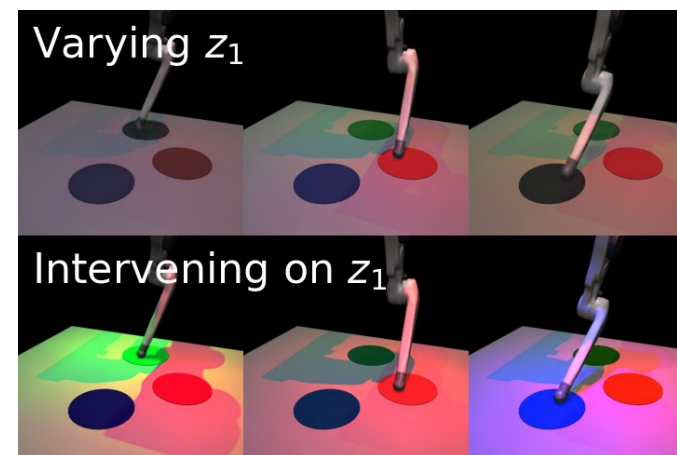
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Can we **learn causal variables & causal structure from pixels**, without labels?

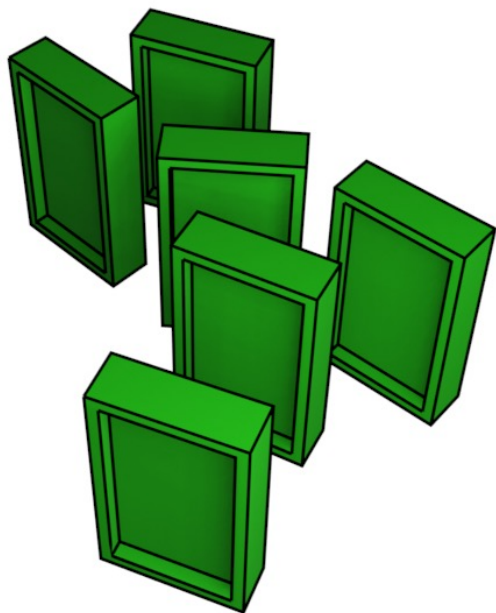


We prove: this is possible with **weak supervision**, when observing effects of interventions

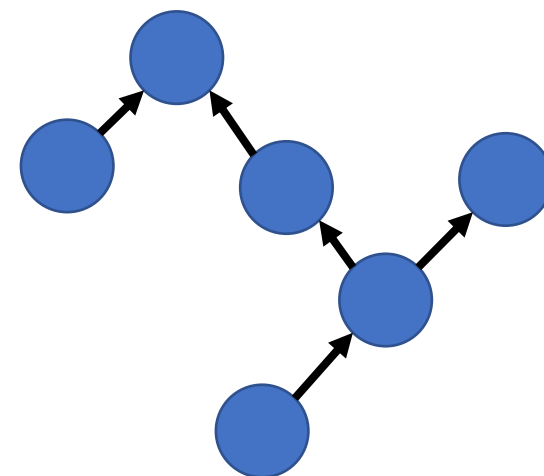
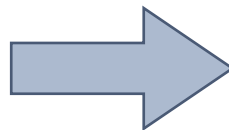


In practice, **implicit latent causal models** can identify the causal structure in image datasets

Causal representation learning

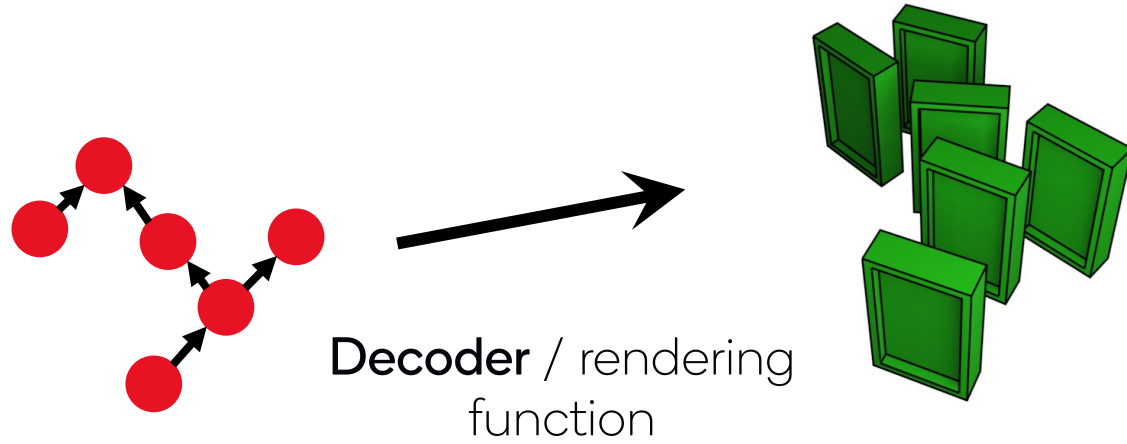


Given: **low-level, unstructured data representation**
(e.g. pixels)



Goal: learn encoder to
high-level variables
(e.g. object positions, states, ...)
and their relations /
causal structure

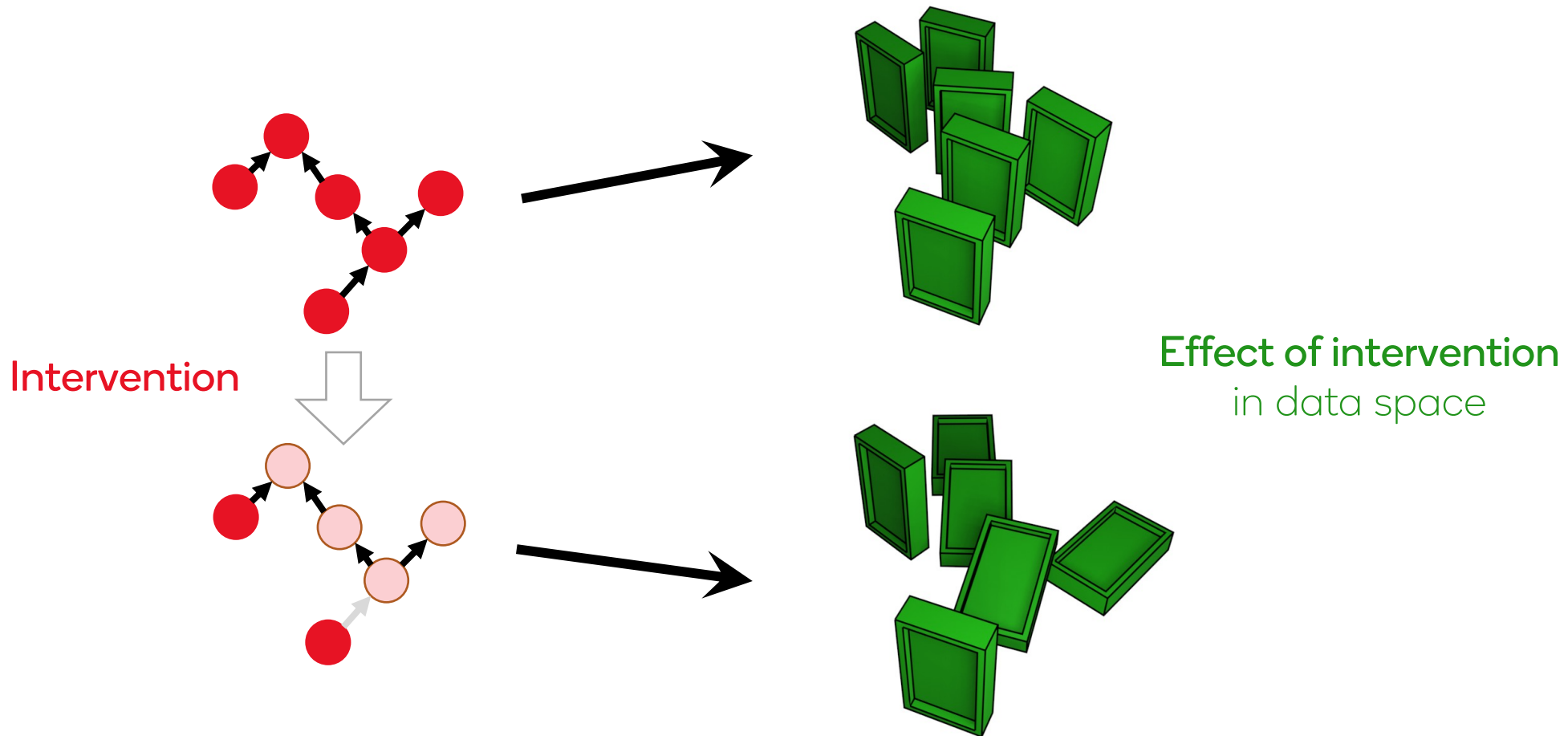
Latent causal model



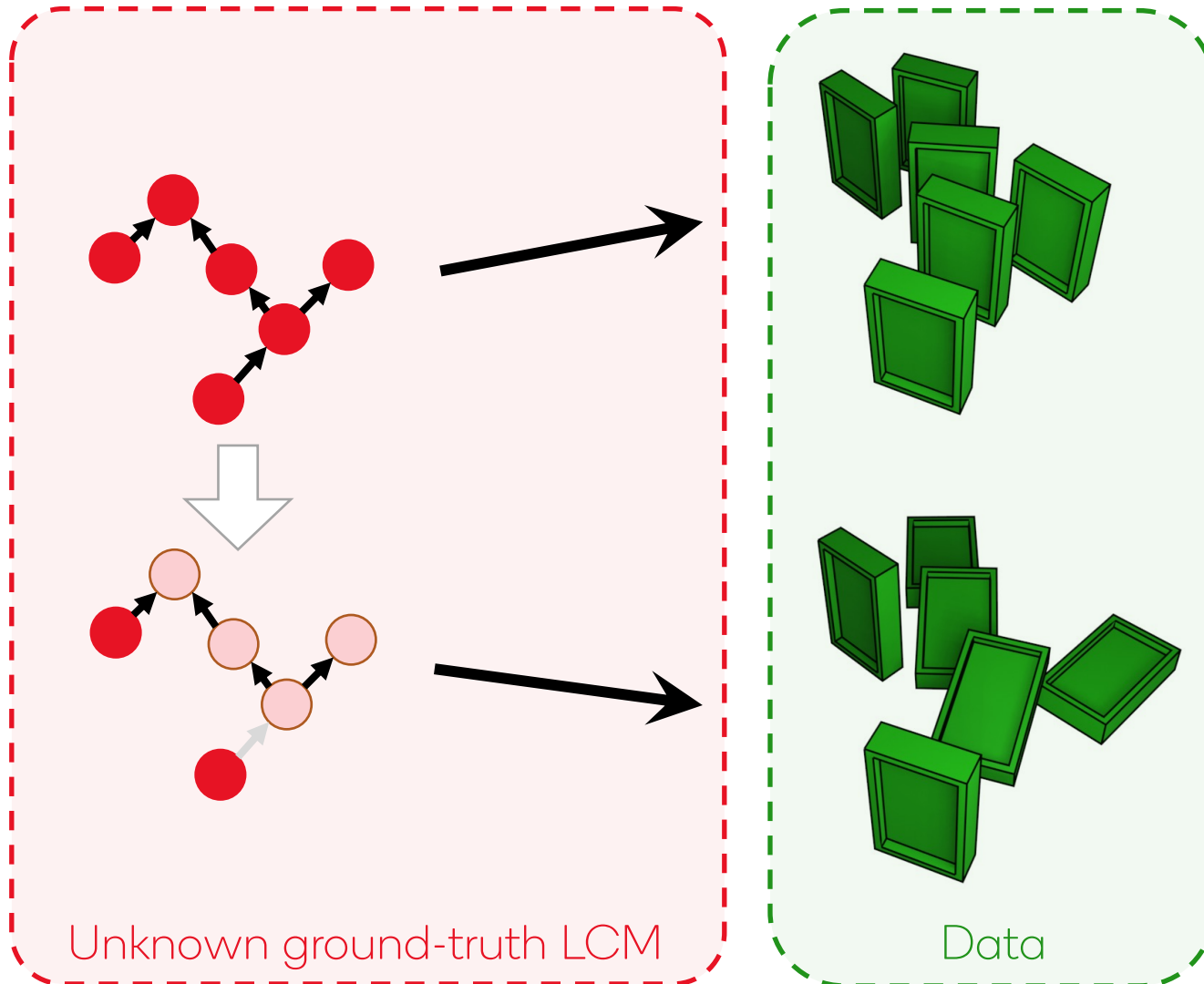
High-level variables with
a structural causal model
between them

Low-level data (pixels)

Interventions

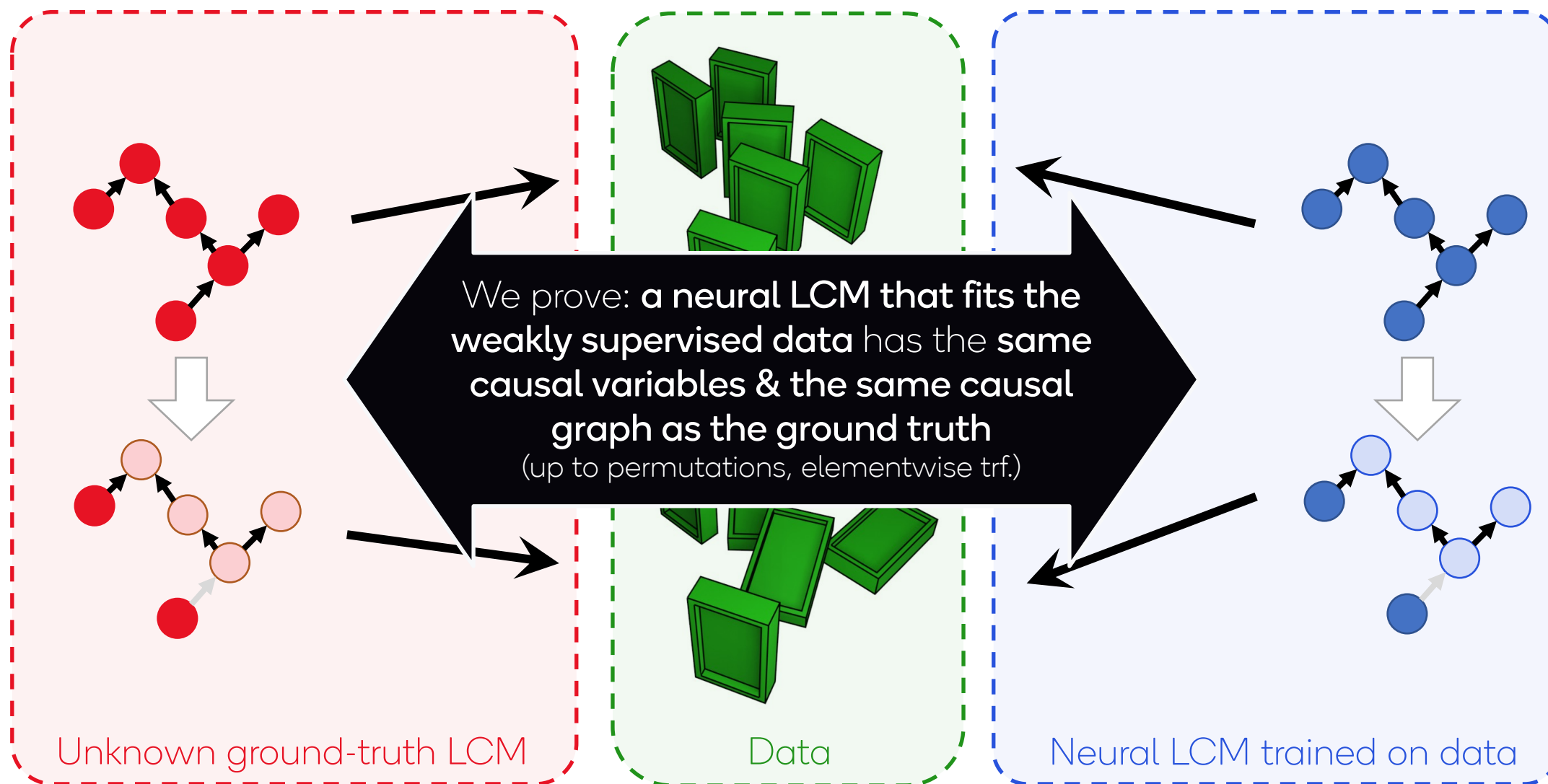


Weakly supervised data setting

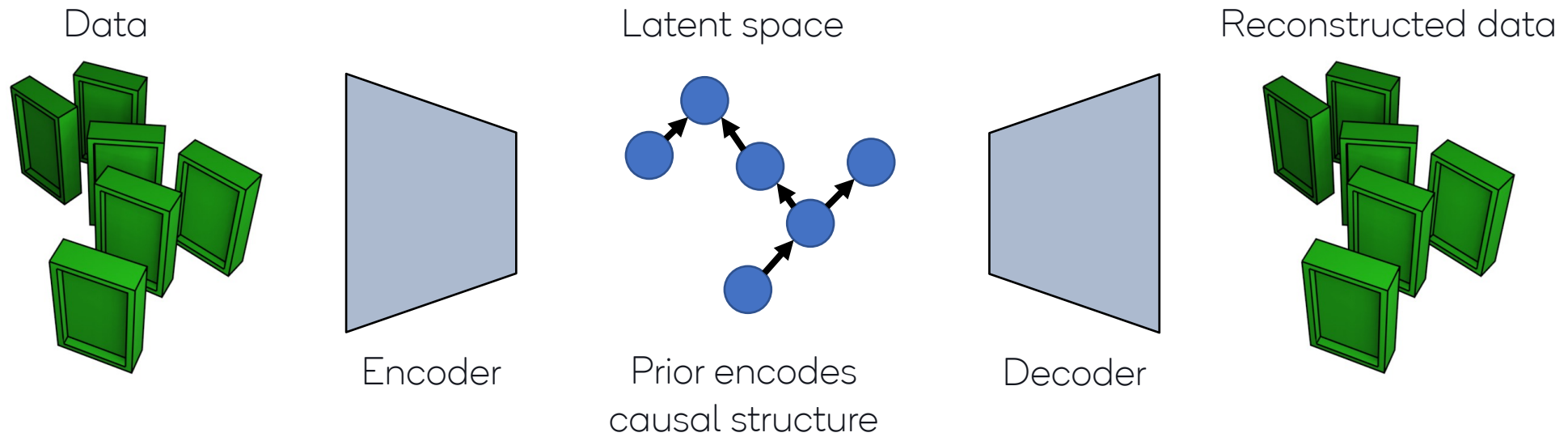


- We assume access to **data pairs of the system before and after interventions**
- Otherwise, **no labels**

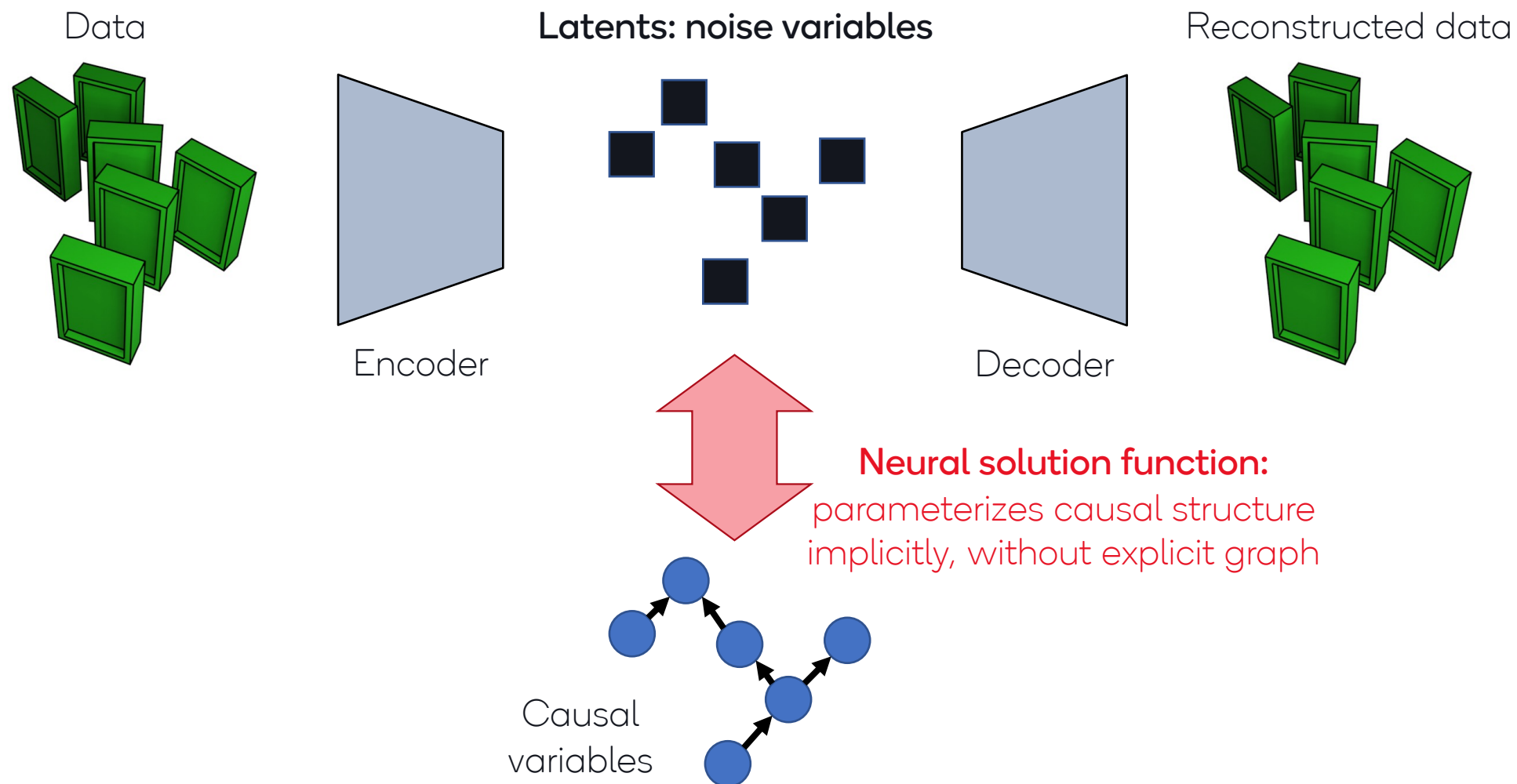
Identifiability theorem



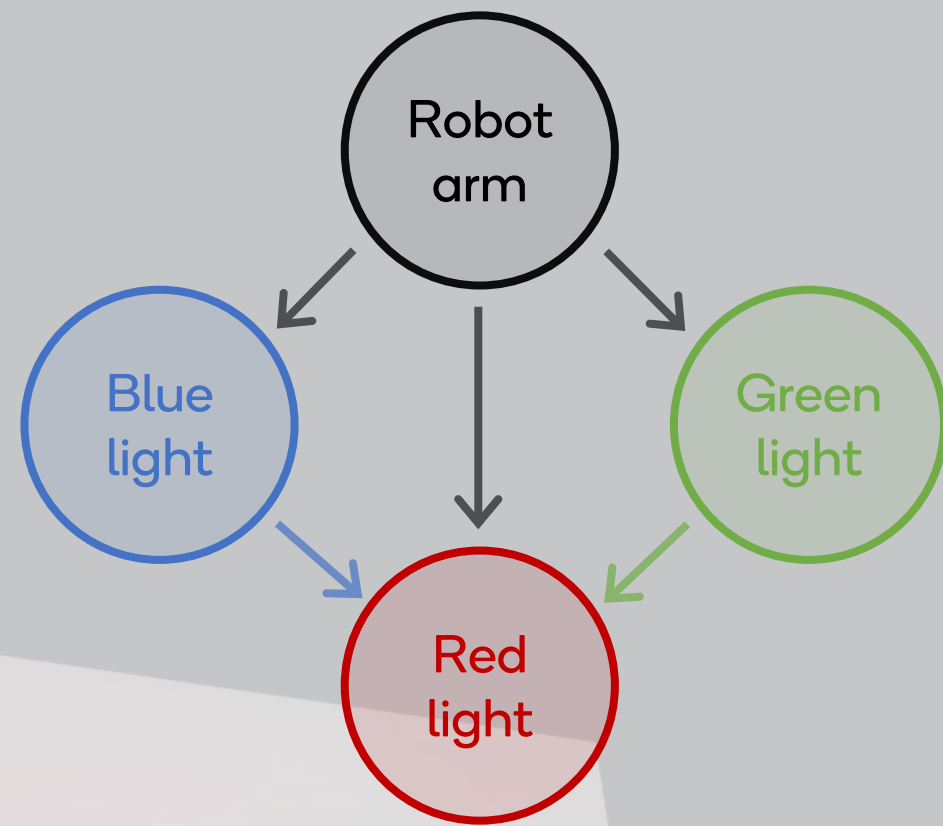
Operationalizing latent causal models



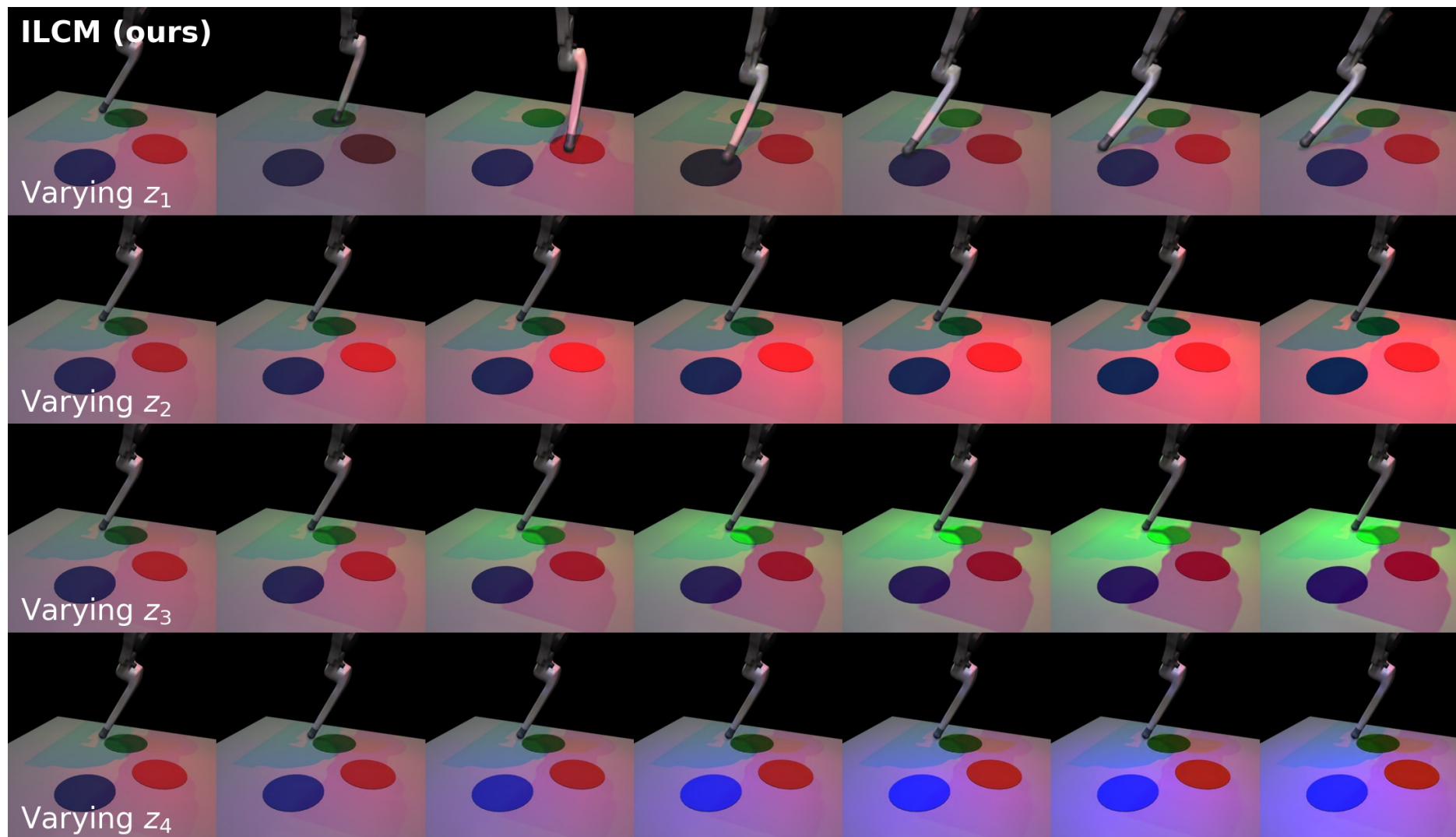
Implicit latent causal models



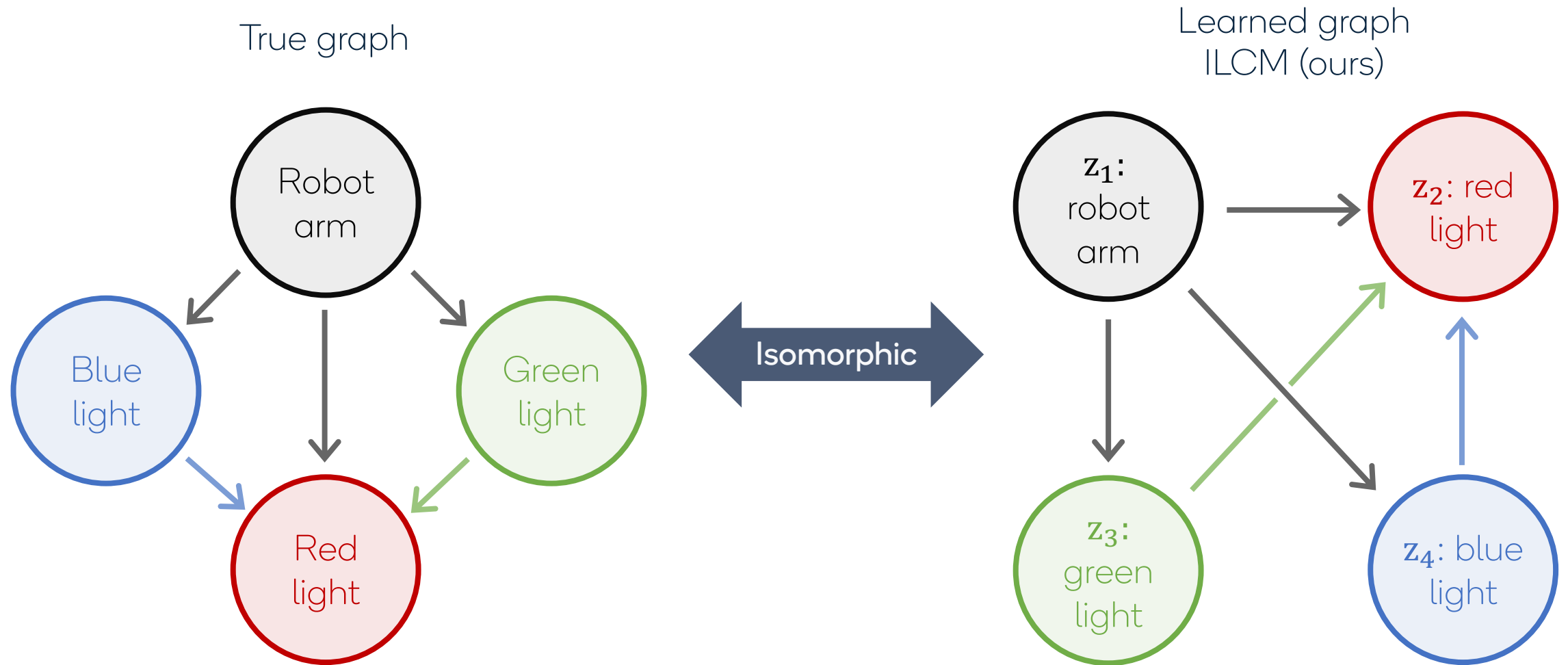
CausalCircuit



LCMs **disentangle** the causal variables

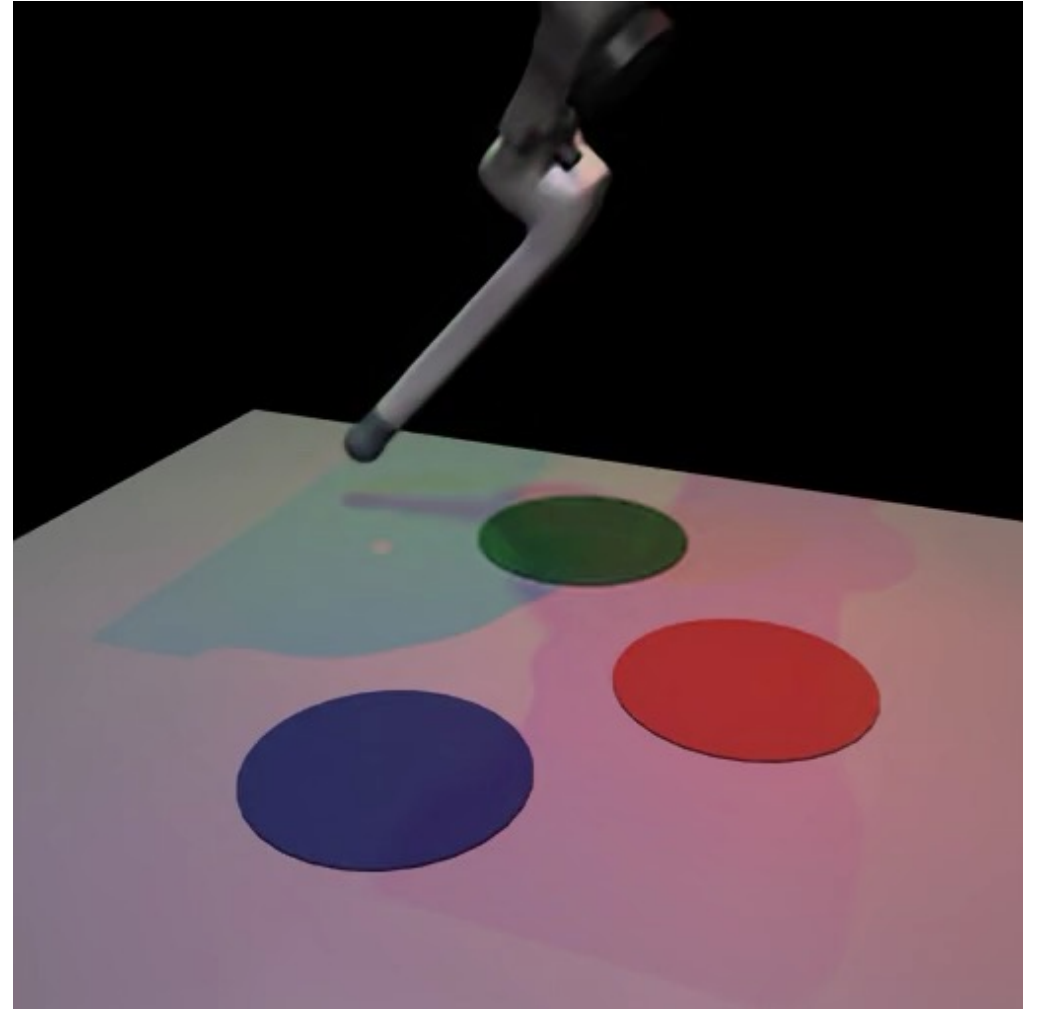


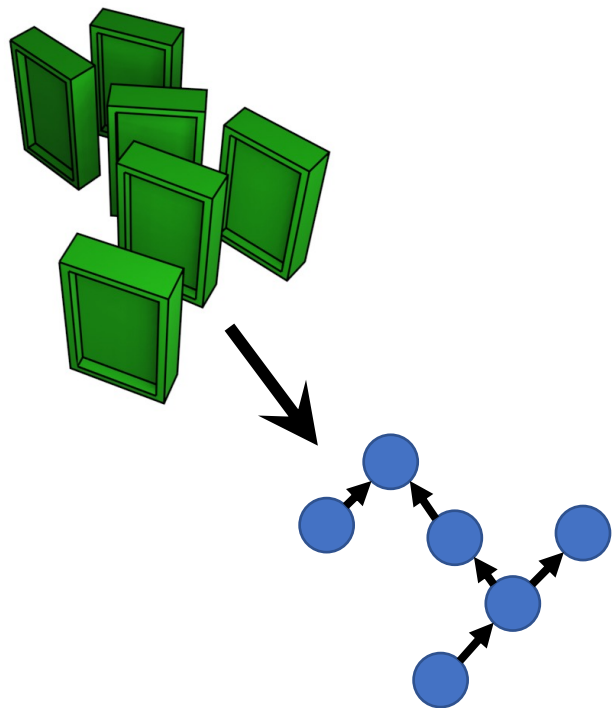
LCMs learn the **correct** graph



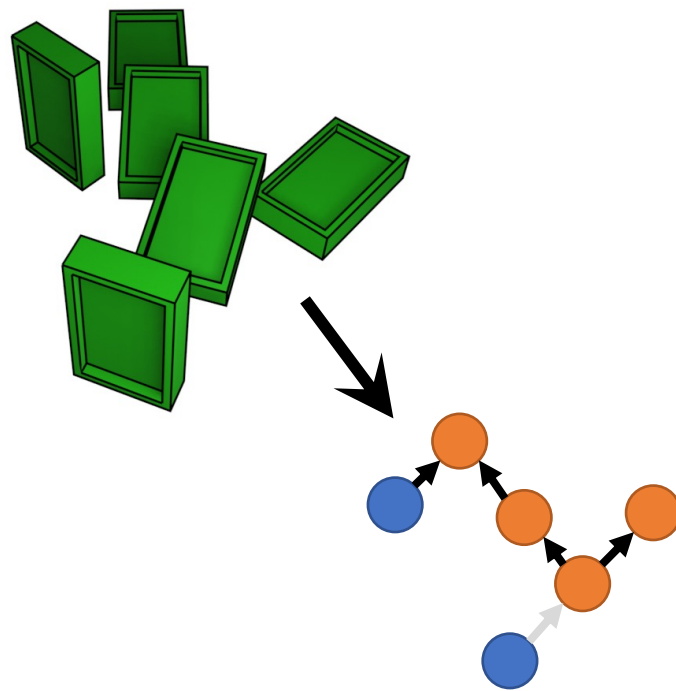
ILCMs let us **reason causally**

ILCM samples, **intervening** on a single latent
(including causal effects)

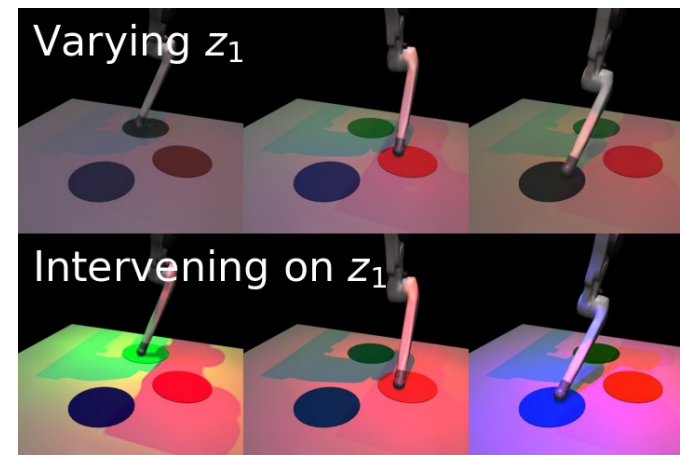




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Thank you



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