

draft

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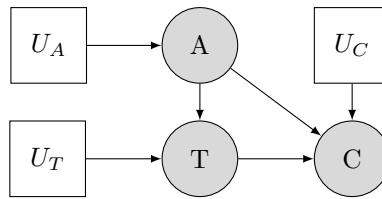


Figure 1: Structural Causal Model

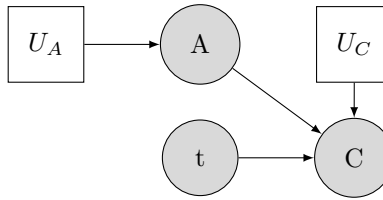


Figure 2: Atomic Intervention

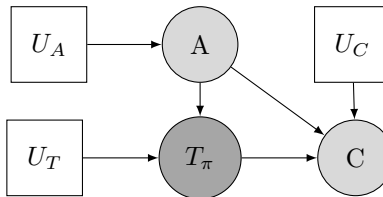


Figure 3: Policy Intervention

Counterfactuals

Process is described as follows:

- (a) Abduction: Cast probability $P(u)$ as conditional probability $P(u|\epsilon)$
- (b) Action: Exchange ($X = x$)
- (c) Prediction: Compute ($Y = y$)

Table 1: Pearl - Hierachy of Causation

Method	Action	Example
Prediction	Observation/Co-occurrence	What happened...
Intervention	Do-manipulation	What happens if ...
Counterfactual	Hypothetical Realities	What would have happened if...

Probabilistic Models vs SCMs

Method	CBN	SCM
Prediction	<ul style="list-style-type: none"> • Unstable • Volatile to parameter changes • Re-Estimate entire model 	<ul style="list-style-type: none"> • Stable • More Natural Specification • Only estimate Δ CM
Intervention	<ul style="list-style-type: none"> • Costly for Non-Markovian Models • Unstable(Nature CP) • Only generic estimates(Δ CP) 	<ul style="list-style-type: none"> • Pot. Cyclic Representation • Stable(Nature Eq.) • Context specific(Invariance of Eq.)
Counterfactuals	<ul style="list-style-type: none"> • Impossible • no information on latent factors(ϵ) 	<ul style="list-style-type: none"> • Possible • Inclusion of latent factors