Structural Causal Models - A Gentle Introduction

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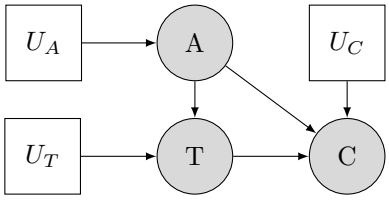

Figure 1: Structural Causal Model

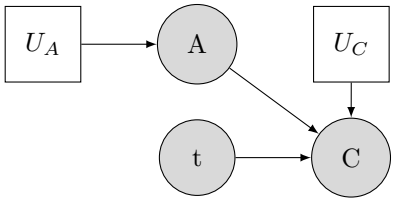

Figure 2: Atomic Intervention

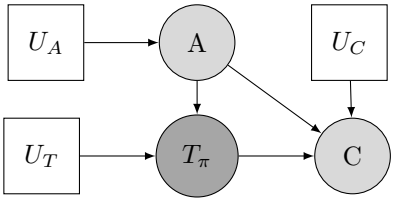

Figure 3: Policy Intervention

1 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...

2 Probabilistic Models vs SCMs

Method	CBN	SCM
Prediction	· Unstable	· Stable
	· Volatile to parameter changes	· More Natural Specification
	· Re-Estimate entire model	· Only estimate Δ CM
Intervention	· Costly for Non-Markovian Models	· Pot. Cyclic Representation
	· Unstable(Nature CP)	· Stable(Nature Eq.)
	· Only generic estimates(Δ CP)	· Context specific(Invariance of Eq.)
Counterfactuals	· **Impossible**	· Possible
	· no information on latent factors(ϵ)	· Inclusion of latent factors