Fairness in Machine Learning WS20/21

Fostering Notions of Dynamic Fairness via Structural Causal Models

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Introduction

- Fairness in dynamical system has become important because equalizing true positive rate at each step does not converge as fast in systems with e.g. population dynamics
- Research on dynamical systems has focused on markov decision processes
- Prior research on causal fairness has focused in static systems
- Recently Creager et al. (2020) proposed a structural causal model for dynamical systems

Why care about causal fairness models?

- Fairness is not static (D'Amour et al. 2020) introduce shortcomings of existing fairness correction measures
- From a modelling perspective, we can improve the specification (Markov Decision Process)
- Regular models may express a model in conditional probabilities (probabilistic model) or may be expressed as differential equation
- SCMs are cast in functional form which is more stable (but may also be expressed as differential equation)
- Additionally, we specify the model beyond conditional probabilities -> we specify the latent variables (exogenous variables not observable within our dataset)

What is a SCM

- Functional specification of our model including latent factors
- Probabilistic specification + additional knowledge

SCMs for Fairness in dynamical Systems

- Fair-MDP
- Judea Pearl:do-calculus
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SCM vs Causal Bayesian Network (Probabilistic Model)

Exisiting Considerations

- Counterfactuals for Fairness in Dynamical Systems
- Off-policy estimation (model based (regression) or model free estimation (propensity weight))

Time and Causal Inference

- Structural causal models are abstractions of physical processes
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Adding to existing Literature

Methodological:

- Cyclic Structural Causal Models with actual reinforcing loops
- Semi-Deterministic SCMs (deterministic -> all variables are known)

Application:

- Off Policy Interventions