Machine learning and fairness in commercial insurance

Insurance Data Science Conference
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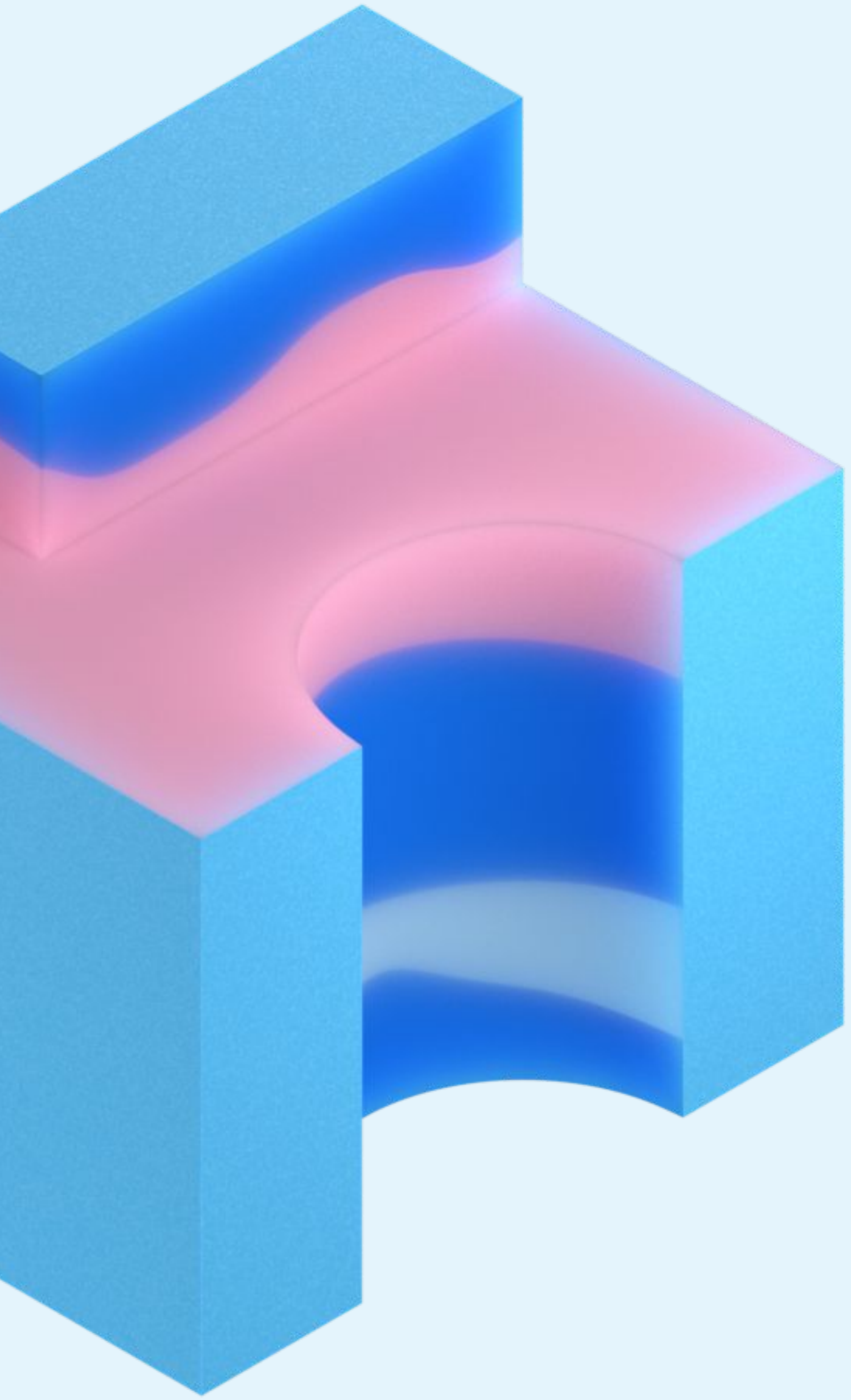
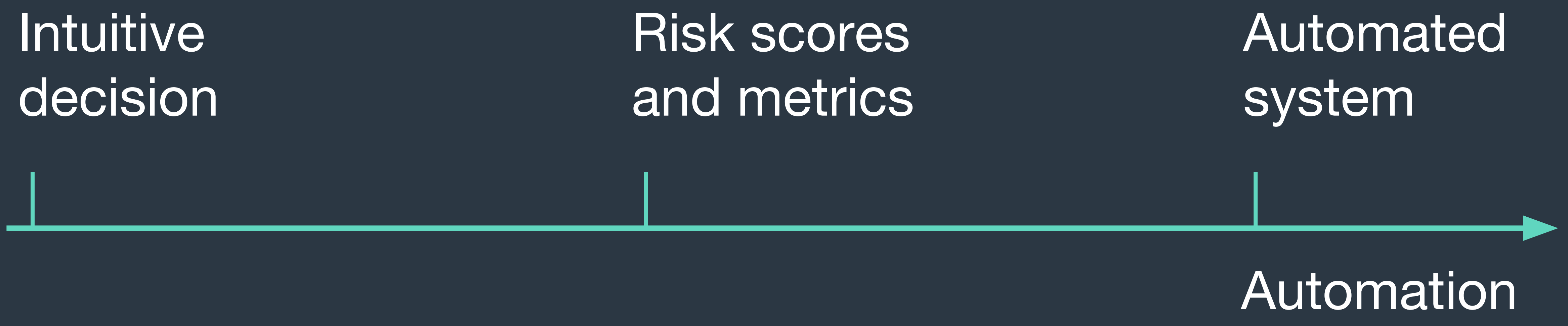
Cytora



Cytora uses artificial intelligence to improve risk targeting, selection, and pricing for commercial insurance

Decisions that personally affect us are increasingly data-driven



- Credit scoring
- Insurance
- Airport security
- Crowd monitoring
- Reoffending rates
- Advertising

Defining fairness

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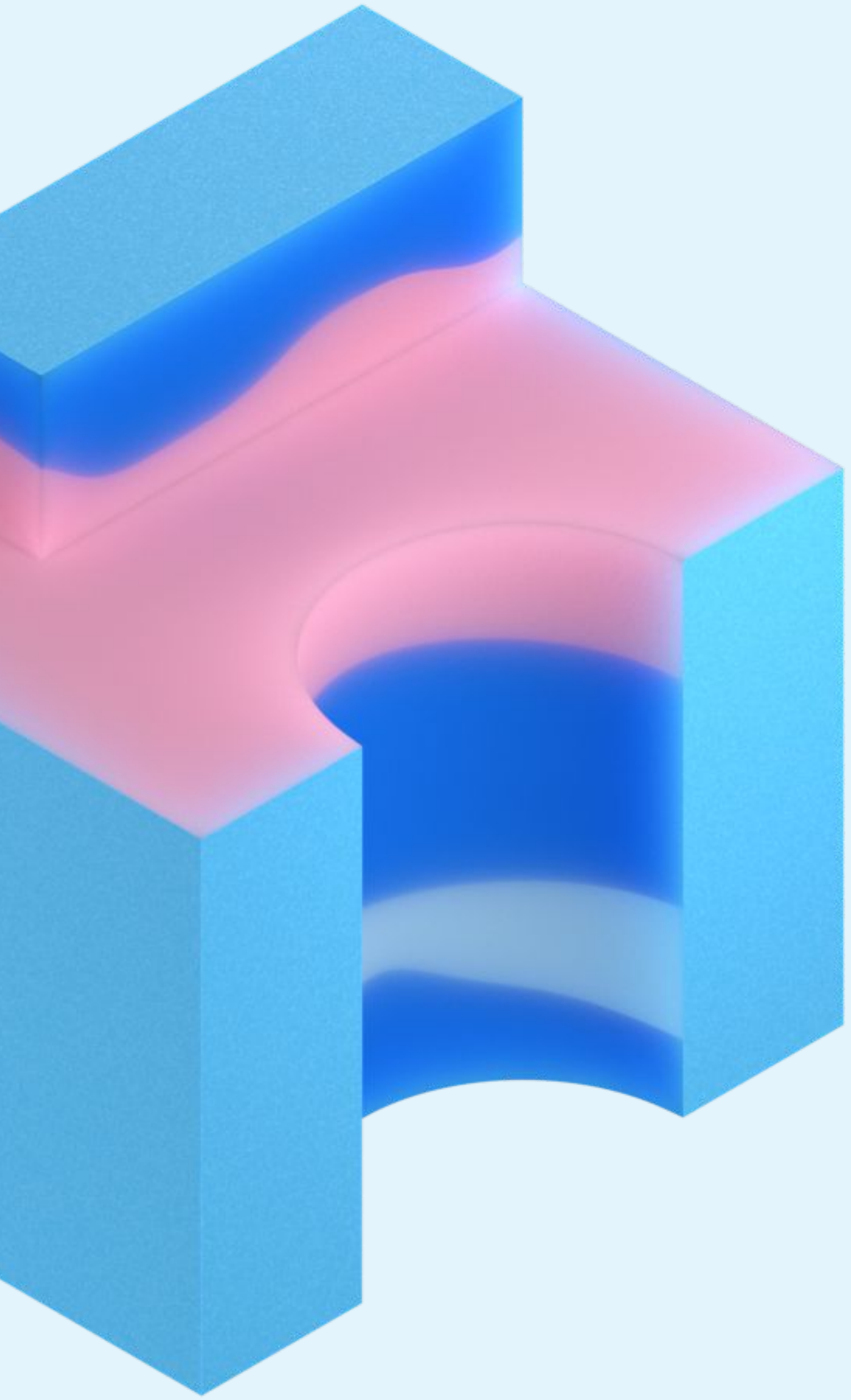
Fairness means treating individuals from different groups equally



Fairness through unawareness is <u>not sufficient</u> to guarantee equal treatment for individuals in protected groups

Careful consideration is necessary when designing decision systems

Data

- Inherent data biases
- Reasoned vetting of variables
- True measures of latent risk
- Measure the protected attribute

Modelling

- Quantify feature contributions
- Tune for fairness
- Bias in, bias out

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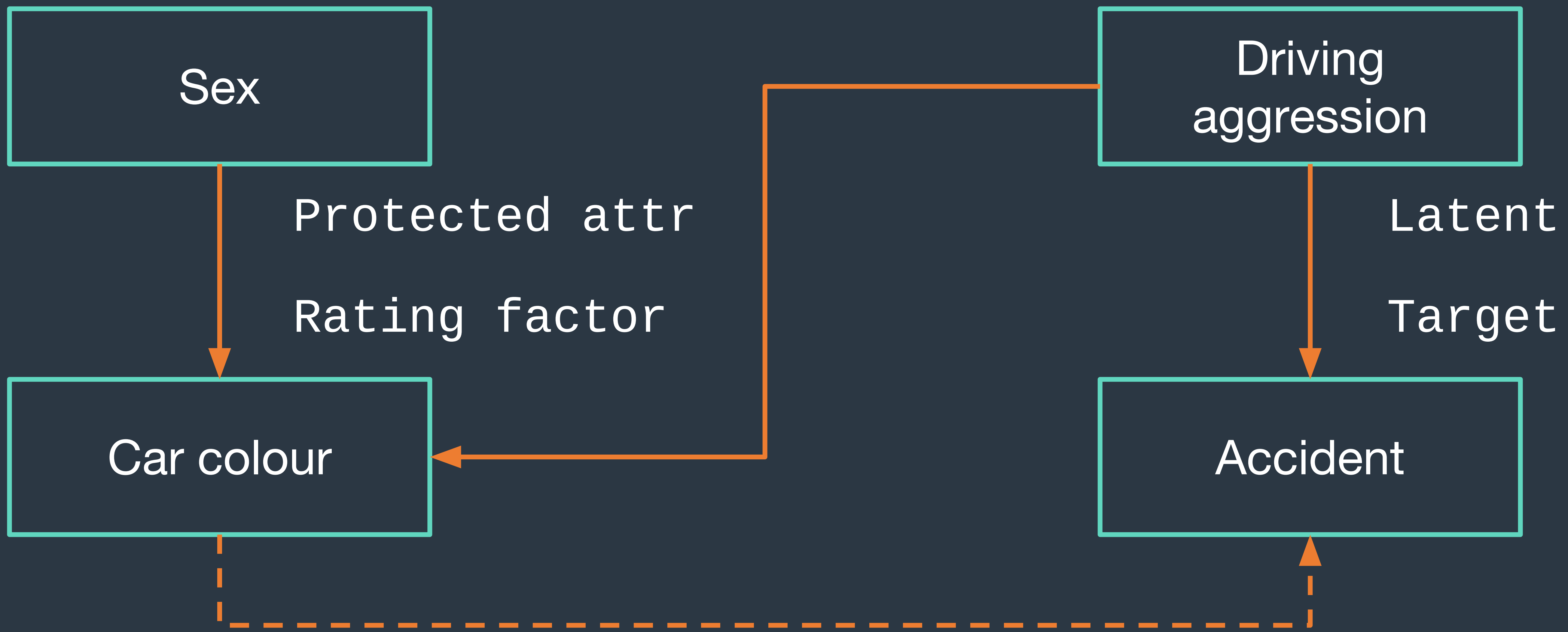
Protected attributes encoded in “harmless” rating factors



Kusner, Loftus, Russell, Silva (2018)
"Counterfactual Fairness"

Strategies for fairer pricing in insurance

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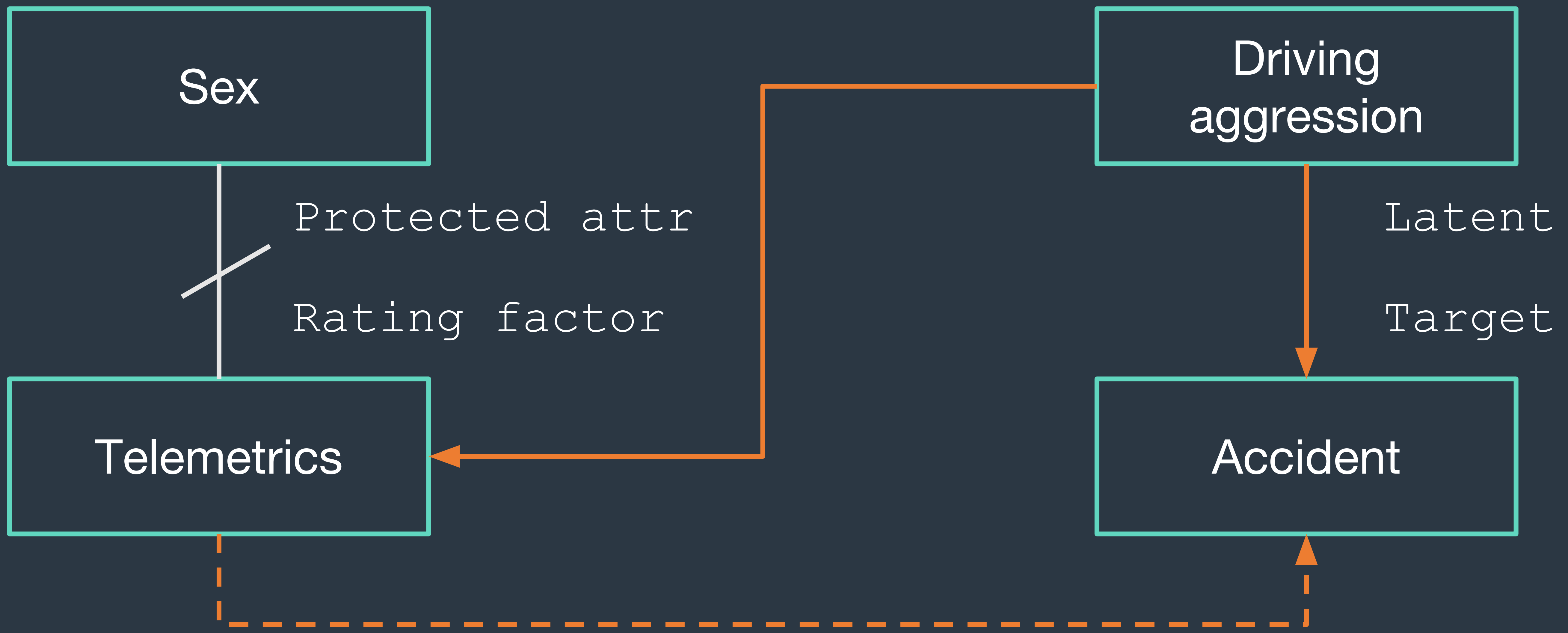
1. Observe relevant rating factors



2. Adjust premiums to optimise metrics of fairness

- Profit (accuracy)
- False positive rate, equal opportunity (FP/N)
- False negative rate (FN/P)
- Equalised odds (FPR & FNR)
- Equality of opportunity (FPR)
- Calibration (true probabilities)
- Demographic parity

Actual \ Predicted	No loss	Loss
No loss	TN	FP
Loss	FN	TP

Confusion matrix per protected group

Berk, Heidari, Jabbari, Kearns, Roth (2017) "Fairness in Criminal Justice Risk Assessments: The State of the Art"

Kleinberg, Mullainathan, Raghavan (2016) "Inherent Trade-Offs in the Fair Determination of Risk Scores

3. Design and train algorithms with fairness baked-in

- Structural models
  - Kilbertes, et. al. (2018) "Avoiding discrimination through causal reasoning"
  - Kusner, Loftus, Russell, Silva (2018) "Counterfactual Fairness"

- Penalised / constrained loss functions
  - Zafar, et. al. (2017) "Fairness Beyond Disparate Treatment & Disparate Impact"
  - Zhao, et. al. (2017) "Men Also Like Shopping: Reducing Gender Bias Amplification using Corpus-level Constraints"

- Model inspection
  - Tan, Caruana, Hooker, Lou (2018) "Detecting Bias in Black-Box Models Using Transparent Model Distillation"

Example: Restaurant shutdown

Rating factor: Cuisine type = Krusty Burgers

Protected attribute: Shelbyville or Springfield resident

Solutions:
1. Observe management quality, menu, online reviews...
2. Geographic analysis of offered premium (adjust?)
3. Use fairness-calibrated algos

Summary

Data-driven modelling and machine learning can improve fairness by

1) Find better approximations of latent risk
2) Quantify effects on domain-specific fairness metrics
3) Calibrate decision making process to optimise fairness

Questions?

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