



Universidade Federal de Minas Gerais
Instituto de Ciências Exatas
Departamento de Ciência da Computação

Plano de Ensino –2022/2

Código	
Disciplina	Causalidade em Aprendizado de Máquina
Turma	A definir.
Horário	Seq-Qua - 17:00-18:40
Professor	Anisio Mendes Lacerda
Público	Graduação e Pós
Área	Sistemas Inteligentes

EMENTA: Ementa variável, focalizando tópicos em Ciência da Computação.

Course overview

This course provides an introduction to causality based on potential outcomes (aka counterfactuals) and graphs. As machine learning are increasingly intervening to improve people's work and daily tasks, it is fundamental to correctly understand the causal effects of these interventions.

Traditional machine learning methods, built on pattern recognition and correlational analyses, are insufficient for causal analysis. Several of the questions that we would like to answer about data are ultimately causal questions, i.e., questions about the effect of one variable on another or counterfactual questions of "what if". For instance:

- Will this recommendation strategy lead to more clicks?
- How effective is a given treatment in preventing a disease?

Causal inference, especially from observational data, is an emergent topic in machine learning and artificial intelligence areas. In this course, we will study various perspectives on causality and motivate the causal inference through examples in domains such as recommender systems, perceptive learning, social media, and health. We will use Jupyter notebooks to demonstrate how core concepts translate to empirical tasks focusing on large-scale datasets.

Course pre-requisites

There is no formal pre-requisite. It is expected basic concepts on probability and statistics. During the course, important concepts will be reviewed before used. Machine Learning course desirable but not required.

If you have trouble following the material that is being presented please contact me as soon as possible. I am always happy to provide additional material or clarifications, if requested.

Course coverage material

Counterfactual reasoning (bayesian graphical models and potential outcomes), confounding, d-separation, randomized experiments, observational methods (matching and stratification), causal graphs, structural equation models, machine learning tasks (regression, classification, clustering, recommender systems).

Course bibliography

- *Statistical Rethinking: A Bayesian Course with Examples in R and STAN*, Richard McElreath, Chapman & Hall/CRC, 2nd edition, 2020
- *Regression and Other Stories*, Andrew Gelman, Jennifer Hill, and Aki Vehtari, Cambridge University Press, 1st edition, 2020.
- *Causal Inference in Statistics: A Primer*. J. Pearl, M. Glymour, N. Jewell, Wiley, 2016.

Complementary bibliography

- *Causality, Models, Reasoning and Inference*. J. Pearl, Cambridge University Press, Cambridge, 2nd Edition, 2009.
- *Counterfactuals and Causal Inference*. S. L. Morgan, C. Winship, Cambridge University Press, 2007.
- *Actual Causality*. J. Y. Happen, The MIT Press, 2016.
- *Observation and Experiment: An Introduction to Causal Inference*. P. R. Rosenbaum, Harvard University Press, 2017.
- *The Book of Why: The New Science of Cause and Effect*. J. Pearl and D. Mackenzie, Basic Books, 2018.