

Introduction to Causal Inference 3 credits

Introduktion till kausal slutledning 3 hp

Second cycle

Main field: Computer Science and Engineering, Second cycle, has only first-cycle course/s as entry requirements (AIN)

Syllabus is adopted by the Research and Education Board (2022-11-02) and is valid for students admitted for the spring semester 2023.

Placement in the Academic System

The course is a single subject course.

Prerequisites and Conditions of Admission

Degree of Bachelor of Science including an independent project 15 credits or Degree of Bachelor of Science in Engineering including an independent project 15 credits, or the equivalent of 180 Swedish credit points or 180 ECTS credits at an accredited university.

5 credits machine learning and 3 credits statistics.

Applicants must have written and verbal command of the English language equivalent to English course 6 in Swedish UpperSecondary School.

Course Objectives

This course aims to discuss how to extract causal information from empirical data. This course also discusses some examples that show how to use causal inference topics in machine learning contexts.

Following successful completion of the course the student should be able to:

Knowledge and understanding

- learning by heart the terminology of causal inference
- describing the difference between causation and correlation
- applying existing methods for calculating expected outcomes or causal graphs

Skills and ability

- formulating key ideas and assumptions of causal inference methods
- implementing causal inference methods for real problems
- using standard tools and libraries for causal inference

Judgement and approach

- determining what advances causal inference methods can bring to the machine learning field

- reflecting when to apply which causal inference methods

Primary Contents

This course contain the definition of cause and effect, Randomized Experiments, do-calculus and graphical models. The primary content of the course answers the following questions:

- Why causal inference? How causal inference can improve decision making?
- What would be the potential outcome given a certain decision?
- How to represent different causal relations in terms of what causes what?
- How can machine learning methods take advantage of causal inference concepts?

Teaching Formats

Each lecture is delivered through a video conference tool offered by university teaching platform, and followed by a practical lab assignment in Python, provided as a Jupyter notebook, which allows the students to dig into the concepts presented in the lecture and put them to practice.

Teaching is in English and online.

Examination

The overall grades of Fail or Pass will be awarded for the course.

Exams will consist of completed labs and project. The project is defined as individual and it is going to be examined orally.

Name of the test		Grading
Lab Exercises	2 credits	U/G
Project	1 credits	U/G

Course Evaluation

If there are special reasons, the examiner may make exceptions from the specified examination format and allow a student to be examined in another way. Special reasons can e.g. be a decision on learning support.

Course evaluation is part of the course. This evaluation should offer guidance in the future development and planning of the course. Course evaluations should be documented and made available to the students.

For elite sports students according to Riktlinjer för kombinationen studier och elitidrott vid Högskolan i Halmstad, DNR: L 2018/177, the examiner has the right to decide on an adapted examination component or let the student complete the examination in an alternative way.

Course Literature and Other Study Resources

Brady Neal. *Introduction to Causal Inference (ICI) from a Machine Learning Perspective*. https://www.bradyneal.com/Introduction_to_Causal_Inference-Dec17_2020-Neal.pdf.

Jonas Peters, Dominik Janzing, and Bernhard Schölkopf. *Elements of Causal Inference: Foundations and Learning Algorithms*. The MIT Press Cambridge, 2017

Judea Pearl. *An Introduction to Causal Inference*. Defense Technical Information Center, 2009