EPFL

CIVIL-459 | **Deep learning for autonomous vehicles**

Alahi Alexandre

Cursus	Sem.	Type
Civil Engineering	MA2, MA4	Opt.
Electrical and Electronical Engineering	MA2, MA4	Opt.
Robotics, Control and Intelligent Systems		Opt.
Robotics	MA2, MA4	Opt.

Language of teaching	English
Credits	6
Session	Summer
Semester	Spring
Exam	During the semester
Workload	180h
Weeks	14
Hours	**6 weekly**
Lecture	2 weekly
Exercises	4 weekly
Number of positions	

Summary

Deep Learning (DL) is the subset of Machine learning reshaping the future of transportation and mobility. In this class, we will show how DL can be used to teach autonomous vehicles to detect objects, make predictions, and make decisions. (Fun fact: this summary is powered by DL)

Content

1. Introduction:
- Defining Autonomous Vehicles, Artificial Intelligence, Machine Learning, and Deep learning
- Overview of the 3 pillars of Autonomous Vehicles: Perception, Prediction, Planning
- Quick overview of sensing modalities
2. Deep learning for Perception (how to extract meaningful information from raw data?)
- Quick recap on the fundamentals of machine learning (fundamentals of regression and classification)
- Intro to deep learning (Neural Network, CNN, regularization techniques)
- State-of-the-art techniques (e.g., Self supervised learning, Vision Transformer)
3- Deep learning for Prediction
- Intro to Recurrent Neural Networks
- Learning to clone socially-accepted human behavior
- State-of-the-art techniques (e.g., Graph Neural Network, Transformer, Diffusion...)
3- Deep Learning for Planning
4- Beyond Deep Learning: role of ethics
- How to integrate ethical decisions?

Keywords

Deep Learning, Autonomous Vehicle, Artificial intelligence, Machine learning, Self-driving car, human-robot tandem race

Learning Outcomes

By the end of the course, the student must be able to:
- Define the fundamental steps behind an AI-driven system
- Design the building steps of an autonomous vehicle
- Implement an algorithm for each step
- Explain and understand the challenges and ethical impacts

Teaching methods

Ex cathedra

Assessment methods

- Lab projects (Individual): 30%
- Midterm (Individual): 30%
- Final project (in group): 40%

Resources

Moodle Link

- https://go.epfl.ch/CIVIL-459