# Deep Reinforcement Learning for Autonomous Systems

This work of this thesis was developed at EURECOM (Sophia Antipolis, France)
in collaboration with
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Prof. Elena Baralis (Politecnico di Torino)

Good morning,

Today I am going to present you the work of my thesis project about Deep Reinforcement Learning algorithms applied to Autonomous Systems. I developed this thesis during my stay at Eurecom in the south of France under the external supervision of Pietro Michiardi and the internal guidance of prof. Elena Baralis.

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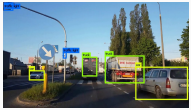
This presentation consists of four main parts:

- In the first part, I will outline the crucial concepts underlying autonomous system technology and the reinforcement learning approach. These two research fields are the baseline of this work.
- The second part will be dedicated to the description of the control system we design to make things work together to build up a solid foundation for the reinforcement learning experimentation part. This part represents the first contribution of this thesis.
- In the third part, we will discuss the experimental methodology used with a showcase of the results obtained together with a constructive comment.
- In the final part, we will analyse what we reached to be able to propose further improvement and research for future work.

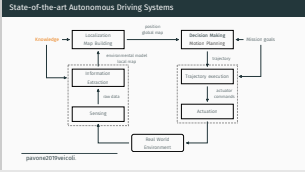

Autonomous systems and self-driving vehicles are attracting much attention from both the research community and industry due to their potential to revolutionise mobility and transport. Nowadays, this technology is based on a comprehensive understanding of the surrounding environment. This fact is made possible thanks to the substantial usage of sensors and camera to gather useful information. The most crucial sensors used are cameras, LIDAR, Short and Long-range Radar and GPS for coarse localisation.

State-of-the-art Autonomous Driving Systems



**Deep Learning** and **Machine Learning** are mainly exploited in object detection and recognition.

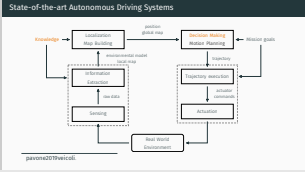
In this scenario, Deep Learning and Machine Learning are mainly exploited for object detection and recognition, while the implementation of the decision-making component is left to control optimisation algorithms.



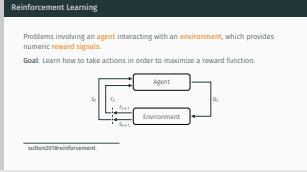

This schema outlines the crucial components of the modern autonomous driving car technology together with the interactions among them.

- At the bottom, we have the surrounding environment.
- In the left section, we have a stack of components from the raw data to feature extraction.
- The right section is the decision-making part, where the algorithm decided what action to make.

Nowadays, we find the application of ML and DL only in the left part to extract features that a control optimisation algorithm will exploit to select what to do deterministically.




The idea underlying this project is trying to implement artificial intelligence inside this decision-making part.




Reinforcement Learning is a paradigm of machine learning that formalises and tries to solve decision-making tasks. In this formalisation, we can find:

- The agent - the brain, the entity that makes decisions.
- The environment: it is everything external to the agent.
- The actions, the mean by which agent can interact and influence the environment.