Course guide
240277 - 240AU134 - Automotive Artificial Intelligence

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications.

Degree: MASTER’S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Optional subject).
MASTER’S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2019). (Optional subject).

Academic year: 2022  ECTS Credits: 4.5  Languages: Catalan, Spanish

LECTURER

Coordinating lecturer: Morros Rubio, Josep Ramon
Others: Vilaplana Besler, Veronica
Marques Acosta, Fernando
Casas Pla, Josep Ramon

PRIOR SKILLS

Vector and matrix algebra

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEAU10. (ENG) Aplicar mètodes d'aprenentatge automàtic i mineria de dades a problemes de conducció assistida tals com planificació de rutes eficients i a problemes d'interfícies home/màquina, tals com la interpretació i generació de comunicació parlada o la interpretació d'escesnes (competència específica de l’especialitat Vehicle Conectat i Conducció Assistida).
CEAU 9. (ENG) Aplicar el funcionament de sensors tals com vídeo, infrarrojos, RADAR, LIDAR en l’àmbit de l’automoció, així com validar la seva comptabilitat electromagnètica.

TEACHING METHODOLOGY

- Lectures
- Individual work (distance)
- Mid and final term exams

LEARNING OBJECTIVES OF THE SUBJECT

The aim of this course is to provide an overview of the concepts and applications of artificial intelligence in the automotive environment. We will introduce machine learning and computer vision techniques of relevance in the automotive field, such as optical flux calculation, video segmentation, and object detection and tracking. Application examples will also be shown.

Learning outcomes of the subject:

- Ability to understand and use machine learning and image and video analysis techniques.
- Ability to use machine learning and computer vision algorithms to implement high-level applications.
## CONTENTS

### 1. Introduction

**Description:**
- Motivation, use of AI in automotive applications
- Problems and solutions

**Full-or-part-time:** 1h  
Theory classes: 0h 30m  
Self study : 0h 30m

### 2. Computer Vision

**Description:**
- Image formation, perception, 3D sensors
- Linear filters, contour detection, feature detection: corners, descriptors
- Lines and shapes: Hough transform.
- Segmentation
- Optical flow and tracking
- 3D

**Full-or-part-time:** 40h  
Theory classes: 20h  
Self study : 20h

### 3. Artificial Intelligence and Machine Learning

**Description:**
- Introduction to machine learning
- Supervised models
- Linear regression
- Logistic regression
- Overfitting and underfitting
- Bias-variance trade-off
- Evaluation metrics
- Cross-validation
- Support Vector Machines
- Neural Networks
- Regularization
- Introduction to deep learning
- Convolutional Neural Networks

**Full-or-part-time:** 20h  
Theory classes: 10h  
Self study : 10h
4. Applications

**Description:**
- Lidar Imaging Systems for Autonomous Vehicles
- Stereo, Lidar and Pseudo Lidar.
- Data Fusion and Calibration Models
- Vision applications in automotive industry: detection, SLAM
- Experience in FS Driverless UPC (Perception and Control)

**Full-or-part-time:** 20h
- Theory classes: 10h
- Self study: 10h

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**GRADING SYSTEM**

First-term examination: 40%
Second term examination: 40%
Exercises assessments: 20%

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**BIBLIOGRAPHY**

**Basic:**

**Complementary:**

**RESOURCES**

**Hyperlink:**
- Google Python's class:. https://developers.google.com/edu/python/