Universitat Autònoma de Barcelona

2020/2021

Autonomous Vehicles

Code: 104551
ECTS Credits: 6

Degree	Type	Year	Semester
2503743 Management of Smart and Sustainable Cities	OT	3	2

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

Name: Antonio Manuel López Peña
Email: AntonioManuel.Lopez@uab.cat

Use of Languages

Principal working language: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

Teachers

Juan Carlos Moure Lopez
Sergio Villar Mesurado

Prerequisites

It is recommended to have completed the subjects of Computer Science, Data Science and Programming of Applications for the Internet.

Objectives and Contextualisation

In this subject, autonomous vehicles are described as an essential piece for the mobility of future smart cities. The main objective is that the students can understand the different paradigms that are being developed for creating the artificial intelligence that performs the functions of a human driver. Therefore, issues related to vehicle perception (sensors, machine learning, computer vision), maneuver planning and control of the vehicle, as well as computation technologies on-board these vehicles, will be discussed.

Competences

- Integrate cyberphysical systems based on the interrelationship between information technology and physical processes in urban environments.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Work cooperatively in complex and uncertain environments and with limited resources in a multidisciplinary context, assuming and respecting the role of the different members of the group.

Learning Outcomes

1. Identify the challenges of mobility in smart cities.
2. Model the technological components of a cyberphysical system.
3. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
4. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
5. Use the technology of autonomous vehicles.
6. Work cooperatively in complex and uncertain environments and with limited resources in a multidisciplinary context, assuming and respecting the role of the different members of the group.

Content

1. Perception of the environment, planning and control: sensors, artificial intelligence, on-board computer system, etc.
2. Simulation: CARLA

Methodology

The subject follows the guidelines of a continuous assessment based on a team project. Therefore, the subject will have a mainly practical character. To develop the project, and once the equipment is established, the main activities are the following:

Classes of theory: they introduce the necessary concepts related to sensors, perception, planning & control, and embedded computing, focused on the field of autonomous vehicles. These concepts will contextualize the project to be developed.

Preparatory exercises: the project to be developed will require previous practical knowledge, more typical of computer science, therefore, preparatory exercises are required so that students can approach this project with greater guarantees of success.

Supervision and feedback: given the nature of a continuous evaluation and to guarantee the success in the development of the project, it is necessary that the faculty can supervise and receive weekly feedback from the teams. In this process, the faculty can assess the contribution of each team member to the development of the project.

Briefing and laboratory work: to maximize the face-to-face work of the teams in the laboratory sessions, they will have to carry out previous briefings where they put in common the work done up to now and the problems that have arisen, and in turn they will have to plan the work to perform until the next briefing (at the level of laboratory sessions and in non-directed work time).

All these activities will be complemented by additional non-directed work, mainly used in tasks related to the project under development, and, of course, also employed in studying for individual exams.

Depending on the resources available in the subject, as well as the number of students enrolled, the teams will be made of between 4 and 8 members.

All communications withthe students will be done through the virtual campus mechanisms.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Briefing and Lab work	24	0.96	2, 6, 5
Preparatory exercises	12	0.48	2, 3, 6, 5

Supervision and feedback	6	0.24	3, 6, 5
Theory classes	12	0.48	1, 2, 4, 3
Type: Autonomous			
Study for individual exams	15	0.6	1, 2, 4, 3, 6, 5
Tasks related to the project	75	3	2, 3, 6, 5

Assessment

The final grade (NA) will be based on the following grades:

Theory (NT): an exam will be carried out to evaluate the theoretical concepts.

Exercises (NE): an exam will be carried out to evaluate the preparatory exercises.

Project (NPCont / NPComp / NPEx): by means of the documentation requested by the lecturers and a final presentation, the final result of the project will be assessed; in addition, the continued progress to reach that result will also be taken into account. We will call NPCont to this grade. Mechanisms will be established to ensure that all team members have contributed similarly in the achievement of the project. This will be done through the direct observation by the lecturers (thanks to the supervision and feedback activities) and from student peer evaluations. If a case is detected in which a student has not done his or her work or has a marginal contribution, the student involved may receive a lower grade, even more, since we are in a continuous evaluation, the student can suspend the subject directly (grade of zero). In any case, we will call NPComp to this individual grade. Finally, there will be an exam to evaluate the knowledge of each student in relation to the project, this grade is called NPEx.

In order to pass the subject, the NT, NE, NPCont, NPComp, and NPEx grades must be pass, that is, each one must be> = 5 out of 10.

[Opportunity 1]

Calculation of NA from cases applied exclusively in the order indicated below:

Case 1: (NPCont <5) Then NA: = NPCont; // Fail, not recoverable. Final grade is the minimum between 4.5 and NPCont

Case 2: (NPComp <5) Then NA: = NPComp; // Fail, not recoverable. Final grade is the minimum between 4.5 and NPComp

Case 3: (NT <5 or NE <5 or NPEx <5) Then The student has to apply to [Opportunity 2];

Case 4: (NT> = 5 and NE> = 5 and NPCont> = 5 and NPComp> = 5 and NPEx> = 5) Then NA: = 0.4 * NPCont + 0.2 * NPComp + 0.1 * NPEx + 0.2 * NT + 0.1 * NE // In this case it is ensured that the subject is passed.

[Opportunity 2]

In this case, the student must pass another exam where, independently of the previous grades, both theory questions and preparatory exercises, as well as questions related to the project, can be included. We will call NR to the grade resulting from this exam. In this case, the calculation of NA will be made from the following cases applied in an exclusive manner in the order indicated below:

Case 1: (NR <5) Then NA: = NR; // Subject definitely failed. Final grade is the minimum between 4.5 and NR

Case 2: (NR> = 5) Then NA: = minimum (7; 0.4 * NR + 0.3 * NPCont + 0.3 * NPComp); // The maximum grade is 7

It is understood that the "non-evaluable" students are only those who have not undergone any evaluation activity.

The number of MH (Excellent with Honors) that can be granted is proportional to the number of students enrolled. In order to obtain MH the student must have NA> 9 in the Opportunity 1. Let's say that "N" MH can be granted. From there, if there are more than N candidates, the teacher will examine the trajectory of the candidate students to MH and select the N. Therefore, it is the teacher who evaluates the evidence that considers more timely (continuous work, relevance within the team, NA, etc.) to make the final decision.

Regarding transversal competences, note that the whole subject is inherently linked to T01 due to the project around which it is articulated. On the other hand, NPCont and NPComp quantify this particular competence.

It should also be noted that the students repeating the subject will not receive any special treatment, they must take the subject as the rest of the students.

Without prejudice to other disciplinary measures deemed appropriate, and in accordance with current academic regulations, will be qualified with a zero the irregularities committed by a student that may lead to a variation of the qualification of an evaluation act. Therefore, plagiarizing, copying or allowing a practice to be copied or any other evaluation activity will involve suspending with a zero and cannot be recovered in the same academic year. If this activity has a minimum associated grade, then the subject will be suspended.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Continuous development of the project	40%	2	0.08	3, 6, 5
Personal assessment of the developed project	(20% + 10%)	1	0.04	2, 4, 3, 6, 5
Preparatory exercises	10%	1	0.04	5
Theory	20%	2	0.08	1, 2, 4, 3

Bibliography

Autonomous driving is a very new multidisciplinary field, in constant change because much research is still necessary. This makes it difficult to have a bibliographic corpus of reference compact enough to be useful to students. In addition, from the moment in which this subject guide has to be closed until the classes begin, there is a delay of almost eight months, which is a lot in this field. Therefore, the bibliography of each course will be established at the beginning and, of course, it will also include the materials prepared by the lecturers.