UNIVERSIDADE DA CORUÑA

Teaching Guide				
Identifying Data				2019/20
Subject (*)	Robotics		Code	614G01098
Study programme	Grao en Enxeñaría Informática			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	2nd four-month period	Fourth	Optional	6
Language	English			
Teaching method	Face-to-face			
Prerequisites				
Department	Ciencias da Computación e Tecnoloxías da InformaciónComputación			
Coordinador	Santos Reyes, Jose	E-mail	jose.santos@udc.es	
Lecturers	Becerra Permuy, Jose Antonio Bellas Bouza, Francisco Javier Santos Reyes, Jose	E-mail	jose.antonio.becerra.permuy@udc.es francisco.bellas@udc.es jose.santos@udc.es	
Web				
General description	This course is focused in the main concepts of autonomous robotics, emphasizing the automatic design of control strategies. The specific contents range from the classical control approaches to the newest based on computational intelligence principles, like artificial neural networks, evolutionary algorithms and reinforcement learning.			

Study programme competences / results	
Code	Study programme competences / results
A43	Capacidade para adquirir, obter, formalizar e representar o coñecemento humano nunha forma computable para a resolución de problemas mediante un sistema informático en calquera ámbito de aplicación, particularmente os relacionados con aspectos de computación, percepción e actuación en ambientes ou contornos intelixentes.
B1	Capacidade de resolución de problemas
B3	Capacidade de análise e síntese
B9	Capacidade para xerar novas ideas (creatividade)
C6	Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.
C8	Valorar a importancia que ten a investigación, a innovación e o desenvolvemento tecnolóxico no avance socioeconómico e cultural da sociedade.

Learning outcomes			
Learning outcomes	Study programme competences / results		
Develop an autonomous control system for its operation in a real environment	A43	B1	C6
Know the non-resolved problems in autonomous robotics	A43	B1 B9	C6 C8
Know the problems of sensing and actuation in systems that operate in the real world and real time	A43	B1	C6
Know the problems of knowledge representation in autonomous robotics	A43	B1 B9	C6
Know the problems to tackle when an autonomous robotic control system is developed	A43	B1 B3 B9	C6 C8

Contents	
Topic	Sub-topic

Introduction to autonomous robotics	¿What is an autonomous robot? History Sensors and actuators Behaviors Planning Learning and evolution
Elements of a robotic system	Robotic system Actuators and effectors Sensors Control architectures
Behavior-based robotics	Antecedents Classical control architectures Control architectures
Knowledge-based robotics	Knowledge Traditional deliberative robotics Navigation
Hybrid approximations	Main hybrid architectures Cognitive robotics
Evolutionary robotics	Evolutionary algorithms Application to robotics
Learning in autonomous robotics	Learning in classifier systems Reinforcement learning: Q-learning Combination of reinforcement and connectionist learning

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Laboratory practice	A43 B9 B1	21	21	42
Supervised projects	B1 B3 B9 C6 C8	0	30	30
Oral presentation	B3 B9 C8	4	28	32
Guest lecture / keynote speech	C8 C6	21	21	42
Personalized attention		4	0	4
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	Description
Laboratory practice	Lab. sessions in which the teachers will explain the robotic platform and its development software in detail. Moreover, during these sessions, the students must perform the design, implementation and validation of the supervised projects under the supervision of a teacher.
Supervised projects	Programming exercises that must be developed using the selected robotic platform. These exercises will be carried out in an autonomous way and their progress will be supervised by the teachers
Oral presentation	Theoretical work about a specific topic from the contents that will be orally presented and discussed with other students
Guest lecture / keynote speech	Oral exposition by the teachers of the theory of the subject.

Personalized attention	
Methodologies	Description

Laboratory practice Supervised projects Oral presentation	During the lab practices and tutorials, the student can consult the teacher all the doubts that appear about the realization of the formulated practical problems or about the use of the simulator or the real robot. Supervised projects: It is recommendable the use of a personal assistance in these activities to resolve conceptual doubts or procedures than can appear during the resolution of the practical problems. Also, the personal assistance will be focused on in the explanation, by the student, of the proposed solution. Oral presentation: the students' progress in their theoretical work must be supervised by the teachers, both in terms of contents and format.

Assessment			
Methodologies	Competencies / Results	Description	Qualification
Laboratory practice	A43 B9 B1	The attendance to the laboratory classes will be considered in the final mark	5
Guest lecture / keynote speech	C8 C6	The attendance to the keynote speeches will be considered in the final mark	5
Supervised projects	B1 B3 B9 C6 C8	Different programming projects will be proposed along the course that must be carried out in an autonomous way by the student and that will be presented and explained to the teachers afterwards. It is mandatory to pass this methodology independently in order to pass the whole subject.	50
Oral presentation	B3 B9 C8	The oral presentation, the participation in the discussion and the written inform will be considered in the final mark. It is mandatory to pass this methodology independently in order to pass the whole subject.	40

Assessment comments
Evaluation of this course is based on independently overcoming the two main methodologies: supervised projects and oral presentation. The first one focuses on the practical demonstration of the knowledge and skills acquired to solve problems in autonomous robotics, and the second one in the completion and presentation of a paper on a specific topic within theoretical agenda. Thus, if the student does not pass the subject in the ordinary call, he / she shall repeat all activities that were not passed in the extraordinary call. As an example, if a student passed the oral presentation but failed the supervised projects, he / she shall repeat these. Students with part-time enrollment can displace the 5% of the qualification of the attendance to the other activities, both in theory and in practice, in case they can not regularly attend classes. This change in the qualification methodology shall be applied to teachers of the subject at the beginning of the course.

Sources of information	
Basic	- Santos, J., Duro, R.J. (2005). Evolución Artificial y Robótica Autónoma. RA-MA - Arkin, R.C. (1998). Behavior Based Robotics. MIT Press - Mataric, Maja J. (2007). The Robotics Primer. MIT Press - Bekey, A. (2005). Autonomous Robots. MIT Press
Complementary	- Santos, J. (2007). Vida Artificial. Realizaciones Computacionales. ServicioPublicaciones UDC - Nolfi, S., Floreano, D. (2000). Evolutionary Robotics. MIT Press - Floreano, D. and Mattiussi, C. (2008). Bio-Inspired Artificial Intelligence. Tema 7. MIT Press - Pfeifer, R. and Scheier, C. (1999). Understanding Intelligence. MIT Press - Salido, J. (2009). Cibernética aplicada. Robots educativos. Ra-Ma - Sutton, R.S., Burton A.G. (1998). Reinforcement Learning. MIT Press - Thurn, S., Burgard, W., Fox, D. (2005). Probabilistic Robotics. MIT Press

Recommendations
Subjects that it is recommended to have taken before

Intelligent Systems/614G01020 Knowledge Representation and Automatic Reasoning/614G01036 Intelligent Systems Development/614G01037 Machine Learning/614G01038
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Other comments
Para axudar a conseguir unha contorna inmediata sustentable e cumprir co obxectivo da acción número 5: "Docencia e investigación saudable e sustentable ambiental e social" do "Plan de Acción Green Campus Ferrol" a entrega dos traballos documentais que se realicen nesta materia: 1. Solicitarase en formato virtual e/ou soporte informático   2. Realizarase a través de Moodle, en formato dixital sen necesidade de imprimilos   3. De se realizar en papel: - Non se empregarán plásticos.   - Realizaranse impresións a dobre cara.   - Empregarase papel reciclado.   - Evitarase a impresión de borradores.