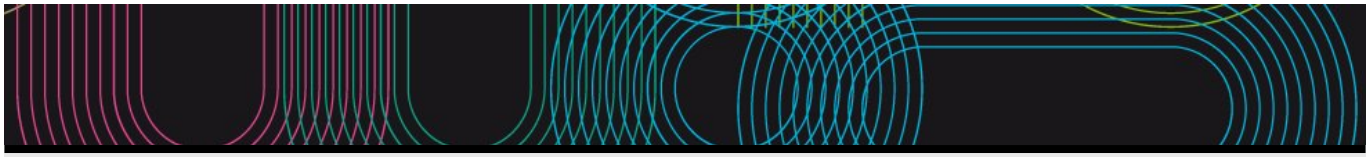

IDENTIFYING DATA				
Intelligent systems programming				
Subject	Intelligent systems programming			
Code	V05G300V01943			
Study programme	Degree in Telecommunications Technologies Engineering - In extinction			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	English			
Department				
Coordinator	Burguillo Rial, Juan Carlos			
Lecturers	Burguillo Rial, Juan Carlos Costa Montenegro, Enrique García Méndez, Silvia			
E-mail	jrial@uvigo.es			
Web	http://http://faitic.uvigo.es			
General description	Technologies related to artificial intelligence, machine learning and intelligent distributed systems (e.g. on the Internet of Things) have significantly impacted the labor market in the past decade. In this course we will address these concepts, starting with the notion of agent, to understand what it is, how to build it and how these agents can interact to model and solve complex problems giving rise to multi-agent systems. In the second part of the course, concepts of game theory and self-organized systems will be introduced. Finally, in the last part of the course, classic artificial intelligence techniques will be reviewed, the basic concepts of machine learning, deep learning; as well as the current platforms/libraries that facilitate its design and development. As part of the practices of the subject, students will learn to program intelligent systems, using classic artificial intelligence techniques and machine learning libraries. They will also carry out a common work, in a group, where they will extend what they have learned in class to topics of their personal interest and developed on Android mobile terminals. This course will be taught in English. However, students have the possibility to interact with teachers in Spanish or Galician if necessary. All the documentation for the course will be in English.			

Competencies	
Code	
B3	CG3: The knowledge of basic subjects and technologies that enables the student to learn new methods and technologies, as well as to give him great versatility to confront and adapt to new situations
B4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
B9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
C86	(CE86/OP29) The ability to program computer applications and services based on artificial intelligence.
D2	CT2 Understanding Engineering within a framework of sustainable development.
D3	CT3 Awareness of the need for long-life training and continuous quality improvement, showing a flexible, open and ethical attitude toward different opinions and situations, particularly on non-discrimination based on sex, race or religion, as well as respect for fundamental rights, accessibility, etc.
D4	CT4 Encourage cooperative work, and skills like communication, organization, planning and acceptance of responsibility in a multilingual and multidisciplinary work environment, which promotes education for equality, peace and respect for fundamental rights.

Learning outcomes			
Expected results from this subject	Training and Learning Results		
To understand the basic concepts of intelligent systems: search, reasoning and learning.	B3 B4 B9		D2 D3 D4
To know the main concepts related with intelligent agents and multiagent systems.	B3	C86	D2 D3
To understand the basic concepts of software engineering in intelligent systems.	B3	C86	
To achieve a suitable level of expertise in the use of IDEs for programming intelligent systems.		C86	D2
To acquire skills in the design and development of intelligent services applied to electronic devices.		C86	D2 D3 D4
To acquire skills for the application of intelligent systems in complex telematic services.		C86	D2 D3 D4

Contents	
Topic	
Introduction to Intelligent Systems	a) Searching b) Reasoning c) Learning
Intelligent Agents	a) Defining an intelligent agent b) Architectures for intelligent agents c) Learning and adaptability
Multiagent Systems	a) Distributed Artificial Intelligence and multiagent systems b) Communication between agents: KQML, FIPA-ACL c) Coordination and protocols of interaction d) Mobile agents
Agent-oriented Software Engineering	a) Programming and methodologies oriented to agents b) Agents vs. Objects c) Agents vs. Expert Systems d) The JADE development platform
Multiagent Systems and Game Theory	a) Cooperation vs. Competition b) Negotiation c) Auctions d) Electronic Commerce
Multiagent Systems and Self-organization	a) Defining a self-organized system b) The concept of emergence
Learning in Intelligent Systems	a) Machine Learning techniques b) Reinforcement Learning c) Neural Networks d) Deep Learning

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	2	0	2
Lecturing	16	32	48
Laboratory practical	14	42	56
Debate	2	0	2
Discussion Forum	0	2	2
Mentored work	7	28	35
Objective questions exam	1	4	5
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Introductory activities	We start doing a generic introduction to the aims, and the global contents of the subject together with the results expected at the end of the course. This activity will be performed individually.
Lecturing	We describe the different topics of the subject providing the necessary educational material. Through this methodology the competencies CG3, CG4, CT2, CT3 and CT4 are developed. This activity will be performed individually.

Laboratory practical	Every student must perform practical tasks in the laboratory to understand better the contents explained along the master lessons. Through this methodology the competencies CG3, CG4, CG9, CE86, CT2 and CT3 are developed. This activity will be performed individually.
Debate	In the classes there will be open discussion, among groups of students, in order to focus on a topic of subject content, the analysis of a case, the outcome of a project, exercise or problem previously developed a keynote address. Through this methodology the competencies CG3, CG4, CG9, CE86, CT2, CT3 and CT4 are developed. This activity will be performed individually.
Discussion Forum	The students must perform some activities within the TEMA platform at FAITIC in order to discuss topics related to the subject. Through this methodology the competencies CG3, CE86, CT2, CT3 and CT4 are developed. This activity will be performed individually.
Mentored work	The students must perform a project in group, with the support of the professor, to extend and personalize the topics seen along the theoretical and practical classes. At the same time, we will try that the students perform such project demos using Android terminals. Through this methodology the competencies CG3, CG4, CG9, CE86, CT2, CT3 and CT4 are developed.

Personalized assistance

Methodologies	Description
Lecturing	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along the course in order to improve the understanding of the basic concepts, and for performing the tasks and activities to be evaluated.
Mentored work	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along the course in order to improve the understanding of the basic concepts, and for performing the tasks and activities to be evaluated.
Laboratory practical	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along the course in order to improve the understanding of the basic concepts, and for performing the tasks and activities to be evaluated.
Debate	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along the course in order to improve the understanding of the basic concepts, and for performing the tasks and activities to be evaluated.
Discussion Forum	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along the course in order to improve the understanding of the basic concepts, and for performing the tasks and activities to be evaluated.

Assessment

	Description	Qualification	Training and Learning Results		
Laboratory practical	The students will perform a practical task in the laboratory, where they will work with the concepts studied in the theoretical classes.	35	B3 B4 B9	C86	D2 D3

Debate	Discussions done along classes related with expositions done or read previously.	5	B3 B4 B9	C86	D2 D3 D4
Discussion Forum	Short answers and interaction done individually by students within the TEMA platform to discuss topics related with the subject.	5	B3	C86	D2 D3 D4
Mentored work	Evaluation of the works developed: understanding, maturity, importance and originality of the work and interaction between the group.	25	B3 B4 B9	C86	D2 D3 D4
Objective questions exam	Three successive tests to evaluate the contents given up to that time in the course. The tests will be individual and with time limit.	30	B3 B4	C86	

Other comments on the Evaluation

The elements that are part of the evaluation of the subject are the following:

- **Questionnaires**: along the course the student will fill 3 questionnaires that will contribute 10% to the final mark (each one).

- **Laboratory practice**: each student will have to perform a set of practical tasks in the laboratory that will contribute 35% to the final mark.

- **Group tutored work**: each student will have to do a work in group, about one among several possible topics, that will contribute 25% (20% work done + 5% presentation) to the final mark shared by all group members. Nevertheless, the teachers will follow the work done by every group member, and they will also perform a peer review of the work done. In the case that a student would perform clearly lower than his/her mates, he/she will be rated individually (see note*).

- **Class participation**: students will discuss in class about expositions done by the professor, and this contributes up to a 5% to the final mark.
- **Forum participation**: students should interact individually in the forum of the subject to achieve up to a 5% to the final mark. To achieve such percentage the student should provide at least two relevant contributions.

Therefore, we have: Final Mark = Questionnaires (3*x10% = 30%) + Lab. practice (35%) + Tutored work (25%) + Class participation (5%) + Forum (5%) = 100%.

The students need to pass the questionnaires, the practical task and the tutored work with at least 4 points over 10 to calculate the average final mark. If any of the marks is below 4, then the final mark will never be higher than 4 points over 10.

The schedule of the midterm/intermediate exams will be approved in the Comisión Académica de Grado (CAG) and will be available at the beginning of each academic semester.

Plagiarism is regarded as serious dishonest behaviour. If any form of plagiarism is detected in any of the tests or exams, the final grade will be FAIL (0), and the incident will be reported to the corresponding academic authorities for prosecution.

Following the degree guidelines, the students that will follow this subject can choose between two possibilities: continuous assessment and eventual assessment at the end of the semester.

Continuous assessment: the student follows the continuous assessment since the moment he/she fulfills two questionnaires. From that moment we assume that he/she will participate in the subject, independently of the participation in the extraordinary call.

First Call: if the continuous assessment is not performed, then the student will have to perform a final exam that substitutes the questionnaires done along the course, in addition to provide the practical tasks and the equivalent work to be done as part of the continuous assessment.

Second Call: the student will have to perform the part not passed previously.

Extraordinary Call: the student will have to perform a final exam that substitutes the questionnaires done along the course, in addition to provide the practical tasks and the equivalent work to be done as part of the continuous assessment.

This subject will be evaluated in English, but students have the possibility to interact in Spanish with the teachers at any time.

The questionnaires and tasks, proposed and performed along the module, are only valid for the current course.

***NOTE: Multidisciplinar Group Tutored Work (optional)**
In this subject, and as a part of an innovation project at UVIGO, some students have the possibility to join a multidisciplinary group (MDG) with other three subjects: (1) Video Games: design and development, 4th year, Degree in Audiovisual Communication. (2) Multimedia Technology and Computer graphics, 4th year, Degree in Telecommunication Engineering Technologies, Sound and Image module. (3) Intelligent systems programming, 4th year, Degree in Telecommunication Engineering Technologies, Telematics module. The activity is coordinated by teachers of the Teaching Innovation Group: ComTecArt (Communication, Technology and Art in Virtual Environments).

The activities and tasks to be performed by the students of this subject in the MDG will be related with using artificial intelligent techniques in videogames. The students that would join this multidisciplinary tutored work will not participate in the ordinary groups C. Besides, each MDG will only join one student from this subject, so he/she will be rated individually in such case.

The participation in the MDG is optional, and if there are more request than available positions; then those students will be ranked and selected according to the global grade mark, provided by the Escola de Enxeñaría de Telecomunicación Secretary.

There will be group work sessions on Wednesday mornings, alternating between the Campus of Vigo and Pontevedra. The University will provide free round trip transportation from the Escola de Enxeñaría de Telecomunicación or the Facultad de Ciencias Sociais e a Comunicación, respectively.

Sources of information

Basic Bibliography

Michael Wooldridge,, **An Introduction to Multiagent Systems**, 2a, Addison-Wesley, 2009

Juan C. Burguillo, **Self-organizing Coalitions for Managing Complexity**, doi.org/10.1007/978-3-319-69898-4, 1a, Springer International Publishing, 2018

Jordi Torres, **First Contact with Deep Learning, practical introduction with Keras**, ISBN 978-1-983-21155-3, 1a, WHAT THIS SPACE, 2018

Complementary Bibliography

Travis Booth, **Deep Learning with Python: A Hands-On Guide for Beginners**, 1a, Independently published, 2019

Stuart Russell, Peter Norvig, **Artificial Intelligence: A Modern Approach,**, 3a, Prentice Hall, 2014

François Chollet, **Deep learning with Python**, 1a, Manning Publications, 2018

Recommendations

Other comments

The only requirement for the students, in order to follow this subject, is to have a basic understanding of Java programming.

Contingency plan

Description

In the case that the teaching would be exclusively remote, the classes of the subject will be developed in a similar way, but using the platforms provided by the University.

Virtual classes will be taught weekly through the Remote Campus, either the theoretical sessions (groups A), the practical sessions (groups B) or group work (groups C). In the cases of B or C group activities, students will perform the practices using their personal computers.

The means enabled for the resolution of the doubts raised by the students will include online consultation forums or tutoring at the teacher's virtual office.

The non-face-to-face assessment of the subject will be governed by the conditions described in the teaching guide for the face-to-face teaching modality, including the same number of evaluations, identical weighting and minimum grades. The theoretical and practical exams will be carried out virtually, using the platforms provided by the University.