

Teaching Guide					
	Identifying Data			2022/23	
Subject (*)	Evolutionary Computation Code			614544015	
Study programme	Máster Universitario en Intelixencia Artificial				
		Descriptors			
Cycle	Period	Year		Туре	Credits
Official Master's Degre	e 2nd four-month period	First		Optional	3
Language	English				· ·
Teaching method	Face-to-face				
Prerequisites					
Department	Ciencias da Computación e Tecnoloxías da Información				
Coordinador	Santos Reyes, Jose	E·	-mail	jose.santos@udc.	es
Lecturers	Rabuñal Dopico, Juan Ramon E-mail juan.rabunal@udc.es				
	Santos Reyes, Jose			jose.santos@udc.	es
Web				I	
General description	The course introduces the stude	nt to the modeling of syste	ms capab	ole of adapting to their e	environments and learning from
	their experience, imitating the evolutionary processes of nature. In this context, the student will be instructed not only in the				
	use of different techniques for the search of solutions inspired by the prevalence or subsistence strategies of a population,				
	but also in the application of meta-heuristics for their optimization.				

	Study programme competences / results
Code	Study programme competences / results
A11	CE10 - Ability to implement, validate and apply a stochastic model starting from the observed data on a real system, and to perform a
	critical analysis of the obtained results, selecting those ones most suitable for problem solving
A12	CE11 - Understanding and command of the main techniques and tools for data analysis, both from the statistical and the machine learning
	viewpoints, including those devised for large volumes of data, and ability to select those ones most suitable for problem solving
A13	CE12 - Ability to outline, formulate and solve all the stages of a data project, including the understanding and command of basic concepts
	and techniques for information search and filtering in big collections of data
A16	CE15 - Knowledge of computer tools in the field of machine learning and ability to select those ones most suitable for problem solving
B2	CG02 - Successfully addressing each and every stage of an AI project
B3	CG03 - Searching and selecting that useful information required to solve complex problems, with a confident handling of bibliographical
	sources in the field
B4	CG04 - Suitably elaborating written essays or motivated arguments, including some point of originality, writing plans, work projects,
	scientific papers and formulating reasonable hypotheses in the field
B5	CG05 - Working in teams, especially of multidisciplinary nature, and being skilled in the management of time, people and decision making
B6	CB01 - Acquiring and understanding knowledge that provides a basis or opportunity to be original in the development and/or application of
	ideas, frequently in a research context
B7	CB02 - The students will be able to apply the acquired knowledge and to use their capacity of solving problems in new or poorly explored
	environments inside wider (or multidisciplinary) contexts related to their field of study
B8	CB03 - The students will be able to integrate different pieces of knowledge, to face the complexity of formulating opinions (from
	information that may be incomplete or limited) and to include considerations about social and ethical responsibilities linked to the
	application of their knowledge and opinions
B9	CB04 - The students will be able to communicate their conclusions, their premises and their ultimate justifications, both to specialised and
	non-specialised audiences, using a clear style language, free from ambiguities
C3	CT03 - Use of the basic tools of Information and Communications Technology (ICT) required for the student's professional practice and
	learning along her life
C4	CT04 - Acquiring a personal development for practicing a citizenship under observation of the democratic culture, the human rights and
	the gender perspective
C7	CT07 - Developing the ability to work in interdisciplinary or cross-disciplinary teams to provide proposal that contribute to a sustainable
	environmental, economic, political and social development



C8	CT08 - Appreciating the importance of research, innovation and technological development in the socioeconomic and cultural progress of
	society
C9	CT09 - Being able to manage time and resources: outlining plans, prioritising activities, identifying criticisms, fixing deadlines and sticking
	to them

Learning outcomes     Study programmeter       competences /     results       Know the basic concepts of evolutionary computation, classical evolutionary algorithms and bio-inspired algorithms.     AC10     BC2     CC3       AC11     BC3     CC4     AC12     BC4     CC7       AC15     BC5     CC8     BC6     CC9       BC7     BC6     CC9     BC7     BC8     BC9       Have the ability to design bio-inspired and complex system models of real systems.     AC10     BC2     CC3       AC11     BC3     CC4     AC11     BC3     CC4       AC15     BC6     CC9     BC7     BC8     CC9       BC3     CC4     AC11     BC3     CC4       AC10     BC2     CC3     AC11     BC3     CC4       AC11     BC3     CC4     AC12     BC4     CC7       AC11     BC3     CC4     AC11     BC3     CC4       AC11     BC3     CC4     AC12     BC4     CC7       AC11     BC3
Image: conserve of evolutionary computation, classical evolutionary algorithms and bio-inspired algorithms.   AC10   BC2   CC3     AC11   BC3   CC4     AC12   BC4   CC7     AC15   BC5   CC8     BC6   CC9     BC7   BC6     BC8   BC9     Have the ability to design bio-inspired and complex system models of real systems.   AC10   BC2   CC3     AC11   BC3   CC4   AC12   BC4   CC7     AC11   BC3   CC4   AC12   BC6   CC9     BC6   CC9   BC7   BC8   CC4     AC11   BC3   CC4   AC11   BC3   CC4     AC11   BC3   CC4   AC11   BC3   CC4     AC11   BC3   CC4   AC12   BC4   CC7     AC11   BC3   CC4   AC11   BC3   CC4     AC12   BC4   CC7   AC15   BC5   CC8     BC6   CC9   BC6   CC9   BC6   CC9     BC7   BC6   CC9
Know the basic concepts of evolutionary computation, classical evolutionary algorithms and bio-inspired algorithms.     AC10     BC2     CC3       AC11     BC3     CC4     AC12     BC4     CC7       AC15     BC5     CC8     BC6     CC9     BC7     BC8     BC9     BC7       Have the ability to design bio-inspired and complex system models of real systems.     AC10     BC2     CC3       AC11     BC3     CC4     AC10     BC2     CC3       AC10     BC2     CC3     CC4     AC10     BC2     CC3       BC9     CC4     AC10     BC2     CC3     AC11     BC3     CC4       AC10     BC2     CC3     AC11     BC3     CC4     AC11     BC3     CC4       AC11     BC3     CC4     AC11     BC3     CC4     AC12     BC4     CC7       AC11     BC3     CC4     AC11     BC3     CC4     AC12     BC4     CC7       AC11     BC3     CC4     AC11     BC3     CC4     AC1
Know the basic concepts of evolutionary computation, classical evolutionary algorithms and bio-inspired algorithms.   AC10   BC2   CC3     AC11   BC3   CC4     AC12   BC4   CC7     AC15   BC5   CC8     BC6   CC9     BC7   BC8     BC9   BC7     Have the ability to design bio-inspired and complex system models of real systems.   AC10   BC2   CC3     AC11   BC3   CC4     AC11   BC2   CC3     AC11   BC3   CC4     AC11   BC3   CC4     AC12   BC4   CC7     AC13   BC5   CC8     BC6   CC9   BC7     BC6   CC9   BC7     BC6   CC9   BC7     BC6   CC9   BC7     BC
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PCO
Know and apply techniques based on avalutionary avatame, advanced artificial neurol networks and other his inspired medals AC10, PC2, CC2,
Know and apply techniques based on evolutionary systems, advanced antincial neural networks and other bio-inspired models. AC10 BC2 CC3
ACIS BCS CCS
BCS
Identify the appropriate data-driven solution search techniques according to the type of problem. Understand the different AC10 BC2 CC3
nossibilities of combination or hybridization between global evolutionary search methods and other local search
motohouristics
Know different bio-inspired adaptive models and handle the most current tools and work environments in the field of AC10 PC2 CC3
hio-inspired algorithms



Contents		
Торіс	Sub-topic	
Introduction to optimization algorithms	General scheme of evolutionary algorithms.	
	Basic concepts: search domain, constraints, penalties.	
	No Free Lunch theorem.	
	Basic concepts of multi-objective optimization.	
Paradigms and meta-heuristics of nature-inspired algorithms	Bio-inspired metaheuristics.	
	Swarm intelligence.	
Specific algorithms of evolutionary computation	Genetic algorithms.	
	Evolutionary strategies.	
	Genetic programming.	
	Examples of swarm intelligence: Particle Swarm Optimization, Arficial Bee Algorithm,	
	Bacterial Colony Optimization, Ant algorithms.	
	Examples of other bio-inspired evolutionary algorithms.	
Advances in automatic adaptation of evolutionary algorithms	Automatic adaptation of the defining parameters of an EA.	
	Use of hyper-heuristics.	

Planning				
Methodologies / tests	Competencies /	Teaching hours	Student?s personal	Total hours
	Results	(in-person & virtual)	work hours	
Guest lecture / keynote speech	A11 A12 A13 A16 B2	10.5	10.5	21
	B3 B4 B5 B6 B7 B8			
	B9 C3 C4 C7 C8 C9			
Objective test	A11 A12 A13 A16 B2	3	0	3
	B3 B4 B5 B6 B7 B8			
	B9 C3 C4 C7 C8 C9			
Laboratory practice	A11 A12 A13 A16 B2	10.5	31.5	42
	B3 B4 B5 B6 B7 B8			
	B9 C3 C4 C7 C8 C9			
Mixed objective/subjective test	A11 A12 A13 A16 B2	2	2	4
	B3 B4 B5 B6 B7 B8			
	B9 C3 C4 C7 C8 C9			
Personalized attention		5	0	5
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(\*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

	Methodologies
Methodologies	Description
Guest lecture /	Oral presentation of the theory topics by the professors of the course.
keynote speech	
Objective test	Test/exam of the concepts explained in theory classes.
Laboratory practice	Laboratory sessions in which the necessary concepts will be explained in order to carry out programming practices related to
	optimization problems with evolutionary algorithms. The professors will indicate which optimization problems will be
	considered, as well as the programming platform/language to be used in the use or implementation of different
	evolutionary/bio-inspired algorithms. The professors will indicate whether this work will be carried out by the students
	autonomously or in groups, and their progress will be supervised by the teachers.
Mixed	Continuous monitoring of the practices carried out, by means of class attendance and continuous and final correction of the
objective/subjective	same. The possibility of a brief oral presentation of the work done in this part is included.
test	

**Personalized attention** 



Methodologies	Description
Laboratory practice	In the laboratory practices, the student will be able to ask the teacher all the doubts that may arise about the realization of the
Mixed	practical problems formulated, as well as about the aspects that will be evaluated in the resolution of the problems.
objective/subjective	
test	

		Assessment	
Methodologies	Competencies /	Description	Qualification
	Results		
Guest lecture /	A11 A12 A13 A16 B2	The theoretical part of the course will be continuously monitored through class	5
keynote speech	B3 B4 B5 B6 B7 B8	attendance and possible test-type questionnaires at the end of the lectures.	
	B9 C3 C4 C7 C8 C9		
Laboratory practice	A11 A12 A13 A16 B2	Evaluation of the different practices carried out by the students.	50
	B3 B4 B5 B6 B7 B8		
	B9 C3 C4 C7 C8 C9		
Objective test	A11 A12 A13 A16 B2	Final exam of the theoretical part.	40
	B3 B4 B5 B6 B7 B8		
	B9 C3 C4 C7 C8 C9		
Mixed	A11 A12 A13 A16 B2	There will be a continuous monitoring of the practices carried out, by means of class	5
objective/subjective	B3 B4 B5 B6 B7 B8	attendance and continuous and final correction of the same. The possibility of a brief	
test	B9 C3 C4 C7 C8 C9	oral presentation of the work done in this part is included.	

Assessment comments

	Sources of information
Basic	- Dan Simon (2013). Evolutionary Optimization Algorithms. Wiley
	- A. E. Eiben (2010). Introduction to Evolutionary Computing (Natural Computing Series). Springer
Complementary	

Recommendations
Subjects that it is recommended to have taken before
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Other comments

(\*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.