

IDENTIFYING DATA				
Concurrency and distribution				
Subject	Concurrency and distribution			
Code	O06G150V01602			
Study programme	(*)Grao en Enxeñaría Informática			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	Formella , Arno			
Lecturers	Formella , Arno García Lourenco, Analia María Olivieri Cecchi, David Nicholas			
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General description	The content forms the necessary basis to understand the operation of competing and / or distributed applications, the evaluation of competing algorithms, the description of data and information in distributed systems, the operation of modern processors, and the specific characteristics of the programming with processes / threads even in a distributed way. The classes are given mainly in Spanish. The student can choose to work in Galician, Spanish, German, Portuguese, and / or English. Certain additional information (such as manuals and additional information) will be given in English. English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Competencies	
Code	
A1	Students will have shown they have sufficient knowledge and understanding of an area of study, starting after completion of general secondary education, and normally reaching a level of proficiency that, being mostly based on advanced textbooks, will also include familiarity with some cutting-edge developments within the relevant field of study.
A2	Students will be able to apply their knowledge and skills in their professional practice or vocation and they will show they have the required expertise through the construction and discussion of arguments and the resolution of problems within the relevant area of study.
A3	Students will be able to gather and interpret relevant data (normally within their field of study) that will allow them to have a reflection-based considered opinion on important issues of social, scientific and ethical nature.
A5	Students will acquire the learning skills that are required to pursue further studies with a high degree of independence.
B1	Ability to conceive, write, organize, plan, develop and sign projects in the field of computing engineering whose aim is, according to the acquired knowledge and training, the design, development and exploitation of computing systems, services and applications.
B3	Ability to design, develop, assess and ensure accessibility, ergonomics, usability and safety of computing systems, services and applications, as well as the information managed by them.
B4	Ability to define, assess and select hardware and software platforms for the development and execution of computing systems, services and applications, according to the acquired knowledge and training.
B5	Ability to conceive, develop and maintain computing systems, services and applications through use of software engineering methods as tools to ensure quality, according to the knowledge and training acquired.
B6	Ability to conceive and develop centralized or distributed computing systems and architectures, integrating hardware, software and networks, according to the knowledge and training acquired.
B8	Knowledge of the essential subjects and technologies that will allow students to learn and develop new methods and technologies, as well as those that will endow them with versatility to adapt to new situations.

B9	Ability to solve problems by taking the initiative, making decisions and acting independently and creatively. Ability to communicate the knowledge contents, skills and abilities of the Computer Science Engineer profession.
B12	Conocimiento y aplicación de elementos básicos de economía y de gestión de recursos humanos,organización y planificación de proyectos, así como la legislación, regulación y normalización en elámbito de los proyectos informáticos, de acuerdo con los conocimientos adquiridos.
C4	Essential knowledge of use and programming of computers, operating systems, data bases and computer programs with application in engineering.
C5	Knowledge of the structure, organization, functioning and interconnection of computing systems, the foundations of their programming, and their application to the resolution of specific problems in engineering.
C7	Ability to design, develop, choose and assess computer applications and systems to guarantee their reliability, safety and quality, according to ethical principles and existing legislation and regulations.
C12	Knowledge and application of basic algorithmic procedures of computer technologies to design solutions to problems, analyzing the appropriacy and complexity of the proposed algorithms.
C13	Knowledge, design and efficient use of the most appropriate data structures and types for the resolution of a problem.
C14	Ability to analyze, design, build and maintain applications in a robust, safe and efficient way, choosing the most appropriate paradigm and programming languages.
C15	Ability to know, understand and assess the structure and architecture of computers, as well as their basic components.
C16	Knowledge of the characteristics, functions and structure of Operating Systems and design and implementation of applications based on their services.
C20	Knowledge and application of the fundamental principles and basic techniques of parallel, concurrent, distributed and real-time programming.
C22	Knowledge and application of the principles, methodologies and life cycles of software engineering.
C25	Ability to develop, maintain and assess software systems and services that satisfy all the demands of users and work reliably and efficiently, are easy to develop and maintain, and meet the quality standards, applying the theories, principles, methods and practices of Software Engineering.
C26	Ability to assess clients needs and determine the software requirements to satisfy these needs, reconciling conflicting goals through attempts to reach acceptable compromises within the limits imposed by costs, available times, existing developed systems and organizations themselves.
C27	Ability to solve problems of integration according to available strategies, standards and technologies.
C28	Ability to identify and analyze problems and design, develop, implement, verify and document software solutions on the basis of sound knowledge of the theories, models and techniques available nowadays.
C33	Ability to employ user- and organization-oriented methodologies for the development, assessment and management of applications and systems based on information technologies to guarantee accessibility, ergonomics and usability of systems.
C35	Ability to select, design, implement, integrate and manage information systems that meet the needs of organizations, once the costs and quality criteria have been identified.
C36	Ability to design systems, applications and services based on network technologies, including the Internet, web, e-commerce, multimedia, interactive services and mobile computing.
D1	I1: Analysis, synthesis and assessment skills.
D2	I2: Organization and planning skills.
D3	I3: Oral and written communication skills in one s native language.
D5	I5: Abstraction skills: ability to create and use models that reflect real situations.
D6	I6: Ability to design and carry out simple experiments and analyze and interpret their data.
D7	I7: Ability to search for, establish links and organize information coming from different sources and to integrate ideas, knowledge and skills.
D8	I8: Problem-resolution skills.
D9	I9: Ability to make decisions.
D10	I10: Ability to present arguments and justify one s decisions and opinions in logical terms.
D11	P1: Ability to act independently.
D12	P2: Ability to work in situations where information is lacking and under pressure.
D15	P5: Interpersonal relations skills.
D16	S1: Critical-thinking skills.
D18	S3: Independent-learning skills.
D20	S5: Creativity.
D22	S7: Ability to take the initiative and be determined.
D24	S9: Commitment to striving for quality and continuous improvement.

Learning outcomes

Expected results from this subject	Training and Learning Results

RA1: To know the theoretical foundations of concurrent and distributed systems.	A1	B3	C4	D1
	A2	B4	C5	D2
	A3	B5	C7	D3
	A5	B6	C12	D5
		B8	C13	D6
		B9	C14	D7
		B12	C15	D8
			C16	D9
			C20	D10
			C26	D11
			C27	D12
			C28	D15
			C33	D16
			C35	D18
			C36	D20
				D22
				D24
RA2: To know systems and environments with concurrency and distribution.	A1	B1	C4	D1
	A2	B3	C5	D2
	A3	B4	C7	D3
	A5	B5	C12	D5
		B6	C13	D6
		B8	C14	D7
		B9	C15	D8
		B12	C16	D9
			C20	D10
			C22	D11
			C25	D12
			C26	D15
			C27	D16
			C28	D18
			C33	D20
			C35	D22
			C36	D24
RA3: To know the process of generating applications for concurrent and distributed systems.	A1	B1	C4	D1
	A2	B3	C5	D2
	A3	B4	C7	D3
	A5	B5	C12	D5
		B6	C13	D6
		B8	C14	D7
		B9	C15	D8
		B12	C16	D9
			C20	D10
			C22	D11
			C25	D12
			C26	D15
			C27	D16
			C28	D18
			C33	D20
			C36	D22
				D24
RA4: To know the tools and their properties in use to generate code for concurrent and distributed systems.	A1	B3	C4	D1
	A2	B4	C5	D2
	A3	B5	C7	D3
	A5	B6	C12	D5
		B8	C13	D6
		B9	C14	D7
		B12	C15	D8
			C16	D9
			C20	D10
			C22	D11
			C25	D12
			C26	D15
			C27	D16
			C28	D18
			C35	D20
			C36	D22
				D24

Contents	
Topic	
Concurrent and distributed systems	- Concept of concurrent and distributed programming - Introduction to the modeling of competing or distributed systems - Hardware architectures for the concurrence and distribution -Tools for the development of competing and distributed applications
Processes	- Concept of processes - Scheduler - Atomicity and mutual exclusion - Transactional concurrence - Clock and distributed status
Synchronisation and communication	- Synchronization and communication in concurrent and distributed systems - Synchronization and communication at the low level - Synchronization and communication at the high level - Security and vivacity in competing and distributed systems
Programming and application development tools	- Concurrent and distributed programming with JAVA - Concurrent and distributed programming with C / C ++ - Design patterns for the development of concurrent and distributed applications - Tools and methodologies of design, verification and debugging of competing and distributed applications

Planning	Class hours	Hours outside the classroom	Total hours
Introductory activities	0.5	0	0.5
Lecturing	18	9	27
Previous studies	0	17	17
Laboratory practical	26	26	52
Problem solving	1.5	19.5	21
Presentation	0	1.75	1.75
Seminars	1.25	1.25	2.5
Problem and/or exercise solving	1	0	1
Essay questions exam	2	0	2
Practices report	0	12	12
Laboratory practice	1	0	1
Problem and/or exercise solving	0	12	12
*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	(*)Presentación da asignatura e aclaración de tódolos aspectos relacionados coa guia docente. Planificación temporal das actividades presenciais. Introdución das ferramentas de control e avaliación. Recomendacións específicas para lograr os obxectivos da signatura.
Lecturing	(*)Exposición dos contidos teóricos da asignatura. Presentación de exemplos e casos específicos. Controis de estudos e lecturas previos. Controis do avance da adquisición de coñecemento por parte do/a estudante. Interacción con/entre os estudantes mediante actividades específicas.
Previous studies	(*)Lectura de documentos relacionados co contido da asignatura. Análise e deseño das tarefas dos exercicios no laboratorio.
Laboratory practical	(*)Implementación e depuración dos exercicios suscitados como tarefas de programación. Realización de probas de funcionamento e/ou rendemento de aplicacións concorrentes e distribuídas cunha análise crítica das observacións.
Problem solving	(*)Desenvolvemento de propostas de resolución de problemas. Comprobaciones de corrección e analisis de rendemento. Implementación de solucións alternativas. Análise crítica de solucións propostas.
Presentation	(*)Exposicións breves dos fitos alcanzados nas tarefas de programación e exercicios relacionados.
Seminars	(*)Control do avance da aprendizaxe. Recomendacións para lograr os objectivos da asignatura a nivel individual. Apoio e axuda na resolución das tarefas propostas.

Personalized assistance	
Methodologies	**Description**
Introductory activities	

Lecturing	
Presentation	
Laboratory practical	
Seminars	

Tests	**Description**
Problem and/or exercise solving	
Essay questions exam	
Practices report	
Laboratory practice	
Problem and/or exercise solving	

Assessment

	Description	Qualification	Training and Learning Results		
Problem and/or exercise solving	(*)(P1) Conxunto de preguntas curtas para o control da realización de actividades, tarefas, e estudos. Media das probas realizadas cunha puntuación de 1-10. (RA1, RA2, RA3, RA4)	10	A1 A2	C4 C5 C7 C12 C13 C14 C15 C16 C20 C22 C25 C26 C27 C28 C33 C35 C36	D1 D2 D3 D5 D6 D7 D8 D10 D12 D16 D18
Essay questions exam	(*)(P2) Conxunto de preguntas longas que relacionan os diferentes apartados dos contidos e miden o nivel da aquisición das competencias da materia. Proba con puntuación de 1-10, mínimo requerido: 4. (RA1, RA2, RA3, RA4)	40	A1 A2	C4 C5 C7 C12 C13 C14 C15 C16 C20 C22 C25 C26 C27 C28 C33 C35 C36	D1 D2 D3 D5 D6 D7 D8 D10 D12 D16 D18

Practices report	(*)(P3) Elaboración de informes (segundo unha guia) que recollen os principais desenvolvementos e resultados obtidos polo/a estudante. Partes de devanditos informes elaborarase en pequenos grupos. Media das avaliacións das actividades con puntuacións de 1-10. (RA1, RA2, RA3, RA4)	25	A3 A5	C4 C5 C7 C12 C13 C14 C15 C16 C20 C22 C25 C26 C27 C28 C33 C35 C36	D1 D2 D3 D5 D6 D7 D8 D9 D10 D11 D15 D16 D18 D20 D22 D24
Laboratory practice	(*)(P4) Demonstración dos desenvolvementos e implementacións das tarefas de programación e experimentos de estudo. Media das avaliacións das actividades con puntuacións de 1-10, mínimo requerido: 4. (RA1, RA2, RA3, RA4)	25	A3 A5	C4 C5 C7 C12 C13 C14 C15 C16 C20 C22 C25 C26 C27 C28 C33 C35 C36	D1 D2 D5 D6 D7 D8 D9 D10 D11 D15 D16 D20 D22 D24
Problem and/or exercise solving	(*)(P5) Elaboración de algoritmos ou aplicacións e as súas análises con certo nivel de formalismo para comprobar a corrección e estudar o rendemento. Avaliación cunha puntuación de 1-10, participación optativa e voluntaria. (RA1, RA2, RA3, RA4)	5		C4 C5 C7 C12 C13 C14 C15 C16 C20 C22 C25 C26 C27 C28 C33 C35 C36	D1 D5 D6 D8 D10 D20 D22 D24

Other comments on the Evaluation

Sources of information

Basic Bibliography

Complementary Bibliography

J.T. Palma Méndez, M.C. Garrido Carrera, F. Sánchez Figueroa, A. Quesada Arencibia., **Programacion Concurrente**,

D. Lea, **Programación concurrente en Java**,

G. Coulouris, J. Dollimore, T. Kindberg, **Sistemas distribuidos : conceptos y diseño**,

M.L. Liu, **Computación distribuida : fundamentos y aplicaciones**,

D. Schmidt, M. Stal, H. Rohnert, F. Buschman, **Pattern-oriented Software Architecture, Pattern for Concurrent and Networked Objects**,

Varios, **Internet**,

M. Herlihy, N. Shavit, **The Art of Multiprocessor Programming**,

C. Breshears, **The Art of Concurrency**,

Recommendations

Subjects that it is recommended to have taken before

Algorithms and data structures II/O06G150V01302
Computer Architecture II/O06G150V01303
Parallel architectures/O06G150V01401
Software engineering I/O06G150V01304
Software engineering 2/O06G150V01403
Computer networks 1/O06G150V01404
Operating systems I/O06G150V01305
Operating systems 2/O06G150V01405
Computer networks 2/O06G150V01505