Universida de Vigo

IDENTIFYING DATA
Parallel architectures

Subject	Parallel architectures
Code	O06G150V01401
Study programme	(*)Grao en Enxeñaría Informática

Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd

Teaching language	#EnglishFriendly Spanish Galician
Department	
Coordinator	García Rivera, Matías
Lecturers	García Rivera, Matías Sotelo Martínez, José Manuel
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General description	Complete the knowledges in the area of Architecture and Technology of Computers studying parallelism of execution of instructions, possibilities that offer the multicore processors, multiprocessors systems, vectorial processors and cluster of computers. It will use technical documentation 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	
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.
B2	Ability to manage the project□s activities from the computing field in accordance with the acquired knowledge and training.
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.
B7	Ability to learn, understand and apply the necessary legislation during professional practice as a Computer Science Engineer and to use the relevant binding specifications, regulations and norms.
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.
C15	Ability to know, understand and assess the structure and architecture of computers, as well as their basic components.
C21	Knowledge and application of the fundamental principles and basic techniques of intelligent systems and their practical application.
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.
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.
C29	Ability to identify, assess and deal with associated risks that could potentially arise.

C30	Ability to design appropriate solutions in one or more domains of application by using methods of software engineering that include ethical, social, legal and economic issues.
C31	Ability to understand the environment of an organization and its needs in the area of information and communication technologies.
C32	Ability to select, design, implement, integrate, assess, build, manage, exploit and maintain hardware, software and network technologies, within the appropriate costs and quality requirements.
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.
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.
D13	P3: Ability to quickly fit into a group and to work efficiently in intradisciplinary teams and to cooperate in an interdisciplinary environment.
D15	P5: Interpersonal relations skills.
D16	S1: Critical-thinking skills.
D17	S2: Commitment to uphold ethical and democratic values.
D18	S3: Independent-learning skills.
D19	S4: Ability to adapt to new situations.
D20	S5: Creativity.
D21	S6: Leadership skills.
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			
New	A2	B2	C26	D1	
		B4	C30	D2	
		B5		D3	
		B6		D5	
		B7		D7	
				D8	
				D9	
				D10	
				D11	
				D12	
				D13	
				D15	
				D16	
				D17	
				D18	
				D19	
				D20	
				D21	
				D22	
				D24	

New	A2	B2	C15	D1
		B4		D2
		B5		D3
		B6		D5
		B7		D7
				D8
				D9
				D10
				D11
				D12
				D13
				D15
				D16
				D17
				D18
				D19
				D20
				D21
				D22
				D24
New	A2	B2	C15	D1
		B4		D2
		B5		D3
		B6		D5
		B7		D7
				D8
				D9
				D10
				D11
				D12
				D13
				D15
				D16
				D17
				D18
				D19
				D20
				D21
				D22
				D24
New	A2	B2	C29	D1
		B4	C36	D2
		B5		D3
		B6		D5
		B7		D7
				D8
				D9
				D10
				D11
				D12
				D13
				D15
				D16
				D17
				D18
				D19
				D20
				D21
				D22
				D24

New	A2	B2 B4 B5 B6 B7	C7 C21 C26	D1 D2 D3 D5 D7 D8 D9 D10 D11 D12 D13 D15 D16 D17 D18 D19 D20 D21 D22 D24
New	A2	B2 B4 B5 B6 B7	C25 C32 C35	D1 D2 D3 D5 D7 D8 D9 D10 D11 D12 D13 D15 D16 D17 D18 D19 D20 D21 D22 D24
New	A2	B2 B4 B5 B6 B7	C28 C31	D1 D2 D3 D5 D7 D8 D9 D10 D11 D12 D13 D15 D16 D17 D18 D19 D20 D21 D22 D24

Contents

Topic	
Introduction to parallel computing. Increasing preformance	Historical perspective. Classification of architectures for parallel processing. Performance measures.

Segmentation and segmented processors	Principles of segmentation. Improvement of performance. Risks
Superscalar, VLIW and vector processors	Superscalar processors: motivation, architecture and benefits. VLIW processors: motivation, architecture and features. Vector processors: motivation, architecture and features.
Parallel computers	Parallel processors: motivation, architecture and prestacions.
Multiprocessors	Parallel programming Performance. Consistency of the memory system. Consistency of memory. Synchronization
Multimedia applications	Parallelism in video applications. Parallelism in audio applications,
LABORATORY PRACTICES I. Programming at low and medium level of the different architectures	C programming of examples of image processing. C programming of examples of image processing with SIMD. C programming of examples of image processing with threads.
LABORATORY PRACTICES II. Use of several benchmarking programs	Benchmarking Profilers Tools for optimization of algorithms. Detection of bottlenecks.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	24	48
Problem solving	19	19	38
Laboratory practical	6	18	24
Mentored work	2	13	15
Essay	4	0	4
Problem and/or exercise solving	3	18	21

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	(*)Exposición ao alumnado dos contidos da materia.
Problem solving	(*)Formulación, análise, resolución e debate de problemas ou exercicios relacionados coa temática da materia.
Laboratory practical	(*)Formulación, análise, resolución e debate de problemas de programación relacionados coa temática da materia.
Mentored work	(*) Actividade dirixida á resolución dun problema relacionado coa temática da materia.

Personalized assistance

Methodologies	Description
Laboratory practical	An individualized analysis of the student will be carried out through continuous monitoring of the partial tests carried out and the work to be carried out.
Mentored work	An individualized analysis of the student will be carried out through continuous monitoring of the partial tests carried out and the work to be carried out.

Assessment

Description	Qualification	Training and Learning Results

Laboratory practical	2 tests of laboratory practices to evaluate group classes reduced. Each of these 2 tests will be 20% of the qualification final. In order to pass the subject, it is mandatory that the student present to all the tests and in each test get a note equal to or greater than 3 out of 10. Learning outcomes; RA03, RA06.	40	C7 C21 C25 C26 C28 C30 C31 C35 C36	D1 D2 D3 D5 D7 D8 D9 D10 D11 D13 D15 D16 D17 D18 D19 D20 D21 D22 D24
Essay	Delivery of an individual work to solve a problem of a parallel nature: a first solution without the application of parallelism techniques, a second solution applying parallelism techniques, and a performance comparison of both solutions. This work will be 10% of the final grade. This work is not mandatory. Learning outcomes: RA03, RA05, RA06 y RA07.	10	C7 C21 C25 C26 C28 C30 C31 C35 C36	D1 D2 D3 D5 D7 D8 D9 D10 D11 D12 D13 D15 D16 D17 D18 D19 D20 D21 D22 D24
Problem and/or exercise solving	2 short answer tests to evaluate the large group classes. Each of these 2 tests will be 25% of the final grade. For To pass the subject it is mandatory that the student presents himself to all the tests and that in each test obtain a grade equal to or greater than 3 about 10. Learning results: RA01, RA02, RA04.	50	C7 C15 C21 C25 C29 C31 C32 C36	D1 D2 D3 D5 D7 D8 D9 D10 D11 D12 D13 D16 D17 D18 D20 D24

Other comments on the Evaluation

All references to numeric grades in this guide are about 10.

ASSESSMENT CRITERIA FOR ASSISTANTS 1st EDITION OF ACTS

For the students attending the first edition of the acts, there will be 4 obligatory partial tests and a non mandatory work:

- 2 short answer tests to evaluate the large group classes. Each of these 2 tests will be 25% of the final grade.
- 2 laboratory practice tests to evaluate the small group classes. Each of these 2 tests will be 20% of the final grade.
- A non-obligatory work. This work will be 10% of the final grade.

In order to pass the subject, it is mandatory that the student presents himself / herself to all 4 tests and that in each test he / she obtains a grade equal to or greater than 3.

In the case of not performing any test or obtain in a test a grade lower than 3, if the overall score is higher than 5, the final grade in the act will be 4.9, fail.

The dates of these 4 tests for the attending students can be consulted in the calendar of activities of the ESEI.

EVALUATION CRITERIA FOR NON-ASSISTANTS 1st EDITION OF ACTS

The evaluation for the non-attending students in the first edition of the acts will be 2 tests:

Methodology / Test 1: short answer test

Description: A mandatory test with short answers on all the contents of the large group classes.

% Grade: This test will be 50% of the final grade.

Evaluated competences: CE7, CE15, CE21, CE25, CE29, CE31, CE32, CE36, CT1, CT2, CT3, CT5, CT7, CT8, CT9, CT10, CT11, CT12, CT13, CT16, CT17, CT18, CT20, CT24

Evaluated learning outcomes: RA01, RA02, RA04.

Methodology / Test 2: laboratory practice

Description: A mandatory practical test of the content of the small group classes. This test will be done in front of a PC, with the following SW tools: Windows Operating System, Netbeans development environment, ANSI C Cygwin compiler, and openCV library.

% Grade: This test will be 50% of the final grade.

Evaluated competences: CE7, CE21, CE25, CE26, CE28, CE30, CE31, CE35, CE36, CT1, CT2, CT3, CT5, CT7, CT8, CT9, CT10, CT11, CT13, CT15, CT16, CT17, CT18, CT19, CT20, CT21, CT22, CT24

Evaluated learning outcomes: RA03, RA05, RA06 y RA07.

To pass the subject, it is mandatory that the student presents himself / herself to the 2 tests and that in each test he / she obtains a grade equal to or greater than 3.

In the case of not performing any test or obtain in a test a grade lower than 3, if the overall score is higher than 5, the final grade in the minutes will be 4.9, fail.

EVALUATION CRITERIA FOR THE 2nd EDITION AND OTHERS ACTS

The same evaluation system applied for non-assistants will be used.

ACTS QUALIFICATION PROCESS

Regardless of the call, in the case of not performing any test or obtain in a test a grade lower than 3, if the overall score was greater than 5, the final grade in minutes will be 4.9, fail.

EVALUATION DATES.

The calendar of evaluation tests officially approved by the Center Board of the ESEI is published on the web page http://www.esei.uvigo.es/index.php?id=29.

PROHIBITION OF USE OF ANY ELECTRONIC DEVICE

All students are reminded to prohibit the use of any electronic device in exercises and practices.

JUSTIFICATION OF ABSENCE

To be able to justify the absence to a test, a certificate issued by a doctor is necessary. A proof of the doctor's appointment

will not be valid.

Sources of information

Basic Bibliography

Stallings, William, **Organización y arquitectura de computadores**, Prentice Hall, 2006

Bertrán, Guzmán, **Diseño y Evaluación de Arquitectura de Computadoras**, Pearson, 2010

Aart J.C. Bik, **Software Vectorization Handbook, The: Applying Intel Multimedia Extensions for Maximum Performance**, 1ª Edicion, Intel Press, 2004

Taylor, Stewart, **Optimizing Applications for Multi-Core Processors, Using the Intel® Integrated Performance Primitives, Second Edition**, 2nd ed, Intel press, cop., 2007

Reinders, James, **Intel threading building blocks : outfitting C++ for multi-core processor parallelism**, 1ª Edición, O'Reilly, 2007

Complementary Bibliography

Richard Gerber, **The Software Optimization Cookbook: High Performance Recipes for IA-32 Platforms, 2nd Edition**, 2nd Edition, Intel Press, 2005

Recommendations

Subjects that continue the syllabus

Application-specific hardware/O06G150V01502

Subjects that are recommended to be taken simultaneously

Operating systems 2/O06G150V01405

Subjects that it is recommended to have taken before

Computer Architecture II/O06G150V01303