



## IDENTIFYING DATA

### (\*)Transformadas

Subject	(*)Transformadas			
Code	O06M060V01102			
Study programme	(*)Máster Universitario en Sistemas Software Intelixentes e Adaptables			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	1st
Teaching language	Galician			
Department				
Coordinator	Olivieri Cecchi, David Nicholas			
Lecturers	Lado Touriño, Maria Jose Olivieri Cecchi, David Nicholas			
E-mail				
Web	<a href="http://ssia.ei.uvigo.es/">http://ssia.ei.uvigo.es/</a>			
General description	It is recommended that this course is taken in the first semester in order to provide a mathematical basis for several techniques used in the field of artificial intelligence. The aim of this course are not only to learn Fourier and Wavelet transform theory, but also to provide a deep concept of complex vector spaces.			

## Competencies

Code	
A0	(*)(1) Proxectar, calcular, deseñar e avaliar sistemas software intelixentes e adaptables
A2	(*)(1b) Aprender novos coñecementos e técnicas axeitados para a concepción, o desenvolvemento ou a explotación de sistemas software intelixentes e adaptables
A3	(*)(1c) Poder deseñar e avaliar sistemas software interactivos intelixentes e adaptables
A4	(*)(1d) Propoñer, deseñar e realizar probas que verifiquen a validez funcional, a integridade dos datos e da interface de comunicación, e o rendemento de software intelixente e adaptable
A5	(*)(1e) Deseñar, escribir, avaliar e probar código nunha linguaxe de programación axeitada á resolución de problemas de elevada dificultade algorítmica
A6	(*)(2) Interpretar, analizar, valorar e crear novos conceptos, usos e desenvolvementos tecnolóxicos relacionados coa informática e a súa aplicación, usando os fundamentos teóricos para o desenvolvemento de sistemas software intelixentes e adaptables
A7	(*)(2a) Comprender e aplicar coñecementos teóricos avanzados de computación no desenvolvemento de sistemas software intelixentes e adaptables
A8	(*)(2b) Aplicar métodos matemáticos, estatísticos e de intelixencia artificial para especificar, deseñar e desenvolver sistemas intelixentes e sistemas baseados no coñecemento
A9	(*)(2c) Utilizar e desenvolver metodoloxías, métodos, técnicas, programas de uso específico, normas e estándares
A10	(*)(2d) Adquirir unha formación axeitada en: aplicacións da análise numérica en inxeñería; técnicas de simulación e optimización en software; análise e desenvolvemento de sistemas intelixentes; aprendizaxe automático e minería de datos
A11	(*)(2e) Atopar, inferir e investigar solucións algorítmicas a problemas, comprendendo a idoneidade e complexidade das solucións necesarias
A17	(*)(4) Ter capacidade para o modelado teórico, cálculo e simulación en centros tecnolóxicos e de enxeñería de empresa, particularmente en tarefas de investigación, desenvolvemento e innovación en sistemas software intelixentes e adaptables
A18	(*)(4a) Coñecer, comprender, aplicar e combinar teorías, métodos, técnicas e ferramentas da matemática discreta, a lóxica, o álgebra e o análise matemático para analizar, modelar, manipular e deseñar elementos e sistemas software intelixentes e adaptables
A19	(*)(4b) Coñecer, comprender, aplicar e combinar teorías, métodos, técnicas e ferramentas da estatística para analizar, modelar, manipular e deseñar elementos e sistemas software intelixentes e adaptables
A25	(*)(7) Aplicar os coñecementos adquiridos e resolver problemas en contornos novos ou pouco coñecidos dentro de contextos máis amplos e multidisciplinares, sendo capaces de integrar estes coñecementos

B0 (\*)I2 Capacidade de organización e planificación

B4 (\*)I5 Capacidade de abstracción

B7 (\*)I8 Capacidade de resolver problemas

B9 (\*)P1 Capacidade de actuar autónomamente

B13 (\*)S1 Razoamento crítico

B15 (\*)S3 Aprendizaxe autónomo

B17 (\*)S5 Creatividade

B19 (\*)S7 Ter iniciativa e ser resolutivo

## Learning aims

Expected results from this subject	Typology	Training and Learning Results
Know and understand the basic concepts of abstract vector spaces and how this relates to the Fourier and Wavelet theory. This objective includes the following:	know Know How	A2 A3 A6 A7 A8 A10 A17
a. Learn aspects about the theory and techniques of Fourier and Wavelets series/transforms in order to be able to integrate them into problems in artificial intelligence.		A18 A19 B5 B8 B10 B14 B16 B18
b. To have a deeper understanding of the mathematical theory of complex vector spaces, both analytically and by numerical analysis, in order to understand how and when to use transformed to solve real problems.		
Be able to use the theory of transforms in real situations, specifically in the following manner:	know Know How	A1 A3 A4 A5 A6 A7 A8 A9
a. Show the connection between the theory of Fourier and Wavelets.		A10 A11
b. Learn short time Fourier transform for such problems as the analysis of voice, audio and images.		A17 A18 A19 A25
c. Interpret and assess algorithms based on Fourier and wavelet transforms.		B1 B5 B8 B18 B20
d. Design, develop and evaluate algorithms based on Fourier transforms, and wavelet filtered signals.		
d. Propose, analyze, validate and interpret different bases of orthogonal functions and Wavelets for specific problems, and be able to choose the best basis in each case.		

## Contents

Topic	
Part I: Introduction and Motivation	1.1 Problems involving transforms in artificial intelligence. 1.2 Motivation for using Fourier and Wavelet transforms 1.3 Programming tools: Matlab/Octave
Part II: Mathematics of Vector Spaces	2.1 Mathematical foundations of abstract vector spaces, 2.2 Theory of functions, 2.3 Hilbert spaces and the theory of orthogonality and biorthogonality; 2.4 Temporal signal processing
Part III: Fourier Analysis	3.1 The theory and application of the Fourier transform 3.2 Analytical Solutions; 3.3 Numerical solutions with FFT 3.4 SFFT and Filters
Part IV: Wavelet Analysis	4.1 Wavelets-scale space. 4.2 Multiresolution Analysis 4.3 Separable multiresolution. Wavelets in two dimensions. 4.4 Applications of Wavelets to image processing.

## Planning

	Class hours	Hours outside the classroom	Total hours
(*) Prácticas de laboratorio	21	10.5	31.5
(*) Trabajos tutelados	4.5	22.5	27
(*) Presentacións/exposiciones	3	0	3
(*) Resolución de problemas e/ou ejercicios	6	12	18
(*) Sesión maxistral	22.5	22.5	45
(*) Probas de resposta longa, de desenvolvemento	1.5	3	4.5
(*) Outras	1	6	7

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

### Methodologies

	Description
(*) Prácticas de laboratorio	Laboratory practice is used to reinforce the content presented in the lectures. Labs consist of exercises that will help the student develop necessary skills, while at the same time serve to assess their attitude and aptitude.
(*) Trabajos tutelados	The aim is to develop skills for working in groups. With this activity, students should benefit from team spirit by completing and implementing tasks. This exercise fosters the ability to work in teams.
(*) Presentacións/exposicións	Students shall be required to present the results of their work in front of other students.
(*) Resolución de problemas e/ou ejercicios	Exercises that are designed to strengthen understanding of subject matter shall be provided. These shall be used for the evaluation and of aptitude of the student.
(*) Sesión maxistral	Lectures provide an in depth discussion of the subject matter, with special emphasis on teaching based on examples where students will learn how to deal with common situations provide further indications of how to deal with more unusual situations.

### Personalized attention

Methodologies	Description
Resolución de problemas e/ou ejercicios	Troubleshooting and problem solving: In the area of problem solving of exercises, the attitude and aptitude of the students shall be evaluated. Other: Students who are absent for more than 15% of the in class sections shall need to pass a single oral test in which proposed to solve a problem (other).
Tests	Description
Outras	

### Assessment

	Description	Qualification
(*) Prácticas de laboratorio	During laboratory practices and assess the suitability of activud students sumándoles to 0.5 points out of 10 in the final grade.	5
(*) Presentacións/exposiciones	The subject project will be evaluated both in terms of clarity of presentation and appearance quality.	20
(*) Resolución de problemas e/ou ejercicios	Assess the student's ability to solve problems or exercises. This type of testing will be done in small groups and personal treatment.	20
(*) Probas de resposta longa, de desenvolvemento	There will be a test to assess student knowledge. In this test all students must attend.	35
(*) Outras	It is an oral test for students not only attend 85% of the classes and / or have not covered all evaluation activities. This test replaces the test labs and resolution of problems / exercises	20

### Other comments on the Evaluation

The students have of two modalities for \*acudir to this \*asignatura:

\*Presencial: Consider that a student is \*presencial when \*acude to more than 85% of the classes of theory and realises all the proofs.

No \*presencial: When a student does not fulfil the necessary condition to be considered a student \*presencial.

The students \*presenciales will be evaluated of continuous form evaluating the following appearances:

- Presentation of the work end of \*asignatura (in groups)
- Development and participation in the practices of laboratory

- Resolution of problems and/or exercises of form \*personalizada
- A proof written in which will do a final evaluation of his knowledges

So that a student \*presencial can surpass the \*asignatura has to surpass like minimum the proof written and the work of the \*asignatura.

The students us \*presenciales will be evaluated with three proofs that will have to surpass of independent form:

- A proof written in the than will do a final evaluation of the his knowledges
- \*Unha Oral proof in which will do an evaluation of the knowledges and capacities of the student when facing a real problem
- Besides they will have to present a work that will be equivalent to the realised by his mates. They Will have to do it of individual form and present it in front of the professor.

So that a student no \*presencial can surpass the matter will have to surpass all these proofs.

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### Sources of information

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### Recommendations