Universitat de les Illes Balears

Teaching guide

Academic year	2016-17
Subject	11555 - Image Processing and Analysis
Group	Group 1, 2S
Teaching guide	B
Language	English

Subject identification

Subject	11555 - Image Processing and Analysis
Credits	0.72 de presencials (18 hours) 2.28 de no presencials (57 hours) 3 de totals (75 hours).
Group	Group 1, 2S (Campus Extens)
Teaching period	Second semester
Teaching language	Spanish

Professors

Lecturers	**Horari d'atenció als alumnes**					
	Starting time	**Finishing time**	**Day**	**Start date**	**Finish date**	**Office**
Yolanda González Cid yolanda.gonzalez@uib.es	12:30	13:30	Tuesday	05/09/2016	14/07/2017	219-Anselm Turmeda (cita previa por mail)
Javier Varona Gómez xavi.varona@uib.es	09:30	11:00	Wednesday	01/09/2016	28/07/2017	Anselm Turmeda, 210

Contextualisation

This subject is one of the four of the "Vision and Robotics" module. If the student chose this specialisation of the course, they should enrol the four subjectsofthe module. However, it is also possible to choose this subject as an elective one, while the student is taking one of the other modules.

This subject aims to initiate the student in the basics of digital image processing and analysing and their applications. In this sense, the concept of digital image is introduced and the existing algorithms to manipulate digital images are presented to, for instance, improve the quality of the image, to obtain relevant information or torecognize the existing objects.

The subject is divided in two parts. Part 1 consists of chapters 1 and 2 (T1 & T2) and part 2, chapters 3 and 4 (T3 & T4). The first part is taught in English while the second one in Spanish.

Requirements

This subject has no specific requirements, taking into account that the students of the course are Computer Science graduates or equivalent.

Date of publication: 27/07/2016

Recommendable

Basic knowledge of programming. In particular Matlab and C++.

Skills

Specific

* CE10 - Understand and apply advanced knowledge of high-performance computing and numerical or computational methods to engineering problems.
* CE12 - Apply mathematical, statistical and artificial-intelligence methods to model, design and develop applications, services, intelligent systems and knowledge-based systems.

Generic

* CG1- Propose, calculate and design products, processes and installations in all areas of computer engineering.
* CG4 - Undertake mathematical modelling, calculation and simulation in technological centres and engineering companies, especially in research, development and innovation tasks in all areas related to computer engineering.
* CG8 - Integrate and apply the knowledge acquired and solve problems in new or little-known situations within broader (or multidisciplinary) contexts.

Basic

* You may consult the basic competencies students will have to achieve by the end of the Master's degree at the following address: http://estudis.uib.cat/master/comp_basiques/

Content

Theme content

T1. Image Enhancement and Image Spacial Filtering.

Histogram processing. Point processing. Smoothing and sharpening operations. Correlation and convolution.Noise models and noise removal.

T2. Feature Detection

Thresholding.Edge Detection (first and second derivatives).Morphological operations.

T3. Segmentation

Pixel-based segmentation. Region-based segmentation. Case of study: skin-colour segmentation.

T4. Face detection

Date of publication: 27/07/2016

Face detection using Haar cascades.

Teaching methodology

The theoretical content will be discussed in classroom lectures based on reference texts to which students have access through the library. The theoretical concepts presented will be applied to problem solving / practice, both during (where appropriate) lectures, and specific classes of problems, or tutoring in small groups or individually.

The student will solve problems / simple practices reinforcement of concepts and techniques in class views. Also, to deepen these techniques, problems / practices of higher complexity is proposed. The monitoring of the work will be done both in class and through tutorials, where reduced or individual level group will proceed to the discussion and exchange of information between student (s) and teacher. This type of activity can be associated oral presentation of work by students.

In order to encourage autonomy and personal work, the course is part of the project Campus Extens. This project incorporates the use of telematics for flexible and distance university teaching tools. In this way, the student will have electronic documents and Internet links related to the content of the subject, statements of problems / practices.

In-class work activities

Modality	Name	Typ. Grp.	Description	Hours
Theory classes	Master classes	Large group (G)	The lecturer will describe the theoretical and practical fundamentals of the different topics covered in the course. In addition, for each topic the lecturer will provide information on the recommended working method and materials that students should use to autonomously study the subject. These master classes will be distributed throughout the semester. Each session will last from 1.5 to 2.5 hours, during which the theoretical descriptions and the resolution of exercises and problems will alternate.	6
Laboratory classes	Laboratory	Medium group 2 (X)	Practical sessions related to the design of image processing algorithms will be organized. These will allow verifying the correct understanding of the techniques described in the theoretical and practical sessions. The student should hand in several reports with their explained solution on how they deal with the posed problems during the semester. This evaluation will assess whether the student knows how to correctly use the procedures and techniques related to some practical aspects of the subject.	9
Assessment	Oral defense of some topics	Small group (P)	The student will do some oral presentations of different topics related to the content of the subject during the semester. This evaluation will assess whether the student understand those topics and is able to present the main concepts to the rest of the group.	2
Assessment	Written exam	Large group (G)	The student will do a written examination at the end of the semester. This evaluation will assess whether the student has understood the theory and if they know how to correctly use	1

Date of publication: 27/07/2016

Modality	Name	Typ. Grp.	Description	Hours
			the procedures and techniques that have been presented during the course. The numerical scoring criteria will be provided together with the exam questions.	

At the beginning of the semester a schedule of the subject will be made available to students through the UIBdigital platform. The schedule shall at least include the dates when the continuing assessment tests will be conducted and the hand-in dates for the assignments. In addition, the lecturer shall inform students as to whether the subject work plan will be carried out through the schedule or through another way included in the Campus Extens platform.

Distance education work activities

Modality	Name	Description	Hours
Individual self-study	Completion of the practical exercises started in the laboratory	Each student will have to devote some extra time (besides the time established in the course schedule) to complete the resolution of the problems proposed in the laboratory sessions. The solutions to these problems will have to be delivered for the lecturer to score them.	33
Group or individual self-study	Study to assimilate the theory described in the sessions.	Each student will have to devote some time to individually assimilate the theoretical contents that were presented by the lecturer in the sessions.	24

Specific risks and protective measures

The learning activities of this course do not entail specific health or safety risks for the students and therefore no special protective measures are needed.

Student learning assessment

The skills that have to be acquired in this course will be evaluated by means of a series of assessment procedures associated to each evaluative activity. The table in this section describes, for each evaluative activity, the evaluation technique that will be used, the type of evaluation (recoverable or non-recoverable), the scoring criteria and the weight of the mark in the final mark of the subject (depending on the specific evaluative itinerary).

This subject considers a single evaluative itinerary (labelled “A”) which is suitable both for students who can attend to all the sessions and for those who cannot. The students commit themselves to perform all the activities included in the “A” itinerary.

The student will get a numeric mark comprised between 0 and 10 for each evaluative activity. This mark will be used (with the corresponding weight) to compute the final mark of the subject. In order to pass the student must get a minimum of 5 points.

The assessment of the subject will be made in two independent blocks. The themes T1 and T2will be assessed in Block 1 whileT3 and T4 in Block 2. To pass the course the student should

Date of publication: 27/07/2016

obtain a minimum of 5 points in each block. The final mark of the subject will be the arithmetic mean of thescores on each block.

The evaluation of Block 1 will be as follows:
* A writtenexam, with a weight of 10% on this block. Recoverable.
* A laboratoy project, with a weight of 70% on this block. Recoverable.
* An oral presentation, with a weight of 20% on this block. Do not recoverable.
The mark of Block 1 will be calculated with the weighted sum of the three elements outlined above.

The evaluation of Block 2 will be as follows:
* A case of study, with a weight of 90% on this block. Recoverable.
* An oral presentation, with a weight of 10% on this block. Do not recoverable.
The mark of Block 2will be calculated with the weighted sum of the two elements outlined above.

Laboratory

Modality	Laboratory classes
Technique	Papers and projects **(retrievable)**
Description	Practical sessions related to the design of image processing algorithms will be organized. These will allow verifying the correct understanding of the techniques described in the theoretical and practical sessions. The student should hand in several reports with their explained solution on how they deal with the posed problems during the semester. This evaluation will assess whether the student knows how to correctly use the procedures and techniques related to some practical aspects of the subject.
Assessment criteria	Practical sessions related to the design of image processing algorithms will be organized. These will allow verifying the correct understanding of the techniques described in the theoretical and practical sessions. The student should hand in several reports with their explained solution on how they deal with the posed problems during the semester. This evaluation will assess whether the student knows how to correctly use the procedures and techniques related to some practical aspects of the subject. Assessed skills:CG1, CG4, GC8, CE10 and CE12

Final grade percentage: 85% with minimum grade 5

Oral defense of some topics

Modality	Assessment
Technique	Oral tests **(non-retrievable)**
Description	The student will do some oral presentations of different topics related to the content of the subject during the semester. This evaluation will assess whether the student understand those topics and is able to present the main concepts to the rest of the group.
Assessment criteria	The student will do an oral presentation of different topics related to the content of the subject during thesemester. This evaluation will assess whether the student understand those topics and is able to present the main concepts to the rest of the group. Assessed skills:CG1, CG4, GC8, CE10 and CE12

Final grade percentage: 10%

Written exam

Modality	Assessment
Technique	Objective tests **(retrievable)**
Description	The student will do a written examination at the end of the semester. This evaluation will assess whether the student has understood the theory and if they know how to correctly use the procedures and techniques

Date of publication: 27/07/2016

	that have been presented during the course. The numerical scoring criteria will be provided together with the exam questions.
Assessment criteria	The student will do a written examination at the end of the semester. This evaluation will assess whether the student has understood the theory and if they know how to correctly use the procedures and techniques that have been presented during the course. The numerical scoring criteria will be provided together with the exam questions. Assessed skills:CG1,GC8, and CE12

Final grade percentage: 5%

Resources, bibliography and additional documentation

Basic bibliography

* Digital Image Processing (3rd Edition), Rafael C. Gonzalez, Richard E. Woods Publisher: Prentice Hall,ISBN: 978-0131687288, 2007.
* Computer Vision: A Modern Approach (2nd Edition),Forsyth, D.A. and Ponce, J., Prentice Hall, ISBN: 978-0136085928,2011.

Complementary bibliography

* Digital Image Processing Using MATLAB, 2nd ed.,Rafael C. Gonzalez, Richard E. Woods, StevenL. Eddins Publisher: Gatesmark Publishing; 2nd edition (2009), ISBN-10: 0982085400, ISBN-13:978-0982085400
* Robotics, Vision and Control: Fundamental Algorithms in MATLAB, Peter Corke Publisher: Springer; 1sted. 2011 edition (March 1, 2013),ISBN-10: 3642201431,ISBN-13: 978-3642201431
* Matlab, Second Edition: A Practical Introduction to Programming and Problem,Stormy Attaway Publisher:Butterworth-Heinemann; 2 edition (August 11, 2011),ISBN-10: 0123850819,ISBN-13: 978-0123850812
* Essential matlab for engineers and scientistsBrian H. Hahn and Daniel T. Valentine Publisher: AcademicPress, 2010,SBN:9780123748836
* Learning OpenCV,Computer Vision with the OpenCV Library,Gary Bradski andAdrian Kaehler,O'ReillyMedia,ISBN978-0596516130, 2008.

Other resources

Oficial web of the subject at Campus Extens.
* http://homepages.inf.ed.ac.uk/rbf/CVonline/
* http://sourceforge.net/projects/opencvlibrary/

Date of publication: 27/07/2016