

| Degree                       | Type | Year |
|------------------------------|------|------|
| 2502441 Computer Engineering | OB   | 3    |
| 2502441 Computer Engineering | OT   | 4    |

## Contact

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## Teachers

Jordi Serra Ruiz

## Teaching groups languages

You can view this information at the [end](#) of this document.

## Prerequisites

- Programming in Python.

## Objectives and Contextualisation

Information Technology aims to ensure that, at any time and anywhere, we can access, with different types of devices and different networks, multimedia information. The Information Society is one of the current adventures and for its construction it is necessary to develop ideas and innovative products based on the aforementioned technologies.

After introducing the convergence between the different channels through which users receive multimedia information (digital TV and internet), they enter the JPEG image and MPEG video and multimedia standards that allow them to represent and transmit this information.

The transmission of these data either through the Internet channel, for those of Television or those of mobile phones leads to some characteristic applications with the corresponding user interfaces.

The standards are introduced to describe the metadata associated with Digital Video and some automatic annotation techniques.

With a view to gaining deep knowledge of the methodology associated with the definition of standards, qualitative and quantitative studies will be carried out and created on several known algorithms.

Finally, the theme of Software as a Service (SaaS) is introduced from a modern perspective of manipulation and management of multimedia content, using the tools of Cloud Computing as an element that makes it possible to obtain value from the contents digital

The objectives presented will be addressed from a theoretical perspective, as well as practical, including reporting.

All this approach is given in the context of the study of the perceptual thresholds of the human visual system (HVS), which will allow us to understand the reason for the multiple technological decisions.

## **Competences**

- Computer Engineering
- Acquire thinking habits.
- Capacity to design, develop, evaluate and ensure the accessibility, ergonomics, usability and security of computer systems, services and applications, as well as of the information that they manage.
- Communication.
- Have the capacity to develop and evaluate interactive and complex information display systems and apply them to problem solving in the design of person-computer interaction.

## **Learning Outcomes**

1. Apply basic multimedia content processes for their transmission.
2. Communicate efficiently, orally or in writing, knowledge, results and skills, both in the professional environment and before non-expert audiences.
3. Develop a capacity for analysis, synthesis and prospection.
4. Integrally design and evaluate information systems, taking into account cost and quality criteria.
5. Know how to use different 1D and 2D data compression algorithms.
6. Use English as the language of communication and professional relations .

## **Content**

### **UNIT 1**

1. The Human Visual System (HVS) as an element of technological definition.
2. Statistical properties of images.
3. Perceptual Thresholds: Redundancy.

### **UNIT 2**

1. Image coding: Eliminating spatial redundancy.
2. JPEG Lossy.
3. JPY Lossless.

### **UNIT 3**

1. Video coding: Eliminating temporary redundancy.
2. The generalized video encoding system.

### **UNIT 4**

1. MPEG: Towards efficient video encoding.
2. MPEG-1.
3. MPEG-2.

## UNIT 5

1. The multimedia object.
2. MPEG-4.
3. Advanced codecs.

## UNIT 6

1. Metadata: features, descriptors and coding.
2. MPEG-7.
3. XML.

## UNIT 7

1. The Human Acoustic System.
2. Sound transmission.
3. Audio format WAV
4. MPEG-4 Layer 3 (MP3)

## UNIT 8

1. Software as a Service Model (SaaS)
2. Cloud Computing for Multimedia
3. Multimedia Retrieval Systems
4. Deep Learning networks for multimedia retrieval
5. Future Applications

## Activities and Methodology

| Title                                                | Hours | ECTS | Learning Outcomes |
|------------------------------------------------------|-------|------|-------------------|
| Type: Directed                                       |       |      |                   |
| LECTURES OF THEORETICAL FOUNDATIONS                  | 26    | 1.04 | 1, 2, 5, 3        |
| PRACTICUM SESSIONS                                   | 12    | 0.48 | 1, 5, 4           |
| PROBLM-SOLVING SEMINARS                              | 12    | 0.48 | 5, 3, 4           |
| Type: Supervised                                     |       |      |                   |
| MULTIMEDIA PROGRAMMING (collective)                  | 26    | 1.04 | 1, 5, 4           |
| Type: Autonomous                                     |       |      |                   |
| INDIVIDUAL STUDY                                     | 25    | 1    | 1, 5, 3, 4        |
| PROGRAMMING VIDEO CODECS (individual and collective) | 25    | 1    | 1, 5, 4           |
| REPORT EDITION (individual and collective)           | 18    | 0.72 | 1, 2, 5, 3, 4, 6  |

The learning process will be based on the following 3 types of activities: lectures on theoretical foundations, problem-solving seminars, and practicum sessions.

## LECTURES OF THEORETICAL FOUNDATIONS

During these sessions in the classroom, the contents of the subject will be presented and discussed. The student will be provided with digital materials, impressions, and bibliographical references. They will be active discussion in which progress will be made in a constructive manner through the identification of the main objectives, giving answers and proposed solutions as the subject evolves. All materials will be identified on the Charon website (<http://caronte.uab.cat>)

## PROBLEM-SOLVING SEMINARS

In these activities, students will delve into the analysis of multimedia standards, identifying their main characteristics. Therefore, the students will study the white papers of the different standards and will edit their own technical reports, developing the professional technical document creation capacities in technical English.

The set of exercises will be oriented in a constructive way, and thus the students will begin first with simple technical documents, to finish with qualitative and quantitative analysis. The delivery of all proposed reports will be mandatory.

## PRACTICUM SESSIONS

During the practice sessions, students will code multimedia applications that will allow them to implement and manipulate the parameters of MPEG encoders and Cloud Computing services. With this approach, the students will integrate the knowledge acquired in the theoretical and problem sessions. They will use tools that will allow them to obtain the quantitative and qualitative results for the realization of the reports.

There will be 6 practice sessions that will be carried out in our own laboratories in groups of 3 people. Attendance to class of practices is **COMPULSORY**. Any fault must be communicated by email to the responsible teacher **BEFORE** the end of the corresponding session and must be justified with written evidence.

Otherwise, the practice part will be suspended.

The practicum deliveries consist of:

- Multimedia applications with digital compression libraries in images and video.
- Creation of transformation filters in both images and video
- Automatic detection of scene changes in videos
- Creation of a multi-media application using cloud computing platforms

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

## Assessment

### Continous Assessment Activities

| Title                           | Weighting | Hours | ECTS | Learning Outcomes |
|---------------------------------|-----------|-------|------|-------------------|
| Defense of the Reports          | 0,25      | 1     | 0.04 | 2, 5, 3, 6        |
| Deliverables from the practicum | 0,5       | 4     | 0.16 | 1, 5, 3, 4        |
| Final Exam                      | 0,25      | 1     | 0.04 | 1, 5, 3, 4        |

This subject does not provide for the single assessment system.

The evaluation of the student will take place in a continuous process that will consider the evaluations of the deliveries by the teacher (distributed throughout the subject), and the discussions carried out during the theoretical sessions, problems, and practices.

ALL deliveries are compulsory and consist of:

1. REPORTS of the problem-solving lectures:

- Delivery of Report 1 (R1) (15%)
- Delivery of Report 2 (R2) (20%)
- Delivery of Report 3 (R3) (30%)
- Delivery of Report 4 (R4) (35%)
- Presentation of R4 (R5) (up to 1 extra points)

$$R = R1 + R2 + R3 + R4 + R5$$

2. Reports of presential practicum sessions:

- Delivery of Session 1 (S1)
- Delivery of Session 2 (S2)
- Delivery of Session 3 (S3)
- Delivery of Session 4 (S4)
- Delivery of Session 5 (S5)
- Delivery of Session 6 (S6)

$$S = (S1 + S2 + S3 + S4 + S5 + S6) / 6$$

3. Exam on the theoretical contents

Final exam (EF)

The FINAL MARK will be calculated as follows:

$$\text{FINAL MARK} = 0.25 * EF + 0.25 * R + 0.5 * S$$

The minimum grade in the three evaluation parts is 5.

A 4.5 (fail) will appear in the student's file in case the calculation of the final grade is equal to or greater than 5, but the minimum grade is not reached in any of the evaluation activities.

Positive contributions in the discussions will roundup the decimals. To qualify for the "Matricula d'Honor" (with honors) it is necessary to have a participative attitude in the class discussions.

Students who have passed practices, problems or the theoretical contents in the previous year can validate them with a 5.

In the case of missing a mandatory delivery, both of the 5 problems and 6 practices, the corresponding part will be failed.

The non-presentation to the final exam (EF) implies a "no evaluable" in the student's file.

Granting a grade with honors is the decision of the faculty responsible for the subject. The regulations of the UAB indicate that MH can only be granted to students who have obtained a final grade equal to or greater than 9.00. It is only possible to grant up to 5% of MH of the total number of students enrolled.

Finally, there will be an extraordinary test that will allow students to recover (get a 5) in the theory part in case of having failed the final exam (EF), the date of which will be proposed by the School. There will also be the

possibility of recovering the part of problems before the first theory exam; in this case, all the problems missing before the date will have to be delivered and will opt, in the case of having everything right, to an approved (5) in each delivery.

All exams will be adjusted according to the School's calendar. The dates of continuous evaluation and delivery of works will be published on the website Caronte (<http://caronte.uab.cat>) and may be subject to programming changes for reasons of adaptation to possible incidents; Caronte will always inform on these changes, since it is understood that the Charon website is the usual mechanism for exchanging information between teacher and students.

For each evaluation activity, a place, date and time of revision in which the student can review the activity with the teacher will be indicated. In this context, claims may be made on the activity grade, which will be evaluated by the faculty responsible for the subject. If the student does not show up in this review, this activity will not be reviewed later.

Without prejudice to other disciplinary measures deemed appropriate, and in accordance with current academic regulations, irregularities committed by a student that may lead to a variation of the grade will be scored with a zero (0). For example, plagiarizing, copying, letting copy, etc., an evaluation activity, will imply suspending this evaluation activity with a zero (0). The evaluation activities qualified in this way and by this procedure will not be recoverable. If it is necessary to pass any of these evaluation activities to pass the subject, this subject will be suspended directly, without the opportunity to recover it in the same course.

## Bibliography

Material of the subject: <http://caronte.uab.es>

The main textbook is:

*"Handbook of Image & Video Processing". Ed. Al Bovik. Academic Press.*

Other basic references:

- Furht, B., Smoliar, S.W. Zhang, H. "Video and Processing in Multimedia Systems". Kluwer Academic Publishers. 1995.
- Blanken, H. de Vries, A.P., Ernst Blok, H. Feng, L. "Multimedia Retrieval". Springer 2007
- Benoit H. "Digital Television". Editorial Paraninfo, 1998.
- Wang, Y., J. Ostermann, Zhang, Y. "Video Processing and Communications". Prentice Hall, 2002.

Reference web links: Everything about the data compression <http://compression.ru/video/>

## Software

It will be necessary to have Python installed for the first part of the practice,

For the second part, the software is the choice of each of the projects that result, and that work best to achieve the goals set.

## Language list

| Name | Group | Language | Semester | Turn |
|------|-------|----------|----------|------|
|------|-------|----------|----------|------|

|                               |     |         |                 |               |
|-------------------------------|-----|---------|-----------------|---------------|
| (PAUL) Classroom practices    | 441 | Catalan | second semester | morning-mixed |
| (PAUL) Classroom practices    | 442 | Catalan | second semester | morning-mixed |
| (PLAB) Practical laboratories | 441 | Catalan | second semester | morning-mixed |
| (PLAB) Practical laboratories | 442 | Catalan | second semester | morning-mixed |
| (PLAB) Practical laboratories | 443 | Catalan | second semester | morning-mixed |
| (PLAB) Practical laboratories | 444 | Catalan | second semester | morning-mixed |
| (TE) Theory                   | 440 | Catalan | second semester | morning-mixed |