Course guides
270211 - SIS - Signals and Systems

Unit in charge: Barcelona School of Informatics
Teaching unit: 739 - TSC - Department of Signal Theory and Communications.

Degree: BACHELOR'S DEGREE IN DATA SCIENCE AND ENGINEERING (Syllabus 2017). (Compulsory subject).

Academic year: 2021 ECTS Credits: 6.0 Languages: Spanish

LECTURER

Coordinating lecturer: OLGA MUÑOZ MEDINA

Others:
Primer quadrimestre:
ORESTES MIQUEL MAS CASALS - 11
OLGA MUÑOZ MEDINA - 11

PRIOR SKILLS

The knowledge acquired in the subjects of the Degree in the previous semester.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE5. Design and apply techniques of signal processing, choosing between different technological tools, including those of Artificial vision, speech recognition and multimedia data processing.

Generical:
CG1. To design computer systems that integrate data of provenances and very diverse forms, create with them mathematical models, reason on these models and act accordingly, learning from experience.
CG2. Choose and apply the most appropriate methods and techniques to a problem defined by data that represents a challenge for its volume, speed, variety or heterogeneity, including computer, mathematical, statistical and signal processing methods.
CG5. To be able to draw on fundamental knowledge and sound work methodologies acquired during the studies to adapt to the new technological scenarios of the future.

Transversal:
CT5. Solvent use of information resources. Manage the acquisition, structuring, analysis and visualization of data and information in the field of specialty and critically evaluate the results of such management.

Basic:
CB5. That the students have developed those learning skills necessary to undertake later studies with a high degree of autonomy

TEACHING METHODOLOGY

The course is based on face-to-face theory and laboratory classes. The theory classes follow the program defined in this teaching guide.

Within the theory classes, the dialogue between the teacher and the students is promoted, providing problems and joint activities based on particular aspects of the topic being discussed.

The laboratory classes focus on the topics of Fourier Transform, filtering and processing of signals. They are based on computer programs and are guided by a text.
LEARNING OBJECTIVES OF THE SUBJECT

1.1. The student must be able to understand and be proficient on the basic concepts of signals, linear systems and related functions and transformations.

2.2. The student must know how to do the mathematical analysis of signals and systems in the time and frequency domains both in analogue and digital environments.

3.3. The student must know how to interpret and use discrete signals and systems in 1D and 2D in the temporal / spatial and frequency domains.

4.4. The student must be able to apply the frequency representation of signals and systems to solve various applications.

5.5. The student must be able to evaluate discrete filters and apply them to real systems.

6.6. The student must know how to correctly formulate a problem from the proposed statement and identify the options for its resolution, apply the appropriate resolution method, and validate the solution.

7.7. The student must know how to identify, model and solve problems from open situations. Also to explore and apply the alternatives for resolution. He will work with approximations.

8.8. The student must know how to use autonomously the tools, instruments and software applications available in the laboratories of the basic and advanced subjects. He should know their performances and limitations.

9.9. The student should know additional tools useful for processing discrete generic signals in the time and transformed domains.

10.10. The student must be able to evaluate advantages and disadvantages of different technological alternatives to implement analysis systems for analog and discrete signal.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

Signals and systems in temporal (or spatial) domain

Description:
Continuous-time and discrete-time signals and systems: definition, classification, and properties.
Convolution.
Correlation.
Characterization of linear and time-invariant systems.

Signals and systems in the frequency domain.

Description:
Continuous-time and discrete-time Fourier Transform.
Frequency response of linear and invariant systems.
Frequency analysis of periodic signals.
Discrete Fourier Transform (DFT).

Sampling and reconstruction.

Description:
Sampling Theorem. Interpolation formula. Conversion A/D, D/A.
Change of the sampling frequency: decimation and interpolation.
Filtering.

Description:
Z transform.

ACTIVITIES

Topic 1

Description:
Theory classes and problems corresponding to topic 1

Specific objectives:
1, 2, 3, 5, 6, 8

Related competencies:
CG1. To design computer systems that integrate data of provenances and very diverse forms, create with them mathematical models, reason on these models and act accordingly, learning from experience.
CG5. To be able to draw on fundamental knowledge and sound work methodologies acquired during the studies to adapt to the new technological scenarios of the future.
CG2. Choose and apply the most appropriate methods and techniques to a problem defined by data that represents a challenge for its volume, speed, variety or heterogeneity, including computer, mathematical, statistical and signal processing methods.
CE5. Design and apply techniques of signal processing, choosing between different technological tools, including those of Artificial vision, speech recognition and multimedia data processing.
CT5. Solvent use of information resources. Manage the acquisition, structuring, analysis and visualization of data and information in the field of specialty and critically evaluate the results of such management.
CB5. That the students have developed those learning skills necessary to undertake later studies with a high degree of autonomy

Full-or-part-time: 50h
Theory classes: 10h
Practical classes: 8h
Laboratory classes: 2h
Self study: 30h
Topic 2

Description:
Theory classes and problems corresponding to topic 2

Specific objectives:
1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Related competencies:
CG1. To design computer systems that integrate data of provenances and very diverse forms, create with them mathematical models, reason on these models and act accordingly, learning from experience.
CG5. To be able to draw on fundamental knowledge and sound work methodologies acquired during the studies to adapt to the new technological scenarios of the future.
CG2. Choose and apply the most appropriate methods and techniques to a problem defined by data that represents a challenge for its volume, speed, variety or heterogeneity, including computer, mathematical, statistical and signal processing methods.
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Full-or-part-time: 50h
Theory classes: 10h
Practical classes: 6h
Laboratory classes: 4h
Self study: 30h

Topic 3

Description:
Theory classes and problems corresponding to topic 3

Specific objectives:
1, 2, 3, 4, 6, 7

Related competencies:
CG1. To design computer systems that integrate data of provenances and very diverse forms, create with them mathematical models, reason on these models and act accordingly, learning from experience.
CG5. To be able to draw on fundamental knowledge and sound work methodologies acquired during the studies to adapt to the new technological scenarios of the future.
CG2. Choose and apply the most appropriate methods and techniques to a problem defined by data that represents a challenge for its volume, speed, variety or heterogeneity, including computer, mathematical, statistical and signal processing methods.
CE5. Design and apply techniques of signal processing, choosing between different technological tools, including those of Artificial vision, speech recognition and multimedia data processing.
CT5. Solvent use of information resources. Manage the acquisition, structuring, analysis and visualization of data and information in the field of specialty and critically evaluate the results of such management.
CB5. That the students have developed those learning skills necessary to undertake later studies with a high degree of autonomy

Full-or-part-time: 20h
Theory classes: 4h
Practical classes: 4h
Self study: 12h
Topic 4

Description:
Theory classes and problems corresponding to topic 4

Specific objectives:
3, 4, 5, 6, 7, 8, 9, 10

Related competencies:
CG1. To design computer systems that integrate data of provenances and very diverse forms, create with them mathematical models, reason on these models and act accordingly, learning from experience.
CG5. To be able to draw on fundamental knowledge and sound work methodologies acquired during the studies to adapt to the new technological scenarios of the future.
CG2. Choose and apply the most appropriate methods and techniques to a problem defined by data that represents a challenge for its volume, speed, variety or heterogeneity, including computer, mathematical, statistical and signal processing methods.
CE5. Design and apply techniques of signal processing, choosing between different technological tools, including those of Artificial vision, speech recognition and multimedia data processing.
CT5. Solvent use of information resources. Manage the acquisition, structuring, analysis and visualization of data and information in the field of specialty and critically evaluate the results of such management.
CB5. That the students have developed those learning skills necessary to undertake later studies with a high degree of autonomy

Full-or-part-time: 30h
Theory classes: 6h
Practical classes: 4h
Laboratory classes: 2h
Self study: 18h

GRADING SYSTEM
The final grade of the course is obtained from:
- Quizzes: Q (0-5%)
- The mid-term exam: P (30%-25%)
- The final exam: F (60%)
- Practices: L (10%)

The quizzes are optional, and only those quizzes with a grade higher than the mid-term exam will count for the final grade. For each student, the mid-term exam will count between 30% and 25% depending on the grades obtained in the theory quizzes. In turn, the weighting of the quizzes can vary between 0% and 5%, depending on the number of quizzes that exceed their mid-term exam grade.

Final grade = max( 0.3-0.25 C + 0-0.05 Q + 0.1 L +0.6 F; 0.1 L + 0.9 F)

In the case of taking a Re-evaluation exam, the final grade is:
Final grade = 0.9 R+0.1 L

BIBLIOGRAPHY

Basic:

Complementary: