



POLITÉCNICA

INTERNATIONAL
CAMPUS OF
EXCELLENCE

COORDINATION PROCESS OF
LEARNING ACTIVITIES
PR/CL/001



E.T.S. de Ingenieros
Informaticos

ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

103000712 - Speech and voice interaction

DEGREE PROGRAMME

10AQ - Eit Digital Master's Programme In Human Computer Interaction And Design

ACADEMIC YEAR & SEMESTER

2018/19 - Semester 1

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Learning guide

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1. Description

1.1. Subject details

| | |
|---------------------------------------|--------------------------------------------------------------------------------|
| Name of the subject | 103000712 - Speech and voice interaction |
| No of credits | 4.5 ECTS |
| Type | Optional |
| Academic year of the programme | First year |
| Semester of tuition | Semester 1 |
| Tuition period | September-January |
| Tuition languages | English |
| Degree programme | 10AQ - Eit digital master's programme in human computer interaction and design |
| Centre | 10 - Escuela Tecnica Superior de Ingenieros Informaticos |
| Academic year | 2018-19 |

2. Faculty

2.1. Faculty members with subject teaching role

| Name and surname | Office/Room | Email | Tutoring hours * |
|---------------------------------------------------|--------------------|------------------------|-------------------------------------------------|
| Agustin Alvarez Marquina (Subject coordinator) | 4211 | agustin.alvarez@upm.es | Sin horario. Please, ask for an appointment. |
| Victor Nieto Lluís | 4208 | victor.nieto@upm.es | Sin horario. Please, ask for an appointment. |

| | | | |
|-----------------------------|------|-------------------------------|-------------------------------------------------|
| Pedro Gomez Vilda | 4209 | pedro.gomezv@upm.es | Sin horario. Please, ask for an appointment. |
| M. Victoria Rodellar Biarge | 4205 | mariavictoria.rodellar@upm.es | Sin horario. Please, ask for an appointment. |
| Rafael Martinez Olalla | 4208 | rafael.martinezo@upm.es | Sin horario. Please, ask for an appointment. |

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

3. Skills and learning outcomes *

3.1. Skills to be learned

CB07 - Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio

CB09 - Que los estudiantes sepan comunicar sus conclusiones y los conocimientos y razones últimas que las sustentan, a públicos especializados y no especializados de un modo claro y sin ambigüedades

CE14 - Capacidad para conceptualizar, diseñar, desarrollar y evaluar la interacción personaordenador de productos, sistemas, aplicaciones y servicios informáticos

CE16 - Habilidad para hacer conexiones entre los deseos y necesidades del consumidor o cliente y lo que la tecnología puede ofrecer

3.2. Learning outcomes

RA31 - Plan and perform evaluation of prototypes

RA17 - Understand techniques, technologies and processes that allow to prototype, develop and improve digital interactive systems based on various user interface technology platforms

RA20 - Implement basic interactive android applications

RA16 - Work with other peers collaborating in the design, prototype, and implementation interactive systems

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

4. Brief description of the subject and syllabus

4.1. Brief description of the subject

The contents of this course are focused in the presentation of methods, techniques and tools for the development of man-machine interfaces based on vocal input. This includes speech recognition as well as voice recognition for secure access to installations and services, voice forensics, biomedical applications and assistance to persons with disabilities. Topics to be addressed include Speech analysis, speech recognition, speaker identification, voice biometrics, voice signature analysis and affective computing.

4.2. Syllabus

1. Introduction to Speech and Voice Production.

1.1. The sound.

1.2. Voice & Speech.

1.3. The speech apparatus.

1.4. Neuromotor control of speech.

1.5. Acoustic Phonetics.

1.6. Structure of the spoken message.

2. Speech Perception.

2.1. The auditory system.

- 2.2. The auditory pathway.
- 2.3. The auditory cortex.
- 2.4. Perception of static formants.
- 2.5. Formant dynamics perception.
- 2.6. Semantic reconstruction.
3. Acoustic-Phonetic Parametrization of Speech.
 - 3.1. Frequency representations.
 - 3.2. Fast Fourier Transform.
 - 3.3. Linear Predictive Coding.
 - 3.4. Structure of the syllable.
 - 3.5. Principles of phonation: the glottal wave.
 - 3.6. Parameterization of the glottal wave.
4. Classification and Recognition.
 - 4.1. Feature statistics.
 - 4.2. Clustering.
 - 4.3. Gaussian Mixtures Models (GMMs)
 - 4.4. Support Vector Machines (SVMs).
 - 4.5. Hidden Markov Models (HMMs).
 - 4.6. Classification framework: train & test.
5. Man-Machine Interfaces based on Vocal Interaction.
 - 5.1. Introducción.
 - 5.2. Secure access to facilities and services.
 - 5.3. Characterization of laryngeal pathologies.
 - 5.4. forensic analysis of voice .
 - 5.5. Neurodegenerative disease monitoring.
 - 5.6. Blind assistance systems.
 - 5.7. Motor disabled assistance systems.
6. Applications of Voice and Speech Biometrics.
 - 6.1. Introduction.

6.2. Speech recognition.

6.3. Speaker recognition.

6.4. Emotional evaluation of the speaker.

6.5. Neurological evaluation of the speaker.

5. Schedule

5.1. Subject schedule*

| Week | Face-to-face classroom activities | Face-to-face laboratory activities | Other face-to-face activities | Assessment activities |
|------|--------------------------------------------------------------------------------------|------------------------------------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | 1. Introduction to Speech and Voice Production. Duration: 02:00 Lecture | | | |
| 2 | 1. Introduction to Speech and Voice Production. Duration: 02:00 Lecture | | | Homework. Online test Continuous assessment Duration: 02:00 |
| 3 | 2. Speech Perception. Duration: 02:00 Lecture | | | |
| 4 | 2. Speech Perception. Duration: 02:00 Lecture | | | Homework. Online test Continuous assessment Duration: 02:00 |
| 5 | 3. Acoustic-Phonetic Parametrization of Speech. Duration: 02:00 Lecture | | | |
| 6 | 3. Acoustic-Phonetic Parametrization of Speech. Duration: 02:00 Lecture | | | Homework. Online test Continuous assessment Duration: 02:00 |
| 7 | 4. Classification and Recognition. Duration: 02:00 Lecture | | | |
| 8 | 4. Classification and Recognition. Duration: 02:00 Lecture | | | Homework. Online test Continuous assessment Duration: 02:00 |
| 9 | Tema 5 Duration: 02:00 Lecture | | | |
| 10 | Tema 5 Duration: 02:00 Lecture | | | Homework. Online test Continuous assessment Duration: 02:00 |
| 11 | Tema 6 Duration: 02:00 Lecture | | | Project assignment. Group work Continuous assessment and final examination Duration: 02:00 Homework. Online test Continuous assessment Duration: 02:00 |

| | | | | |
|----|---------------------------------------------------------------------------|--|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12 | Tema 6 Duration: 02:00 Lecture | | | Project assignment. Group work Continuous assessment and final examination Duration: 02:00 Homework. Online test Continuous assessment Duration: 02:00 |
| 13 | Project presentation. Duration: 02:00 Cooperative activities | | | Project assignment. Group work Continuous assessment and final examination Duration: 02:00 |
| 14 | Project presentation. Duration: 02:00 Cooperative activities | | | Project presentation. Group presentation Continuous assessment and final examination Duration: 02:00 |
| 15 | Project presentation. Duration: 02:00 Cooperative activities | | | Project presentation. Group presentation Continuous assessment and final examination Duration: 02:00 |
| 16 | | | | Final exam. Written test Final examination Duration: 01:00 |
| 17 | | | | |

The independent study hours are training activities during which students should spend time on individual study or individual assignments.

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

* The subject schedule is based on a previous theoretical planning of the subject plan and might go through experience some unexpected changes along throughout the academic year.

6. Activities and assessment criteria

6.1. Assessment activities

6.1.1. Continuous assessment

| Week | Description | Modality | Type | Duration | Weight | Minimum grade | Evaluated skills |
|------|-----------------------|--------------------|---------------|----------|--------|---------------|----------------------|
| 2 | Homework. | Online test | No Presential | 02:00 | 30% | / 10 | CB07 CE14 CE16 |
| 4 | Homework. | Online test | No Presential | 02:00 | 30% | / 10 | CB07 CE14 CE16 |
| 6 | Homework. | Online test | No Presential | 02:00 | 30% | / 10 | CB07 CE14 CE16 |
| 8 | Homework. | Online test | No Presential | 02:00 | 30% | / 10 | CB07 CE14 CE16 |
| 10 | Homework. | Online test | No Presential | 02:00 | 30% | / 10 | CB07 CE14 CE16 |
| 11 | Project assignment. | Group work | Face-to-face | 02:00 | 40% | / 10 | CB09 |
| 11 | Homework. | Online test | No Presential | 02:00 | 30% | / 10 | CB07 CE14 CE16 |
| 12 | Project assignment. | Group work | Face-to-face | 02:00 | 40% | / 10 | CB09 |
| 12 | Homework. | Online test | No Presential | 02:00 | 30% | / 10 | CB07 CE14 CE16 |
| 13 | Project assignment. | Group work | Face-to-face | 02:00 | 40% | / 10 | CB09 |
| 14 | Project presentation. | Group presentation | Face-to-face | 02:00 | 30% | / 10 | CB09 |
| 15 | Project presentation. | Group presentation | Face-to-face | 02:00 | 30% | / 10 | CB09 |

6.1.2. Final examination

| Week | Description | Modality | Type | Duration | Weight | Minimum grade | Evaluated skills |
|------|-------------|----------|------|----------|--------|---------------|------------------|
|------|-------------|----------|------|----------|--------|---------------|------------------|

| | | | | | | | |
|----|-----------------------|--------------------|--------------|-------|-----|------|----------------------|
| 11 | Project assignment. | Group work | Face-to-face | 02:00 | 40% | / 10 | CB09 |
| 12 | Project assignment. | Group work | Face-to-face | 02:00 | 40% | / 10 | CB09 |
| 13 | Project assignment. | Group work | Face-to-face | 02:00 | 40% | / 10 | CB09 |
| 14 | Project presentation. | Group presentation | Face-to-face | 02:00 | 30% | / 10 | CB09 |
| 15 | Project presentation. | Group presentation | Face-to-face | 02:00 | 30% | / 10 | CB09 |
| 16 | Final exam. | Written test | Face-to-face | 01:00 | 30% | / 10 | CB07 CE14 CE16 |

6.1.3. Referred (re-sit) examination

No se ha definido la evaluación extraordinaria.

6.2. Assessment criteria

A minimum grade of 5.0 over a total of 10 is required for completing the course.

OPTION A. CONTINUOUS ASSESSMENT GRADING.

GRADE = 30% Homework + 40% Project written report + 30% Project oral presentación.

OPTION B. FINAL EXAMINATION GRADING.

GRADE = 30% Final exam + 40% Project written report + 30% Project oral presentación.

7. Teaching resources

7.1. Teaching resources for the subject

| Name | Type | Notes |
|----------------------------------------------------------------------------------------------------------------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------|
| Speech Processing in the Auditory System, S. Greenberg, W. A. Ainsworth, A. N. Popper, R. R. Fay, Springer, 2004 | Bibliography | |
| The Digital Signal Processing Handbook, V. K. Madisetti, D. B. Williams, IEEE Press, 1998 | Bibliography | |
| Listening to Speech: An Auditory Perspective, S. Greenberg, W. A. Ainsworth, Lawrence Erlbaum Assoc., 2005 | Bibliography | |
| Spoken Language Processing, X. Huang, A. Acero, H. W. Hon, Prentice-Hall, 2001 | Bibliography | |
| A Wavelet Tour of Signal Processing, S. Mallat, Associated Press, 1998 Springer Handbook of Speech Processing, Springer, 2008 | Bibliography | |
| Machine Audition: Principles, Algorithms and Systems, K. Wang, IGI Global, 2010 | Bibliography | |
| Principles of Neural Science, E. R. Kandel, J. H. Schwartz, T. M. Jessell, McGraw-Hill, 2000 | Bibliography | |
| Web site | Web resource | http://tamarisco.datsi.fi.upm.es/ASIGNATURAS/ApliBioVoz |

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|---------------------------------------------------------|-----------|--|
| Laboratorio de Comunicación Oral "Robert W. Newcomb" | Equipment | |
|---------------------------------------------------------|-----------|--|