Data analytics for the smart society

Academic Year: (2021 / 2022) **Review date: 24-01-2022**

Department assigned to the subject: Signal and Communications Theory Department

Coordinating teacher: GALLARDO ANTOLIN, ASCENSION

Type: Electives ECTS Credits : 3.0

Year : 1 Semester : 2

OBJECTIVES

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1.- General/Cross-curricular objectives
1.1. General basic knowledge
1.2. Analysis and synthesis abilities
1.3. Capability of applying the knowledge they have acquired
1.4. Problem-solving skills
1.5. Capability of integration of knowledge

2.- Specific learning objectives

(Knowledge-related objectives)
2.1. Mathematical basis of signal processing
2.2. General knowledge on potential text, speech, image, and video processing applications in the big data framework.
2.3. Basic subsystems of signal processing applications in the big data framework.

(Instrumental objectives)
2.5. Use of signal processing software.
2.6. Mastering of basic processing tools in the big data framework.
2.7. Solving signal processing problems in the big data framework by using several basic tools.

(Attitudinal objectives)
2.8. Individual- and team-work
2.9. Decision-making
2.10. Analysis and problem-solving capabilities

DESCRIPTION OF CONTENTS: PROGRAMME

The aim of this subject is to describe automatic tools for analysis of text, speech, audio, image and video in the Big Data framework, according to a Project-Based Learning approach.

Additionally, some sessions of the subject will be devoted to discuss an issue of great social impact, such as health, from the perspective of data analytics.

The subject will have a practical orientation, combining theoretical and lab sessions, so that the students will be able to do some practical work on which they will be evaluated. Technologies will be described first; then, their applications, combining theory with practical work on the lab when possible. Emphasis will be placed on applications in the Big Data framework, with the aim of motivating the use of automatic analysis tools from a realistic perspective.

The syllabus is as follows. It focuses on multimedia information analytics (vs. analysis). In this field there is an extensive use of mathematics and statistics to extract valuable knowledge from data¿data analysis, going beyond and using the insights from data to generate recommendations, to guide a decision making process, etc.

0.- Course Presentation

1.- Image and Video Analytics
1.1.- Basic concepts in image and video processing

1.2.- Image categorization
1.3.- An introduction to CNNs for image and video analytics

2.- Speech Analytics
2.1.- Fundamentals of Speech Analysis
2.2.- Speech Technologies
2.3.- An introduction to RNNs/LSTMs for speech analytics

3.- Big Data in Health
3.1.- From Ambulatory Monitoring to the Healthy Apps

LEARNING ACTIVITIES AND METHODOLOGY

Two teaching activities are proposed: theoretical classes with examples and lab exercises.

THEORETICAL CLASSES WITH EXAMPLES (1.5 ECTS)

The theoretical class will be given in the blackboard, with slides or any other means to illustrate the main concepts of the course.

The explanations will be completed with examples, demonstrations and students' presentations of topics and practical cases related to the content of the course.

LABORATORY EXERCISES (1.5 ECTS)

Some basic concepts will be studied in the lab. The students will participate actively in the implementation of the solution.

There will be two types of lab exercises:
- Guided lab exercises
- Project: solving problems by means of automatic analysis of multimedia information.

ASSESSMENT SYSTEM

The final course grade will have two parts:

- 75% sum of the grades obtained in the three lab exercises corresponding to three main blocks of the course and the students' presentations.
- 25%: multiple-choice written test.

% end-of-term-examination:	25
% of continuous assessment (assigments, laboratory, practicals…):	75

BASIC BIBLIOGRAPHY

- Forsyth and Ponce Computer Vision: a Modern Approach (2nd Edition), Pearson Education, 2012

- Neustein, Amy (Ed.) Advances in Speech Recognition. Mobile Environments, Call Centers and Clinics, Springer, 2010. http://link.springer.com/book/10.1007%2F978-1-4419-5951-5"

ADDITIONAL BIBLIOGRAPHY

- Alex Krizhevsky, Ilya Sutskever, and Geoffrey E. Hinton ImageNet Classification with Deep Convolutional Neural Networks, NIPS (Neural Information Processing Systems), 2012
- B. Gold & N. Morgan Speech and Audio Signal Processing: Processing and Perception of Speech and Music, John Wiley & Sons, Inc. New York, NY, USA, 1999
- Christian Szegedy, Wei Liu, Yangqing Jia, Pierre Sermanet, Scott Reed, Dragomir Anguelov, Dumitru Erhan, Vincent Vanhoucke, Andrew Rabinovich Going Deeper with Convolutions, http://arxiv.org/abs/1409.4842, 2014

- Gonzalez and Woods Digital Image Processing 3rd Ed., Prentice Hall, 2008

- J. Hill et al. Effects of stimulus type and of error-correcting code design on BCI speller performance, NIPS (Conference on Neural Information Processing Systems), 2009
- LeCun, Yann; Léon Bottou; Yoshua Bengio; Patrick Haffner Gradient-based learning applied to document recognition, Proceedings of the IEEE 86 (11): 2278¿2324. doi:10.1109/5.726791, 1998
- Wilhelm Burger and Mark J. Burge Digital Image Processing: An Algorithmic Introduction using Java, Springer-Verlag, 2010