COURSE DETAILS

"SISTEMI MULTIMEDIALI"

SSD ING-INF/05

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2023-2024

GENERAL INFORMATION – TEACHER REFERENCES

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GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.

MODULE (IF APPLICABLE): N.A.

CHANNEL (IF APPLICABLE): N.A.

YEAR OF THE DEGREE PROGRAMME (I, II, III): III

SEMESTER (I, II): II

CFU: 6

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")
Basi di Dati.

PREREQUISITES (IF APPLICABLE)
None.

LEARNING GOALS
The course provides students with the basic knowledge and methodological tools necessary to understand and design multimedia systems. The course will present models, techniques and technologies for the management of multimedia data together with the architectural aspects of multimedia systems. Different methodologies and standards for multimedia representation will be presented and discussed. Software tools will be used for the implementation of multimedia descriptor extraction and their use in different applications.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding
The course provides students with the knowledge and methodological tools necessary to analyze the problems related to multimedia to allow its management. These tools will allow students to recognize the main relationships between the representation of multimedia data, the analysis and management of the same and to understand their effects in terms of effectiveness and efficiency within the entire multimedia management process.

Applying knowledge and understanding
The course provides skills and methodological and operational tools necessary to concretely apply the knowledge related to the analysis of multimedia data for the identification of effective techniques to represent them and the use of efficient technologies to implement multimedia systems.

COURSE CONTENT/SYLLABUS
INTRODUCTION TO MULTIMEDIA - Media and multimedia, types of media, multimedia computing, components of multimedia applications, semiotics, semantic gap. MULTIMEDIA BASICS - Metadata, document formats, markup languages, text properties, document organization, image formats, audio formats, video formats, multimedia document preprocessing. IMAGE REPRESENTATION - Bit Plan, Dithering, 1-bit Images, 8-bit 24-bit, Graphic/Image Data Types, Color Search Tables, Popular File Formats. COLOR IN IMAGES AND VIDEOS - Color science, color models in images, color models in video. BASIC CONCEPTS IN VIDEO - Analog Video, Digital Video, Display Video Interfaces, 3D Video and TV. DIGITAL AUDIO FUNDAMENTALS - Sound digitization, signal-to-noise ratio (SNR), signal-quantization-to-noise ratio (SQNR), linear and nonlinear quantization, audio filtering, audio quantization and transmission, Pulse Code Modulation, Differential audio coding, lossless predictive coding, DPCM, DM, ADPCM. DATA COMPRESSION – Lossless compression, basics of information theory, Run-Length Coding, Variable-Length Coding, dictionary-based coding, arithmetic coding (outline), lossy compression, distortion measures, rate-distortion theory, quantization, transform coding, Wavelet-based coding, Wavelet packets, Embedded Zerotree of Wavelet coefficients, Set Partitioning in Hierarchical Trees (outline). IMAGE COMPRESSION STANDARDS - The JPEG standard, Main steps in JPEG image compression, JPEG mode, Bitstream JPEG, the JPEG2000 standard, main steps of JPEG2000 image compression, adaptation of EBCOT to JPEG2000, ROI, JPEG and JPEG2000 performance comparison. INTRODUCTION TO VIDEO COMPRESSION - Video compression based on motion compensation, motion vector search (outline), H.261, H.263 (outline), MPEG-1, 2, 4, 7 and 21. MPEG AUDIO COMPRESSION - Psychoacoustics, Frequency masking, Time masking, MPEG audio, MPEG layers, MPEG audio strategy, MPEG audio compression algorithm. MULTIMEDIA DESCRIPTORS - Color histograms, Color layout, Texture characteristics, Multiresolution analysis (outline), Shape characteristics, Shape representation, SIFT, SURF, Audio characteristics, Video (outline). MULTIMEDIA SYSTEMS ARCHITECTURE - Multimedia Content Management, Multimedia Information Retrieval Systems (MIRS), Systems Evaluation, Multimedia Databases, Indexes for multimedia data.

READINGS/BIBLIOGRAPHY

Libri di testo: Ze-Nian Li , Mark S. Drew, e al., "*Fundamentals of Multimedia*", 2ed, Springer, 2014.
Vittorio Castelli and Lawrence D. Bergman, editors, "*Image Databases. Search and Retrieval of Digital Imagery*", Wiley, 2002
Course Slides.

TEACHING METHODS

Lectures, exercises, seminars, specialized software for the extraction of multimedia descriptors and applications (OPENCV: Open Source Computer Vision Library)

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
oral	X
project discussion	X