# UNIVERSITÀ DEGLI STUDI DI PALERMO

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| **DEPARTMENT** | Matematica e Informatica |
| **ACADEMIC YEAR** | 2016/2017 |
| **BACHELOR'S DEGREE (BSC)** | COMPUTER SCIENCE |
| **SUBJECT** | DIGITAL IMAGE ANALYSIS |
| **TYPE OF EDUCATIONAL ACTIVITY** | B |
| **AMBIT** | 50166-Discipline Informatiche |
| **CODE** | 15833 |
| **SCIENTIFIC SECTOR(S)** | INF/01 |
| **HEAD PROFESSOR(S)** | VALENTI CESARE FABIO Professore Associato Univ. di PALERMO |
| **OTHER PROFESSOR(S)** | |
| **CREDITS** | 6 |
| **INDIVIDUAL STUDY (Hrs)** | 102 |
| **COURSE ACTIVITY (Hrs)** | 48 |
| **PROPAEDEUTICAL SUBJECTS** | 05880 - PROGRAMMING AND LABORATORY - INTEGRATED COURSE<br>16670 - ALGORITHMS AND DATA STRUCTURES<br>16784 - OPERATING SYSTEMS<br>16450 - COMPUTER ARCHITECTURES<br>16448 - MATHEMATICAL METHODS FOR COMPUTER SCIENCE<br>16671 - THEORETICAL COMPUTER SCIENCE |
| **MUTUALIZATION** | |
| **YEAR** | 3 |
| **TERM (SEMESTER)** | 1° semester |
| **ATTENDANCE** | Not mandatory |
| **EVALUATION** | Out of 30 |
| **TEACHER OFFICE HOURS** | **VALENTI CESARE FABIO**<br>Wednesday 14:30 18:30 da concordare via email |

**DOCENTE:** Prof. CESARE FABIO VALENTI

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| **PREREQUISITES** | Basic knowledge of trigonometry and calculus. |
| **LEARNING OUTCOMES** | - Knowledge and ability to understand.<br>Acquisition of advanced tools for the analysis of digital images and to design computer systems and interfaces. Acquisition of the tools used in the field of computer graphics. Ability to use the technical language of this specific field.<br><br>- Ability to apply knowledge and understanding.<br>Ability to recognize the main characteristics of the images and to design an ad hoc system for their processing and interpretation.<br><br>- Making judgments.<br>Being able to evaluate the implications and the results of image processing systems, considering their nature and the use of the produced information (for example, for biomedical or satellite data surveys, for the realization of virtual systems).<br><br>- Ability to communicate.<br>Capacity to expose the specific problem and the expected results by the developed system. To be able to support and to highlight both the importance and the reliability of the carried out processing (eg, validation of the unsupervised classification).<br><br>- Learning ability.<br>Ability to upgrade through scientific publications regarding the fields of image analysis, computer vision and, more in general, the theory of algorithms. Ability to attend, using the knowledge acquired during the course, second level masters, in-depth courses, specialized seminars both in image analysis and computer graphics industry. |
| **ASSESSMENT METHODS** | Optional ongoing evaluation for the self-evaluation of the student. Final oral examination to verify skills and disciplinary knowledge provided by the course. The clarity of the presentation will be evaluated, too.<br><br>Excellent (29-30 / 30+) - excellent knowledge about the topics, excellent ability of the technical language, good analytical ability, the student is able to apply knowledge to solve independently all proposed problems<br><br>Good (24-26) - good knowledge about the topics with reasonable ability of the technical language, the student is able to apply knowledge to solve most proposed problems<br><br>Sufficient (18-23) - the student does not have full ability of the main topics but he has the underlying knowledge; just sufficient ability of the technical language with little ability to apply independently the knowledge acquired<br><br>Insufficient - the student does not have an acceptable knowledge about the contents of the topics covered during the course |
| **EDUCATIONAL OBJECTIVES** | Aim of the course is the study of the basic tools for the analysis of digital images and for computer graphics. In particular the convolution theorem, examples of non-linear filters, spatial operators, mathematical morphology on grayscale images, improving quality techniques, segmentation and compression algorithms will be presented. The main acquisition methods and the most popular graphics formats for their proper storage will be described. During the course real cases will be discussed and articles present in the industry literature to highlight the application of the proposed techniques will be studied. |
| **TEACHING METHODS** | Lectures. |
| **SUGGESTED BIBLIOGRAPHY** | di carattere generale:<br>R.C.Gonzales, R.E.Woods. Elaborazione delle Immagini Digitali. Pearson Prentice Hall, 2008.<br><br>di carattere generale:<br>L.G.Shapiro, G.C.Stockman. Computer Vision. Prentice Hall, 2001.<br><br>di carattere generale:<br>R.Szeliski. Computer Vision: Algorithms and Applications. Springer 2010.<br><br>specificatamente per la morfologia matematica:<br>P.Soille. Morphological Image Analysis. Springer-Verlag, 2003.<br><br>specificatamente per le trasformate nel dominio delle frequenze:<br>A.S.Glassner. Principles of Digital Image Synthesis. Morgan Kaufmann Publishers, 1995.<br><br>a integrazione del testo di gonzales e woods: |

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| | R.C.Gonzales, R.E.Woods, S.L.Eddins. Digital Image Processing using Matlab. Prentice Hall, 2004. |

## SYLLABUS

| Hrs | Frontal teaching |
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| 4 | Introduction to the visual system, limited to the aspects useful to justify the technological choices that will be presented during the course (e.g. separating luminance / chrominance channels, Bayer filter, interlacing). |
| 8 | Digital acquisition systems. Color spaces. Truecolor and indexed images; quantization. Histogram of the gray levels; stretching; equalization; thresholding. Deepgrey. Geometric transforms (e.g. resize and rotate). Segmentation and quadtrees. |
| 15 | Convolution (mean, Gauss, Laplace, Sobel, Prewitt). Edge Histogram. Median filter. Applications (e.g. noise reduction, contrast enhancement, inpainting and normalized convolution, fast radial symmetry). |
| 6 | Mathematical morphology for grayscale images (erosion, dilation, opening, closing). Applications (e.g. contours and contrast enhancement). |
| 15 | Digital image compression; Error measures. Two-dimensional discrete cosine transform and wavelet (e.g. Haar filter bank, multiresolution, a trous). Applications (e.g. graphic formats and noise reduction). static graphic formats (e.g. BMP, GIF, HAM, JPG) and for simple animations (e.g. GIF, IFF). |