

SECRETARÍA ACADÉMICA



DIRECCIÓN DE EDUCACIÓN SUPERIOR

SYNTHESED SCHOOL PROGRAM

LEARNING UNIT:	Image Analysis	LEVEL:	III
ACADEMIC PROGRAM:	Ingeniero en Sistemas Computacionales.		
ACADEMIC UNIT:	Escuela Superior de Cómputo.		

The student evaluates several digital image analysis algorithms through the spatial, morphological and frequency domains.

CONTENTS:

- I. Introduction
- II. Spatial Analysis
- III. Frequency Analysis
- IV. Morphological analysis

TEACHING PRINCIPLES:

A Projects-Based learning process will be applied through inductive and heuristic methods using analysis techniques, technical data, charts, cooperative presentation, exercise-solving and the production of the learning evidences. Moreover, an autonomous learning will be encouraged by the development of a final project. The teacher is responsible to decide the project and programs characteristics and planning.

EVALUATION AND PASSING REQUIREMENTS:

The program will evaluate the students in a continuous formative and summative way, which will lead into the completion of learning portfolio. Some other assessing methods will be used, such as revisions, practical's, class participation, exercises, learning evidences and a final project.

Other means to pass this Unit of Learning:

- Evaluation of acknowledges previously acquired, with base in the issues defined by the academy.
- Official recognition by either another IPN Academic Unit of the IPN or by a national or international external academic institution besides IPN.

REFERENCES:

- Bradski, G., Kaehler, A. (2008). *Learning OpenCV: Computer Vision with the OpenCV Library.* (1^a Ed.), U.S.A.: O'Reilly Media. ISBN- 978-0596516130.
- Díaz-de-León Santiago, J.L., Yáñez Márquez, C. (2003). Introducción a la morfología matemática de conjuntos. (1ª Ed.), Mexico: Colección de Ciencia de la Computación, CIC-IPN-UNAM-FCE. ISBN: 970-36-0075-1
- González, R., Woods, R. (2007). Digital Image Processing. (3^a Ed.). U.S.A.: Prentice Hall. ISBN-978-0131687288.
- Ritter, G. Wilson, J. (2000) . Handbook of Computer Vision Algorithms in Image Algebra. (2^a Ed.). U.S.A.: CRC Press. ISBN- 978-0849300752.
- Soille, P. (2004). Morphological Image Analysis: Principles and Applications. (2^a Ed.). U.S.A.: Springer. ISBN- 978-3540429883.





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DIRECCIÓN DE EDUCACIÓN SUPERIOR

ACADEMIC UNIT: Escuela Superior de Cómputo. ACADEMIC PROGRAM: Ingeniero en Sistemas Computacionales LATERAL OUTPUT: Analista Programador de Sistemas de Información. FORMATION AREA: Professional. MODALITY: Presence. LEARNING UNIT: Image Analysis. TYPE OF LEARNING UNIT: Theorical - Practical, Optative. USE: August, 2011 LEVEL: III. CREDITS: 7.5 Tepic, 4.39 SATCA

EDUCATIVE AIM

Furthermore, this program develops abilities to analyze and design efficient algorithms to extract information from digital images. It contributes to the debit profile reinforcing it integration of the knowledge of other Units of Learning to plan, to negotiate and to foment the analysis skills; designing and coordinating projects in the context of systems and Image Analysis. It dominates the practical and methodological principles, aspects for the construction of systems. Decision making, solution of problems, assertive communication, and creative, strategic thought.

This unit has like antecedents Algorithm and Structured Programming, Object-Oriented Programming, Data Structures and Computing Theory. It uses some concepts form Discrete Mathematics, Lineal Algebra and Advanced Mathematics for Engineering.

AIM OF THE LEARNING UNIT:

The student evaluates several digital image analysis algorithms through the spatial, morphological and frequency domains.

CREDITS HOURS

THEORETICAL CREDITS / WEEK: 3.0

PRACTICAL CREDITS / WEEK: 1.5

HOURS THEORETICIAN /TERM: 54

HOURS PRACTICAL / SEMESTER: 27

81

CREDITS HOURS / SEMESTER:

UNIT OF LEARNING DESIGNED BY: Academia de Ingeniería de Software.

REVISED BY: Dr. Flavio Arturo Sánchez Garfias. Subdirección Académica

APPROVED BY: Ing. Apolinar Francisco Cruz Lázaro. Presidente del CTCE AUTHORIZED BY: Comisión de Programas Académicos del Consejo General Consultivo del IPN

Ing. Rodrigo de Jesús Serrano Domínguez Secretario Técnico de la Comisión de Programas Académicos



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Image Analysis.



LEARNING UNIT:

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N° THE	MATIC UNIT:				TITLE	Introduction		
The stud	UNIT OF COMPETENCE The student differentiates between the different type of digital images through their main components							
No.	No.CONTENTSTeacher led- Instruction HOURSAutonom Learnin 		iomus ning URS	REFERENCES KEY				
		Т	Р	Т	Р	-		
1.1 1.2 1.3 1.3.1 1.3.2 1.3.3 1.3.4 1.3.5 1.4 1.4.1 1.4.2	The image analysis in computer science. The human vision system Digital image acquisition Sampling and quantization. Binary images Grayscale images Color Images The histogram Digital image storage Spatial format (BMP, PNG and JPEG) Vector format (AI and CDR)	0.5 1.0 0.5	0.5 0.5	0.5 0.5 0.5	1.0 2.5	1C, 3B, 4C		
	Subtotals:	2.5	1.0	2.0	3.5			
TL' . T L	TEACHING PRINC	IPLES			L. During			

This Thematic Unit must begin with a framing of the course and the formation of teams. Will be Projects-Based learning strategy, trough inductive method, with the techniques of elaboration of charts and technical data, exhibition in team, practical and production of learning evidence and the accomplishment of a project proposal.

LEARNING EVALUATION

Assessment	
Portfolio of Evidences:	
Technical data	5%
Charts	5%
Cooperative Presentation	20%
Report of Practical	30%
Proposal of project	10%
Rubric of Self-Evaluation	5%
Rubric of Co-Evaluation	5%
Learning Evidence	20%



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LEARNING UNIT:

Image Analysis.

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N° THEMATIC UNIT: II **TITLE:** Spatial Analysis UNIT OF COMPETENCE The student implements image analysis algorithms in a high level programming language through the spatial domain techniques. **Teacher led-**Autonomus Instruction Learning REFERENCES No. CONTENTS HOURS HOURS KEY Ρ Т Ρ Т 2.1 The convolution 2.5 4.5 1C, 3B, 4C 2.1.1 The convolution of two continuous functions. 2.1.2 The convolution of two discrete functions. The digital image as a 2 dimensional discrete function. 2.1.3 2.2 Using the convolution 2.5 0.5 2.5 4.5 2.2.1 Bright adjust. Pass-low filters (Average, Gaussian, etc.) 2.2.2 2.2.3 High-pass filters (Gradient, Sobel, Canny, etc.) Mode and median filters. 2.3 2.0 1.5 0.5 1.0 Segmentation. 2.4 1.5 0.5 2.0 1.0 2.4.1 Thresholding. Automatic thresholding using the histogram. 2.4.2 1.5 13.0 Subtotals: 8.0 4.5 **TEACHING PRINCIPLES**

Will be projects-Based learning strategy, trough inductive and heuristic methods, with the techniques of elaboration of exercise-solving, cooperative presentation, practical and learning evidence, the production of the learning evidences and advance of the project.

LEARNING EVALUATION

Portfolio of Evidences:	
Technical data	5%
Charts	5%
Cooperative Presentation	10%
Advance of project	10%
Report of Practical	40%
Rubric of Self-Evaluation	5%
Rubric of Co-Evaluation	5%
Learning Evidence	20%



N° THEMATIC UNIT: IV

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LEARNING UNIT:	Image Analysis.
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TITLE: Frequency Analysis

UNIT OF COMPETENCE

The student implements image analysis algorithms in a high level programming language through the frequency domain techniques.

No.	CONTENTS		CONTENTS Teacher led- Instruction HOURS		Autonomus Learning HOURS		REFERENCES KEY			
3.1	The Fourier transform (FT)	2.5	0.5	3.5	2.5	1C, 3B, 4C				
3.1.1	The Fourier transform of continuous functions									
3.1.2	The Fourier transform of discrete functions									
3.1.3	The fast Fourier transform									
3.1.4	The inverse Fourier transform									
3.1.5	Lising the Fourier transform in image analysis	20	0.5	4 0	25					
321	Bright adjust	2.0	0.5	4.0	2.0					
3.2.2	Low-pass filters.									
3.2.3	High-pass filters.									
	Subtotals:	4.5	1.0	7.5	5.0					

TEACHING PRINCIPLES

Will be projects-Based learning strategy, trough inductive and heuristic methods, with the techniques of elaboration of exercise-solving, cooperative presentation, practical and learning evidence, the production of the learning evidences and advance of the project.

LEARNING EVALUATION

Portfolio of Evidences:	
Technical data	5%
Charts	5%
Cooperative Presentation	10%
Advance of project	10%
Report of Practical	40%
Rubric of Self-Evaluation	5%
Rubric of Co-Evaluation	5%
Learning Evidence	20%



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LEARNING UNIT:

Image Analysis.

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TITLE: Morphological Analysis

N° THEMATIC UNIT: V

UNIT OF COMPETENCE

The student implements image analysis algorithms in a high level programming language through morphological techniques .

No.	CONTENTS		CONTENTS Teacher led- Instruction HOURS		nomus rning URS	REFERENCES KEY	
		Т	Р	Т	Р		
4.1 4.1.1 4.1.2 4.1.3 4.1.4 4.1.5 4.1.6 4.1.7 4.2 4.2.1 4.2.2 4.2.3 4.2.4 4.2.5 4.2.6 4.2.7	Mathematical morphology on sets The binary image as a set Translation y reflection Dilation and erosion Opening and closing Morphological filters Hit & Miss transform Granulometry Mathematical morphology on lattices The lattices The grayscale image as a lattice Translation y reflection Dilation and erosion Opening and closing Morphological filters Watershed transform	3.0	1.0	4.0	5.0	1C, 2B, 3B, 4C, 5C	
	Subtotals:	6.5	2.0	10.0	8.5		
Will be p presenta	TEACHING PRINCIPLES Will be projects-Based learning strategy, trough inductive and heuristic methods, with the techniques of cooperative presentation, practical, the production of the learning evidences and the presentation of the final project.						
	LEARNING EVALU	JATION					

Portfolio of	Evidences:
Та	ملما ممام

Technical data	5%
Charts	5%
Cooperative Presentation	10%
Final project	30%
Report of Practical	40%
Rubric of Self-Evaluation	5%
Rubric of Co-Evaluation	5%



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LEARNING UNIT:

Image Analysis.

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RECORD OF PRACTICES

PRACTICAL No.	NAME OF THE PRACTICE	THEMATIC UNITS	DURATION	ACCOMPLISHMENT LOCATION
1	Getting, showing and storing a digital	Ι	3.0	Computer Lab
	image			
2	Getting the histogram	I	1.5	
3	Getting the convolution of two digital	II	3.0	
	images			
4	Getting the mode and median filter of a digital image	II	1.5	
5	Thresolding a grayscale image	II	1.5	
6	Getting the Fourier transform of a digital	III	3.0	
	image			
7	Getting the inverse Fourier transform of	III	3.0	
	a digital image			
8	Getting the erosion, dilation, opening	IV	1.5	
_	and closing of a binary image			
9	Getting the Hit and Miss transform	IV	1.5	
10	Getting the granulometry	IV	3.0	
11	Getting the erosion, dilation, opening	IV	1.5	
	and closing of a grayscale image			
12	Getting the watershed transform	IV	30	
12			0.0	
		HOURS	27.0	

EVALUATION AND PASSING REQUIREMENTS:

The practical are considered mandatory to pass this unit of learning.

The practicals worth 30% in thematic unit I.

The practicals worth 40% in thematic unit II.

The practicals worth 40% in thematic unit III.

The practicals worth 40% in thematic unit IV.



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LEARNING UNIT:		Image Ar	nalysis.	PAGE:	8	OF	9
PERIOD	UNIT		EVALUATION TER	MS			
1 2 3	I and II II and III IV	Continuous as Continuous as Continuous as Unit I Unit II and III Unit IV Other means to e Evalua define Officia nation	sessment 80% and written learning e sessment 80% and written learning e sessment 100% 20% of the total of the final evaluation 40% of the total of the final evaluation 40% of the total of the final evaluation ation of acknowledges previously a d by the academy. I recognition by either another IPN al or international external academic in	vidence 2 vidence 2 on on on acquired, with Academic Ur institution bes	0% 0% it base hit of th	in the is le IPN or N.	sues by a
		If accredited b guidelines est	by Special Assessment or a certificate ablished by the academy on a previo	e of proficiency us meeting fo	y, it will r this pu	be based urpose.	l on

KEY	В	С	REFERENCES
1		Х	Bradski, G., Kaehler, A. (2008). Learning OpenCV: Computer Vision with the OpenCV Library (1 ^a Ed.), U.S.A.: O'Reilly Media. ISBN- 978-0596516130
2	Х		Díaz-de-León Santiago, J.L.,Yáñez Márquez, C. (2003). Introducción a la morfología matemática de conjuntos (1ª Ed.), México: Colección de Ciencia de la Computación, CIC-IPN-UNAM-FCE. ISBN: 970-36-0075-1
3	х		González, R., Woods, R. (2007). Digital Image Processing (3 ^a Ed.). U.S.A.: Prentice Hall. ISBN-978-0131687288
4		Х	Ritter, G. Wilson, J. (2000) . Handbook of Computer Vision Algorithms in Image Algebra (2 ^a Ed.). U.S.A.: CRC Press. ISBN- 978-0849300752
5		Х	Soille, P. (2004). Morphological Image Analysis: Principles and Applications (2 ^a Ed.). U.S.A.: Springer. ISBN- 978-3540429883



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DIRECCIÓN DE EDUCACIÓN SUPERIOR

TEACHER EDUCATIONAL PROFILE PER LEARNING UNIT

1. GENERAL INFORMATION

ACADEMIC UNIT:	Escuela Superior de Có	mputo.			
ACADEMIC PROGRAM:	Ingeniería en Sistemas Computacionales.				
FORMATION AREA:	Institutional	Basic Scientist	Professional	Te	erminal and ntegration

ACADEMY:	Ingenieria de Software	LEARNING UNIT:	Image Analysis.
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SPECIALTY AND ACADEMIC REQUIRED LEVEL: Masters or PhD Degree in Computing Science.

2. AIM OF THE LEARNING UNIT:

The student evaluates several digital image analysis algorithms through the spatial, morphological and frequency domains.

3. PROFESSOR EDUCATIONAL PROFILE:

KNOWLEDGE	PROFESSIONAL EXPERIENCE	ABILITIES	APTITUDES	
 Image analysis method using the spatial, frequency and morphological domains. Programming languages Knowledge of the Institutional Educational Model. English. 	 A year experience in image analysis A year experience in educational as facilitator of the knowledge. A year experience in cooperative work. A year experience in the Institutional Educational Model. 	 Analysis and synthesis. Leadership Conflict management Group management. Fluent Didactic abilities 	 Responsible. Tolerant. Honest. Respectful. Collaborative. Participative. Assertive. 	
DESIGNED BY	REVI	SED BY	AUTHORIZED BY	

Dr. Flavio Arturo Sánchez Garfias COORDINATING PROFESSOR Dr. Flavio Arturo Sánchez Garfias SUBDIRECTOR ACADÉMICO Ing. Apolinar Francisco Cruz Lázaro DIRECTOR

Date: 2011