INSTITUTO POLITÉCNICO NACIONAL
SECRETARÍA ACADÉMICA
DIRECCIÓN DE EDUCACIÓN SUPERIOR

ESCOM

SYNTHETIC PROGRAM

SCHOOL: ESCUELA SUPERIOR DE CÓMPUTO.

ACADEMIC PROGRAM: Ingeniero en Sistemas Computacionales.

LEARNING UNIT: Image Analysis **LEVEL:** III

PURPOSE OF THE LEARNING UNIT:

To evaluate some 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 ASSESSMENT:

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 (1ª 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 (3ª Ed.). U.S.A.: Prentice Hall. ISBN-978-0131687288
- Ritter, G. Wilson, J. (2000) . Handbook of Computer Vision Algorithms in Image Algebra (2ª Ed.). U.S.A.: CRC Press. ISBN- 978-0849300752
- Soille, P. (2004). Morphological Image Analysis: Principles and Applications (2ª 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: Theoretician - 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.

PURPOSE OF THE LEARNING UNIT:

To evaluate some 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
CREDITS HOURS / SEMESTER:	81

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

REVIEWED 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

N° THEMATIC UNIT: I **NAME:** Introduction

UNIT OF COMPETENCE

Differentiates between the different type of digital images through their main components

No.	CONTENTS	HOURS Activities with Professor		HOURS Activities of Autonomous Learning		REFERENCES KEY
		T	P	T	P	
1.1	The image analysis in computer science.	0.5		0.5		1C, 3B, 4C
1.2	The human vision system	1.0		0.5		
1.3	Digital image acquisition	0.5	0.5	0.5	1.0	
1.3.1	Sampling and quantization.					
1.3.2	Binary images					
1.3.3	Grayscale images					
1.3.4	Color Images					
1.3.5	The histogram					
1.4	Digital image storage	0.5	0.5	0.5	2.5	
1.4.1	Spatial format (BMP, PNG and JPEG)					
1.4.2	Vector format (AI and CDR)					
	Subtotals:	2.5	1.0	2.0	3.5	

LEARNING STRATEGIES

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.

EVALUATION OF THE LEARNING

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%

N° THEMATIC UNIT: II **NAME:** Spatial Analysis

UNIT OF COMPETENCE

Implements image analysis algorithms in a high level programming language through the spatial domain techniques

No.	CONTENTS	HOURS Activities with Professor		HOURS Activities of Autonomous Learning		REFERENCES KEY
		T	P	T	P	
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.					
2.1.3	The digital image as a 2 dimensional discrete function.					
2.2	Using the convolution	2.5	0.5	4.5	2.5	
2.2.1	Bright adjust.					
2.2.2	Pass-low filters (Average, Gaussian, etc.)					
2.2.3	High-pass filters (Gradient, Sobel, Canny, etc.)					
2.3	Mode and median filters.	1.5	0.5	2.0	1.0	
2.4	Segmentation.	1.5	0.5	2.0	1.0	
2.4.1	Thresholding.					
2.4.2	Automatic thresholding using the histogram.					
	Subtotals:	8.0	1.5	13.0	4.5	

LEARNING STRATEGIES

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.

EVALUATION OF THE LEARNING

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%

LEARNING UNIT: Image Analysis. **PAGE:** 5 **OF** 9

N° THEMATIC UNIT: IV **NAME:** Frequency Analysis

UNIT OF COMPETENCE

Implements image analysis algorithms in a high level programming language through the frequency domain techniques

No.	CONTENTS	HOURS Activities with Professor		HOURS Activities of Autonomous Learning		REFERENCES KEY
		T	P	T	P	
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	The convolution and the Fourier transform					
3.2	Using the Fourier transform in image analysis	2.0	0.5	4.0	2.5	
3.2.1	Bright adjust.					
3.2.2	Low-pass filters.					
3.2.3	High-pass filters.					
	Subtotals:	4.5	1.0	7.5	5.0	

LEARNING STRATEGIES

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.

EVALUATION OF THE LEARNING

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%

LEARNING UNIT: Image Analysis. **PAGE:** 6 **OF** 9

N° THEMATIC UNIT: V **NAME:** Morphological Analysis

UNIT OF COMPETENCE

Implements image analysis algorithms in a high level programming language through morphological techniques

No.	CONTENTS	HOURS Activities with Professor		HOURS Activities of Autonomous Learning		REFERENCES KEY
		T	P	T	P	
4.1	Mathematical morphology on sets	3.0	1.0	4.0	5.0	1C, 2B, 3B, 4C, 5C
4.1.1	The binary image as a set					
4.1.2	Translation y reflection					
4.1.3	Dilation and erosion					
4.1.4	Opening and closing					
4.1.5	Morphological filters					
4.1.6	Hit & Miss transform					
4.1.7	Granulometry					
4.2	Mathematical morphology on lattices	3.5	1.0	6.0	3.5	
4.2.1	The lattices					
4.2.2	The grayscale image as a lattice					
4.2.3	Translation y reflection					
4.2.4	Dilation and erosion					
4.2.5	Opening and closing					
4.2.6	Morphological filters					
4.2.7	Watershed transform					
	Subtotals:	6.5	2.0	10.0	8.5	

LEARNING STRATEGIES

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.

EVALUATION OF THE LEARNING

Portfolio of Evidences:

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%

LEARNING UNIT: Image Analysis. **PAGE:** 7 **OF** 9

RECORD OF PRACTICES

PRACTICAL No.	NAME OF THE PRACTICE	THEMATIC UNITS	DURATION	ACCOMPLISHMENT LOCATION
1	Getting, showing and storing a digital image	I	3.0	Laboratory of computation
2	Getting the histogram	I	1.5	
3	Getting the convolution of two digital images	II	3.0	
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 image	III	3.0	
7	Getting the inverse Fourier transform of a digital image	III	3.0	
8	Getting the erosion, dilation, opening and closing of a binary image	IV	1.5	
9	Getting the Hit and Miss transform	IV	1.5	
10	Getting the granulometry	IV	3.0	
11	Getting the erosion, dilation, opening and closing of a grayscale image	IV	1.5	
12	Getting the watershed transform	IV	3.0	
		TOTAL OF HOURS	**27.0**	

EVALUATION AND VALIDATION:

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

They practical mean 40% in each thematic unit.

LEARNING UNIT: Image Analysis. **PAGE:** 8 **OF** 9

PERIOD	UNIT	EVALUATION TERMS
1 2 3	I and II II and III IV	Continuous assessment 80% and written learning evidence 20% Continuous assessment 80% and written learning evidence 20% Continuous assessment 100% Unit I 20% of the total of the final evaluation Unit II and III 40% of the total of the final evaluation Unit IV 40% of the total of the final evaluation 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.

KEY	B	C	REFERENCES
1		X	Bradski, G., Kaehler, A. (2008). Learning OpenCV: Computer Vision with the OpenCV Library (1ª Ed.), U.S.A.: O'Reilly Media. ISBN- 978-0596516130
2	X		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	X		González, R., Woods, R. (2007). Digital Image Processing (3ª Ed.). U.S.A.: Prentice Hall. ISBN-978-0131687288
4		X	Ritter, G. Wilson, J. (2000) . Handbook of Computer Vision Algorithms in Image Algebra (2ª Ed.). U.S.A.: CRC Press. ISBN- 978-0849300752
5		X	Soille, P. (2004). Morphological Image Analysis: Principles and Applications (2ª Ed.). U.S.A.: Springer. ISBN- 978-3540429883

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EDUCATIONAL PROFILE BY LEARNING UNIT

1. GENERAL PERFORMANCES

SCHOOL: ESCUELA SUPERIOR DE CÓMPUTO.

ACADEMIC PROGRAM: Ingeniero en Sistemas Computacionales. **LEVEL** III

FORMATION AREA:

Institutional	Basic Scientist	Professional	Terminal and Integration

ACADEMIC: Ingenieria de Sfotware **LEARNING UNIT:** Image Analysis.

SPECIALTY AND ACADEMIC REQUIRED LEVEL: Masters or PhD Degree in Computing Science.

2. PURPOSE OF THE LEARNING UNIT:

To evaluate some digital image analysis algorithms through the spatial, morphological and frequency domains.

3. 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.

ELABORATED	REVIEWED	AUTHORIZED
Dr. Flavio Arturo Sánchez Garfias COORDINATING PROFESSOR	**Dr. Flavio Arturo Sánchez Garfias** SUBDIRECTOR ACADÉMICO	**Ing. Apolinar Francisco Cruz Lázaro** DIRECTOR DE LA UNIDAD