



INSTITUTO POLITÉCNICO NACIONAL

SECRETARÍA ACADÉMICA

DIRECCIÓN DE EDUCACIÓN SUPERIOR

SYNTHESIZED SCHOOL PROGRAM



ACADEMIC UNIT: Escuela Superior de Cómputo

ACADEMIC PROGRAM: Ingeniería en Sistemas Computacionales.

LEARNING UNIT: Pattern Recognition

LEVEL: III

AIM OF THE LEARNING UNIT:

The student develops pattern-recognition applications through techniques and classifiers methods.

CONTENTS:

- I. Introduction to Pattern Recognition.
- II. Feature Selection.
- III. Bayesian Classification.
- IV. Linear Classifiers.
- V. Non-linear Classification.
- VI. Associative Memories.

TEACHING PRINCIPLES:

The teacher will apply a Case-Based learning process, through inductive and heuristic methods to carry out learning activities that guides the development of skills of abstraction, analysis and design of efficient algorithms; using theoretical and practical techniques, analysis techniques, cooperative presentation, exercise-solving and the production of the learning evidences.

Address issues through presentations and research literature by the student in order to identify the main techniques, tools and procedures used in Pattern Recognition, developing practices that confront the student with the development of a case study to identify the need for pattern recognition previous to the development of a system.

The activities done in class to encourage students some techniques, such as collaborative work, graphic organizers, brainstorming, supplementary statement of issues, and the implementation of project software.

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 Learning Unit:

- 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:

- Duda O. R., Hart P. E., Store G. D. (2000). *Pattern Classification* (2ª Ed.) USA: Ed. Wiley-Interscience. ISBN: 0-471-05669-3.
- Marques de Sá, J. P. (2001). *Pattern Recognition: Concepts, Methods and Application* (1ª Ed.) USA: Ed. Springer, 2001. ISBN: 3-540-42297-8.
- Sergios, T. Konstantinos, K. (2009). *Pattern Recognition* (4ª Ed.) USA: Elsevier Inc. ISBN: 0-12-685875-6.
- Simon, H. (2008). *Neural Networks and Learning Machines* (3ª Ed.) USA: Ed. Prentice Hall. 2008. ISBN-13: 9780131471399.
- Yañez, C. Díaz de León. S., M. Juan Luis (2003) *Introducción a las Memorias Asociativas*. Serie Research on Computing Science, Vol. 6, Instituto Politécnico Nacional, México. ISBN: 970-360116-2.



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ACADEMIC UNIT: Escuela Superior de Cómputo.
ACADEMIC PROGRAM: Ingeniería en Sistemas Computacionales
LATERAL OUTPUT: Analista Programador de Sistemas de Información.
FORMATION AREA: Professional.
MODALITY: Presence.

LEARNING UNIT: Digital processing of Voice and Image.
TYPE OF LEARNING UNIT: Theoretical - Practical, Optative.
VALIDITY: August, 2011
LEVEL: III.
CREDITS: 7.5 Tepic, 4.39 SATCA

ACADEMIC AIM

This learning unit contributes to the profile of graduate in Engineering in Computer Sciences to develop skills for analyzing problems, developing systems that solve problems by applying techniques of pattern recognition and evaluation. This will develop strategic thinking, creative thinking, collaborative work and participatory and assertive communication.

This unit has the units Algorithm and Structured Programming, Object-Oriented Programming, Compilers and Computational theory as antecedents.

AIM OF THE LEARNING UNIT:

The student develops pattern-recognition applications through techniques and classifiers methods.

CREDITS HOURS

THEORETICAL CREDITS / WEEK: 3.0
PRACTICAL CREDITS / WEEK: 1.5
THEORETICAL HOURS / SEMESTER: 54
PRACTICAL HOURS / SEMESTER: 27
AUTONOMOUS LEARNING HOURS: 54
CREDITS HOURS / SEMESTER: 81

LEARNING UNIT 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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LEARNING UNIT: Pattern Recognition

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THEMATIC UNIT: I **TITLE:** Introduction to Pattern Recognition

UNIT OF COMPETENCE

The student specifies feature vectors based on fundamental concepts of pattern recognition and machine learning methods.

No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
1.1	Introduction to Pattern Recognition.	0.5				3B,4B
1.2	Classes, Patterns and Features.	0.5		1		
1.3	Characteristic vectors and Classifier.	0.5		1		
1.4	Supervised Learning.	1.0		0.5		
1.5	Unsupervised Learning.	1.0		0.5		
1.6	Semi-Supervised Learning.	1.0		1.5		
Subtotals:		4.5	0	4.5	0	

TEACHING PRINCIPLES

This Thematic will apply a Case-Based learning process, through inductive and heuristic methods, thus permitting the consolidation of the following learning techniques: address issues through exhibitions based on documentary research, led discussion, problem solving and practical work. In the state of the art form the student develops underpins work to make a concept map. In each topic we propose to move the project to evidence its development so this unit should submit a proposal.

LEARNING EVALUATION

Diagnostic Test

Project Portfolio:

Concept maps	5%
Technical data	5%
Cooperative Presentation	10%
Reports of practicals	20%
Project Proposal	20%
Self-Evaluation Rubrics	5%
Cooperative Evaluation Rubrics	5%
Written Learning Evidence	30%



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LEARNING UNIT: Pattern Recognition

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THEMATIC UNIT: II		TITLE: Feature Selection				
UNIT OF COMPETENCE						
The student determines the characteristics of patterns based on fundamental concepts of feature selection.						
No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
2.1	Introduction to Feature Selection.	0.5				3B,4C,2C
2.2	Pre-Processing.	0.5		1		
2.3	Feature selection based on statistical hypothesis testing.	1.0		1		
2.4	Selection class metrics.	0.5		1.5		
2.5	Optimal generation characteristics.	1.0		1		
	Subtotals:	3.5	0	4.5	0	
TEACHING PRINCIPLES						
This Thematic will apply a Case-Based learning process, through inductive and heuristic methods using theoretical and practical tools. Address issues through exhibitions based on documentary research, led discussion, problem solving and practical work.						
LEARNING EVALUATION						
Project Portfolio:						
Revision of papers		10%				
Cooperative Presentation		10%				
Reports of practicals		20%				
Project advance		20%				
Self-Evaluation Rubrics		5%				
Cooperative Evaluation Rubrics		5%				
Written Learning Evidence		30%				



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LEARNING UNIT: Pattern Recognition

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THEMATIC UNIT: III			TITLE: Bayesian Classification.			
UNIT OF COMPETENCE						
The student constructs a pattern classifier based on techniques, tools and Bayesian classification procedures.						
No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
3.1	Introduction.	0.5		1.0		3B,6B,4C
3.2	Bayesian Decision Theory.	0.5		1.0	1.0	
3.3	Discriminants Functions.	0.5		1.0	1.0	
3.4	Normal Bayesian Classification.	1.0		0.5	2.0	
3.5	The K-Nearest Neighbours Method.	1.0		1.0	2.0	
3.6	Bayesian Networks	1.0	0.5	1.0	2.5	
	Subtotals:	4.5	0.5	5.5	8.5	
TEACHING PRINCIPLES						
This Thematic will apply a Case-Based learning process, through inductive and heuristic methods using theoretical and practical tools. Address issues through exhibitions based on documentary research, led discussion, problem solving and practical work.						
LEARNING EVALUATION						
Project Portfolio:						
Revision of papers		10%				
Cooperative Presentation		10%				
Reports of practicals		20%				
Project advance		20%				
Self-Evaluation Rubrics		5%				
Cooperative Evaluation Rubrics		5%				
Written Learning Evidence		30%				



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LEARNING UNIT: Pattern Recognition

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THEMATIC UNIT: IV				TITLE: Linear classifiers			
UNIT OF COMPETENCE							
The student constructs a pattern classifier based on techniques, tools and procedures for linear classification.							
No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY	
		T	P	T	P		
4.1	Introduction.	0.5				3B,6C,4C	
4.2	Linear Discriminants Functions.	1.0		1.5	1.0		
4.3	The Perceptron concept and Neural Networks.	1.0		2.0	2.5		
4.4	The Support Vector Machine.	1.0	0.5	2.0	2.0		
	Subtotals:	3.5	0.5	5.5	5.5		
TEACHING PRINCIPLES							
This Thematic will apply a Case-Based learning process, through inductive and heuristic methods using theoretical and practical tools. Address issues through exhibitions based on documentary research, led discussion, problem solving and practical work.							
LEARNING EVALUATION							
Project Portfolio:							
Revision of papers		10%					
Cooperative Presentation		10%					
Reports of practicals		20%					
Project advance		20%					
Self-Evaluation Rubrics		5%					
Cooperative Evaluation Rubrics		5%					
Written Learning Evidence		30%					



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LEARNING UNIT: Pattern Recognition

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THEMATIC UNIT: V			TITLE: Non-Linear Classification			
UNIT OF COMPETENCE						
The student constructs a pattern classifier based on techniques, tools and procedures for non-linear classification.						
No.	CONTENTS	Teacher led- instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
5.1	Introduction to non-linear classifiers.	0.5				5C,3B,1C
5.2	The XOR problem.	0.5		1.0	0.5	
5.3	Two-layer perceptron	1.0		1.0	1.0	
5.4	Three-layer perceptron	1.0	0.5	1.5	2.0	
5.5	Back-Propagation Algorithm	1.0		1.0	2.0	
	Subtotals:	4.0	0.5	4.5	5.5	
TEACHING PRINCIPLES						
This Thematic will apply a Case-Based learning process, through inductive and heuristic methods using theoretical and practical tools. Address issues through exhibitions based on documentary research, led discussion, problem solving and practical work.						
LEARNING EVALUATION						
Project Portfolio:						
Revision of papers		10%				
Cooperative Presentation		10%				
Reports of practicals		20%				
Project advance		20%				
Self-Evaluation Rubrics		5%				
Cooperative Evaluation Rubrics		5%				
Written Learning Evidence		30%				

THEMATIC UNIT: VI			TITLE: Associative Memories			
UNIT OF COMPETENCE						
The student constructs a pattern recognizer based on techniques, tools and procedures of associative memories.						
No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
6.1	Introduction to Associative Memories.	0.5				3B,7C,2C
6.2	Learnmatrix.	0.5		0.5		
6.3	Correlograph.	0.5		0.5	1.0	
6.4	Linear Asociator.	1.0		1.5	1.5	
6.5	Hopfield's Associative Memories	1.0		1.0	1.5	
6.6	Alpha-Beta Associative Memories	1.5	0.5	1.0	1.5	
	Subtotals:	5.0	0.5	4.5	5.5	
TEACHING PRINCIPLES						
This Thematic will apply a Case-Based learning process, through inductive and heuristic methods using theoretical and practical tools. Address issues through exhibitions based on documentary research, led discussion, problem solving and practical work.						
LEARNING EVALUATION						
Project Portfolio:						
Revision of papers		10%				
Cooperative Presentation		10%				
Reports of practicals		20%				
Project report		50%				
Self-Evaluation Rubrics		5%				
Cooperative Evaluation Rubrics		5%				



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LEARNING UNIT:

Pattern Recognition

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RECORD OF PRACTICALS

No.	NAME OF THE PRACTICAL	THEMATIC UNITS	DURATION	ACCOMPLISHMENT LOCATION
1	Bayesian classifier implementation.	III	3.0	Computer Labs.
2	K-NN classifier implementation.	III	3.0	
3	Bayesian network model implementation.	III	3.0	
4	Neural network classifier with Perceptron implementation.	IV	3.0	
5	Support Vector Machine classifier implementation.	IV	3.0	
6	Back-Propagation Neural network implementation.	V	3.0	
7	Fingerprint Recognizer with Neural Networks implementation.	V	3.0	
8	Fingerprint Recognizer with Associative Memories implementation.	VI	3.0	
9	Classifier using Associative Memories implementation.	VI	3.0	
		TOTAL OF HOURS	27.0	

EVALUATION AND PASSING REQUIREMENTS:

The practical are considered mandatory to pass this unit of learning.
The practical worth 20% in each thematic unit.



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LEARNING UNIT:

Pattern Recognition

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PERIOD	UNIT	EVALUATION TERMS
1	I , II	Continuous evaluation 70% and written learning evidence 30%
2	III , IV	Continuous evaluation 70% and written learning evidence 30%
3	V	Continuous evaluation 70% and written learning evidence 30%
	VI	Continuous evaluation 100%
		<p>The learning unit I is 10% worth of the final score. The learning unit II is 10% worth of the final score. The learning unit III is 20% worth of the final score. The learning unit IV is 20% worth of the final score. The learning unit V is 20% worth of the final score. The learning unit VI is 20% worth of the final score</p> <p>Other means to pass this Learning Unit:</p> <ul style="list-style-type: none">• 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. <p>If accredited by Special Assessment or a certificate of proficiency, it will be based on guidelines established by the academy on a previous meeting for this purpose.</p>



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LEARNING UNIT:

Pattern Recognition.

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KEY	B	C	REFERENCES
1		X	Bishop, C. (1996) <i>Neural Networks for Pattern Recognition</i> . Oxford University Press, USA (January 18, 1996) ISBN: 0198538642
2		X	Duda O. R., Hart P. E., Store G. D. (2000). <i>Pattern Classification</i> (2ª Ed.) USA: Ed. Wiley-Interscience. ISBN: 0-471-05669-3.
3	X		Marques de Sá, J. P. (2001). <i>Pattern Recognition: Concepts, Methods and Application</i> (1ª Ed.) USA: Ed. Springer, 2001. ISBN: 3-540-42297-8.
4		X	Sergios, T. Konstantinos, K. (2009). <i>Pattern Recognition</i> (4ª Ed.) USA: Elsevier Inc. ISBN: 0-12-685875-6.
5		X	Simon, H. (2008). <i>Neural Networks and Learning Machines</i> (3ª Ed.) USA: Ed. Prentice Hall. 2008. ISBN-13: 9780131471399.
6	X		Webb, A. (2002) <i>Statistical Pattern Recognition</i> . (2nd Edition), John Wiley and Sons, ISBN: 0-470-84514-7.
7		X	Yañez, C. Díaz de León. S., M. Juan Luis (2003) <i>Introducción a las Memorias Asociativas</i> . Serie Research on Computing Science, Vol. 6, Instituto Politécnico Nacional, México. ISBN: 970-360116-2.



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TEACHER EDUCATIONAL PROFILE PER LEARNING UNIT

1. GENERAL INFORMATION

ACADEMIC UNIT : Escuela Superior de Cómputo.

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

FORMATION AREA:

Institutional	Basic Scientific	Professional	Terminal and Integration
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ACADEMY: Ingeniería de Software **LEARNING UNIT:** Pattern Recognition.

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

2. AIM OF THE LEARNING UNIT:

The student develops pattern-recognition applications through techniques and classifiers methods.

3. PROFESSOR EDUCATIONAL PROFILE:

KNOWLEDGE	PROFESSIONAL EXPERIENCE	ABILITIES	APTITUDES
<ul style="list-style-type: none">• Pattern recognition.• Analysis on the extraction and feature selection.• Knowledge about techniques classifier.• Programming Languages.• Knowledge of the Institutional Educational Model.• English.	<ul style="list-style-type: none">• A year in PR programming• Actual in educational as facilitator of the knowledge of six months.• A year in applying Artificial Intelligence techniques.• A year experience in the Institutional Educational Model.	<ul style="list-style-type: none">• Analysis and synthesis.• Problems resolution.• Cooperative.• Leadership.• Teaching skills.• Ability to manage groups.• Editorial review and evaluation.• Applications of Institutional Educational Model.• Decision making.	<ul style="list-style-type: none">• Responsible.• Tolerant.• Honest.• Respectful.• Collaborative.• Participative.• Interested to learning.• Assertive.

DESIGNED BY

REVISED BY

AUTHORIZED BY

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Director

Dr. Benjamín Luna Benoso
M. en C. Miriam Pescador Rojas.
COLLABORATING PROFESSORS

Date: 2011