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: Neuronal Networks **LEVEL:** III

AMI OF THE LEARNING UNIT:
The student select the models of neural network artificial appropriate for resolve problems of learning and classification in the artificial intelligence.

CONTENTS:

I. Introduction to Artificial Neural Networks (ANN).
II. Definitions and basic concepts.
III. Unsupervised ANN.
IV. Supervised ANN.
V. Probabilistic ANN.
VI. ANN Applications.

TEACHING PRINCIPLES:

In this unit is elaborated from strategies of learning in base of cases and method inductive which one have activities of learning, that it will guide the development and the abilities of abstract, analysis and design of models of neural networks with theoretical tools and practice, such as the case of the programs realized of computing that evidence the concepts of unit. The activities are going to realize in the class promote in the students some technics, such as: Work, exposition of complement of themes, and discussion guide.

EVALUATION AND PASSING REQUIREMENTS:
This Learning Unit will be evaluated from evidence, which is made up of: formative assessment, summative and self-assessment rubrics, peer assessment and hetero.
This learning unit will also be established through:
• Evaluation of previously acquired knowledge, based on the guidelines established by the academy.
• Accreditation in another IPN AU educational institution, or other national or inteANNtional.

REFERENCES:

- del Brío Bonifacio, Martín. Sanz Molina, Alfredo. (2002). *Redes Neuronales y Sistemas Difusos* (2ª Ed.). España. Alfa Omega. ISBN: 9789701512500.
- Karayiannis, Nicolaos. Venetsanopoulos, Anastasios N. (2010). *Artificial Neural Networks: Learning Algorithms, Performance Evaluation, and Applications*. (1ª Ed.). India. Kluwer Academic. ISBN 0792392392973.
- Kussel, Ernst. Baidyk, Tatiana. Wunsch, Donal C. (2010). Neural Networks and Micromechanics. (1ª Ed.). USA. Springer. ISBN: 9783642025341.
- Taylor, Brian J. (2006). *Methods and Procedures for the Verification and Validation of Artificial Neural Networks*. (1ª Ed.). USA. Springer. ISBN: 9780387282886.
- Tosh, Colin. Ruxton, Graeme. (2010). *Modelling perceptions with artificial neural networks*. (1ª Ed.). UK. Cambridge University Press. ISBN: 9780521763950.

INSTITUTO POLITÉCNICO NACIONAL

SECRETARÍA ACADÉMICA

DIRECCIÓN DE EDUCACIÓN SUPERIOR

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: Neural Networks
TYPE OF LEARNING UNIT: Theorical - Practical, Optative.
USE: August, 2011
LEVEL: lll.
CREDITS: 7.5 Tepic, 4.39 SATCA

ACADEMIC AIM

Furthermore, this program to provide the knowledge on the optimization of the digital processing of voice and image, being caused the independent learning by means of the use of tools and methods; developing abilities to use different algorithms in the analysis, design, improvement and implementation of voice systems and image of efficient form, for the solution of computer problems related to this area. 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 digital processing of voice and image. 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 the units Algorithm and Structured Programming, Object-Oriented Programming and Compilers as antecedents. The consequent units are Terminal Work I and II.

AIM OF THE LEARNING UNIT:

The student select the models of neural network artificial appropriate for resolve problems of learning and classification in the artificial intelligence.

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

N° THEMATIC UNIT: I **TITLE:** Introduction to Artificial Neural Networks (ANN).

UNIT OF COMPETENCE

The student discover the underlying fundamentals of artificial neural networks, based on their models, general characteristics and types of applications.

No.	CONTENTS	Teacher led-Instruction HOURS		Autonomus Learning HOURS		REFERENCES KEY
		T	P	T	P	
1.1	History ANN.	0.5		1.0		1B, 2B, 3C, 4C
1.2	Applications ANN.	0.5		1.0		
1.3	Biological model.	1.0	0.5	1.0	0.5	
1.4	Mathematical model of the ANN	1.0		1.0	0.5	
	Subtotals:	3.0	0.5	4.0	1.0	

TEACHING PRINCIPLES

Course framing and team building.
This unit will be addressed from the learning strategy focused on cases and inductive method, allowing the consolidation of the following learning techniques: brainstorming worksheet, documentary research, led discussion, concept mapping, resolution problems, exposure to additional equipment items and internship.

LEARNING EVALUATION

Diagnostic test
Portfolio of Evidences:

Charts	5%
Technical data	5%
Cooperative Presentation	10%
Report of Practicals	30%
Rubric of Self-Evaluation	5%
Rubric of Co-Evaluation	5%
Learning Evidence	40%

N° THEMATIC UNIT: II **TITLE:** Definitions and basic concepts

UNIT OF COMPETENCE

The student discover basic concepts of mathematical modeling in general the perceptron based on the theory of operation of a biological neuron and the concept of learning.

No.	CONTENTS	Teacher led-Instruction HOURS		Autonomus Learning HOURS		REFERENCES KEY
		T	P	T	P	
2.1	The concept of an artificial neuron.	0.5		0.5		1B, 2B, 3C
2.2	Threshold potential.	0.5		0.5		
2.3	Neuron firing.	0.5		0.5		
2.4	Activation functions.	0.5		0.5		
2.5	Perceptron.	0.5	0.5	1.0	0.5	
2.6	Training method.	1.0	0.5	1.5	1.5	
2.7	Performance indicators.	0.5	0.5	1.5	1.5	
	Subtotals:	4.0	1.5	6.0	3.5	

TEACHING PRINCIPLES

This unit will be addressed from the learning strategy focused on cases and inductive method, allowing the consolidation of the following learning techniques: brainstorming worksheet, documentary research, led discussion, concept mapping, resolution problems, exposure to additional equipment items and internship.

LEARNING EVALUATION

Portfolio of Evidences:

Charts	5%
Technical data	5%
Cooperative Presentation	10%
Report of Practicals	30%
Rubric of Self-Evaluation	5%
Rubric of Co-Evaluation	5%
Learning Evidence	40%

LEARNING UNIT:

N° THEMATIC UNIT: III **TITLE:** Unsupervised ANN

UNIT OF COMPETENCE

The student derives the neural network models based on theoretical and mathematical foundations of an unsupervised training and performance evaluation.

No.	CONTENTS	Teacher led-Instruction HOURS		Autonomus Learning HOURS		REFERENCES KEY
		T	P	T	P	
3.1	Introduction.	0.5		0.5		1B, 5C, 6C
3.2	Model "Hopfield.	0.5		0.5	0.5	
3.3	Model "ART. "	0.5		0.5	0.5	
3.4	Model "ART II. "	0.5		0.5	0.5	
3.5	Network Software unsupervised.	0.5		1.5	1.0	
3.6	Performance indicators (eg R2, Davies-Bouldin indicator).	1.5	0.5	2.0	1.5	
	Subtotals:	4.0	0.5	5.5	4.0	

TEACHING PRINCIPLES

This unit will be addressed from the learning strategy focused on cases and inductive method, allowing the consolidation of the following learning techniques: brainstorming worksheet, documentary research, led discussion, concept mapping, resolution problems, exposure to additional equipment items and internship.

LEARNING EVALUATION

Portfolio of Evidences:

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

N° THEMATIC UNIT: IV **TITLE:** Supervised ANN

UNIT OF COMPETENCE

The student derives the artificial neural network models based on theoretical and mathematical foundations of supervised training and performance evaluation.

No.	CONTENTS	Teacher led-Instruction HOURS		Autonomus Learning HOURS		REFERENCES KEY
		T	P	T	P	
4.1	Introduction	0.5		0.5		1B, 5C, 6C
4.2	Model "Adaline".	0.5		1.0	1.0	
4.3	Model "Backpropagation. "	2.0		1.5	1.0	
4.4	Network Software supervised.	0.5	0.5	1.5	1.0	
4.5	Performance indicators.	1.0	0.5	1.5	2.5	
	Subtotals:	4.5	1.0	6.0	5.5	

TEACHING PRINCIPLES

This unit will be addressed from the learning strategy focused on cases and inductive method, allowing the consolidation of the following learning techniques: brainstorming worksheet, documentary research, led discussion, concept mapping, resolution problems, exposure to additional equipment items and internship.

LEARNING EVALUATION

Portfolio of Evidences:

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

N° THEMATIC UNIT: V **TITLE:** Probabilistic ANN

UNIT OF COMPETENCE

The student reviews the theoretical basis of neural networks based on probability theory techniques.

No.	CONTENTS	Teacher led-Instruction HOURS		Autonomus Learning HOURS		REFERENCES KEY
		T	P	T	P	
5.1	Computational aspects.	0.5		0.5		5C, 6C
5.2	Sigma optimization.	0.5		0.5		
5.3	Related models.	0.5		0.5	1.0	
5.4	Cost functions.	0.5		2.0	1.0	
5.5	Signal to noise ratio.	1.0	0.5	2.5	1.0	
	Subtotals:	3.0	0.5	6.0	3.0	

TEACHING PRINCIPLES

This unit will be addressed from the learning strategy focused on cases and inductive method, allowing the consolidation of the following learning techniques: brainstorming worksheet, documentary research, led discussion, concept mapping, resolution problems, exposure to additional equipment items and internship.

LEARNING EVALUATION

Portfolio of Evidences:

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

N° THEMATIC UNIT: VI **TITLE:** ANN Applications of ANN

UNIT OF COMPETENCE

The student designs computational application s based on neural network models developed.

No.	CONTENTS	Teacher led-Instruction HOURS		Autonomus Learning HOURS		REFERENCES KEY
		T	P	T	P	
6.1	Solving problems with neural networks.	0.5		0.5	1.5	4C, 6C
6.2	Control applications.	0.5		0.5	0.5	
6.3	Applications in Robotics.	0.5		0.5	0.5	
6.4	PDI applications.	0.5		0.5	0.5	
6.5	Medical applications.	0.5		0.5	0.5	
6.6	Data Mining Applications.	0.5		0.5	0.5	
6.7	Other Applications.	1.0	0.5	1.0	1.5	
	Subtotals:	4.0	0.5	4.0	5.5	

TEACHING PRINCIPLES

This unit will be addressed from the learning strategy focused on cases and inductive method, allowing the consolidation of the following learning techniques: brainstorming worksheet, documentary research, led discussion, concept mapping, resolution problems, exposure to additional equipment items and internship.

LEARNING EVALUATION

Portfolio of Evidences:

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

RECORD OF PRACTICES

PRACTICAL No.	NAME OF THE PRACTICE	THEMATIC UNITS	DURATION	ACCOMPLISHMENT LOCATION
1	Experimental determination of parameters of ANN mathematical model	I	1.5	Computer Labs.
2	Implementation of a perceptron.	II	1.5	
3	Performance indicators and their interpretation.	II	3.5	
4	Implementation of Hopfield-type models, and ARTII ART.	III	2.5	
5	Performance Indicators of different types of ANN. unsupervised.	III	2.0	
6	Adaline and Backpropation Model implementation.	IV	3.0	
7	Performance Indicators for ANN. supervised type.	IV	3.5	
8	ANN Implementation and interpretation of cost functions.	V	2.0	
9	Signal to noise ratio in ANN.	V	1.5	
10	A pattern classifier ANN. signal in an application.	VI	2.5	
11	Pattern classifier with a ANN. In a Image application and interpretation of performance indicators.	VI	3.5	
		TOTAL OF HOURS	27.0	

EVALUATION AND VALIDATION:

Practices contribute 30% of the grade of each unit.
Practices are considered a prerequisite for this learning unit credit.

PERIOD	UNIT	EVALUATION TERMS
1	I , II	Continuous assessment 70% Evidence of learning 30%
2	III, IV	Continuous assessment 80% Evidence of learning 20%
3	V, VI	Continuous assessment 100%
		Unit I contributes 5% of the final grade. Unit II accounts for 20% of the final grade. Unit III provides 20% of the final grade. Unit IV contributes 20% of the final grade. Unit V contributes 15% of the final grade. Unit VI provides 20% of the final grade.
		Other means to pass this learning unit: • Evaluation of previously acquired knowledge. • Accreditation in another IPN AU educational institution, or other national or international. 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.

KEY	B	C	REFERENCES
1	X		del Brío Bonifacio, Martín. Sanz Molina, Alfredo. (2002). Redes Neuronales y Sistemas Difusos (2ª Ed.). España. Alfa Omega. ISBN: 9789701512500.
2	X		Karayiannis, Nicolaos. Venetsanopoulos, Anastasios N. (2010). Artificial Neural Networks: Learning Algorithms, Performance Evaluation, and Applications. (1ª Ed.). India. Kluwer Academic. ISBN 0792392392973.
3		X	Kussel, Ernst. Baidyk, Tatiana. Wunsch, Donal C. (2010). Neural Networks and Micromechanics. (1ª Ed.). USA. Springer. ISBN: 9783642025341.
4		X	Taylor, Brian J. (2006). Methods and Procedures for the Verification and Validation of Artificial Neural Networks. (1ª Ed.). USA. Springer. ISBN: 9780387282886.
5		X	Tosh, Colin. Ruxton, Graeme. (2010). Modelling perceptions with artificial neural networks. (1ª Ed.). UK. Cambridge University Press. ISBN: 9780521763950.
6		X	Yegnanarayana, B. (2006). Artificial Neural Networks (1ª Ed.). India. Prentice-Hall. ISBN: 8120312538. B. Yegnanarayana, Artificial Neural Networks, Prentice-Hall 2006. ISBN: 8120312538.

INSTITUTO POLITÉCNICO NACIONAL

SECRETARÍA ACADÉMICA

DIRECCIÓN DE EDUCACIÓN SUPERIOR

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
		■	

ACADEMY: Ingeniería de software. **LEARNING UNIT:** Neuronal networks

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

2. AIM OF THE LEARNING UNIT:

The student select the models of neural network artificial appropriate for resolve problems of learning and classification in the artificial intelligence.

3. PROFESSOR EDUCATIONAL PROFILE:

KNOWLEDGE	PROFESSIONAL EXPERIENCE	ABILITIES	APTITUDES
• Programming visual languages. • Handling of the Operating Systems. • Mathematics for analysis of signals. • Algorithmic complexity. • Knowledge of the Institutional Educational Model. • English.	• A year in voice and image programming • Actual in educational as facilitator of the knowledge of six months. • Six months in the handling of equipment of calculation. • A year experience in the Institutional Educational Model.	• Analysis and synthesis. • Problems resolution. • Cooperative. • Leadership. • Applications of Institutional Educational Model. • Decision making.	• Responsible. • Tolerant. • Honest. • Respectful. • Collaborative. • Participative. • Interested to learning. • Assertive.

DESIGNED BY	REVISED BY	AUTHORIZED BY
Dr. Jesús Yaljá Montiel Pérez COORDINATING PROFESOR	Dr. Flavio Arturo Sánchez Garfias Subdirector Académico	Ing. Apolinar Francisco Cruz Lázaro Director

Date: 2011