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: Genetic Algorithms **LEVEL:** III

AIM OF THE LEARNING UNIT:
The student builds intelligent computer systems in solving optimization problems, automatic programming and machine learning based on genetic algorithms theory.

CONTENTS:

I. Genetic Algorithms Foundations.
II. Terminology and Operators of Genetic Algorithms.
III. Classification of Genetic Algorithms.
IV. Problem solving using genetic algorithms.
V. Simulation and Implementation of Genetic Algorithms.

TEACHING PRINCIPLES:
The teacher will apply a Projects-Based learning process, through inductive and heuristic methods using analysis techniques, technical data, organization charts, cooperative presentation, exercise-solving and the production of the learning evidences. It will encourage teamwork and individual integrity and responsibility to the environment. Moreover, an autonomous learning will be encouraged by the development of a final project.

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.

Unit Learning can also be approved through:

- Evaluation of acknowledges previously acquired, by developing a computer program and a written evidence of learning
- Official recognition by either another IPN Academic Unit of the IPN or by a national or international external academic institution besides IPN with a current cooperation a agreement.

REFERENCES:

- Aliev R. A., Aliev R.R. (2001) *SOFT COMPUTING & ITS APPLICATIONS*. USA: World Scientific Pub Co Inc. ISBN-10: 9810247001.
- Golberg D. I. (1989). *GENETIC ALGORITHMS*. (1st edition). USA: Addison-Wesley.ISBN-10: 0201157675. ISBN-13:-978-0201157673.
- Lagdon W.B. Poli R. (2010). *FOUNDATIONS OF GENETIC PROGRAMMING.* (1st edition). Springer. ISBN-10: 3642076327.
- Sivanandam S. N. Deepa S. N. (2010). *INTRODUCCTION TO GENETIC ALGORITHMS*. Springer. ISBN-10: 9783642092244. ISBN-13: 978-3642092244.
- Van Rooij A. J. F. Jain L.C. Johnson R .P. (1998). *NEURAL NETWORK TRAINING USIN GENETIC ALGORITHMS.* Singapure: World Scientific publishing Co. Pte. Ltd. ISBN-10: 9810229194.

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: Genetic Algorithms.
TYPE OF LEARNING UNIT: Theorical - Practical, Optative.
VALIDITY: August, 2011
LEVEL: lll.
CREDITS: 7.5 Tepic, 4.39 SATCA

ACADEMIC AIM

This program contributes to the profile of graduated on Ingeniería en Sistemas Computacionales, to develop the skills to design computer systems based on Generic Algorithms for solving computational problems in engineering, the ability to describe and differentiate the main concepts, characteristics and structures of genetic algorithms, the ability to design and simulate genetic algorithms through the main simulator dedicated to this purpose.

It also helps to develop generic skills such as strategic thinking, creative thinking, collaborative and participatory work, assertive communication, contributing to their integral development, so The student will be able to perform in different sectors of society, public private research and integrate and manage internal work teams and multidisciplinary with an attitude of leadership, ethics and responsibility. The student is continuously updated to meet the needs of society and sustainable development of the country

It is based on the programs of linear algebra, calculus, algorithms and structured programming, analysis and object-oriented design, and software engineering. It is related laterally to pattern recognition, artificial intelligence, Supervised Artificial Neural Networks, Fuzzy Systems in Engineering, Computational Intelligence in Control Engineering and Unsupervised Artificial Neural Networks. This supports subsequent to the learning units Terminal Work I and II.

AIM OF THE LEARNING UNIT:

The student builds intelligent computer systems in solving optimization problems, automatic programming and machine learning based on genetic algorithms theory.

CREDITS HOURS

THEORETICAL CREDITS / WEEK: 3.0

PRACTICAL CREDITS / WEEK: 1.5

THEORETICAL HOURS / SEMESTER: 54

HOURS PRACTICAL / 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

THEMATIC UNIT: I **TITLE:** Genetic Algorithms Foundations

UNIT OF COMPETENCE

The student classifies the features and elements of genetic algorithms based on the fundamental structure.

No.	CONTENTS	Teacher led-Instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
1.1	Brief semblance of evolutionary computation.	3.0	1.0	6.0	3.0	5B, 8B, 2C, 6C
1.2	Biological basis AG.					
1.2.1	Cell					
1.2.2	Chromosomes					
1.2.3	Genetics					
1.2.4	Reproduction					
1.2.5	Natural Selection					
1.3	Definitions of Genetic Algorithms.					
1.4	Characteristics of Genetic Algorithms.					
1.5	Applications of Genetic Algorithms.					
1.6	Mathematical Foundations of the AG.					
	Subtotals:	3.0	1.0	6.0	3.0	

TEACHING PRINCIPLES

This thematic unit must start in the frame of the course and team building. Thematic unit will be addressed through the strategy of project-based learning, using the inductive method; This unit uses learning techniques such as concept mapping, cognitive maps, worksheets, presentation of additional issues, development of practice and final project proposal.

LEARNING EVALUATION

Diagnostic Test

Project Portfolio

Project proposal	5%
Graphic Organizers	10%
Worksheet	5%
Cooperative Presentation	10%
Report of Practical	20%
Self-Evaluation Rubrics	5%
Cooperative-evaluation Rubrics	5%
Written Learning Evidence	40%

THEMATIC UNIT: II **TITLE:** Terminology and Operators of Genetic Algorithms

UNIT OF COMPETENCE

The student classifies the terms and operators of genetic algorithms based on the fundamental structure.

No.	CONTENTS	Teacher led-Instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
2.1	Genetic Algorithm Terminology	3.0	1.5	3.5	4.0	5B, 8B, 2C, 6C
2.1.1	Key Elements					
2.1.2	Individuals					
2.1.3	Genes					
2.1.4	Fitness					
2.1.5	Population					
2.1.6	Coding.					
2.1.7	Breeding.					
2.1.8	Search termination.					
2.1.9	Examples and exercises.					
2.2	Advanced Operators and Techniques AG	1.0		3.5		
	Subtotals:	4.0	1.5	7.0	4.0	

TEACHING PRINCIPLES

This unit will be addressed through the strategy of project-based learning, using the inductive method also will be added concept mapping techniques, cognitive maps, exercises-solving, exposure of issues, development of practical programming algorithms, and advance final project.

LEARNING EVALUATION

Project Portfolio

Graphic Organizers	5%
Exercise delivery	5%
Cooperative Presentation	10%
Computer Programs w/report	10%
Practice Report	20%
Advance of the Project	10%
Self-Evaluation Rubrics	5%
Cooperative-evaluation Rubrics	5%
Written Learning Evidence	30%

THEMATIC UNIT: III **TITLE:** Classification of Genetic Algorithms

UNIT OF COMPETENCE

The student solves engineering problems based on different kinds of genetic algorithms

No.	CONTENTS	Teacher led-Instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
3.1	Simple Genetic Algorithm (SGA)	4.0	1.5	7.0	4.0	5B, 8B, 2C, 6C, 4C
3.2	Parallel and Distributed Genetic Algorithm (PGA and DGA)					
3.3	Hybrid Genetic Algorithm (HGA)					
3.4	Adaptive Genetic Algorithm (AGA)					
3.5	Fast Messy Genetic Algorithm (MGFA)					
3.6	Exercises					
	Subtotals:	4.0	1.5	7.0	4.0	

TEACHING PRINCIPLES

This unit will be addressed through the strategy of project-based learning, using the inductive method also will be added concept mapping techniques, cognitive maps, exercises-solving, exposure of issues, development of practical, programming algorithms, and advance final project.

LEARNING EVALUATION

Project Portfolio:

Graphic Organizers	5%
Exercise delivery	5%
Cooperative Presentation	10%
Report of Practical	20%
Program delivery	10%
Advance of the Project	10%
Self-Evaluation Rubrics	5%
Cooperative-evaluation Rubrics	5%
Written Learning Evidence	30%

THEMATIC UNIT: IV **TITLE:** Problem solving using genetic algorithms

UNIT OF COMPETENCE

The student solves optimization and classification problems based on different kinds of genetic algorithms

No.	CONTENTS	Teacher led-Instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
4.1 4.1.1 4.1.2	Optimization problems using GA Fuzzy Optimization Problems. Combinatorial optimization problems	1.5	0.5	2.0	2.0	8B, 1C, 4C, 7C, 9C
4.2 4.2.1 4.2.2 4.2.3	Pattern Classification. GA-based classifier Relationship with the Bayes classifier Bayes decision regions and optimization H.	1.5	0.5	2.0	1.5	
4.3 4.3.1	Fuzzy Classification Systems with rules based on AG Automatic generation of linguistic if-then rules.	1.0	0.5	1.5	1.5	
4.4 4.4.1 4.4.2	Training Neural Networks based on AG. Combination of Genetic Algorithms and Neural Networks. Adjusting parameters of genetic algorithms and neural networks.	1.0		1.5		
	Subtotals:	5.0	1.5	7.0	5.0	

TEACHING PRINCIPLES

This unit will be addressed through the strategy of project-based learning, using the inductive method also will be added concept mapping techniques, cognitive maps, exercises-solving, exposure of issues, development of practical, programming algorithms, and advance final project.

LEARNING EVALUATION

Project Portfolio:

Graphic Organizers	5%
Exercise delivery	5%
Cooperative Presentation	10%
Report of Practical	20%
Program delivery	10%
Advance of the Project	10%
Self-Evaluation Rubrics	5%
Cooperative-evaluation Rubrics	5%
Written Learning Evidence	30%

THEMATIC UNIT: V **TITLE:** Simulation and Implementation of Genetic Algorithms

UNIT OF COMPETENCE

The student designs optimization systems based on Genetic Algorithms simulation tools.

No.	CONTENTS	Teacher led-Instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
5.1 5.1.1 5.1.2 5.1.3 5.1.4 5.1.5 5.2 5.3 5.3.1 5.3.2	Data structure. Chromosomes Phenotypes Objective function values Fitness values Multiple subpopulation Simulation of Genetic Algorithms. Matlab Toolbox for AG. Graphical Interface Toolbox AG. Troubleshooting using Matlab Toolbox AG .	2.0 2.0	 1.5	3.5 3.5	1.5 4.0	8B, 5B,3C
	Subtotals:	4.0	1.5	7.0	4.0	

TEACHING PRINCIPLES

This unit will be addressed through the strategy of project-based learning, using the inductive method also will be added concept mapping techniques, cognitive maps, exercises-solving, exposure of issues, development of practical, programming algorithms, and final project.

LEARNING EVALUATION

Project Portfolio

Graphic Organizers	5%
Exercise delivery	5%
Cooperative Presentation	10%
Report of Practical	20%
Program delivery	10%
Final Project	30%
Self-Evaluation Rubrics	5%
Cooperative-evaluation Rubrics	5%
Written Learning Evidence	10%

RECORD OF PRACTICALS

No.	NAME OF THE PRACTICAL	THEMATIC UNITS	DURATION	ACCOMPLISHMENT LOCATION
1	Genetic Algorithm Toolbox Matlab.	I	4.0	Computer Labs.
2	Operadores Genéticos.	II	5.5	
3	Clases de Algoritmos Genéticos.	III	5.5	
4	Solución de Problemas de Optimización y Clasificación con Algoritmos Genéticos.	IV	6.5	
5	Simuladores de Algoritmos Genéticos.	V	5.5	
		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.
The practices contribute 35% of the final grade.

PERÍOD	UNIT	EVALUATION TERMS
1 2 3	I, II III, IV V	Continuous evaluation 60% and written learning evidence 40% Continuous evaluation 70% and written learning evidence 30% Continuous evaluation 90% and written learning evidence 10% The Learning unit I is 15% worth of the final score The Learning unit II is 15% worth of the final score The Learning unit III is 15% worth of the final score The Learning unit IV is 15% worth of the final score The Learning unit V is 40% worth of the final score Learning unit can also be approved through: • Evaluation of acknowledges previously acquired, by developing a computer program and a written evidence of learning • Official recognition by either another IPN Academic Unit of the IPN or by a national or international external academic institution besides IPN agreement which has. If accredited by Special Assessment or a certificate of proficiency, this will include a practical part which contribute 50% of the grade and a theoretical part that will provide the remaining 50%, based on guidelines established by the academy.

KEY	B	C	REFERENCES
1		X	Aliev R. A., Aliev R.R. (2001) SOFT COMPUTING & ITS APPLICATIONS. USA. World Scientific Pub Co Inc. ISBN-10: 9810247001.
2		X	Golberg D. I. (1989). GENETIC ALGORITHMS. (1st edition). USA: Addison-Wesley.ISBN-10: 0201157675. ISBN-13:-978-0201157673.
3		X	(2004). GENETIC ALGORITHM AND DIRECT SEARCH TOOLBOX FOR USE WITH MATLAB 1.0 USER´S GUIDE. USA: The Matworks, Inc. On line only (01/abril/2011). http://www.mathworks.com/access/helpdesk_r13/help/pdf_doc/gads/gads_tb.pdf
4		X	Haupt R. L. Haupt S. E. (2004). PRÁCTICAL GENETIC ALGORITHMS. (2nd Edition). USA: Wiley-Interscience. ISBN-10: 0471455652. ISBN-13: 978-0471455653
5	X		Lagdon W.B. Poli R. (2010) Foundations of Genetic Programming (1st edition). Springer. ISBN-10: 3642076327.
6		X	Mitchell M. (1998). AN INTRODUCCTION TO GENETIC ALGORITHMS. USA: MIT Press. ISBN-10: 0262631857. ISBN-13: 978-0262631853
7		X	Pal S. K. (2010). CLASSIFICATION AND LEARNING USING GENETIC ALGORITMS: Applications in bioinformatics and Web Intelligence (Natural Computing Series). USA.Springer. ISBN-10: 3642080545.
8	X		Sivanandam S. N. Deepa S. N. (2010) INTRODUCCTION TO GENETIC ALGORITHMS. Springer. ISBN-10: 9783642092244. ISBN-13: 978-3642092244.
9		X	Van Rooij A. J. F. Jain L.C. Johnson R .P. (1998) NEURAL NETWORK TRAINING USIN GENETIC ALGORITHMS, Singapure: World Scientific publishing Co. Pte. Ltd. ISBN-10: 9810229194.

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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:** Genetic Algorithms.

SPECIALTY AND ACADEMIC REQUIRED LEVEL: Master or PhD in Computer Science or Electrical Engineering

2. AIM OF THE LEARNING UNIT:

The student builds intelligent computer systems in solving optimization problems, automatic programming and machine learning based on genetic algorithms theory.

3. PROFFESSOR EDUCATIONAL PROFILE:

KNOWLEDGE	PROFESSIONAL EXPERIENCE	ABILITIES	APTITUDES
• Concepts of Genetic Algorithms. • Techniques for design and simulation of Genetic Algorithms. • Solving optimization problems and pattern classification. • Knowledge of the Institutional Educational Model. • English	• One year experience in the design of systems based on Genetic Algorithms • Two years experience in handling groups and collaborative work • A year experience in the Institutional Educational Model.	• Analysis and synthesis. • Leadership. • Decision making. • Conflict Management. • Group management. • Verbal fluency of ideas. • Teaching Skills • Applications of Institutional Educational Model.	• Responsible. • Tolerant. • Honest. • Respectful. • Collaborative. • Participative. • Interested to learning. • Assertive.

DESIGNED BY	REVISED BY	AUTHORIZED BY
M en C. José Luis Calderón Osorno COORDINATING PROFESOR M en C. Edmundo René Durán Camarillo M en C. Ignacio Ríos de la Torre. COLLABORATING PROFESSORS	Dr. Flavio Arturo Sánchez Garfias Subdirector Académico	Ing. Apolinar Francisco Cruz Lázaro Director

Date: 2011