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: Evolutionary Computing **LEVEL:** III

AIM OF THE LEARNING UNIT:
The student designs tools for data analysis based on bio-inspired paradigms.

CONTENTS:

I. Optimization and bio-inspired optimization algorithms.
II. Biological systems modeling and systems biology.
III. Web applications and high-performance computing in Bioinformatics.

TEACHING PRINCIPLES:
The learning unit will be addressed from the project-oriented learning strategy, the teacher apply the heuristic method, with which it carried out learning activities that will guide the development of skills of abstraction, analysis and design of efficient algorithms, using theoretical and practical tools, such is the case for the implementation of computer programs that demonstrate the concepts of the unit. The activities done in class to encourage students some techniques, such as collaborative, participatory, brainstorming, graphic organizers, inquiry documents, worksheets, supplementary statement of issues, discussion and directed the execution of a project software. It is the responsibility of the teacher decide the features of the project and the programs implemented by fixing the time of preparation and delivery.

EVALUATION AND PASSING REQUIREMENTS:

This learning unit will be assessed from the portfolio of evidence, which is made up of: formative assessment, summative and self-assessment and peer assessment rubrics.

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:

- Alon, U. (2007). An introduction to systems biology : design principles of biological circuits. (1a Ed.). Boca Raton, FL: Chapman & Hall/CRC. ISBN: 978-1584886426.
- Cauldwell, P. (2002). Servicios Web XML. (1a Ed.). Madrid, España: Desarrollos Editoriales, S. L., Anaya Multimedia. ISBN: 978-8441513631.
- Coffey, W.T. Kalmykov, Y.P. (2006). Fractals, diffusion, and relaxation in disordered complex systems. (1a Ed.). New Jersey: Wiley-Interscience. ISBN: 978-0471725077.
- Cormen, T. H. (2009). Introduction to algorithms (3a Ed.). Cambridge, Mass. : MIT Press. ISBN: 978-0262533058.
- Goles, E. (2009). Cellular automata: dynamical systems and neural networks. (2a Ed.). Boston: Kluwer Academic Publishers. ISBN: 978-9048143825.

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

ACADEMIC AIM

This learning unit contributes to the exit profile of the Engineer in Computer Systems to develop the skills of effective problem solving in complex dynamic systems modeling of practical problems. It also develops strategic thinking, creative thinking, collaborative and participatory and assertive communication.

Requires learning units Probability and Statistics and Bioinformatics with the knowledge to the analysis of biological, Advanced Mathematics for Engineering and Discrete Mathematics with the use of theoretical tools to characterize the objects of study.

AIM OF THE LEARNING UNIT:
The student designs tools for data analysis based on bio-inspired paradigms.

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 Ciencias de la Computación

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:** Optimization and bio-inspired optimization algorithms.

UNIT OF COMPETENCE

The student solves optimization problems based on bio-inspired algorithms techniques.

No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
1.1 1.1.1 1.1.2 1.1.3	Advanced Programming Techniques Dynamic Programming Integer Linear Programming Gradient methods	2.0	1.5	4.0	3.0	B1, B2, B3, C7, C8, C13
1.2 1.2.1 1.2.2 1.2.3 1.2.4	Optimization Artificial Neural Networks Self-organizing maps Genetic algorithms Autoimmune system	2.0	1.5	4.0	3.0	
1.3	Other bio-inspired algorithms	2.0		4.0		
	Subtotals:	6.0	3.0	12.0	6.0	

TEACHING PRINCIPLES

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, technical data and exercise-solving, exhibition in team, practical and production of learning evidence and the accomplishment of a project proposal.

LEARNING EVALUATION

Diagnostic Test
Project Portfolio:

Technical data	5%
Charts	5%
Exercise-solving	10%
Cooperative Presentation	10%
Report of Practicals	20%
Proposal of project	10%
Self-Evaluation Rubrics	5%
Cooperative Evaluation Rubrics	5%
Written Learning Evidence	30%

THEMATIC UNIT: II **TITLE:** Biological systems modeling and systems biology.

UNIT OF COMPETENCE

The student designs data-collection probabilistic models based on biological systems modeling techniques.

No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
2.1	Modeling biological systems	3.0	1.5	6.0	3.0	B3, B4, C9, C11, C12
2.1.2	Morphogenesis					
2.1.3	Turing patterns					
2.1.4	Cellular automata					
2.1.5	Fractals					
2.2	Systems biology	3.0	1.5	6.0	3.0	
2.2.1	Biological control systems					
2.2.2	Modeling metabolic pathways					
2.2.3	Synthetic Biology					
2.2.4	Artificial Life					
	Subtotals:	6.0	3.0	12.0	6.0	

TEACHING PRINCIPLES

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

LEARNING EVALUATION

Project Portfolio:

Technical data	5%
Charts	5%
Computer programs w/report	15%
Cooperative Presentation	10%
Report of Practicals	15%
Proposal of project	30%
Self-Evaluation Rubrics	2%
Cooperative Evaluation Rubrics	3%
Written Learning Evidence	15%

THEMATIC UNIT: III **TITLE:** Web applications and high-performance computing in Bioinformatics

UNIT OF COMPETENCE

The student designs Web applications and high-performance computing systems in Bioinformatics based on the latest techniques.

No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
3.1 3.1.1 3.1.2 3.1.3 3.1.4 3.2 3.2.1 3.2.1	High Performance Computing in Bioinformatics Complexity in Bioinformatics Distributed computing Parallel computing Collaborative computing Web applications in Bioinformatics Web Services Data Mining	3.0 3.0	1.5	6.0 6.0	3.0	B5, B6, C9, C10
	Subtotals:	6.0	3.0	12.0	6.0	

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

Project Portfolio:

Technical data	5%
Charts	5%
Computer programs w/report	10%
Cooperative Presentation	10%
Report of Practicals	10%
Project report	50%
Self-Evaluation Rubrics	5%
Cooperative Evaluation Rubrics	5%

RECORD OF PRACTICALS

No.	NAME OF THE PRACTICAL	THEMATIC UNITS	DURATION	ACCOMPLISHMENT LOCATION
1	Efficient optimization	I	3.0	Computer Labs.
2	Bio-inspired optimization	I	6.0	
3	Generation of patterns observed in nature	II	3.0	
4	Biological control model	II	6.0	
5	Generating an application of high performance computing	III	3.0	
6	Web application for access to biological information	III	6.0	
		TOTAL OF HOURS	27.0	

EVALUATION AND PASSING REQUIREMENTS:

The practicals are considered mandatory to pass this learning unit.
The practicals worth 20% in thematic unit I.
The practicals worth 15% in thematic unit II.
The practicals worth 10% in thematic unit III.

PERIOD	UNIT	EVALUATION TERMS
1 2 3	I y II III IV	Continuous evaluation 70% and written learning evidence 30% Continuous evaluation 85% and written learning evidence 15% Continuous evaluation 100% The learning unit I is 30% worth of the final score The learning unit II is 30% worth of the final score The learning unit III is 40% worth of the final score 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.

KEY	B	C	REFERENCES
1	X		Alon, U. (2007). *An introduction to systems biology : design principles of biological circuits*. (1a Ed.). Boca Raton, FL: Chapman & Hall/CRC. ISBN: 978-1584886426.
2	X		Cauldwell, P. (2002). *Servicios Web XML*. (1a Ed.). Madrid, España: Desarrollos Editoriales, S. L., Anaya Multimedia. ISBN: 978-8441513631.
3	X		Coffey, W.T. Kalmykov, Y.P. (2006). *Fractals, diffusion, and relaxation in disordered complex systems*. (1a Ed.). New Jersey: Wiley-Interscience. ISBN: 978-0471725077.
4	X		Cormen, T. H. (2009). *Introduction to algorithms* (3a Ed.). Cambridge, Mass. : MIT Press. ISBN: 978-0262533058.
5	X		Goles, E. (2009). *Cellular automata: dynamical systems and neural networks*. (2a Ed.). Boston: Kluwer Academic Publishers. ISBN: 978-9048143825.
6	X		Helman, N. Wendell, L. Peisajovich, S. Pincus, D. Sommovilla, N. (2007). *Bio Building Basics: A Conceptual Instruction. Manual for Synthetic Biology*. (1a Ed.). USA: University of California San Francisco.
7		X	Kohonen, T. (2008). *Self-organizing maps*. (3a. Ed.). Berlin: Springer. ISBN: 978-3540679219.
8		X	Kuri, M. A. (2002). *Algoritmos genéticos*. (1a Ed.). México: Fondo de Cultura Económica. ISBN: 9789681663834.
9		X	Maimon, O. Rokach, L. (2010). *Data mining and knowledge discovery handbook*. (2a Ed.). New York: Springer. ISBN: 978-0387098227.
10		X	Mata, C.H. (1966). *Algebra matricial con determinantes, espacios vectoriales, programación lineal.* (1a Ed.). Madrid, España: Dossat. ISBN: 9684228864.
11		X	Resnick, M. (2001). *Turtles, termites, and traffic jams : explorations in massively parallel microworlds*. (2a Ed.). Cambridge, Mass.: MIT Press. ISBN: 978-0262680936.
12		X	Sarker, R. Mahammadian, M. Xin, Y. (2002). *Evolutionary optimization*. (1a Ed.). New York: Klower Academic. ISBN: 978-0792376545.
13		X	Torres, J.J. (2000). *Conceptos de cómputo paralelo*. (1a Ed.). México: Trillas. ISBN: 978-9682462221.

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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: Ciencias de la Computación **LEARNING UNIT:** Evolutionary Computation

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

2. **AIM OF THE LEARNING UNIT**:
The student designs tools for data analysis based on bio-inspired paradigms.

3. PROFFESSOR EDUCATIONAL PROFILE:

KNOWLEDGE	PROFESSIONAL EXPERIENCE	ABILITIES	APTITUDES
• Methods of analysis of algorithms. • Algorithm design techniques. • Evolutionary Computation • Programming languages. • MEI. • English Language	• One year experience in the analysis of algorithms. • One year experience in the use of algorithm design techniques. • Two years experience in handling groups and collaborative work. • One year experience as a Professor of Higher Education.	• 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
Rosaura Palma Orozco COORDINATING PROFESOR	Dr. Flavio Arturo Sánchez Garfias Subdirector Académico	Ing. Apolinar Francisco Cruz Lázaro Director

Date: 2011