

SECRETARÍA ACADÉMICA



DIRECCIÓN DE EDUCACIÓN SUPERIOR

SINTHESIZED SCHOOL PROGRAM

ACADEMIC UNIT:	Escuela Superior de Cómputo	
ACADEMIC PROGRAM: LEARNING UNIT:	Ingeniería en Sistemas Computacionales. Parallel and Concurrent Programming	LEVEL: III

AIM OF THE LEARNING UNIT:

The student develops parallel and concurrent systems based on design pattern techniques.

CONTENT:

- I. Introduction.
- II. Parallel architectures.
- III. Concurrent programming.
- IV. Parallel programming.
- V. Design patterns for parallel and concurrent programming.

TEACHING PRINCIPLES:

Teacher will apply the projects strategy as well as the heuristic and analogical learning methods, using techniques such as: case-control studies, brainstorming, information search through information and communication technologies (ICT), analysis of data, cooperative work, graphic organizers, teacher led discussions, design of plans and/or experiments, technical reports, and oral communication.

EVALUATION AND PASSING REQUIREMENTS:

The program will evaluate the students using a learning portfolio which is integrated by:

• Formative and summative evaluation, rubrics, self-evaluation and cooperative evaluation rubric, and learning evidence.

Other ways to pass this Learning Unit:

- Evaluation of knowledge previously acquired with base in the issues defined by the academy.
- In other Academic Unit of the IPN.
- In other national or international academic undergraduate or graduate institution.

REFERENCES:

- Clavin, L, Synder, L. (2008). Principles of Parallel Programming (1^a Ed.). Estados Unidos de América: Ed. Addison Wesley. ISBN: 978-0321487902.
- Gregory, R. A. (1991). Concurrent Programming: Principles and Practice (2^a Ed.). Estados Unidos de América: Ed. Addison Wesley. ISBN: 978-0805300864.
- Michle, J. Q. (2003). Parallel Programming in C with MPI and OpenMP (1^a Ed.). Estados Unidos de América: Ed. McGraw Hill. ISBN: 978-0071232654.
- Pacheco, P. (1996). Parallel Programming with MPI (1^a Ed.). Estados Unidos de América: Ed. Morgan Kaufmann. ISBN: 978-1558603394.
- Timothy, G. M. Beverly, A. S. Berna, L. M. (2004). *Patterns for Parallel Programming* (1^a Ed.). Estados Unidos de América: Ed. Addison Wesley. ISBN: 978-0321228116.



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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: Parallel and Concurrent Programming. TYPE OF LEARNING UNIT: Theorical - Practical, Optative. USE: August, 2011. LEVEL: III CREDITS: 7.5 TEPIC – 4.39 SATCA

ACADEMIC AIM

This Learning Unit provides students the knowledge and abilities on the development of parallel and concurrent systems required by a computational system, working in a cooperative, tolerant and respectful environment. It contributes to form the Computer Science Engineer graduate profile in the parallel and concurrent computing field, reinforcing it with the integration of the acquired knowledge of the Operative Systems, Analysis and Design of Oriented Objects, Computer Networks, Web Technologies, Software Engineering, Data Structure, Analysis and Design of Computing Systems, Computers Architecture, Web Applications, Analysis and Design of Parallel Algorithms.

AIM OF THE LEARNING UNIT:

The student develops parallel and concurrent systems based on design pattern techniques.

CREDITS HOURS	LEARNING UNIT DESIGNED BY: Academia	AUTHORIZED BY: Comisión de Brogramas Académicos del Cansoia
THEORETICAL CREDITS / WEEK: 3.0	de Sistemas Distribuídos.	General Consultivo del IPN.
PRACTICAL CREDITS / WEEK: 1.5		
THEORETICAL HOURS/SEMESTER: 54	Dr. Flavio Arturo Sánchez Garfias Subdirección Académica	
PRACTICALS HOURS/SEMESTER: 27		
AUTONOMOUS LEARNING HOURS:	APPROVED BY:	Ing. Rodrigo de Jesus Serrano Domínguez
CREDIT HOURS / SEMESTER : 81	Presidente del CTCE.	de Programas Académicos



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LEARNING UNIT:

Parallel and Concurrent Programming.

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NAME: Introduction

THEMATIC UNIT: |

UNIT OF COMPETENCE

The student analyzes the objectives and the design characteristics in the parallel and concurrent systems based on design requirements.

No.	Io. CONTENTS		HOURS Teacher - led instruction		JRS omous ning	REFERENCES KEY
		т	Р	т	Р	
1.1 1.1.1	Parallel and concurrent systems definition. Examples of parallel and concurrent systems.	1.0	0.5	0.5	2.5	1B,3B
1.2 1.2.1 1.2.2 1.2.3 1.2.4	Objectives of parallelism and concurrency. Parallelism. Concurrency. Homogeneity. Security.	1.0		1.0		
1.3 1.3.1 1.3.2 1.3.3 1.3.4	Design requirements. Answer speed. Productivity. Use of cache and replication. Concurrency in parallel systems.	1.0		0.5		
	Subtotal:	3.0	0.5	2.0	2.5	
TEACHING PRINCIPLES						

Course framing and team arrangement.

This current unit will be approached through the projects learning strategy as well as the heuristic and analogical learning methods, using techniques such as: study cases, information search and analysis, teacher led discussions, elaboration of concept maps and the practical 1 in teams.

LEARNING EVALUATION

Diagnostic evaluation Project	
Worksheets	20%
Concept maps	60%
Practical reports	10%
Self-evaluation rubric	5%
Cooperative evaluation rubric	5%



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LEARNING UNIT:

Parallel and Concurrent Programming.

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NAME: Parallel architectures

THEMATIC UNIT: II

UNIT OF COMPETENCE

The student applies the characteristics and operation of the parallel architectures based on the parallel programming environments.

No.	CONTENTS	HOU Teache instru	URS er - led uction	HOI Auton Lear	URS omous ming	REFERENCES KEY
		т	Р	т	Р	
2.1	Introduction.	1.0	0.5	0.5	2.5	1B,4B,5C
2.1.1	Model of centralized hardware architectures.					
2.1.2	Centralized model vs parallel.					
2.2	Parallel architectures.	2.0		3.0		
2.2.1	Flynn Taxonomy.					
2.2.2	SISD Systems.					
2.2.3	SIMD Systems.					
2.2.4	MIMD Systems.					
2.2.5	Shared memory.					
2.2.6	Distributed memory.					
2.2.7	ccNUMA.					
2.2.8	MISD Systems.					
2.2.9	Multi-nucleus systems.					
2.3	Parallel programming environments.	1.0		2.0		
	Subtotal:	4.0	0.5	5.5	2.5	

TEACHING PRINCIPLES

This current unit will be approached through the projects learning strategy as well as the heuristic and analogical learning methods, using techniques such as: study cases, information search and analysis, teacher led discussions, elaboration of concept maps and the practical 2 and 3 in teams, and a project plan also designed in teams of four members that applies the knowledge and skills acquired in this current thematic unit and the previous one.

LEARNING EVALUATION

Project Portfolio:	
Worksheets	20%
Concept maps	10%
Practical reports	10%
Project plan design	50%
Self-evaluation rubric	5%
Cooperative evaluation rubric	5%



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LEARNING UNIT:

Parallel and Concurrent Programming.

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NAME: Concurrent Programming

UNIT OF COMPETENCE The student applies the characteristics and operation of the concurrent programming based on synchronization techniques.

Teach instru	HOURS Teacher - led instruction		omous	REFERENCES KEY	
т	Р	т	Р		
0.5	0.5		8.5	3B,2C,5C	
1.0		2.5			
1.0		3.0			
1.0		3.0			
1: 3.5	0.5	8.5	8.5		
TEACHING PRINCIPLES					
F	Teach instru 0.5 1.0 1.0 1.0 1.0 8 1.0	Teacher - led instruction T P 0.5 0.5 1.0 1.0 1.0 1.0 1.0 0.5 1.0 0.5 1.0 0.5 1.0 0.5 1.0 0.5 1.0 0.5 1.0 0.5 1.0 0.5 1.0 0.5	Teacher - led instruction Auton Lear T P T 0.5 0.5 2.5 1.0 2.5 1.0 3.0 1.0 3.0 1.0 3.0 1.0 3.0 1.0 3.0	Teacher - led instruction Autonomous Learning T P T P 0.5 0.5 8.5 1.0 2.5 8.5 1.0 3.0 1.0 1.0 3.0 3.0 1.0 3.0 3.0 1.0 3.0 3.0	

This current unit will be approached through the projects learning strategy as well as the heuristic and analogical learning methods, using techniques such as: study cases, information search and analysis, teacher led discussions, elaboration of concept maps and practical 4, 5 and 6 in teams, and a project plan also designed in teams of four members that applies the knowledge and skills acquired in this current thematic unit and the previous ones.

LEARNING EVALUATION				
Project Portfolio: Worksheets Concept maps Practical reports Project advances report (first part) Written and oral presentation of the partial technical report Self-evaluation rubric Cooperative evaluation rubric	20% 10% 10% 25% 25% 5% 5%			



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LEARNING UNIT:

Parallel and Concurrent Programming.

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THEMA	THEMATIC UNIT: IV NAME: Parallel programming				allel programming	
The etc.	UNIT OF COMPETENCE					
The stu	The student implement parallel systems based on parallel programming techniques.					
		HOU	JRS ar - led	HO		
No.	CONTENTS	instru	iction	on Learning		REFERENCES KEY
		т	Р	Т	Р	-
4.1	Introducción.	0.5	0.5		8.5	1B,4B,6C
4.2	Data and task parallelism.	1.0		0.5		
4.3	Formulating parllelism.	0.5		1.0		
4.3.1	Composed Parallelism.					
4.3.2	Unlimited Parallelism.					
4.3.3	Scalable Parallelism.					
4.4	Parallel programming techniques.	1.5		3.0		
4.4.1	Blocks of independent computing.					
4.4.2	Reducing and exploring abstraction.					
4.4.3	Dynamic work assignment.					
4.4.4	Static work assignment.					
4.4.5	Trees.					
4.5	Parallel programming.	1.5		3.0		
4.5.1	Programming threads.					
4.5.2	MPI programming.					
4.5.3	Partitioned global address space.					
	Subtotal:	5.0	0.5	7.5	8.5	
	TEACHING PRI	NCIPLE	S			
This current unit will be approached through the projects learning strategy as well as the heuristic and analogical						
learning methods, using techniques such as: case-control studies, information search and analysis, teacher led						
discussions, elaboration of concept maps and practical 7, 8 and 9 in teams, in addition to the plan and development re-						
design	of the second part of the proposed project, applying the	knowled	dge and	skills acqu	ired in this	current thematic
l unit and	unit and the previous ones.					

LEARNING EVALUATION				
Project Portfolio:Worksheets20%Concept maps10%Practical reports10%Project advances report (second part)25%Written and oral presentation of the partial technical report25%Self-evaluation rubric5%Cooperative evaluation rubric5%				

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LEARNING UNIT:

Parallel and Concurrent Programming.

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THEMA	THEMATIC UNIT: V NAME: Design patterns for parallel and concurrent programming					
UNIT OF COMPETENCE The student build parallel and concurrent computing systems based on design patterns.						
No.	CONTENTS	HOURS Teacher - led instruction		HOURS Autonomous Learning		REFERENCES KEY
		Т	Р	т	Р	
5.1	Introduction.	0.5	0.5	1.0	2.5	7B,2C
5.2	Design patterns and pattern language.	1.0		2.0		
5.3	Patterns for parallel and concurrent programming.	3.0		5.0		
5.3.1	Task descomposition pattern.					
5.3.2	Data descomposition pattern.					
5.3.3	Task group pattern.					
5.3.4	Task order pattern.					
5.3.5	Shared data pattern.					
5.3.6	Parallel task pattern.					
5.3.7	Divide and conquer pattern.					
5.3.8	Geometric descomposition pattern.					
5.3.9	Recursive data pattern.					
5.3.10	Pipeline pattern.					
5.4	Patterns for parallel and concurrent programming.	1.5		1.0		
	Subtotal:	6.0	0.5	9.0	2.5	
	TEACHING PRINCIPLES					
This cur	rent unit will be approached through the projects learnir	ng strate	egy as we	ell as the h	neuristic a	nd analogical
learning	learning methods, working on practical 10 elaboration in teams and the final re-design and implementation of the					
propose	proposed project, applying the knowledge and skills acquired in this current thematic unit and the previous ones.					
LEARNING EVALUATION						

Project Portfolio:	
Practical reports	10%
Project delivery	50%
Written and oral presentation of the final report	20%
Learning evidence	10%
Self-evaluation rubrics	5%
Cooperative evaluation rubric	5%

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RECORD OF PRACTICALS

No.	NAME OF THE PRACTICAL	THEMATIC UNITS	DURATION	ACOMPLISHMENT LOCATION				
1	Threads for Linux and Windows	I	3.0	ESCOM laboratories.				
2	Multi-nucleus systems	П	1.5					
3	Multi-nucleus applications programming	П	1.5					
4	Tie-breaking algorithm programming	Ш	3.0					
5	Ticket algorithm programming	Ш	3.0					
6	Bakery algorithm programming	Ш	3.0					
7	Parallel data algorithm programming	IV	3.0					
8	Threads Parallel programming	IV	3.0					
9	MPI Parallel programming	IV	3.0					
10	Design patterns application	V	3.0					
		TOTAL OF HOURS	27.0					
EVALUATION	NAND PASSING REQUIREMENTS:							
Practicals are 10% worth of the each thematic unit evaluation.								

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LEARNING UNIT:

Parallel and Concurrent Programming. **PAGE:** 9

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PERIOD	UNIT	EVALUATION TERMS			
1	I and II	Continuous evaluation 100%			
2	III and IV	Continuous evaluation 100%			
3	V	Continuous evaluation90%Learning evidence10%			
		The thematic unit I is 10% worth of the learning unit final score. The thematic unit II is 15% worth of the learning unit final score. The thematic unit III is 20% worth of the learning unit final score. The thematic unit IV is 20% worth of the learning unit final score. The thematic unit V is 35% worth of the learning unit final score. Other ways to pass this Learning Unit:			
		 Evaluation of knowledge previously acquired with base in the issues defined b the academy. In other Academic Unit of the IPN. In other national or international academic undergraduate or graduate institution. 			
		guidelines established by the academy on a previous meeting for this purpose.			

KEY	В	С	REFERENCES
1	Х		Clavin, L, Synder, L. (2008). <i>Principles of Parallel Programming</i> (1 ^a Ed.). Estados Unidos de América: Ed. Addison Wesley. ISBN: 978-0321487902.
2		Х	Gadi, T. (2006). <i>Synchronization Algorithms and Concurrent Programming</i> (1 ^a Ed.). Estados Unidos de América: Ed. Prentice Hall. ISBN: 978-0131972599.
3	Х		Gregory, R. A. (1991). <i>Concurrent Programming: Principles and Practice</i> (2 ^a Ed.). Estados Unidos de América: Ed. Addison Wesley. ISBN: 978-0805300864.
4	Х		Michle, J. Q. (2003). <i>Parallel Programming in C with MPI and OpenMP</i> (1 ^a Ed.). Estados Unidos de América: Ed. McGraw Hill. ISBN: 978-0071232654.
5		Х	Mordechai, B. (2006). <i>Principles of Concurrent and Distributed Programming</i> (2 ^a Ed.). Estados Unidos de América: Ed. Addison Wesley. ISBN: 978-0321312839.
6		х	Pacheco, P. (1996). <i>Parallel Programming with MPI</i> (1ª Ed.). Estados Unidos de América: Ed. Morgan Kaufmann. ISBN: 978-1558603394.
7	Х		Timothy, G. M. Beverly, A. S. Berna, L. M. (2004). <i>Patterns for Parallel Programming</i> (1 ^a Ed.). Estados Unidos de América: Ed. Addison Wesley. ISBN: 978-0321228116.

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TEACHER EDUCATIONAL PROFILE PER LEARNING UNIT

1. GENERAL INFORMATION

ACADEMIC UNIT	: _	Escuela Superior de Cómputo					
ACADEMIC PROGRAM:		Ingeniería en Sistema	LEVEL	111			
FORMATION AREA:		Institutional	Institutional Basic Scientific		Terminal and integration		
ACADEMY:	Sistema	as Distribuidos.	LEARNING UN	IIT: Parallel and C	oncurrent Pro	ogramming	
SPECIALTY AND	ACADE	MIC REQUIRED LEVEL	: Master degree	e in Computer Scie	nce.		

2. AIM OF THE LEARNING UNIT: The student develops parallel and concurrent systems based on design pattern techniques.

3. PROFESSOR EDUCATIONAL PROFILE:

	KNOWLEDGE	PR E	OFESSIONAL XPERIENCE		ABILITIES		ATTITUDES
• • • • •	Parallel and distributed systems. Concurrent systems. Operative systems. Computer networks and web applications. C++ and Java languages programming. UNIX and Windows systems programming. Oriented objects design and ULM. MPI and multi-nucleus architectures domain. MEI. English language.	•	One year experience in teaching professional level education. One year experience in the parallel and concurrent applications design and implementation.	•	Able to Analyze and synthesize. Able to apply knowledge into practice. Problem solving ability. Team work and groups management.	• • • • •	Responsable. Honest. Respectful. Tolerant. Assertive. Cooperative. Participative. Academic vocation. Social and Institutional commitment.

DESIGNED BY

REVISED BY

AUTHORIZED BY

M. en C. Jorge Cortés Galicia Profesor coordinador

Dr. Flavio Arturo Sánchez Garfias Subdirector Académico Ing. Apolinar Francisco Cruz Lázaro Director

Date: 2011