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: Computational Geometry **LEVEL:** III

AIM OF THE LEARNING UNIT:
The student designs optimization algorithms geometric in computational vision systems, graphics and computer animation systems, based on techniques of computational geometry.

CONTENTS:

I. Foundations of geometry and Voronoi Diagrams.
II. Polygons and convex hull.
III. Geometric Searching and Intersection.

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:

- Cormen, T.L. (2003). Introduction to algorithms (2nd. Ed.) Estados Unidos de América: MIT press. ISBN-13: 978-0072970548.
- de Berg, M. Cheong, O. van Kreveld, M. Overmars, M. (2008) Computational Geometry: Algorithms and Applications. (·a Ed.). USA: Springer. ISBN-10: 3540779736.
- Goodman, J.E. O'Rourke, J. (2004) Handbook of Discrete and Computational Geometry. (2a Ed.). London: Chapman & Hall/CRC. ISBN-10: 1584883014.
- O'Rourke, J. (2001). Computational Geometry in C. (3a Ed.). USA: Cambridge University Press. ISBN-10: 0521649765.
- Preparata, F.P. Shamos, M.I. (1988). Computational Geometry - An Introduction. (2a Ed.). USA: Springer-Verlag. ISBN-10 3-540-96131-3.

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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: Computational Geometry
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 profile of graduates in Computer Systems Engineering, to develop the skills to design efficient algorithms in computational geometry to solve conceptual problems, and evaluation. It also develops strategic thinking, creative thinking, collaborative and participatory and assertive communication.

Requires from learning units Analysis of Algorithms, the ability to program solutions in a high-level language, from Data Structures, the use of appropriate structures to manipulate data efficiently and from Computational Theory the use of tools theory to characterize computational processes.

AIM OF THE LEARNING UNIT:

The student designs optimization algorithms geometric in computational vision systems, graphics and computer animation systems, based on techniques of computational geometry.

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:** Foundations of geometry and Voronoi Diagrams.

UNIT OF COMPETENCE

The student solves basic problems in combinatorial geometry based on Voronoi 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 1.1.4 1.1.5	Historical perspective Notions of Complexity in Classical Geometry Convex Set Theory, Metric Geometry and Combinatorics Preliminaries Invariant Under Linear Transformation Group Geometric duality	4.0		4.0	3.0	1C, 2C, 3B, 4B, 5B, 6C
1.2 1.2.1 1.2.2 1.2.3 1.2.4	Voronoi geometry Triangulation: definition and properties Dealunay Triangulations Basic Algorithms Applications: Combinatorial Geometry, Geometric Duality, Triangulations	4.0	1.0	6.0	5.0	
	Subtotals:	8.0	1.0	10.0	8.0	

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:

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

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DIRECCIÓN DE EDUCACIÓN SUPERIOR

THEMATIC UNIT: II **TITLE:** Polygon and convex hull

UNIT OF COMPETENCE

The student solves geometric combinatorial optimization problems based on methods of convex hulls.

No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
2.1	Polygon Triangulation	2.0		2.5	2.0	1C, 2C, 3B, 4B, 5B, 6C
2.1.1	Polygon Partitioning					
2.1.2	Monotonous partition					
2.1.3	Trapezoidal partition					
2.1.4	Triangulation in Linear Time					
2.1.5	Convex Partition					
2.2	Geometry of Rectangles	2.0		2.5	2.0	
2.2.1	Applications of the Geometry of Rectangles					
2.2.2	Union and Intersection of Rectangles					
2.3	Convex hull algorithms in Plano	2.0	1.0	2.5	2.0	
2.3.1	Quick-Hull Technology					
2.3.2	Divide and Conquer Algorithms					
2.3.3	Dynamic convex hull algorithms					
2.3.4	Convex hull in more than Two Dimensions					
2.4	Extensions and Applications	2.0		2.5	2.0	
2.4.1	Approximation algorithms for convex hull					
2.4.2	The Problem of the Maximum of a Set of Points					
2.4.3	Applications to Statistics					
2.4.4	Robust Estimation					
2.4.5	Clustering					
	Subtotals:	8.0	1.0	10.0	8.0	

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/reports	10%
Cooperative Presentation	10%
Report of Practicals	10%
Advance of the Project	30%
Self-Evaluation Rubrics	2%
Rubric of Co-Evaluation	3%
Written Learning Evidence	25%

THEMATIC UNIT: III **TITLE:** Geometric Searching and Intersection

UNIT OF COMPETENCE

Develop algorithms for locating points in space based on geometric search techniques.

No.	CONTENTS	Teacher led-instruction HOURS		Autonomous Learning HOURS		REFERENCES KEY
		T	P	T	P	
3.1	Convex hull in three dimensions	3.0		4.0	3.0	1C, 2C, 3B, 4B, 5B, 6C
3.1.1	Polyhedra					
3.1.2	Shell algorithms					
3.1.3	Polyhedral representations Border					
3.1.4	Convex hull in higher dimensions					
3.2	Geometric Search. Introduction	3.0	1.0	4.0	2.5	
3.2.1	Problems of Point Location					
3.2.2	General considerations. Simple Cases					
3.2.3	Planar Location of a Point in a Planar Subdivision. Best Techniques					
3.2.4	A shortcut method and its variants					
3.2.5	Iterative Search					
3.3	Intersections	2.0		2.0	2.5	
3.3.1	Segment-Segment Intersection					
3.3.2	Segment-Triangle Intersection					
3.3.3	Intersection of Convex Polygons					
	Subtotals:	8.0	1.0	10.0	8.0	

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	20%
Cooperative Presentation	10%
Report of Practicals	20%
Self-Evaluation Rubrics	5%
Cooperative Evaluation Rubrics	5%
Project report	30%

RECORD OF PRACTICALS

No.	NAME OF THE PRACTICAL	THEMATIC UNITS	DURATION	ACCOMPLISHMENT LOCATION
1	Foundations of geometry and Voronoi Diagrams.	I	9.0	Computer Labs.
2	Polygons and convex hull.	II	9.0	
3	Geometric Searching and Intersection.	III	9.0	
		TOTAL OF HOURS	27.0	

EVALUATION AND PASSING REQUIREMENTS:

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

PERIOD	UNIT	EVALUATION TERMS
1 2 3	I II III	Continuous evaluation 70% and written learning evidence 30% Continuous evaluation 75% and written learning evidence 25% Continuous evaluation 100% The learning unit I and II is 30% worth of the final score The learning unit III is 30% worth of the final score The learning unit IV 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	Cormen, T.L. (2003). Introduction to algorithms (2nd. Ed.) Estados Unidos de América: MIT press. ISBN-13: 978-0072970548.
2		X	de Berg, M. Cheong, O. van Kreveld, M. Overmars, M. (2008) Computational Geometry: Algorithms and Applications. (·a Ed.). USA: Springer. ISBN-10: 3540779736.
3	X		Goodman, J.E. O'Rourke, J. (2004) Handbook of Discrete and Computational Geometry. (2a Ed.). London: Chapman & Hall/CRC. ISBN-10: 1584883014.
4	X		O'Rourke, J. (2001). Computational Geometry in C. (3a Ed.). USA: Cambridge University Press. ISBN-10: 0521649765.
5	X		Preparata, F.P. Shamos, M.I. (1988). Computational Geometry - An Introduction. (2a Ed.). USA: Springer-Verlag. ISBN-10 3-540-96131-3.
6		X	Skienna, S. (2008). The algorithm design manual (2a Ed.). Estados Unidos de América: Ed. Springer. ISBN-13: 978-1848000698.

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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: Ciencias de la Computación **LEARNING UNIT:** Computational Geometry

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

2. **AIM OF THE LEARNING UNIT**:
The student designs optimization algorithms geometric in computational vision systems, graphics and computer animation systems, based on techniques of computational geometry.

3. PROFFESSOR EDUCATIONAL PROFILE:

KNOWLEDGE	PROFESSIONAL EXPERIENCE	ABILITIES	APTITUDES
• Methods of analysis of algorithms. • Algorithm design techniques. • Computational geometry • 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. • Conflict resolution • Group management	• Responsible. • Tolerant. • Honest. • Respectful. • Collaborative. • Participative. • 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