

Course guide

270532 - DSI GE - Software Development for Geographic and Spatial Information

Last modified: 02/02/2024

Unit in charge: Barcelona School of Informatics
Teaching unit: 749 - MAT - Department of Mathematics.
Degree: MASTER'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2012). (Optional subject).
Academic year: 2023 **ECTS Credits:** 3.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: RODRIGO IGNACIO SILVEIRA ISOBA
Others: Segon quadrimestre:
RODRIGO IGNACIO SILVEIRA ISOBA - 10

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CTE11. Capability to conceptualize, design, develop and evaluate human-computer interaction of products, systems, applications and informatic services.
CTE12. Capability to create and exploit virtual environments, and to the create, manageme and distribute of multimedia content.
CTE7. Capability to understand and to apply advanced knowledge of high performance computing and numerical or computational methods to engineering problems.

Generical:

CG4. Capacity for mathematical modeling, calculation and simulation in technology and engineering companies centers, particularly in research, development and innovation tasks in all areas related to Informatics Engineering.
CG6. Capacity for general management, technical management and research projects management, development and innovation in companies and technology centers in the area of Computer Science.
CG8. Capability to apply the acquired knowledge and to solve problems in new or unfamiliar environments inside broad and multidisciplinary contexts, being able to integrate this knowledge.

Transversal:

CTR4. INFORMATION LITERACY: Capability to manage the acquisition, structuring, analysis and visualization of data and information in the area of informatics engineering, and critically assess the results of this effort.
CTR6. REASONING: Capacity for critical, logical and mathematical reasoning. Capability to solve problems in their area of study. Capacity for abstraction: the capability to create and use models that reflect real situations. Capability to design and implement simple experiments, and analyze and interpret their results. Capacity for analysis, synthesis and evaluation.

Basic:

CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.
CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

TEACHING METHODOLOGY

The course will consist of presentations of the main theoretical topics, followed by a discussion of the more practical aspects associated with them, and the presentation of practical tools to address them.

LEARNING OBJECTIVES OF THE SUBJECT

1. Learn what geographic information systems (GIS) are.
2. Analyze concrete problems that a GIS must be able to solve.
3. Study some of the algorithms behind GIS.
4. Learn different ways to represent and process geographic and spatial data.

STUDY LOAD

Type	Hours	Percentage
Hours large group	27,0	36.00
Self study	48,0	64.00

Total learning time: 75 h

CONTENTS

Introduction to geographic information systems, spatial information, and geometric algorithms.

Description:

Principios básicos de la información espacial y los sistemas de información geográfica. Ejemplos de aplicaciones de GIS. Introducción a los algoritmos geométricos. Relación entre la implementación de un GIS y los algoritmos geométricos.

Map representation, combination and overlay of geographic subdivisions.

Description:

Introducción a la combinación de mapas. Unificación de sistemas de coordenadas. Estructuras de datos para representar mapas y subdivisiones geográficas. Algoritmos para calcular superposiciones de subdivisiones. Algoritmos y estructuras de datos para localizar puntos en subdivisiones geográficas.

Digital terrain models, vector and raster terrains

Description:

Modelos para representar terrenos. Modelos raster y TIN (triangulated irregular network). Algoritmos básicos para rasters y TINs. Recorrido y localización en TINs. Conversión entre modelos diferentes de terrenos.

Algorithms for terrain analysis: visibility and hydrology problems

Description:

Aplicaciones de análisis de terrenos en visibilidad e hidrografía. Cálculo de viewsheds y watersheds en rasters y TINs. Eliminación de mínimos locales y otros artifacts.

Voronoi diagrams applied to facility location and pattern analysis problems

Description:

Definición del diagrama de Voronoi. Aplicaciones a GIS. Algoritmos para construir el diagrama de Voronoi. Análisis espacial: basado en posiciones y basado en distancia. Detección de clusters. Interpolación espacial.

Basic algorithms for digital cartography: map generalization and labeling

Description:

Introducción a los mapas y la cartografía. Principios del diseño de mapas. Simbolización y generalización cartográfica. Simplificación de líneas, algoritmo de Douglas-Peucker. Etiquetado de mapas.

Extra topics to be chosen by the students.

Description:

Los temas específicos serán definidos por los estudiantes y los docentes durante la primer mitad del curso.

ACTIVITIES

Introduction

Specific objectives:

1

Related competencies :

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Full-or-part-time: 4h

Theory classes: 2h

Self study: 2h

Map representation, combination and overlay of geographic subdivisions

Specific objectives:

2, 3, 4

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Full-or-part-time: 8h

Theory classes: 4h

Self study: 4h

Digital terrain models

Specific objectives:

2, 3, 4

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Full-or-part-time: 7h

Theory classes: 5h

Self study: 2h

Voronoi diagrams

Specific objectives:

2, 3, 4

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Full-or-part-time: 6h

Theory classes: 4h

Self study: 2h

Algorithms for terrain analysis

Specific objectives:

2, 3

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Full-or-part-time: 6h

Theory classes: 4h

Self study: 2h

Basic algorithms for digital cartography

Specific objectives:

2, 3

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Full-or-part-time: 5h 30m

Theory classes: 4h

Self study: 1h 30m

Extra topics to be defined during the course

Specific objectives:

2, 3

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Full-or-part-time: 4h

Theory classes: 4h

GRADING SYSTEM

Evaluation will be based on a final project that will consist of theory and bibliography research tasks about a concrete GIS problem, and in class participation.



BIBLIOGRAPHY

Basic:

- Longley, P.A. [et al.]. Geographic information systems & science. 4th ed. Hoboken, NJ: Wiley, 2015. ISBN 9781118676950.
- Kreveld, M. van [et al.]. Algorithmic foundations of geographic information systems. Berlin: Springer, 1997. ISBN 3540638180.
- Xiao, N. GIS algorithms. Thousand Oaks, CA: SAGE Publications, 2015. ISBN 9781446274330.

Complementary:

- O'Sullivan, D.; Unwin, D.J. Geographic information analysis. 2nd ed. Hoboken: John Wiley & Sons, 2010. ISBN 978-0470288573.
- DeMers, M.N. Fundamentals of geographic information systems. 4th ed. Hoboken: Wiley, 2009. ISBN 978-0470129067.
- Kimerling, A.J.; Buckley, A.R.; Muehrcke, P.C.; Muehrcke, J.O. Map use: reading, analysis, interpretation. 8th ed. Redlands, California: ESRI Press Academic, 2016. ISBN 978-1589484429.