

## GUÍA DOCENTE ABREVIADA DE LA ASIGNATURA

1454 - Computing in Civil Engineering

Máster Universitario en Ingeniería de Caminos, Canales y Puertos

Curso Académico 2024-2025

1. DATOS IDENTIFICATIVOS					
Título/s	Máster Universitario en Ingeniería de Caminos, Canales y Puertos			Tipología v Curso	Obligatoria. Curso 1
Centro	Escuela Técnica Superior de Ingenieros de Caminos, Canales y Puertos				
Módulo / materia	AMPLIACIÓN DE COMPUTACIÓN EN INGENIERÍA CIVIL AMPLIACIÓN DE FORMACIÓN CIENTÍFICA				
Código y denominación	1454 - Computing in Civil Engineering				
Créditos ECTS	9	Cuatrimestre	Cuatrimestral (2)		
Web					
Idioma de impartición	Inglés	English friendly	No	Forma de impartición	Presencial

Departamento	DPTO. MATEMATICA APLICADA Y CIENCIAS DE LA COMPUTACION				
Profesor responsable	JAVIER GONZALEZ VILLA				
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Número despacho	E.T.S. de Ingenieros de Caminos, Canales y Puertos. Planta: + 1. DESPACHO PROFESORES (1026)				
Otros profesores	CESAR ANTONIO OTERO GONZALEZ FERNANDO JAVIER MENDEZ INCERA BORJA ARROYO MARTINEZ LAURA CAGIGAL GIL				

### 3.1 RESULTADOS DE APRENDIZAJE

- Solve problems in the field of civil engineering using programming techniques and data structures.
- Handle regression, classification and clustering methods on data sets of application in the different fields related to civil engineering using machine learning techniques.
- Handle tools for tackling big data problems and modelling with supervised and unsupervised learning techniques.
- Statistically modelling extreme events, choosing the most appropriate model in each situation.
- Spatially modelling geographic datasets.
- Identify the random variables that influence engineering projects and how they are dealt with.
- Conduct reliability studies of engineering projects and design and implement and solve engineering problems as optimisation problems.
- Skills to develop and integrate software for automation or modelling of tasks in the field of civil engineering.
- Describe the basic and fundamental elements of object-oriented programming.
- Handling relational databases and their application to engineering processes.
- Addressing visual programming processes, and in particular in BIM environments.

### 4. OBJETIVOS

- To learn the basics of Python programming and the use of the most common libraries.
- Knowing the techniques and tools for designing, developing and using computer programmes to solve problems in the field of civil engineering.
- To know the machine learning techniques and tools needed to create predictive regression , classification and clustering models.
- To know the techniques and tools for the processing and analysis of large volumes of data.
- Acquire the ability to work through Visual Programming with advanced analytical and numerical models of project , planning and management of Civil Works.
- Acquire the ability to interpret the results obtained by means of Visual Programming.

6. ORGANIZACIÓN DOCENTE	
CONTENIDOS	
1	<p>Block I: Programming with Python.</p> <ol style="list-style-type: none"> <li>1. Anaconda and JupyterLab environment.</li> <li>2. Python fundamentals.</li> <li>3. Object-oriented programming.</li> <li>4. Basic libraries and databases.</li> </ol>
2	<p>Block II: Computational Statistics.</p> <ol style="list-style-type: none"> <li>1. Time series.</li> <li>2. Theory of extremes.</li> <li>3. Multivariate data analysis.</li> <li>4. Geostatistics.</li> <li>5. Spatial data infrastructure.</li> <li>6. Data dimensional reduction techniques.</li> <li>7. Remote sensing and image analysis.</li> <li>8. Interpolation / Krigging.</li> </ol>
3	<p>Block III: Optimisation.</p> <ol style="list-style-type: none"> <li>1. Linear optimisation.</li> <li>2. Non-linear optimisation.</li> <li>3. Dynamic optimisation.</li> <li>4. Genetic algorithms.</li> <li>5. Heuristic evolutionary algorithms .</li> <li>6. Multi-objective optimisation.</li> <li>7. Mathematical modelling with optimisation.</li> </ol>
4	<p>Block IV: Machine learning.</p> <ol style="list-style-type: none"> <li>1. Data preparation.</li> <li>2. Selection and classification techniques.</li> <li>3. Dimensional reduction techniques.</li> <li>4. Decision trees.</li> <li>5. Artificial neural networks.</li> </ol>
5	<p>Block V: Visual programming in BIM models.</p> <ol style="list-style-type: none"> <li>1. Dynamo environment.</li> <li>2. Computational design.</li> <li>3. Dynamo for Revit and Civil 3D.</li> <li>4. BIM data flow in civil engineering projects: interchangers.</li> <li>5. Python scripts in Dynamo.</li> </ol>

7. MÉTODOS DE LA EVALUACIÓN				
Descripción	Tipología	Eval. Final	Recuper.	%
Evaluation: Programming with Python, Computational Statistics and Optimisation.	Otros	No	Sí	50,00
Evaluation: Machine Learning and Visual Programming in BIM models.	Otros	No	Sí	50,00
<b>TOTAL</b>				<b>100,00</b>
<b>Observaciones</b>				
Those students who do not pass the evaluation criteria may, during the extraordinary exam period, carry out additional work to increase their grades, allowing them to pass the subject. The final mark of the subject in the extraordinary exam period, for those students who present themselves for the extraordinary exam, will be calculated according to the same criteria of the ordinary evaluation referred to in this teaching guide.				
<b>Criterios de evaluación para estudiantes a tiempo parcial</b>				
For part-time students, practical laboratory tests may be replaced by practical assignments.				

8. BIBLIOGRAFÍA Y MATERIALES DIDÁCTICOS
<b>BÁSICA</b>
Hunt, J. (2019). A Beginners Guide to Python 3 Programming. Springer.
Hunt, J. (2019). Advanced Guide to Python 3 Programming. Springer.
Géron, A. (2019). Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: Concepts, tools, and techniques to build intelligent systems. O'Reilly Media.
AutoDesk (2019). The Dynamo Primer. <a href="https://primer.dynamobim.org">https://primer.dynamobim.org</a>

Esta es la Guía Docente abreviada de la asignatura. Tienes también publicada en la Web la información más detallada de la asignatura en la Guía Docente Completa.