

Course Title	Knowledge Representation, Reasoning and the Semantic Web				
Course Code	AI610				
Course Type	Compulsory				
Level	Master (2 <sup>nd</sup> cycle)				
Year / Semester	1 <sup>st</sup> Year / 1 <sup>st</sup> Semester				
Teacher's Name	TBA				
ECTS	8	Lectures / week	Up to 6 Teleconferences	Laboratories / week	None
Course Purpose and Objectives	<p>Knowledge representation and reasoning (KR) is the field of artificial intelligence dedicated to representing information about the world in a form that computer systems can manipulate and utilize to solve complex tasks such as making decisions, diagnosing a medical condition, finding suitable answers to queries or having a dialog in a natural language. Specific KR languages have been developed to express representations. Once information representations are established, reasoning algorithms can be applied to draw conclusions from the available information in a traceable, explainable way. Each KR language is supported by such reasoning algorithms. KR is at the heart of the area of the semantic web, and has found deployment in big corporations such as Google and Amazon in the form of knowledge graphs. This module will enable learners to familiarize themselves with basic principles and algorithms of knowledge representation and reasoning, and gain experience in using them to solve practical problems.</p>				
Learning Outcomes	<p>Upon successful completion of this course students should be able to:</p> <ul style="list-style-type: none"> <li>● Define the main ingredients of propositional logic and use it to represent knowledge</li> <li>● Explain and apply the main semantic concepts of propositional logic</li> <li>● Identify and apply satisfiability (SAT) solvers</li> <li>● Record the main ingredients of predicate logic and use it to represent knowledge</li> <li>● Describe and apply the main semantic concepts of predicate logic</li> <li>● Discuss the main ways of reasoning and logic programming</li> <li>● Explain the driving ideas of semantic web, linked data and knowledge graphs</li> <li>● Use RDF to represent knowledge on the Web</li> <li>● Use SPARQL to query knowledge on the Web in RDF</li> <li>● Have insights into the use of knowledge graphs in industry and key application scenarios.</li> </ul>				

Prerequisites	None	Co-requisites	None
Course Content	<p><u>Propositional logic syntax</u>: the language of propositional logic, well-defined syntax, proving properties through structural induction.</p> <p><u>Propositional logic semantics</u>: truth tables, satisfiability, entailment</p> <p><u>Propositional logic inference</u>: derivability, inference procedures.</p> <p><u>Satisfiability solving</u>: working with SAT solvers to solve problems.</p> <p><u>Predicate logic syntax</u>: the language of propositional logic, well-defined syntax, proving properties through structural induction.</p> <p><u>Predicate logic semantics</u>: models, satisfiability, entailment.</p> <p><u>Predicate logic reasoning 1</u>: inference rules, generalized modus ponense, backward and forward reasoning.</p> <p><u>Predicate logic reasoning 2</u>: resolution, logic programming and Prolog.</p> <p><u>Semantic web</u>: semantic integration, ontologies, basic layers, LOD principles, overview of uses of knowledge graphs.</p> <p><u>RDF</u>: semantic annotation, design principles, XML and N3 syntax, triple data stores.</p> <p><u>RDF Schema</u>: classes and inheritance, language overview, semantics, using Protégé.</p> <p><u>Querying</u>: the query language SPARQL, SPARQL on Protégé.</p> <p><u>Modern knowledge graphs</u>: knowledge graphs in Google, Amazon, EBay; applications of LOD and ontologies in key domains such as biomedicine and smart cities.</p> <p>All lectures will consist of a theoretical part presenting concepts and techniques and a practical part where the AI techniques will be applied for problem solving.</p>		
Teaching Methodology	E-Learning		
Bibliography	<p>“Logical Foundations of Artificial Intelligence”, Morgan Kaufmann, by Michael Genesereth and Nils Nilsson, Latest Edition</p> <p>“Handbook of Knowledge Representation”, Elsevier, by Frank van Harmelen, Vladimir Lifschitz and Bruce Porter, Latest Edition</p> <p>“A Semantic Web Primer”, MIT Press, by Grigoris Antoniou, Paul Groth, Frank van Harmelen and Rinke Hookstra, Latest Edition</p>		

Assessment	<table border="1"> <tr> <td data-bbox="454 232 1013 293">Final Examination</td> <td data-bbox="1013 232 1244 293">50%</td> </tr> <tr> <td data-bbox="454 293 1013 353">Assignments/On-going evaluation</td> <td data-bbox="1013 293 1244 353">50%</td> </tr> <tr> <td></td> <td data-bbox="1013 353 1244 414">100%</td> </tr> </table>	Final Examination	50%	Assignments/On-going evaluation	50%		100%
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Language	English						