INSTITUTION	NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS					
SCHOOL	SCHOOL OF SCIENCE					
DEPARTMENT	INFORMATICS AND TELECOMMUNICATIONS					
COURSE LEVEL	GRADUATE					
COURSE TITLE	**Language and Cognitive Robotics**					
COURSE CODE	**C20**		**Semester**	**3**	**ECTS**	**6**
TEACHING HOURS per week	**THEORY**	**1**	**SEMINAR**	**1**	**LABORATORY**	**1**
URL	https://eclass.uoa.gr/courses/DI533					

COURSE CONTENT

The course focuses on artificial cognitive systems and in particular on robots, with a special emphasis on the role of natural language within such systems. It is an interdisciplinary course which brings together theories, findings and methodologies from Cognitive Science, Neuroscience, Theoretical and Computational Linguistics and Multimedia Systems.

In using multimodal and multisensory communication examples, the idiosyncratic characteristics and the semantic interaction of natural language with perception and action is presented. This interaction takes place - among others- through "syntax", a fundamental cognitive mechanism. Syntax is shown to be core not only in verbal but also in sensorimotor behaviour; its relation to long term memory is specifically presented and a semantic memory model for cognitive agents is explained in detail. The latter involves getting familiar with multimodal, referential, and recursive semantic networks. Within this framework, natural language processing is revisited, rendering *reference* a core requirement in language analysis, that forms a bridge with the sensorimotor aspects of a cognitive system. The course is enriched with examples from two robotic applications: (a) verbal human-robot interaction in everyday life, and (b) visual scene understanding and verbalization.

Indicative Topics:

- Introduction to Artificial Cognitive Systems and Cognitive Robotics
- Cognitive Architectures and the role of Language
- Language, Perception and Action (1): characteristics and relations
- Language, Perception and Action (2): semantic interaction in multisensory and multimodal communication
- Syntax as a Fundamental Cognitive Mechanism: from language grammar to the grammar of action
- Recursion as a Cognitive Phenomenon
- Embodied Language Processing
- Computational Semantic Memory and the Role of Language
- Robotic Applications: (a) Verbal Human-Robot Interaction: from language to action, and (b) Visual Scene Understanding: from image to language

STUDENT LEARNING OBJECTIVES AND EXPECTED LEARNING OUTCOMES

The course aims at providing students with basic knowledge on cognitive systems (cognitive robots in particular) and expose them to questions related to the role of language within such systems. In particular, the main learning objectives of the course comprise:

- Explaining what cognitive robots/systems are, the main challenges in developing such systems and the role language can play in such systems;

- Describing the semantic characteristics and interrelations among language, perception and action and semantically analysing multisensory and multimodal communication;
- Interpreting 'syntax' as a supra-modal, cognitive mechanism and applying a common syntactic framework for the analysis of both sensorymotor experiences and language;
- Experiment with computational semantic memories in the form of multimodal, referential and recursive semantic networks.

Upon successful completion of the course the students will be able to:

1. Engage in discussion on the basic challenges in cognitive systems and be advocates of the role of language in such systems
2. Semantically analyse multimodal/multisensory communication/material
3. Use a common syntactic framework for the analysis of language and sensorimotor experience
4. Use and enrich computational semantic memories

TEACHING AND LEARNING METHODS - ASSESSMENT	
TEACHING METHOD	Remotely (Online)
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES	Learning process supported by the e-class platform (e.g. Announcements, Task assignments, Student groups) Email communication Live transmission of lectures Ability to track recorded lectures
TEACHING ORGANIZATION *Describe in detail the way and methods of teaching:* *Enhanced Lectures,* *Online Lectures,* *Seminars,* *Tutorial,* *Laboratory,* *Laboratory Exercise,* *Study & analysis of literature,* *Practice (Positioning),* *Interactive teaching,* *Developing a project,* *Individual / group work* *Telework (reference to tools) etc.* *Details of the student's study hours for each learning activity and hours of non-guided study are shown to ensure that the total workload at the semester corresponds to the ECTS*	**Activity** / ***Student Workload*** *(hours)* Online Lectures: 13 Seminars: 13 Laboratory: 13 Team Project: 40 Individual Project: 31 Independent Study: 40 ***Total Course (25 hours of workload per unit of credit)***: ***150***
ASSESSMENT OF STUDENTS *Description of the assessment process* *Assessment Methods, Formative or Concluding, Multiple Choice Test, Quick Response Questions, Test Development Questions, Problem Solving, Written Work, Report / Report, Oral Examination, Public Presentation, Laboratory Work, Other / Other* *Fully defined evaluation criteria are mentioned and if and where they are accessible to students.*	• **Course Participation**: Students will be assessed for their active participation in class, comprising engagement in class discussion, and contribution to group activities during the 'seminar' part of the course. • **Individual Project**: Each student will choose a multimodal document/file for semantic annotation using an annotation tool and corresponding qualitative and quantitative analysis of findings. The work will be assessed through an oral presentation and a written report (approx. 2000 words). • **Team Project**: Building on a "verbal human-robot interaction" scenario, student teams will proceed to

using a robotic semantic memory for endowing the robot with the prior knowledge needed in interaction. The work will be assessed through an oral presentation and a written report (approx. 4000 words).

Assessment methods	*Number*	*Percentage*
Class participation	1	10%
Individual Project	2	40%
Team Project	3	50%

LITERATURE AND STUDY MATERIALS / READING LIST

- Cangelosi, A., & Schlesinger, M. (2015). *Developmental robotics: From babies to robots*. MIT press.
- Vernon, D. (2014). *Artificial Cognitive Systems: A Primer*. The MIT Press.
- Pastra, K., & Aloimonos, Y. (2012). *The minimalist grammar of action*. Philosophical Transactions of the Royal Society B: Biological Sciences, *367*(1585), 103-117.
- Pastra, K., Balta, E., Dimitrakis, P., & Karakatsiotis, G. (2011). *Embodied language processing: a new generation of language technology*. In *Workshops at the Twenty-Fifth AAAI Conference on Artificial Intelligence*.
- Pastra, K. (2008). *Cosmoroe: A cross-media relations framework for modelling multimedia dialectics*. Multimedia Systems, *14*(5), 299-323.
- Vatakis, A., and Pastra, K. (2016). *A multimodal dataset of spontaneous speech and movement production on object affordances*. Nature - *Scientific Data*, *3*(150078).