

SYLLABUS

1. Information regarding the programme

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| 1.1 Higher education institution | Babeş-Bolyai University |
| 1.2 Faculty | Faculty of Mathematics and Computer Science |
| 1.3 Department | Department of Computer Science |
| 1.4 Field of study | Computer Science |
| 1.5 Study cycle | Master |
| 1.6 Study programme / Qualification | Computer Science/ Applied Computational Intelligence |

2. Information regarding the discipline

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| 2.1 Name of the discipline | Knowledge Based Systems and Language Technology | | | | | | |
| 2.2 Course coordinator | Lecturer Ph.D. Lupea Mihaiela | | | | | | |
| 2.3 Seminar coordinator | Lecturer Ph.D. Lupea Mihaiela | | | | | | |
| 2.4. Year of study | 1 | 2.5 Semester | 2 | 2.6. Type of evaluation | exam | 2.7 Type of discipline | compulsory |

3. Total estimated time (hours/semester of didactic activities)

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| 3.1 Hours per week | 4 | Of which: 3.2 course | 2 | 3.3 seminar/laboratory | 1 sem +1pr |
| 3.4 Total hours in the curriculum | 56 | Of which: 3.5 course | 28 | 3.6 seminar/laboratory | 28 |
| Time allotment: | | | | | hours |
| Learning using manual, course support, bibliography, course notes | | | | | 30 |
| Additional documentation (in libraries, on electronic platforms, field documentation) | | | | | 20 |
| Preparation for seminars/labs, homework, papers, portfolios and essays | | | | | 30 |
| Tutorship | | | | | 10 |
| Evaluations | | | | | 20 |
| Other activities: individual project | | | | | 34 |
| 3.7 Total individual study hours | 144 | | | | |
| 3.8 Total hours per semester | 200 | | | | |
| 3.9 Number of ECTS credits | 8 | | | | |

4. Prerequisites (if necessary)

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| 4.1. curriculum | Formal languages, Data structures, Machine learning |
| 4.2. competencies | Programming skills in a high level programming language |

5. Conditions (if necessary)

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| 5.1. for the course | |
| 5.2. for the seminar /lab activities | <ul style="list-style-type: none"> Laboratory with computers; high level programming language environment (.NET or any Java environment a.s.o.) |

6. Specific competencies acquired

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| Professional competencies | <ul style="list-style-type: none"> • Assimilation of mathematical concepts and formal models to understand, verify and validate software systems ; • Advanced ability to approach, model and solve phenomena and problems from natural language and economy using fundamental knowledge from mathematics and computer science; • Ability to approach and solve complex problems using various techniques of computational intelligence; • Proficient use of methodologies and tools specific to programming languages and software systems. |
| Transversal competencies | <ul style="list-style-type: none"> • Etic and fair behavior, commitment to professional deontology • Team work capabilities; able to fulfill different roles • Professional communication skills; concise and precise description, both oral and written, of professional results , negotiation abilities; • Antepreneurial skills; working with economical knowledge; continuous learning • Good English communication skills |

7. Objectives of the discipline (outcome of the acquired competencies)

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| 7.1 General objective of the discipline | <ul style="list-style-type: none"> • To introduce the basic principles, technologies and applications of Language Technology (LT) and Knowledge based systems. • To understand the current state of the art in LT in order to realize original research in LT. |
| 7.2 Specific objective of the discipline | <ul style="list-style-type: none"> • Apply and use formal models (logics, grammars, parsing), statistic models (HMM), artificial intelligence algorithms (clustering, machine learning) and techniques (unsupervised, supervised) to solve different tasks at the syntactic level (POS-tagging, parsing, chunking), and semantic level (word sense disambiguation, information extraction, anaphora resolution) in Natural Language Processing domain. |

8. Content

| 8.1 Course | Teaching methods | Remarks |
|--|--|---------|
| Course 1. Natural Language Processing (NLP): stages, domains, applications. | Exposure: description, explanation, examples, debate, dialogue | |
| Course 2. - WordNet: knowledge structure, semantic relations, lexical relations, applications, interfaces; corpora. - Part-of-speech tagging. | Exposure: description, explanation, examples, debate, dialogue | |
| Course 3. Syntactic parsing - grammar rules for English - sentence level construction; - Cocke-Kasami-Yonger (CKY) algorithm; | Exposure: description, explanation, examples, debate, dialogue | |

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| Course 4. Statistical parsing - Probabilistic Context-Free Grammars (PCFG); - Probabilistic CKY algorithm | Exposure: description, explanation, examples, debate, dialogue | |
| Course 5. Hidden Markov Model (1) - Markov chains, Hidden Markov Model(HMM); - three canonical problems associated with HMM - the forward algorithm; the Viterbi algorithm | Exposure: description, explanation, examples, debate, dialogue | |
| Course 6. Hidden Markov Model (2) - the Baum-Welch algorithm for HMM; - applications to part-of-speech tagging. | Exposure: description, explanation, examples, debate, dialogue | |
| Course 7. Word Sense Disambiguation (1) - unsupervised (by clustering); - dictionary based approach (Lesk, Yarowsky). | Exposure: description, explanation, examples, debate, dialogue | |
| Course 8. Word Sense Disambiguation (2) - machine learning approach; - the bootstrapping algorithm | Exposure: description, explanation, examples, debate, dialogue | |
| Course 9. Document summarization - aproaches based on clustering, graphs and Formal Concept Analysis | Exposure: description, explanation, examples, debate, dialogue | |
| Course 10. Anaphora and co-reference resolution - hard constraints and preferences - Hobb's algorithm, Lapin and Lease algorithm - Mitkov's algorithm | Exposure: description, explanation, examples, debate, dialogue | |
| Course 11. Opinion mining/Sentiment analysis | Exposure: description, explanation, examples, debate, dialogue | |
| Course 12. Textual entailment | Exposure: description, explanation, examples, debate, dialogue | |
| Course 13. Information extraction | Exposure: description, explanation, examples, debate, dialogue | |
| Course 14. Students' presentations of the practical project. | Debate, dialog | |

Bibliography

1. J.ALLEN : Natural language understanding, Benjamin/Cummings Publisher, 2nd ed., 1995.
2. E. CHARNIAK: Statistical language learning, MIT press, 1996.
3. B.CARPENTER: ALE: The attribute logic engine. User's guide. Carnegie Mellon University,1994.
4. D.FEHRER et al: Description logics for natural language processing. In Proc. of the 1994 Description Logic Workshop (DL'94), 1994.
5. H. HELBIG: Knowledge Representation and the Semantics of Natural Language, Springer, 2006.
6. D.JURAFSKY, J.MARTIN: Speech and language processing, Prentice Hall, 2000.
7. C.MANNING, H.SCHUTZE: Foundation of statistical natural language processing, MIT, 1999.
8. R. MITKOV(ed): The Oxford Handbook of Computational Linguistics, Oxford University Press, 2003.
9. D.TATAR: Inteligenta artificiala: demonstrare automata de teoreme, prelucrarea limbajului natural, Editura Albastra, Microinformatica, 2001.
10. D. TATAR: Inteligenta artificiala. Aplicatii in prelucrarea limbajului natural, Editura Albastra, Microinformatica, 2003, ISBN 973-650-100-01.

| 8.2 Seminar / laboratory | Teaching methods | Remarks |
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| 1. Working with WordNet, Romanian WordNet and WordnetSimilarity tool. | Explanation, dialogue, case studies | The seminar/lab is structured as 2 hours classes every second week |
| 2. Working with dedicated parsers and taggers (Stanford, CST tools, Racai tools) | Explanation, dialogue, case studies | |
| 3. Students' presentations of the theoretical papers | Dialogue, debate | |
| 4. Students' presentations of the theoretical papers | Dialogue, debate | |
| 5. Working with dedicated tools for information summarization, anaphora and co-reference resolution | Explanation, dialogue, case studies | |
| 6. Working with dedicated tools for information extraction, sentiment analysis. | Explanation, dialogue, case studies | |
| 7. Students' presentations of the practical projects. | Dialogue, debate | |
| Bibliography | | |
| 1. Rada Mihalcea: www.cs.unt.edu/~rada/downloads.html | | |
| 2. Resurse lingvistice in limba romana: www.racai.ro | | |

9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

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| <ul style="list-style-type: none"> • The course respects the IEEE and ACM Curricula Recommendations for Computer Science studies; • The course exists in the studying program of all major universities in Romania and abroad; • The optimization of the search on Web, the interfaces in natural language and the recent aspects of text mining need a good understanding of Natural Language Processing. |
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10. Evaluation

| Type of activity | 10.1 Evaluation criteria | 10.2 Evaluation methods | 10.3 Share in the grade (%) |
|--|---|---|-----------------------------|
| 10.4 Course | - know the theoretical concepts of the domain; - apply the course methods, algorithms in problem solving | Written exam | 30% |
| 10.5 Seminar/lab activities | - know to synthesize and compare different approaches/results of the same studied subject. | Theoretical paper based on recent research papers in NLP domain; | 30% |
| | - be able to implement course algorithms | Practical project - implementation of a NLP tool based on the studied methods | 30% |
| | Class attendance | | 10% |
| 10.6 Minimum performance standards | | | |
| ➤ The final grade to be at least 5 (from a scale of 1 to 10) . | | | |

Date

23.04.2021

Signature of course coordinator

Lect. Ph.D. Lupea Mihaiela

Signature of seminar coordinator

Lect. Ph.D. Lupea Mihaiela

Date of approval

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Signature of the head of department

Prof. Ph.D. Dioşan Laura