SYLLABUS / FIȘA DISCIPLINEI

1. Information on the study programme / Date despre programul de studii

1.1. Institution / Instituția de învățământ superior	Universitatea de Vest din Timișoara
1.2. Faculty / Facultatea	Matematică și Informatică
1.3. Department / Departamentul	Computer Science (Informatică)
1.4. Study program field	Computer Science (Informatică)
1.5. Study cycle/ Ciclul de studii	Bachelor / licență
1.6. Study programme / Programul de studii / calificarea*	Computer Science / Informatică în limba engleză / Database administration / *Administrator baze de date - 252101; Computer network administration / Administrator de retea de calculatoare - 252301; Analyst / Analist - 251201; Research assistant in computer science / Asistent de cercetare în informatica - 214918; Teacher in secondary schools / Profesor în învatamântul gimnazial - 233002; Programmer / Programator - 251202; Software systems designers / Proiectant sisteme informatice - 251101*

2. Information on the course / Date despre disciplină

2.1. Title of the course / Denumirea disciplinei	Formal Languages and Automata Theory						
2.2. Teacher in charge of the course / Titularul activităților de curs	Madalina Erascu						
2.3. Teacher in charge of the seminar / Titularul activităților de seminar	Madalina Erascu						
2.4. Study year / Anul de studii	1	2.5. Semester / Semestrul	2	2.6. Examination type / Tipul de evaluare: E(xam)/C(olloquim)	E	2.7. Course type / Regimul disciplinei: M(andatory)/ E(lective)/ F(acultative)	M

3. Estimated study time (number of hours per semester) /Timpul total estimat (ore pe semestru al activităților didactice)

3.1. Attendance hours per week / Număr de ore pe săptămână	4	out of which / din care: 3.2 lecture/ curs	2	3.3. seminar/laborator	2
3.4. Attendance hours per semester / Total ore din planul de învățământ	56	out of which: 3.5 lecture / curs	28	3.6. seminar/laborator	28

Distribution of the allocated amount of time / Distribuția fondului de timp*	**hours/ ore**
Individual study /Studiu după manual, suport de curs, bibliografie și notițe	14
Supplementary documentation at library or using electronic repositories / Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate	23
Preparing for laboratories, homework, reports etc. /Pregătire seminarii/laboratoare, teme, referate,	28

portofolii și eseuri	
Exams / Examinări	2
Tutoring / Tutorat	2
3.7. Total number of hours of individual study / Total ore studiu individual	69
3.8. Total number of hours per semester / Total ore pe semestru	125
3.9. Number of credits (ECTS) / Număr de credite	5

4. Prerequisites (if it is the case) / Precondiții (acolo unde e cazul)

4.1. curriculum / de curriculum	Not the case
4.2. skills / de competențe	Basic mathematical knowledge, problem solving and programming skills

5. Requirements (if it is the case) / Condiții (acolo unde e cazul)

5.1. for the lecture / de desfășurare a cursului	Weekly amphitheater (with blackboard and video projector) according to the timetable.
5.2. for the seminar, laboratory / de desfășurare a seminarului/laboratorului	Weekly seminar room (with blackboard and video projector) according to the timetable.

6. Acquired skills / Competențe specifice acumulate

Professional skills / Competențe profesionale	● Identify different formal languages classes and the relationship among them. ● Design grammars and recognizers for different formal languages. ● *Optional*: Implementation of different algorithms for problems related to grammars, languages, and automata. ● Analyze the advantages and disadvantages of using different concepts related to languages, grammars and automata theory in specific problems/contexts. ● Choose and (evaluation) motivate the application of different types of languages, grammars, and automata for a given problem. ● Prove or disprove theorems in automata theory using their properties. ● Determine the decidability and intractability of computational problems.
Transversal skills / Competențe transversale	Cooperation and teamwork (in IT teams); communication of their work, critical thinking.

7. Objectives of the course / Obiectivele disciplinei (reieșind din grila competențelor specifice acumulate)

7.1. General objective / Obiectivul general al disciplinei	Development of a set of competences: - necessary to an IT specialist, so that it is able to recognize, define, analyze, have a conversation with other IT specialists on concepts like: automata, grammar, decidability, undecidability; - necessary for a student to be able understand more advanced topics on formal languages and automata theory, research oriented.
7.2. Specific objectives / Obiectivele specifice	*Knowledge objectives:* (1) Identify different formal language classes and their relationships (2) Design grammars and recognizers for different formal languages *Habilitation objectives*: (1) Prove or disprove theorems in automata theory using its properties (2) Determine the decidability and intractability of computational problems *Attitudinal objectives*: (1) to argue the importance of formal languages, automata, decidability results to an IT specialist.

8. Content / Conținuturi*

8.1. Lecture / Curs	**Teaching strategies / Metode de predare**	**Remarks, details / Observații**
C1. (2h) Course overview. Introduction to Automata Theory & Formal Languages	Lecture, conversation, illustration	References: 1. M. Erascu - slides 2. Chapter *Automata: the Methods and the Madness* of [1] 3. Chapter *Introduction* of [2]
C2. (2h) Finite Automata	Lecture, conversation, illustration	References: 1. M. Erascu – slides 2. Chapter *Finite Automata* of [1] 3. Chapter *???* of [2]
C3. (2h) Regular Expressions	Lecture, conversation, illustration	References: 1. M. Erascu – slides 2. Chapter *Regular Expressions and Languages* of [1]
C4. (2h) Regular Language Properties	Lecture, conversation, illustration	References: 1. M. Erascu – slides 2. Chapter *Properties of Regular Languages* of [1]
C5. (2h) Context Free Grammars and Languages	Lecture, conversation, illustration	References: 1. M. Erascu – slides 2. Chapter *Context-free Grammars and Languages* of [1]

C6. (2h) Pushdown Automata	Lecture, conversation, illustration	References: 1. M. Erascu – slides 2. Chapter *Pushdown Automata* of [1] 3. Chapter *Pushdown Automata and Context-Free Languages* of [2]
C7. (2h) Midterm		
C8-9. (4h) Context-Free Language Properties	Lecture, conversation, illustration	References: 1. M. Erascu – slides 2. Chapter *Properties of Context-free Languages* of [1]
C10-11. (2h) Turing Machines	Lecture, conversation, illustration	References: 1. M. Erascu – slides 2. Chapter *Introduction to Turing Machines* of [1] 3. Chapter *Turing Machines and Effective Computability* of [2]
C12-C13. (4h) Undecidability	Lecture, conversation, illustration	References: 1. M. Erascu – slides 2. Chapter *Undecidability* of [1] 3. Chapter *Turing Machines and Effective Computability* of [2]
C14. (2h) Course & Finals Review	Lecture, conversation, illustration	All the bibliographic material listed above

Recommended bibliography / Bibliografie:

[1] JE Hopcroft, R Motwani and JD Ullman. Introduction to automata theory, languages and computation Addison Wesley/Pearson; 3rd Edition

[2] Dexter C. Kozen. Automata and Computability (Undergraduate Texts in Computer Science). Springer (August 1997)

8.2. Seminar, lab / Seminar, laborator	**Teaching/learning strategies / Metode de predare/ invățare**	**Remarks, details / Observații**
S1-2. (4h) Detect the language generated by a grammar; detect the grammar which generates a given language.	Questioning, dialogue, collaborative learning	Based on the notions presented in the lecture, the students will be able to access the homework from the course website (https://merascu.github.io/links/FLAT.html). They have to prepare it. It will then be discussed in the class.
S3-4. (4h) Design of Finite Automaton: deterministic finite automaton (DFA) or nondeterministic finite	Same as above	Same as above

automaton (NFA).		
S5-6. (4h) Construction of regular expressions and of regular languages generated by then. Construction of eps-NFA.	Same as above	Same as above
S7-8. (4h) Usage of Pumping lemma	Same as above	Same as above
S9-10. (4h) Design of Context Free Grammars from given languages		
S11-12. (4h) Design of Pushdown Automata	Same as above	Same as above
S13-14. (4h) Turing Machines and Undecidability	Same as above	Same as above

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[1] JE Hopcroft, R Motwani and JD Ullman. Introduction to automata theory, languages and computation Addison Wesley/Pearson; 3rd Edition

[2] Dexter C. Kozen. Automata and Computability (Undergraduate Texts in Computer Science). Springer (August 1997)

[3] Azadeh Farzan. Introduction to Theory of Computation. Lecture notes. https://www.cs.toronto.edu/~azadeh/teaching/teaching.html

9. Correlations between the content of the course and the requirements of the IT field / Coroborarea conținuturilor disciplinei cu așteptările reprezentanților comunității epistemice, asociațiilor profesionale și angajatorilor reprezentativi din domeniul aferent programului

The content of the lecture is consistent with the one of similar courses from other universities. It covers the fundamental aspects necessary for the familiarity with issues of formal languages and automata. The content is not very useful for ordinary IT companies, but students can train their algorithmic thinking and programming languages through the proposed projects. Nevertheless, the lecture trains the ability of thinking and problem solving, tasks which are indispensable for a programmer.

10. Evaluation / Evaluare*

Activity / Tip de activitate	10.1. Evaluation criteria / Criterii de evaluare**	10.2. Evaluation methods / Metode de evaluare***	10.3. Weight in the averaged mark / Pondere din nota finală
10.4. Lecture / Curs	Knowledge and application of	Midterm	30%

	notions from C1-C7.		
	Knowledge and application of notions from C1-C14.	Written exam in the exam session	40%
10.5. Seminar/ lab	The ability to learn and apply concepts presented during the lectures.	Homeworks and activity (oral examination)	30%
10.6. Projects	The ability to (1) implement an algorithm in a certain programming language for certain notions presented during the lecture, (2) self-study of a new topic related to the lecture, (3) study of 2-3 research papers on a topic related to the one of the lecture, (4) students own projects related to the lecture topic.	Oral presentation	20%
	Reading and presenting a book (biography, historical, etc.) of a personality related to the lecture.	Oral presentation	5%

10.6. Minimal knowledge for passing / Standard minim de performanță

Minimal knowledge for passing (grade 5):

- Acquiring fundamental understanding of the knowledge of automata theory and formal languages.

The final grade is computed as a weighted average of the grades given for the components specified in Sections 10.4, 10.5, and 10.6, however it does not have negative impact on the grade if this activity is not fulfilled. The items presented in Section 10.6 are exclusive. The exam is passed if the average is equal or greater than 4.1 (not necessary that each grade is greater than 4.1). The start at Midterms and Final Exam is 0. If the grade is greater than equal to 4.1 means 5, greater than equal to 5.1 means 6, …, greater than equal to 9.1 means 10.

At each exam sessions (including reexamination and improvements), the score is computed by the same rule. Midterm cannot be retaken.

There is no mandatory presence requirement, however, note that your seminar grade is based on your activity during the semester (solving exercises at the whiteboard, tests, etc).

Note: Students may attend office hours (2 modules / week according to the schedule set out at the beginning of the semester) where the lecturer (course/seminar) answers questions students and provides further explanations related to course content, applications from seminary themes.

Date/ Data completării
29.01.2020

Signature (lecture) /
Semnătura titularului de curs
Madalina Erascu

Signature (seminar)
Semnătura titularului de seminar
Madalina Erascu

Signature (director of the department)
Semnătura directorului de departament
Conf.dr. Victoria Iordan