CENG 280 Formal Languages and Abstract Machines
Spring 2017-2018 Spring

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Teaching Assistants: Tuğberk İşyapar, Burak Kerim Akkuş.
Prerequisite: CENG 223 Discrete Computational Structures

Textbook:
• Lewis, H.R and Papadimitriou, C.H. Elements of the Theory of Computation (2nd ed.), Prentice-Hall, 1998.

Reference Books
• T.A.Sudkamp, Languages and Machines: An Introduction to the Theory of Computer Science, 3.Edition, Addison-Wesley, 2005.
• M.Sipser, Introduction to the Theory of Computation, 2.Edition, Thomson Course Technology, 2006.
• J.E.Hopcroft, R.Motwani and J.D.Ullman, Introduction to Automata Theory, Languages and Computation, 3.Edition, Addision-Wesley, 2007.

Contents: Computer Science needs mathematical languages to abstract away from particulars of computing machinery and to concentrate on systematicity, capacity, and efficiency of computing in the abstract. Theory of formal languages studies such languages while automata theory studies their acceptors. Both theories have found scientific and practical use in all areas of computer science and engineering. In fact, description of any computational process can be recast in formal language theory or automata theory. From this perspective, the theory can be seen as a vehicle for communicating the ideas clearly and precisely among computer scientists.
This course is an introduction to the topic. We will cover approximately chapters 1 – 5 from the textbook, with quite a few sections and subsections omitted. We will not deal with complexity, which is covered in CENG 315. Application of the theory to programming language specification and implementation will be the subject of of CENG 242 AND CENG 444.

Topics by content:
• Mathematical concepts; alphabets and languages
• Regular languages and finite automata
• Context-free languages and pushdown automata
• Recursively enumerable sets and Turing machines
• The language hierarchy
• Correspondence between grammars and automata
• Determinism vs. nondeterminism

Grading (Tentative):
Midterm Exam 1: 20% (Date: March 23, 2017)
Midterm Exam 2: 25% (Date: April 27, 2017)
Final: 35%

3 Take-home Exams: 20%
Attendance: 5% (Bonus)

IMPORTANT NOTES

Exams:
• Exams are closed book exams but one page of A4 size(both sides), hand-written (no photocopies) cheat sheet is allowed.
• Exams will cover the textbook material mentioned in the weekly syllabus and the material covered in class. Coverage will be cumulative.
• There will be only one make-up exam. If you miss any of the exam(s) and you have a legal and documented excuse , you can take the make-up exam after the final exams.

Take-home Exams:
• Experience shows that studying just before the exam is not the way to learn this topic. Doing exercises by yourself is necessary to grasp the material. You need to do more exercises than we can assign you to build your competence.
• There will be 3 take-home exams. Take-home exams are meant to be exercises for self-study. Any work you submit must be your own. Copying from others or Internet is considered as cheating.
• You will submit your take-home exams as latex files, they will be checked by Turnitin.
• Late submission strategy: You have 2 days in total for late submission of all take-home exams. All exams will be graded as normal in this period. No further late submissions accepted if you used all late submission time allocated.

Attendance:
High attendance makes the classes livelier and more discussion-oriented. This is a topic which is learned in class by participation. Without discussions, it's a soup of symbols and formal descriptions. We'll try to get to the concepts behind all this in class. Many former students remarked that they could have got better grades if they had attended classes more regularly. You will get bonus grade for the attendance. You need to attend the section that you are registered.

Announcements:
Please read the newsgroup metu.ceng.course.280 regularly for course announcements and off-class discussion. It is your responsibility to keep track of announcements, handouts, take-home exams, etc.

CODE OF HONOR: In case of cheating, the university regulations will be applied.

Weekly Schedule:

• W1: Overall introduction to the course (1 hour)
• W1: Overview of related concepts [1.4-1.6] (2 hours)
• W2: Alphabets and languages [1.7] (1 hour)

• W2: Finite representations of languages [1.8] (2 hours)
• W3: Deterministic finite automata [2.1] (1 hour)
• W3: Nondeterministic finite automata -introduction [2.2] (2 hours)
• W4: Equivalence of DFA and NFA (theorem 2.2.1) [2.2] (1 hour)
• W4: Finite automata and regular languages (theorems 2.3.1 and 2.3.2) [2.3] (2 hours)
• W5: Pumping lemma and its applications (theorem 2.4.1) [2.4] (2 hours)
• W5: State minimization (lemma 2.5.1) [2.5] (1 hour)
→MT1
• W6: Context-free grammars --introduction [3.1] (2 hours)
• W7: Parse trees and derivations [3.2] (2 hours)
• W7: Pushdown automata-introduction [3.3] (1 hour)
• W8: Pushdown automata-examples [3.3] (1 hour)
• W8: Pushdown automata and context-free grammars (theorem 3.4.1) [3.4] (2 hours)
• W9: Closure properties (theorems 3.5.1-2) [3.5] (2 hours)
• W9: Pumping theorem (3.5.3) and its applications [3.5] (1 hour)
• W10: Algorithms for CFGs: CNF and CYK Algorithm [3.6] (1 hour)
• W10: Deterministic PDAs (theorem 3.7.1) [3.7] (2 hours)
→MT2
• W11: Turing machines --definition and examples , Computing with TMs [4.1,4.2] (2 hours)
• W11: Recursive and recursively enumerable languages [4.2] (1 hour)
• W12: Extensions of TMS --summary [4.3] (2 hours)
• W13: Nondeterministic TMs --definition and theorem 4.5.1 (proof outline) [4.5] (2 hours)
• W13: Unrestricted grammars --summary [4.6] (1 hour)
• W14: Church-Turing thesis, universal Turing machines [5.1,5.2] (2 hours)
• W14: Halting problem [5.3] (1 hour)

Have a nice semester!

-280 Staff