CMPE 534 Automated Deduction

Department: Computer Engineering

Instructor Information
Name: Assoc. Prof. Zeki Bayram
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Assistant Information
No assistant.

Meeting times and places
Tuesday 12:30- 13:20, Room CMPE 129
Thursday 10:30 – 12:20, Room CMPE 129

Program Name: Computer Engineering	**Program Code:** 25

Course Code	**Credits**	**Year/Semester**
CMPE 534	3	2019-2020 Fall

Prerequisite(s)
Graduate standing.

Specialization Categories (For the Ph.D. qualifying Exam)
B3 – INFORMATION SYSTEMS

Catalog Description
This course is about automatically (and mechanically) proving theorems in first order predicate calculus. Introduction to propositional logic, predicate calculus and proof methods. Herbrand's theorem. The resolution principle (in its various forms) as the theoretical background for the programming language Prolog. Paramodulation, term rewriting systems and e-unification under equational logic. Applications of automated reasoning.

Course Web Page
https://staff.emu.edu.tr/zekibayram/en

Textbook
Jean H. Gallier. “Logic For Computer Science, Foundations of Automatic Theorem Proving”. John Wiley & Sons, 2003 (Second Edition, copyright Jean H. Gallier) (Available by the author at ftp://ftp.cis.upenn.edu/pub/papers/gallier/logic.pdf.gz)

Reference books
Chin-Liang Chang, Richard Char-Tung Lee. “Symbolic Logic and Mechanical Theorem Proving”. Academic Press, 1973

Rolf Socher-Abbrosius, Patricia Johann. “Deduction Systems”. Springer Verlag, 1996

M. Ben Ari. "Mathematical Logic for Computer Science", Prentice Hall, 1993

Topics Covered and Class Schedule
(3 hours of lectures per week)

Week 1	Overview of Automated Deduction
Week 2	Syntax and semantics of Propositional Logic
Week 3	Proof Theory of Propositional Logic: The Gentzen System G
Week 4	Proof Theory for Infinite Sequents
Week 5	Programming in Flora-2
Week 6	The Resolution Method for Propositional Logic
Week 7	First-Order languages - syntax and semantics
Week 8	Proof Theory of First-Order Languages
Week 9	Negation Normal Form, Prenex Normal Form
Week 10	Herbrand's Theorem for Prenex Formulae
Week 11	Resolution Method for First-order Logic
Week 12	SLD-Resolution and Prolog
Week 13	Review

Course Learning Outcomes

Upon successful completion of the course, students are expected to have the following competencies:
(1) Write syntactically correct propositional and first order formulas to describe a situation
(2) Prove validity of formulas in propositional logic using the truth table method
(3) Prove validity of formulas in propositional logic using Gentzen Systems
(4) Prove validity of formulas in propositional logic using resolution
(5) Prove validity of formulas in first-order logic using Gentzen Systems
(6) Prove validity of formulas in first-order logic using resolution
(7) Write simple theorem provers in FLORA-2
(8) Draw resolution trees

	Method	**No**	**Percentage**
Assessment	Midterm Exam(s)	1	40%
	Final Examination	1	45%
	Project	1	15%

Policy on makeups: For eligibility to take a makeup exam, the student should bring a doctor's report within 3 working days of the missed exam.

Policy on cheating and plagiarism: Any student caught cheating at the exams or assignments will automatically fail the course and may be sent to the disciplinary committee at the discretion of the instructor.

Prepared by: Assoc. Prof. Dr. Zeki Bayram	**Date Prepared:** 23 September 2019