EXPANDED COURSE DESCRIPTION
ELECTRICAL ENGINEERING AND COMPUTER SCIENCE
Lassonde School of Engineering
Electrical Engineering Computer Science
LE / EECS 4401 3.0 SECTION A
ARTIFICIAL INTELLIGENCE
FALL 2017 / WINTER 2018

COURSE CALENDAR DESCRIPTION

This is a second course in Artificial intelligence that covers selected topics in this area such as: reasoning about action and planning, uncertain and fuzzy reasoning, knowledge representation, automated reasoning, non-monotonic reasoning and answer set programming, ontologies and description logic, local search methods, Markov decision processes, autonomous agents and multi-agent systems, machine learning, reasoning about beliefs and goals, and expert systems. Prerequisites: General prerequisite; LE/EECS 2030 3.00 or LE/EECS 1030 3.00; LE/EECS 3401 3.0. (NOTE: The General Prerequisite is a cumulative GPA of 4.50 or better over all major EECS courses. EECS courses with the second digit "5" are not major courses.)

INSTRUCTOR(S)

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TOPICS AND CONCEPTS

The satisfiability problem (SAT) for classical propositional (or Boolean) logic is easy to formulate but its theoretical properties are of great significance to the theoretical as well as applied computer science. Researchers and practitioners in areas such as theoretical computer science, artificial intelligence (AI), or software and hardware verification benefit not only from the theoretical advancements in SAT but also from practical tools that the SAT community is continuously developing and offering as powerful and versatile problem solving tools.

Many "classical" problems in AI can be conveniently formulated as SAT instances and practically solved using the so-called SAT solvers. For instance, successful applications of SAT algorithms have been reported in the area of planning, scheduling, diagnosis, knowledge representation and reasoning, games, to name just a few of the subareas of AI. This is why SAT-based methods have been extensively studied almost from the first days of AI as an academic discipline. However, the success of SAT-based techniques extends far beyond AI. SAT-based tools are routinely used by industry in areas ranging from software and hardware verification to scheduling. IBM, Intel, and Microsoft are just a few large companies that research and employ SAT methods in the design and verification of their products.

This course will cover both the theoretical as well as applied aspects of SAT. Apart from theory, a number of practical SAT algorithms will be discussed and experimented with. The course will also cover a range of applications of SAT techniques in AI.

Some of the topics to be covered:

- SAT and complexity theory
- Encoding problems as SAT instances: theory and applications
- Complete and incomplete SAT solvers
• Non-clausal SAT solvers
• SAT techniques for circuit satisfiability and quantifier-free first-order logic (Satisfiability Modulo Theory (SMT))
• SAT and constraint satisfaction problem
• SAT applications: from diagnosis to verification
• SAT applications in AI

SUBJECTS COVERED

week 1: propositional logic (review), clausal fragment of propositional logic, SAT defined, DPLL algorithm.

Lecture notes (informal): DPLL_intro.pdf (in the course directory).
• See also: this intro to logic and this intro to SAT
• week 2: Improving the performance of DPLL with learned clauses.
• week 3: SAT applications: planning.
• week 4: Stochastic Local Search (SLS): from GSAT to WalkSAT.
• week 5: SAT applications: Diagnosis as satisfiability.
• week 6: Non-clausal SLS methods.
• week 7: SAT applications: Bounded model checking.
• week 8,9: Circuit SAT.
• week 10,11: Satisfiability modulo theory (SMT).

READING LIST AND WEB RESOURCES

There is no text book for this course. The reading list, consisting of WEB resources and relevant research paper publications, will be provided (and updated, if necessary).

You can find a wealth of information on SAT following these links:
• SAT Live!
• SATLIB - The Satisfiability Library
• Microsoft's Z3 page

See also:
• Z3 SMT solver
• Z3 Tutorial

ACADEMIC INTEGRITY LINKS

• Senate Policy on Academic Honesty - http://secretariat-policies.info.yorku.ca/policies/academic-honesty-senate-policy-on/
• Academic Integrity - http://lassonde.yorku.ca/academic-integrity

STUDENT LINKS

• Student Rights and Responsibilities - http://oscr.students.uit.yorku.ca/student-conduct
• Religious Observance - https://w2prod.sis.yorku.ca/Apps/WebObjects/cdm.woa/wa/regobs
• Academic Accommodation for Students with Disabilities - http://secretariat-policies.info.yorku.ca/policies/academic-accommodation-for-students-with-disabilities-policy/
• Counselling and Disability Services - http://cds.info.yorku.ca/

Many courses utilize Moodle, York University's course website system. If your course is using Moodle, click here to access it.

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