ECE750 T28 - Fall 2021
SAT and SMT Solvers for Software Engineering

When & where: **Lectures:** ███████████████
Live and recorded lectures via ███████
Slides shall be made available on LEARN.
Link to videos provided on LEARN as well.

Instructor: Professor Vijay Ganesh.
`https://ece.uwaterloo.ca/~vganesh`
Email: vganesh@uwaterloo.ca
Office hours via Piazza or Skype: Upon request.

TAs: TBD

Course materials: All course material made available via LEARN.
Slides on SAT and SMT Solvers developed by Isil Dillig, Vijay Ganesh,...
There are no textbooks for this course. (Recommended books on next page.)

Topics Covered: Foundations - propositional and first-order logic, first-order theories
Proof systems and their properties (soundness, completeness, compactness)
Design of modern CDCL SAT solvers, SMT solvers, CDCL(T).
Decision procedures for theories (bit-vectors, arrays, strings, ...)
Symbolic execution based testing and analysis
Proof complexity (time permitting)

Marking: Assignments: 30% (2 assignments worth 15% of total marks each)
Project: 70%

Assignments: Assignment submission via LEARN. Assignments must be done individually.
Project report submission via LEARN.
Projects also must be done individually

Late Submission: No late submissions accepted, unless authorized by instructor.

University regulations:

Academic integrity: `http://uwaterloo.ca/academicintegrity/`

Petition & Grievance: `http://secretariat.uwaterloo.ca/Policies/policy70.htm`

Discipline: `http://secretariat.uwaterloo.ca/Policies/policy71.htm`

Penalties: `http://secretariat.uwaterloo.ca/guidelines/penaltyguidelines.htm`

Appeals: `http://secretariat.uwaterloo.ca/Policies/policy72.htm`

Disability: `http://www.studentservices.uwaterloo.ca/disabilities/`

ECE750-T28 Tentative Weekly Schedule

Week	Topics	Book(s) chapters (Self-contained slides will be provided for all topics)
Week 1	Introduction to SAT/SMT solvers and their applications. Boolean logic, propositional proof systems – part I	Slides
Week 2	Boolean logic, propositional proof systems, soundness, completeness – part II	Slides
Week 3	Algorithms for the Boolean satisfiability problem – DPLL SAT Solvers	Slides
Week 4	Algorithms for the Boolean satisfiability problem – CDCL SAT Solvers. Use of solvers in symbolic execution-based testing and analysis	Slides
Week 5	First-order logic, first-order proof systems, soundness, completeness – part I	Slides
Week 6	First-order logic, first-order proof systems, soundness, completeness – part II	Slides
Week 7	MID-TERM WEEK	
Week 8	SMT Solvers – architecture, CDCL(T)	Slides
Week 9	Combination of theories – Nelson-Oppen	Slides
Week 10	Decision procedures for theories over bit-vectors and arrays	Slides
Week 11	Decision procedures for integers and real linear arithmetic	Slides
Week 12	Decision procedures for theories over strings	Slides

The following is an additional list of useful texts and resources for a deeper understanding SAT/SMT solvers and the logical foundations that underpin them. The Sipser and Wolf books are highly recommended.

- **Leary Book:** A Friendly Introduction to Mathematical Logic by Leary and Kristiansen
- **Sipser Book:** An Introduction to the Theory of Computation by Michael Sipser
- **Wolf Book:** A Tour through Mathematical Logic by Robert S. Wolf
- **Ganesh/Vardi book chapter:** On the Unreasonable Effectiveness of SAT Solvers by Vijay Ganesh and Moshe Vardi
- **Dennis Gurichev notes –** excellent set of SAT/SMT encoding problems