

EEE 4701/5702- Automated HW/SW Verification

1. Catalog Description – (3 credits) Develop modeling, formal specification, and automated verification skills for analyzing complex hardware and/or software systems. Hands-on experience with model checking tools.
2. Pre-requisites: EEL 4744C (or equivalent) and COP 3530 (or equivalent).
3. Course Objectives – To devise formal models for reasonably complex systems, to learn various property specification formalisms, and how to use automated verification tools to reason about the correctness properties and the behavior of hardware and/or software systems.
4. Contribution of course to meeting the professional component (ABET only – undergraduate courses) 3 credits of Engineering Science.
5. Relationship of course to program outcomes: Skills student will develop in this course (ABET only undergraduate courses) Outcomes a and k.
6. Instructor –Dr. Tuba Yavuz
 1. Office location: 321 Benton Hall
 2. Telephone: (352) 846 0202
 3. E-mail address: tuba@ece.ufl.edu
 4. Class Web site: E-learning CANVAS <http://lss.at.ufl.edu>
 5. Office hours: Tuesdays and Fridays 3 pm – 4 pm (Zoom only, see the course site on CANVAS for the Zoom link)
7. Teaching Assistant - None
 1. Office location:
 2. Telephone:
 3. E-mail address:
8. Meeting times: MWF 10:40 am – 11:30 am
9. Class/laboratory schedule - 3 class periods consisting of 50 minutes each
10. Meeting Location – MAEA 0327 Check out the map: [UF Campus Map \(ufl.edu\)](#)
11. Material and Supply Fees - None
12. Textbooks and Software Required – None.

13. Recommended Reading –

- Theoretical Background on Model Checking
 1. Title: Model Checking.
 2. Author: Edmund M. Clarke, Orna Grumberg, Daniel Kroening, Doron A. Peled, and Helmut Veith.
 3. Publication date and edition: 2018, 2nd edition.
 4. ISBN number: ISBN-13: 978-0262038836
- Theoretical Background on SAT/SMT Solvers
 1. Title: Decision Procedures, An Algorithmic View
 2. Author: Daniel Kroening and Ofer Strichman
 3. Publication date and edition: 2016, 2nd
 4. ISBN number: 978-3662504963

- Practical book on SPIN model checker
 1. Title: The SPIN Model Checker
 2. Author: Gerard J. Holzmann
 3. Publication date and edition: 2003.
 4. ISBN number: 0-321-22862-6

- A list of research papers to be provided by the instructor.

14. Course Outline –

- (1 class) Introduction
- (1 class) Propositional Logic
- (1 class) Modeling with Propositional Logic and the SAT Problem
- (2 classes) SAT Solving using Conflict Resolution
- (2 classes) SAT solving using Binary Decision Diagrams (BDDs)
- (1 class) Predicate/First-order logic
- (2 classes) Uninterpreted functions and equality logic
- (1 class) Bit-vector Logic
- (1 class) Symbolic Execution – KLEE
- (2 classes) PROMPT for component-level analysis
- (1 class) Hardware Trojan Detection using Symbolic Execution
- (1 class) Software Side Channel Detection using Symbolic Execution
- (1 class) Using Alloy for Software Modeling
- (3 classes) Linear-Time Temporal Logic (LTL)
- (3 classes) SPIN (an explicit-state model checking tool for high-level models)
- (2 classes) Explicit-state Model Checking Algorithms
- (3 classes) Computation Tree Logic (CTL)
- (1 class) NuXmv (a symbolic model checking tool)
- (3 classes) Symbolic Model Checking Algorithms (NuXmv)
- (2 classes) Bounded Model Checking (BMC)
- (2 classes) Infinite-state Model Checking
- (1 class) Software Model Checking (Intro & CPAchecker)
- (2 classes) Predicate Abstraction
- (1 class) Counter-example Guided Abstraction Refinement (CEGAR)
- (1 class) Linear Arithmetic (optional)
- (1 class) DPLL(T) (optional)
- (~7 classes) Research Paper presentations
- (1 class) Wrap-up

15. Attendance and Expectations - Attendance is expected. Cell phones and other electronic devices are to be silenced. No text messaging during class or exams.

Requirements for class attendance and make-up exams, assignments, and other work are consistent with university policies that can be found at:
<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>

16. Grading –

Assignments (30% for both sections): Written assignments as well as hands-on experience with some of the formal methods tools.

A final exam on December 14th from 5:30 pm to 7:30 pm (30% for both sections): This will include questions on the theory of automated verification as well as research problems that will require a basic understanding of the fundamental problems in the model checking field and various solutions to these problems and the ability to compare and contrast them. More information will be posted on CANVAS.

Research paper presentations (15% - EEE 5702 only): Each student in EEE 5702 will choose a research paper, preferably related to their term project, in the field of automated verification and present it in class. The presentations will be graded based on 1) the presenter's ability to clearly describe the problem, explain the solution, and evaluate the (experimental) results, 2) the quality of answers provided to the questions, and 3) the content of the slides.

Written Questions about Research Papers (15% - EEE 4701 only): Each student in EEL 4701 will prepare at least one non-trivial question for each of the three different papers that will be presented in class. To get full credit, the question should reveal that the paper has been read carefully and the answer to the question must not be explicitly stated in the paper. Each question should be submitted on CANVAS prior to the presentation.

Term Project (20% for both sections): A semester long project that will involve analysis of a reasonably complex hardware or software system using a verification tool. Students will choose from a list of project topics that will be provided by the instructor.

Participation (5%, for both sections): Class participation. You are encouraged to keep a participation log of any activity along with the date of participation and other information (e.g., the specific question asked or answered) and submit it by the end of the semester.

17. Grading Scale –

A C- will not be a qualifying grade for critical tracking courses. In order to graduate, students must have an overall GPA and an upper-division GPA of 2.0 or

better (C or better).” Note: a C- average is equivalent to a GPA of 1.67, and therefore, it does not satisfy this graduation requirement.

A	A-	B+	B	B-	C+	C	C-	D+	D	D-	E
93-100	90-92	87-89	83-86	80-82	77-79	73-76	70-72	67-69	63-66	60-62	0-59

More information on UF grading policy may be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.ua.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.ua.ufl.edu/public-results/>.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is

considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University's core values, including the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information, and veteran status.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- HWC OE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <https://counseling.ufl.edu>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the [Office of Title IX Compliance](#), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtml>.

Career Connections Center, Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.edu>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

On-Line Students Complaints: <https://distance.ufl.edu/getting-help/>; <https://distance.ufl.edu/state-authorization-status/#student-complaint>.