CS 4384.503 Automata Theory – Fall 2025

TR 5:30 -6:45 PM, ECSS 2.415

Instructor: Beiyu Lin

Office: ECSS 4.406

Office Hours: Tues./Thurs. 10:30 – 11:30 PM (at office)
(For an appointment, please send email to: Beiyu.Lin@utdallas.edu)

Teaching Assistant: TBA

Course Prerequisites: CS 2305 (Discrete Math) or equivalent

Contents Description:

1. Brief review of mathematical background. (Chapter 0 in text)
   (Binary relations, digraphs, strings, languages, inductive definitions and types of proof ...)

2. Finite Automata and Regular Expressions. (Chapter 1 in text)
   (Deterministic and nondeterministic finite automata, regular expressions and regular sets, Kleene's Theorem.)

3. Properties of Regular Sets (Chapter 1, in particular Section 1.4)
   (Pumping Lemma, closure properties, decision algorithms)

4. Context-Free Grammars and Languages. (Chapter 2 in text)
   (Context-free grammars, regular grammars)

5. Simplified Forms and Normal Forms. (Chapter 2 in text)
   (Useful symbols, productions, unit productions, Chomsky normal form)

6. Pushdown Automata. (Section 2.2 in text)
   (Pushdown automaton, equivalence between pushdown automata and context-free languages)

7. Properties of Context-Free Languages. (Section 2.3 in text)
   (Pumping Lemma, closure properties, the CYK algorithm)

8. Turing Machines. (Chapters 3 and 4 in text)
   (Turing machines, their variants and the undecidability of the halting problem)

9. Undecidability. (Chapter 5 in text)

Course Objective: The goal of this course is to introduce students to the theory of computation. We will discuss several basic computational models including the finite automata (FA), pushdown automata (PDA) and Turing machines (TM) as well as the corresponding classes of regular languages, context-free languages and recursively enumerable languages. The classes of regular grammars and context-free grammars (CFG) will be introduced. We will show the equivalence between regular grammars and finite automata, and between context-free grammars and pushdown automata. We will also discuss various properties of regular languages and context-free languages, including the Pumping Lemma, several closure properties as well as some decision algorithms. We will discuss the Turing machine model, the notion of decidability/undecidability, the halting problem for TMs and the proof of its undecidability.

The Learning Objectives include:
• Ability to design and convert between DFA, NFA and regular expressions; • Ability to show that certain languages are not regular; • Ability to design and convert between PDA and CFGs; • Ability to show that certain languages are not context-free; • Ability to design and analyze Turing machines; • Ability to prove and apply the Halting Problem to other undecidable problems

Required Textbooks and Materials:

Sipser, M.: "Introduction to the Theory of Computation", Cengage Learning, (3rd edition) 2013.
(Main Text)

Suggested Course Materials:

Martin, J.C.: "Introduction to Languages and the Theory of Computation", McGraw-Hil1, 2010.

Sudkamp, Th.: "Languages and Machines", Addison Wesley, 2005.

Lewis, H. & Papadimitriou, C.: "Elements of the theory of Computation", Prentice Hall, 1998.

Kozen, D.: "Automata and Computability", Springer Verlag, 1997

Assignments and Academic Calendar/Grade Scale:

- Class attendance 5% (Recording starts Tuesday 9/2/2025. You are required to attend a minimum of 20 lectures (out of a total of more than 26) during the semester to obtain the maximum credit. Attendance credit is calculated as a linear function of the number of lectures you attend.) (Absences **for any reason** will not be considered.)
- 6 Homework assignments 10%. (Last homework will not be graded.)
  (HW assignments are due on eLearning on the date given. *Late HWs will not be accepted*. HW assignments will be uploaded on eLearning. Solutions of HW problems will be provided on eLearning.)
- Exam #1 (75 minutes) 40% Tuesday, October 1, 1:00 pm
- Exam #2 (75 minutes) 45% Thursday, December 5, 1:00 pm

Course and Instructor Policies:

- A copy of the lecture notes (Chapters 1-9) can be found on UTD eLearning
- Exam #2 is not comprehensive. (It will cover slightly more than the second half of the course content.)
- Students are encouraged to discuss HW problems. However, your submission must be your own work. Anyone caught cheating on HWs will receive zero credit.
- If you decide to stop attending class, be sure to drop the course since you will not be dropped automatically.
- Any student wishing to contest a grade on a HW should contact the TA.
- Final grades will be posted by the Records Office.
- All exams will be graded by the instructor. HWs will be graded by the TA.
- There will be no makeup exams under normal circumstances.
- No late homework submission will be accepted!
- If you fix the problem in the assignment within a week after it is returned to you, please let me or the TA know—we will restore half of the lost points to encourage continued practice.
- I do not read e-Learning e-mails. Please use my UTD e-mail account above for any communications.
- All grade disputes must be reported **within 1 week** of the grade in question being posted on eLearning. Uncontested grades will be final after 1 week. If you have questions concerning your exam grades, please contact me. Due to FERPA grades cannot be discussed via email.

Class Materials

The instructor may provide class materials that will be made available to all students registered for this class as they are intended to supplement the classroom experience. These materials may be downloaded during the course, however, these materials are for registered students' use only. Classroom materials may not be reproduced or shared with those not in class, or uploaded to other online environments except to implement an approved Office

of Student AccessAbility accommodation. Failure to comply with these University requirements is a violation of the Student Code of Conduct.

Classroom Conduct Requirements Related to Public Health Measures

UT Dallas will follow the public health and safety guidelines put forth by the Centers for Disease Control and Prevention (CDC), the Texas Department of State Health Services (DSHS), and local public health agencies that are in effect at that time during the Fall 2021 semester to the extent allowed by state governance. Texas Governor Greg Abbott's Executive Order GA-38 prohibits us from mandating vaccines and face coverings for UT Dallas employees, students, and members of the public on campus. However, we strongly encourage all Comets to get vaccinated and wear face coverings as recommended by the CDC. Check the Comets United: Latest Updates webpage for the latest guidance on the University's public health measures. Comets are expected to carry out Student Safety protocols in adherence to the Comet Commitment. Unvaccinated Comets will be expected to complete the Required Daily Health Screening. Those students who do not comply will be referred to the Office of Community Standards and Conduct for disciplinary action under the Student Code of Conduct – UTSP5003.

Class Attendance

The University's attendance policy requirement is that individual faculty set their course attendance requirements. Regular and punctual class attendance is expected. Students who fail to attend class regularly are inviting scholastic difficulty. In some courses, instructors may have special attendance requirements; these should be made known to students during the first week of classes.

Class Participation

Regular class participation is expected. Students who fail to participate in class regularly are inviting scholastic difficulty. A portion of the grade for this course is directly tied to your participation in this class. It also includes engaging in group or other activities during class that solicit your feedback on homework assignments, readings, or materials covered in the lectures (and/or labs). Class participation is documented by faculty. Successful participation is defined as consistently adhering to University requirements, as presented in this syllabus. Failure to comply with these University requirements is a violation of the Student Code of Conduct.

Class Recordings

Students are expected to follow appropriate University policies and maintain the security of passwords used to access recorded lectures. Unless the Office of Student AccessAbility has approved the student to record the instruction, students are expressly prohibited from recording any part of this course. Recordings may not be published, reproduced, or shared with those not in the class, or uploaded to other online environments except to implement an approved Office of Student AccessAbility accommodation. Failure to comply with these University requirements is a violation of the Student Code of Conduct.

Comet Creed

This creed was voted on by the UT Dallas student body in 2014. It is a standard that Comets choose to live by and encourage others to do the same:

"As a Comet, I pledge honesty, integrity, and service in all that I do."

Academic Support Resources

The information contained in the following link lists the University's academic support resources for all students. Please see http://go.utdallas.edu/academic-support-resources

UT Dallas Syllabus Policies and Procedures

The information contained in the following link constitutes the University's policies and procedures segment of the course syllabus. Please review the catalog sections regarding the credit/no credit or pass/fail grading option and withdrawal from class.

Please go to http://go.utdallas.edu/syllabus-policies for these policies.