Automata, Computability and Formal Languages — Fall 23
CS 3350 — L. Longpré

Course Syllabus

Course Description:
Theoretical computing models and the formal languages they characterize: finite state machines, regular expressions, pushdown automata, context-free grammars, Turing machines and computability. Capabilities and limitations of each model, and applications including lexical analysis and parsing.

Prerequisites:

- Either CS 2302 Data Structures and either Discrete Mathematics or Discrete Structures, with grades C or higher,
- or CS 2401 Elementary Data Structures and either Discrete Mathematics or Discrete Structures, with grades B or higher.

Textbook:
Reading and potentially laboratory assignments will be drawn from *Introduction to the Theory of Computation*, by Michael Sipser. Both 2nd and 3rd editions are adequate. In the sections we cover, the material is the same, except that the section and page numbers may differ. This book is available at the bookstore and through major online book retailers, and you are expected to acquire a copy for your use in this course. Photocopied textbooks are illegal and their use will not be tolerated.

Exams:
The purpose of the exams is to allow you to demonstrate mastery of course concepts. Make-up exams will be given only in extremely unusual circumstances. If you must miss an exam, please meet with an instructor, BEFORE the exam if at all possible.

Grading:

Home assignments	20%	
Class quizzes and exercises	5%	
Tests	40%	
Test 1 (Chapters 0 and 1)	10/3/23	
Test 2 (Chapter 2)	10/31/23	
Test 3 (Chapters 3, 4, 5, 7)	12/5/23	
Final (All material)	35%	Thursday 12/14/23, 1pm

The nominal percentage-score-to-letter-grade conversion is as follows:

$\geq 90\%$ is an A
$\geq 80\%$ is a B
$\geq 70\%$ is a C
$\geq 60\%$ is a D
$< 60\%$ is an F

We may adjust these criteria downward, e.g. so that 88% or higher is an A, based on overall class performance. The criteria will not be adjusted upward, however.

Homework Assignments:
Homework and lab assignments are designed to allow you to practice using the concepts presented in lecture and in your reading. Homework and lab assignments may include written problems, tutorial exercises, and programming problems. Assignments usually will be due at the start of the next class. Late homework will be accepted only in unusual circumstances, by prior arrangement if at all possible. Homework must be done individually. While you may discuss the problem in general terms with other people, your answers and your code should be written and tested by you alone. If you need help, consult a TA or a professor.

Quizzes:
The purpose of a quiz is to ensure that you have read the weekly reading assignment and to verify that you have mastered the major concepts of recent lectures. Quizzes typically will be about 5-10 minutes in length. There will be no make-up on missed quizzes. For your quiz grade, we will ignore the worst 30% to 45% of your quizzes grades, depending on the number of quizzes given.

Special Accommodations: If you have a disability and need classroom accommodations, please contact the Center for Accommodations and Support Services (CASS) at 747-5148 or by email to cass@utep.edu, or visit their office located in

UTEP Union East, Room 106. For additional information, please visit the CASS website at http://www.sa.utep.edu/cass. CASS's staff are the only individuals who can validate and if need be, authorize accommodations for students.

Scholastic Dishonesty:
Any student who commits an act of scholastic dishonesty is subject to discipline. Scholastic dishonesty includes, but not limited to cheating, plagiarism, collusion, submission for credit of any work or materials that are attributable to another person.
Cheating is:

- copying from the test paper of another student;
- communicating with another student during a test to be taken individually;
- giving or seeking aid from another student during a test to be taken individually;
- possession and/or use of unauthorized materials during tests (i.e. crib notes, class notes, books, etc.);
- substituting for another person to take a test;
- falsifying research data, reports, academic work offered for credit.

Plagiarism is:

- using someone's work in your assignments without the proper citations;
- submitting the same paper or assignment from a different course, without direct permission of instructors.

To avoid plagiarism see:
`https://www.utep.edu/student-affairs/osccr/_Files/docs/Avoiding-Plagiarism.pdf`
Collusion is unauthorized collaboration with another person in preparing academic assignments.
Instructors are required to – and will – report academic dishonesty and any other violation of the Standards of Conduct to the Dean of Students.
NOTE: When in doubt on any of the above, please contact your instructor to check if you are following authorized procedure.

Instructor:	L. Longpré
Office:	3.0420 CCS building
Phone:	747-6804
e-mail:	longpre @ utep.edu
Office Hours:	TR (in-person in office or MS Teams): 3:00 - 3:30 PM
	MW (virtual): 3:00 - 3:30 PM (MS Teams, send e-mail ahead of time)
	Or, by appointment

To make appointments at other times, see *https://www.utep.edu/cs/people/longpre.html*, select "Student appointments" for instructions.

IA:	Sonam S Tshering
Office hours location :	CS dungeon
e-mail:	sstshering @ miners.utep.edu
Office Hours:	Mondays and Wednesdays 1-5pm

Major Topics Covered in the Course:

- Regular languages, finite automata, non deterministic finite automata
- Context-free languages, pushdown automata
- Parsing, normal forms, ambiguity
- Pumping lemmas and closure properties
- Turing machines and other equivalent models
- Decidable languages, non-decidable languages, recognizable languages, Chomsky hierarchy

Learning Outcomes:

Level 1: Knowledge and Comprehension

Level 1 outcomes are those in which the student has been exposed to the terms and concepts at a basic level and can supply basic definitions. The material has been presented only at a superficial level.

Upon successful completion of this course, students will:

1a. Be familiar with the implications of Church-Turing thesis.

1b. Understand that there are problems for which an algorithm exists, and problems for which there are no algorithms (non-recursive, non-recursively enumerable languages) and understand the implications of such results.

1c. Understand and explain the diagonalization process as used in proofs about computability.

1d. Understand the difference between feasible and non-feasible algorithms, understand the limitations of the current formalization of feasibility as polynomial-time.

1e. Understand the main ideas behind the concepts of NP and NP-hardness, know examples of NP-hard problems.

Level 2: Application and Analysis

Level 2 outcomes are those in which the student can apply the material in familiar situations, e.g., can work a problem of familiar structure with minor changes in the details.

Upon successful completion of this course, students will be able to:

2a. Convert a non-deterministic finite automaton into an equivalent deterministic finite automaton.

2b. Convert a non-deterministic finite automaton into an equivalent regular expression.

2c. Convert a regular expression into an equivalent finite automaton.

2d. Construct a regular expression for a regular language.

2e. Convert a context-free grammar into an equivalent pushdown automaton.

2f. Construct a context-free grammar for a given context-free language.

2g. Design an algorithm for a machine model to simulate another model.

2h. Build simple Turing machines.

2i. Prove formally properties of languages or computational models.

2j. Apply a parsing algorithm.

2k. Build a parse tree or a derivation from a context-free grammar.

2l. Use the closure properties in arguments about languages.

Level 3: Synthesis and Evaluation
Level 3 outcomes are those in which the student can apply the material in new situations. This is the highest level of mastery.
Upon successful completion of this course, students will be able to:

3a. Compare regular, context-free, recursive, and recursively enumerable languages.

3b. Compare finite automata, pushdown automata, and Turing machines.

Daily Schedule: To be distributed separately.