TROY UNIVERSITY
CS372 FORMAL LANGUAGES & THE THEORY OF COMPUTATION
COURSE SYLLABUS

INSTRUCTOR INFORMATION:

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STUDENT EXPECTATION STATEMENT:

It is assumed the student entering this course will already have a fundamental understanding of Discrete Mathematics.

COURSE DESCRIPTION:

This course provides conceptual tools that practitioners use in computer engineering. Designing a new programming language for a specialized application? What you learned about *grammars* in this course comes in handy. Dealing with string searching and pattern matching? Remember *finite automata* and *regular expressions*. Confronted with a problem that seems to require more computer time than you can afford? Think back to what you learned about NP-*completeness*. Various application areas, such as modern cryptographic protocols, rely on theoretical principles that you will learn here.

(Sipser's textbook.)

COURSE OBJECTIVES:

We will study the following topics:

Formal Languages

1. Finite State Automata.
2. Regular Expressions and Regular Grammars.
3. Context-free Grammars and Pushdown Automata.

Computability

4. Computation models: Turing machines (TM).
5. Turing-decidable and Turing-recognizable languages.
6. Enhancements of TMs: multi-tape TMs, non-deterministic TMs. Equivalence of these and the standard TM.
7. Diagonalization. Acceptance problem is undecidable; Acceptance problem is recognizable; the complement of the Acceptance problem is unrecognizable.

Troy University Resources

8. Reductions. Examples of other undecidable languages. Rice's theorem. Post's Correspondence Problem (PCP) is undecidable.

Complexity

9. Running time of Turing Machines. The classes P, NP, NP-hard, and NP-complete.
10. Cook-Levin Theorem. SAT is NP-complete. Some reductions.

TEXTBOOK(S) AND/OR OTHER MATERIALS NEEDED:

Michael Sipser. *Introduction to the Theory of Computation* (3rd edition). Required.

SCHEDULE (TENTATIVE TO CHANGE)

Week	*Topic*	*Readings*
1	Course introduction and syllabus overview. Discussion of the basic ideas of the Computation Theory.	Chapter 0
2	Finite Automata, Deterministic Finite Automata, Nondeterminism	Section 1.1
3	Closure Properties of Regular Languages, Regular Expressions, Equivalence between Regular Expressions and Finite Automata	Section 1.2, 1.3
4	Regular Pumping Lemma, Non-Regular Languages	Section 1.4, 2.1
5	Context Free Languages: Context Free Grammars and Pushdown Automata	Section 2.2
6	Equivalence between Context Free Grammars and Pushdown Automata, CF Pumping Lemma, Non-Context Free Languages	Section 2.3, 3.1
7	Turing Machines, TM Variants, Church-Turing Thesis	Section 3.2
Midterm Exam		
8	Decision Problems for Automata and Grammars	Section 4.1
9	Undecidability, Reducibility,	Section 4.2, Section 5.1
10	Post's Correspondence Problem, Recursion Theorem	Section 5.2, 5.3, Section 6.1, 6.2
11	Time Complexity	Section 7.1
12	P and NP, SAT, Poly-time Reducibility	Section 7.2, 7.3
13	NP-Completeness	Section 7.4
14	**Final Exam**	

BREAKOUT OF HOW GRADES WILL BE DETERMINED:

Course Grade Components Approximate % of Grade

Attendance	10
Homework assignments	20
Presentation	20
Midterm	20
Final exam	30

The overall course grade is based upon the student's performance on the weekly assignments, class participation, and quizzes.

ASSIGNMENT OF GRADES:

Grades will be assigned according to point system on the following scale:

A	90 - 100
B	80 - 89
C	70 – 79
D	60 – 69
F	59 and below

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