**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 is to study various computational models and how they relate to each other. Contents include finite automata, regular expressions and languages, context-free grammars and languages, Turing machines, un-decidable and intractable problems.

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

*Complexity*



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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), Cengage Learning (2012). Required.

## SCHEDULE (TENTATIVE TO CHANGE)

| *Week* | *Topic* | *Readings* |
|---|---|---|
| 1 | Course introduction and syllabus overview<br>Discussion of the basic ideas of the Computation Theory<br>Group project registration | Chapter 0 |
| 2 | Finite Automata, Deterministic Finite Automata, Nondeterminism | Section 1.1 |
| 3 | Closure Properties of Regular Languages, Regular Expressions<br>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, 5.1 |
| 10 | Post's Correspondence Problem | Section 5.2, 5.3, 6.1, 6.2 |
| 11 | Time Complexity, P and NP | Section 7.1 |
| 12 | SAT, NP-Completeness | Section 7.2, 7.3, 7.4 |
| 13 | Rehearsal | |
| 14 | **Final Exam:** group project final defense | |

## BREAKOUT OF HOW GRADES WILL BE DETERMINED:

**Course Grade Components Approximate % of Grade**

| | |
|---|---|
| Attendance and contribution | 20 |
| Homework assignments | 30 |
| Midterm | 20 |
| Final exam: group project | 30 |

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

## 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 |

## HONESTY AND PLAGIARISM

The awarding of a university degree attests that an individual has demonstrated mastery of a significant body of knowledge and skills of substantive value to society. Any type of dishonesty in securing those credentials therefore invites serious sanctions, up to and including suspension and expulsion (see Standard of Conduct in each TROY *Catalog*). Examples of dishonesty include actual or attempted cheating, plagiarism*, or knowingly furnishing false information to any university employee.

*Plagiarism is defined as submitting anything for credit in one course that has already been submitted for credit in another course, or copying any part of someone else's intellectual work – their ideas and/or words – published or unpublished, including that of other students, and portraying it as one's own. Proper quoting, using strict MLA formatting, is required, as described by the instructor. All students are required to read the material presented at: http://troy.troy.edu/writingcenter/research.html

Teams Code: **grkba39**



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