CSC 485 **Theory of Computation**

CATALOG DESCRIPTION:

CSC 485 Theory of Computation (3,0,3) Regular and context-free grammars; Turing machines; recursive and recursively enumerable languages; uncomputability; the Chomsky hierarchy; complexity classes such as P, NP, and NP-complete. PREREQ: C or better in MAT 385.

LAST TAUGHT: Fall 2008 (G. Newell)

SCHEDULED LAB USAGE: None

STUDENT BACKGROUND EXPECTATIONS:

Experience writing proofs by induction and contradiction.
Fundamental knowledge of the concept and operation of finite state automata and regular expressions (from MAT-385).

CORE TOPICS COVERED:

1. Mathematical fundamentals (e.g. Set theory, proof techniques)
2. Concepts of Automata Theory (e.g. alphabets, languages, strings)
3. Deterministic Finite Automata (formal and informal specifications)
4. Language Acceptance via DFA
5. Non-Determinism and NFAs (formal and informal with language acceptance)
6. Equivalence of NFAs and DFAs via subset construction
7. Regular Expression
8. Equivalence of Regular Expressions and Finite Automata
9. Algebra of Regular Expressions
10. Closure Properties of Regular Languages
11. Non-regular languages via the Pumping Lemma for Regular Languages
12. Context Free Grammars
13. Parse Trees and grammar ambiguity
14. Pushdown Automata
15. Final State and Empty Stack acceptance equivalence
16. Equivalence of PDAs and CFGs
17. Normal Form CFGs (e.g. Chomskey, Greibach)
18. Pumping Lemma for CFLs
19. Closure Properties of CFLS
20. Turing Machines
21. TM's as acceptors and as generators
22. TMs and Halting
23. Recursive and Recursively Enumerable languages
24. Undecidability
25. TM codings
26. Proof of an undecidable language (usually via diagonalization) not RE
27. Proof of undecidable problems that are RE
28. Turing Reductions
29. Rice's Theorem
30. The complexity classes P, NP and NP-Complete

MOST RECENT TEXTBOOK USED :

Introduction to Automata Theory, Languages, and Computation, 3rd Edition, Hopcroft, Motwani, Ullman (Addison-Wesley, 2007). Chapters Covered: 1-9, 11.

SOFTWARE REQUIRED:

NONE

STUDENT WORK

Written homework assignments and in-class exams.

LEARNER OUTCOMES

Students will be able to…

1. Understand the fundamental language/problem classes (regular, context-free, recursive and recursively enumerable.
2. Identify and prove the appropriate category of a given language using an appropriate machine, grammar, or regular expression representation.
3. Apply the pumping lemma for both regular and context-free grammars correctly.
4. Identify unsolvable problems via the use of either Turing-reductions or application of Rice's Theorem.

CROSS-LISTINGS

CSC 585