Brooklyn College
Department of Computer & Information Sciences

CISC 7224 [724X] Formal Languages and Automata Theory
37½ hours plus conference and independent work; 3 credits

Theory of grammars, regular grammars, context-free and context-sensitive grammars, recognizers. Models of computation, finite state machines, pushdown automata, random access stored program machines. Introduction to notions of category theory and its influences.

Syllabus:

Introductory Material
- Why Formal Languages
- Sets, Alphabets, Languages

Finite Automata
- Basic Definitions
- Deterministic FA
- Nondeterministic FA
- epsilon-Transition
- Minimizations

Regular Languages
- Regular Expressions
- From Reg. exp. to FA
- Pumping Lemma

Context-Free Languages
- Context-Free Grammars
- Derivations, Parsing, Trees
- Regular Grammars
- Chomsky Normal Form

Push-Down Automata
- From CFG to PDA
- Pumping Lemma

Turing Machines
- Basic Definitions
- Variations of TM

Church Turing Thesis

Chomsky's Hierarchy

Context-Sensitive Languages
Unrestricted Grammars

Textbooks:

a) Martin Davis, Ron Sigal, Elaine J. Weyuker; *Computability, Complexity, and Languages: Fundamentals of Theoretical Computer Science.* Second Edition. (1994)

b) John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman; *Introduction to Automata Theory, Languages, and Computation.* Second Edition. (2001)

c) Harry R. Lewis, Christos H. Papadimitriou, *Elements of the Theory of Computation.* Second Edition. (1997)

d) Michael Sipser; *Introduction to the Theory of Computation.* (1997)

Summary:

Language Type	Machine	Memory	Typical Language	Grammar	Complexity
Human (Natural)	(Animal?) Brains	?	Shakespeare?	?	?
r.e. Recursive Enumerable	Turing Machines a)Chap 6 b)Chap 8 c)Chap 4 d)Chap 3	Unbounded Random Access	All r.e. languages	Unrestricted Grammar α---> α' α, α' in $(V+T)^*$ a)Sec 7.5 c)Sec 4.6	Some TMs never stop and use an infinite amount of space
Context-Sensitive	Linear Bounded Automata a)Sec 11.1 c)Pg 271 d)Pg 177-180	Bounded Random Access	$a^nb^nc^n$	CS Grammar α---> α' α, α' in $(V+T)^*$ $\|\alpha\| <= \|\alpha'\|$ a)Sec 7.5, 11.1 c)Pg 271	n space
Context-Free	Push-Down Automata a)Sec 10.8 b)Chap 6 c)Sec 3.3 d)Sec 2.2	Stacks	a^nb^n	CF Grammar V--->α α in $(V+T)^*$ a)Sec 10.1 b)Sec 5.1 c)Pg 114-115 d)Sec 2.1	n^2 time
Regular	Finite Automata a)Sec 9.1 b)Chap 2 c)Chap 2 d)Sec 1.1	None	a^mb^n	Linear Grammar: V ----> tV' a)Sec 10.2 b)Pg 180	n log n time