CS 3240: Languages and Computation
Fall 2012

Tue, Thur 1:35 to 2:55 pm, CCB 17

Instructor: Santosh Pande (santosh@cc.gatech.edu)
Office: 2338 KACB
Office Hours: Tue., Wednesday. 3:00-4:00pm, or by appointment

TA: Sangho Lee (Tentative)
TA TBD
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Announcements (back to top)

- Everything through T-square

Lectures (back to top)

- Lecture 1
- Lecture 2
- Lecture 3
- Lecture 4
- DFA Minimization Example
- Lecture 5
- Lecture 6
- Lecture 7
- Lecture 8
- Lecture 9
- Presentation 4/10
- Lecture 10
- Lecture 11
- Review

CourseDescription (back to top)

Languages express computation; certain type of computation can only be expressed by certain languages. Languages and machines are intimately related as well; certain machines can only compute certain languages. In this course we will see the relationships between computation and languages and between languages and underlying machines that can execute them. We will learn this through some practical examples. Scanners and parsers of compilers will illustrate the practical computations that can be done by finite state machines and pushdown automatons. Most powerful computational machine is Turing machine – we will discuss the notion of algorithms and Turing complexity of a computation. The key objectives of this course are the following:

- in-depth understanding of computational powers of regular language, context-free languages, and Turing machines;
- understanding of practical applications of regular and context-free languages in compilers;

- problem solving by combining the two in pattern matching languages such as Awk, Perl.

Course Outline (back to top)

Required Textbooks

Bundle ISBN# 1418879746, including (latest editions)

- "Compiler Construction: Principles and Practice" by Kenneth C. Louden, Thompson Course Technology, latest edition, ISBN 0534939724
- "Introduction to the Theory of Computation, Second Edition" by Michael Sipser, Thompson Course Technology, latest edition, ISBN 0534950973

Both textbooks are also available on reserve in the library.

Outline

- Lexical analysis, scanners, pattern matching
- Regular expressions, DFAs, NFAs and automata
- Limits on regular expressions, pumping lemma
- Practical parsing, LL and LR parsing
- Context-free languages, grammars, Chomsky Hierarchy
- Pushdown automata, deterministic vs. non-deterministic
- Attribute grammars, type inferencing
- Context-free vs. context-sensitive grammars
- Decidable vs. Undecidable problems, Turing Machines, Halting Problem
- Complexity of computation, classes of languages P/NP, space and time completeness
- Future topics: Quantum

Grading

- Homeworks: 30%
- Pop-quizzes : 4%
- Midterm : 21%
- Final: 25%
- Mini-project : 20%

Homework and Project Information (back to top)

Collaboration Policy

You are allowed to discuss course materials, homework problems, and programming assignments in small groups, but limited to discussion of general ideas only. You **must write your solutions completely independently**, and **must report the names of your collaborators with whom you discussed** the assignments. Under no circumstances may you copy solutions from any source, including but not limited to other students solutions, official solutions distributed in past terms, and solutions from courses taught at other universities. Violation of these rules may result in disciplinary actions.

Homework Guideline

No late homework or assignment is allowed without prior approval of the instructor. All homeworks due in the class at the beginning.

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Class Schedule (back to top)

- In the reading list, L stands for the textbook by Louden and S by Sipser.
- T-square for everything related to the class.
- **All schedules are very tentative and are subject to change.**
- **A very tentative schedule**

Week	Date	Topic	Reading
1	Tuesday, August 21	Course Introduction/Logistics/Compiler concepts	
	Thursday, August 23	Introduction to compiler concepts	L1
2	Tuesday, August 28	Regular expressions; Deterministic finite automata (DFA)	L2.1-3, S1.1
	Thursday, August 30th	Nondeterministic finite automota; RegExp=regular languages	L2.4,S1.2-3
3	Tuesday, Sept 4th	Topic contd.	
	Thursday, Sept 6th	Topic contd.	
4	Tuesday, Sept 11th	Topic contd.	
	Thursday, Sept 13th	Pumping lemma	S1.4
5	Tuesday, Sept 18th	Pumping lemma	S1.4
	Thursday, Sept 20th	Contd	S 1.4
6	Tuesday, Sept 25th	Lexical analysis; Context-free grammar	L2.3,S2.1
	Thursday, Sept 27th	Pushdown Automata	S2.2
7	Tuesday, Oct 2nd	Contd.	L3.1-5
	Thursday, Oct 4th	Ambiguity; Chomsky normal form	L3.1-5
8	Tuesday, Oct 9th	Review for Midterm	
	Thursday, Oct 11th	Midterm	
9	Tuesday, Oct 16th	Fall Break	
	Thursday, Oct 18th	Recursive descent	S2.3; L4.1
10	Tuesday, Oct 23rd	LL(1) parsing; First and follow sets	L4.2-3
	Thursday, Oct 25th	LL(1) parsing; First and Follow sets	L4.2-3
11	Tuesday, Oct 30th	Overview of bottom-up parsing; LR(0); Simple LR(1)	L5.1-3
	Thursday, Nov 1st	Overview of bottom-up parsing; LR(0); Simple LR(1)	L5.1-3
12	Tuesday, Nov 6th	Overview of bottom-up parsing; LR(0); Simple LR(1)	L5.1-3
	Thursday, Nov 8th	LALR(1), Error Recovery etc.	L5.5-7
13	Tuesday, Nov 13th	LALR(1), Error Recovery etc.	L5.5-7
	Thursday, Nov 15th	Context sensitive grammars : attribute grammars	

14	Tuesday, Nov 20th	Context sensitive grammars : attribute grammars	
	Thursday, Nov 22nd	Thanksgiving Holiday	
15	Tuesday, Nov 27th	Turing Machines	S3.1
	Thursday, Nov 29th	Turing Machines	S3.1
16	Tuesday, Dec 4th	Generalized Parsing : CYK Algorithm	
	Thursday, Dec 6th	Review for Finals	
	Dec 10^{th}-14^{th}	**Finals Week**	