CSC2423  FINITE MODEL THEORY AND DESCRIPTIVE COMPLEXITY  
Fall 2005  
http://www.cs.toronto.edu/~libkin/csc2423/f03

General:  
Class meets on Thursdays  
BA 2135, 4–6pm

Instructor:  
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PT388a  
Office hours: by appointment

Prerequisites:  
being familiar with the basic notions of first-order propositional and predicate logic (if you took an undergrad logic course, you should probably be fine);  
basic knowledge of complexity theory (classes P, NP, PSPACE, LOGSPACE);  
basic knowledge of language theory (regular languages, automata)

Text  

How to buy it:  
(UofT bookstore, Chapters and amazon.ca are overpriced: $73, $68, and $73!)  
Instead:  
amazon.com – US$47=CAD$55  
Springer with author discount – US$37=CAD$44 plus shipping

Topics  
Examples from database theory, language theory, complexity  
First-order logic (FO), expressiveness, failure of classical techniques in the finite  
Ehrenfeucht-Fraïssé games, winning strategies, locality  
Ordered vs unordered settings, Gurevich’s and Grohe-Schwentick theorems  
Complexity of FO  
Extensions of FO: adding counting, locality; Adding second-order quantification, monadic second-order (MSO), connection with regular languages and automata  
Coding Turing machines: Trakhtenbrot’s theorem (failure of completeness in the finite), and Fagin’s theorem (logical characterization of NP)  
Fixed point logics, Immerman-Vardi theorem (capturing PTIME); other complexity classes (logspace, pspace)  
Finite variable logic, pebble games  
0-1 law for FO and finite variable logic, the random graph; randomness phenomena over finite structures  
Finite structures embedded into infinite ones; connection with constraint databases; new techniques for expressive power  
New directions, connections with formal methods and constraint satisfaction

Requirements  
Easy problem sets  
Assignment 1  
Assignment 2  
Each assignment consists of three sections: exercises, problems, and challenges. The first two are compulsory.

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Late Assignments  
No late submission for exercises. The grading standards will be different for problems submitted late. No deadline for challenges.