

FINAL EXAM PREPARATION  
May 26, 2006

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The final exam is on Monday, June 5, 2:30-4:20pm in our regular classroom. There will be a review session, Sunday June 4 at 3:00pm, place TBA.

You can bring in **one**  $8\frac{1}{2}'' \times 11''$  review sheet. You can use **both sides**. Bringing in a review sheet that violates these rules would be considered as cheating. A bit of advice: do not spend a lot of time trying to cram in stuff on the sheet—the exam would primarily test how well you have understood the material. The exam will be closed book and closed notes (except for the review sheet).

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The final exam would cover the entire course and in particular, the following topics. There would be some emphasis on the context-free language material.

1. Strings and languages and operations on them.
2. Regular expressions and regular languages.
3. Deterministic finite automata: Formal definition,  $L(M)$ , as well as state diagrams.
4. Nondeterministic finite automata: Formal definition,  $L(M)$  for NFAs as well as state diagrams.
5. Converting NFAs to DFAs: The subset construction.
6. Construction of an NFA to accept language described by any regular expression.
7. Construction of a regular expression representing the language accepted by any NFA.
8. Closure properties of regular languages, e.g. closure under complement, intersection, reversal.
9. Proofs that languages are not regular using the pumping lemma and using equivalence relation  $\equiv_A$ .
10. The fact that (not the proof)  $A$  is regular if and only if  $\equiv_A$  has a finite number of equivalence classes.
11. Minimizing DFAs.
12. Context-free grammars and languages: Formal definitions, derivations and parse trees, ambiguity.
13. Chomsky Normal form. Fact that any CFG can be converted into CNF.
14. Pushdown Automata: Formal definitions, state diagrams and acceptance.
15. Every CFL is accepted by some PDA: Top-down constructions of PDA from CFG.
16. The fact that languages accepted by PDAs are CFLs.
17. Closure properties of CFL's: Union, concatenation, Kleene star, intersection with regular languages.
18. Pumping Lemma for CFL's: Proofs that languages are not CFL's, CFL's not closed under intersection or complement.
19. Recognizing whether languages are regular, context-free or neither.
20. Notions of Turing-recognizable and decidable languages.
21. Proving certain languages are decidable.
22. Diagonalization and countability.
23. The fact that certain natural properties of programs, such as the halting problem, are not decidable by any program.