Final Exam Study Guide

CSE 30151 Spring 2017

2017/05/01

The final exam will be on May 8, 10:30am–12:30pm, in our usual classroom, 129 DeBartolo. The exam will be open book and open (paper) notes. No computers, smartphones, or tablets will be allowed. The exam will be comprehensive. There will be eight questions, worth 15 points each, for a total of 120 points (20% of your grade).

Many of the practice problems below are from the textbook. The numbers are from the 3rd US edition. If the 3rd international edition has a different number, it is indicated by "intl."

Problems covering material before the midterm exams (HW1–6):

1. Context-free languages
   (a) Prove that a given language is *not* regular, using the pumping lemma, any results proved in the book or in class, or any combination thereof. Like HW3 2b, 3b; Sipser 1.29ac, 1.46b (intl. 1.51b).
   (b) Prove that the same language is context-free, by writing (your choice of) a CFG or a PDA. Like HW4 1ab, 3b; Sipser 2.4ad, 2.6ac, 2.7ac.
2. Decidable languages
   (a) Prove that a given language is *not* context free, using the pumping lemma, any results proved in the book or in class, or any combination thereof. Like HW5 1abc; Sipser 2.30bc (intl. 2.42bc).
   (b) Prove that the same language is in P by writing (a formal description of) a Turing machine that decides it and giving a brief complexity analysis. Like HW6 1ab; Sipser 3.8a.
3. Given some operation on languages and a language class, prove that that language class is/isn't closed under that operation. For example:
   - regular languages (like HW2 Q2, Exercise 1.31 (intl. 1.36), Problem 1.66a (intl. 1.60)).
   - context-free languages (like HW5 2ab, but not as hard), 3a; Sipser 2.38 (intl. 2.50), but not as hard).

- other languages classes are possible as well: P, NP, decidable, or Turing-recognizable.

Problems covering material after the midterm exams (HW7–8):

4. Prove that a language is undecidable, using a reduction from another language known to be undecidable (like HW7 Q1a, Q3).
5. Prove that a language is NP-complete, using a reduction from another language known to be NP-complete (like HW8 Q1–3).

Three more problems on general topics, including the above and possibly:

- Regular operations on languages (union, concatenation, Kleene star)
- Design a finite automaton or regular expression
- Equivalence of DFAs, NFAs, and regular expressions
- Equivalence of CFGs and PDAs
- Turing recognizability
- The Church-Turing Thesis
- Extensions of finite automata, regular expressions, CFGs, PDAs, or TMs
- CP1–3

Topics specifically *not* covered:

- Deterministic context-free languages (2.4)
- Algorithms for context-free grammars (108–110, 198–200)
- Reductions via computation histories (pages 220–226) and Post's Correspondence Problem (5.3)
- Chapter 6
- The proof of the Cook-Levin Theorem (304–310)