CSC320 FINAL REVIEW

Summer 2015

CSC320 FINAL EXAM

- Monday, August 10, 2pm-5pm
- ECS 116
- No aids, scrap paper provided

SUPPLEMENTARY REVIEW SESSION

- Wednesday, August 5, 10:30am-11:30am
- DSB C108
- Will review sample final (to be posted on conneX)

FINAL EXAM FORMAT

- 8 questions
- 4 "sections" – Regular Languages, Context Free Languages, TMs and Computability, Polynomial time and NP
- Each section has 2 questions – a 10 part multiple choice T/F question, and a 3-part long answer question (5/3/2 grading scheme – blank answers worth 2/1/0.5)
- MC questions worth 5 points each, long answer worth 10 points each
- All (and only) material covered in lectures or tutorials will be covered on the exam (except the Cook-Levin theorem!)
- There will be one (very easy) NP-hardness proof (3 points) and one (slightly more challenging) NP-completeness proof (2 points). These do not require a lot of cleverness – more checking that you understand the definitions.

THINGS TO REMEMBER WHICH MAY MAKE LIFE EASIER

- Every language is the subset of *some* regular language (why?). Also, every language has *some* regular language as a subset (why?)
- REG $\subseteq$ CFL $\subseteq$ P $\subseteq$ NP $\subseteq$ REC $\subseteq$ RE (why?)
- P $\subseteq$ NP $\cap$ co-NP
- REC = RE $\cap$ co-RE
- Using reductions: to show that L is undecidable, show that there is a known undecidable L' such that L' $\leq_m$L (note the direction!)
- To show that L is NP-complete, *first* show that L $\in$ NP (i.e. show that L has poly-bounded certificates which can be validated in poly time) and *then* show that from some known NP-hard problem L', L' $\leq_p$L (note the direction!)
- Every poly-time reduction is a reduction

MATERIAL COVERED

- All material covered in class on regular languages, including minimization
- DFAs, NFAs, Regular expressions, Regular languages
  - Constructions for closure properties of Regular languages (using DFA and NFA and RegExp)
  - NFA to DFA
  - RegExp to NFA
  - NFA to RegExp
  - DFA mimization
  - Pumping lemma, proving non-regularity via closure properties

MATERIAL COVERED

- CFGs – derivations, ambiguous grammars, inherently ambiguous grammars
- REG $\subseteq$ CFL
- Algorithms – Chomsky normal form, CYK algorithm
- PDAs – equivalence to CFGs
- Do *not* need to know pumping lemma for CFLs

MATERIAL COVERED

- Turing machine – basic model, equivalence to extended models – complexity of simulations
- Recognizable (RE) languages – equivalence of recognition and enumeration
- Decidable languages, REC $=$ RE $\cap$ co-RE
- Undecidability: encoding strings and machines, A_{TM} (proof that it is undecidable)
- Other undecidable languages – $E_{TM}, EQ_{TM}, \mathrm{HALT}_{\mathrm{TM}}$
- Unrecognizability
- Reductions:
  - $\mathrm{M} \leq_m \mathrm{L} \Rightarrow \bar{\mathrm{M}} \leq_m \bar{\mathrm{L}}$
  - $\mathrm{M} \leq_m \mathrm{L}$ and $\mathrm{L} \leq_m \mathrm{N} \Rightarrow \mathrm{M} \leq_m \mathrm{N}$
  - $\mathrm{M} \leq_m \mathrm{L}$ and L decidable $\Rightarrow$ M decidable

MATERIAL COVERED

- Polynomial time – input size, asymptotic running time, polynomial time TMs
- Determining the length of an input encoding
- NP – poly-time verification, poly-sized certificates, poly-time NDTMs
- SAT, CNFSAT, 3CNFSAT
- NP-completeness: NP-hard problems, reduction method
- Reductions (what are the running times?):
  - M $\leq_p$L and L $\leq_p$ N $\Rightarrow$ M $\leq_p$ N
  - M $\leq_p$ L and L poly time $\Rightarrow$ M poly time
  - M $\leq_p$L $\Rightarrow$ M $\leq_m$ L
  - NP-completeness proofs

BOOK SECTIONS COVERED

- All of Chapter 1
- 2.1, 2.2
- All of Chapter 3
- All of Chapter 4
- 5.1 (excluding LBAs and computation histories)
- 5.3
- Chapter 7 (excluding Cook-Levin, and reductions not covered in the lecture)
- NOTE: The is some material not in the book which may be covered: DFA minimization, and CYK algorithm