CSCI 320 Review

1. Regular Languages

1. Given one of these, find the others

   a) formal / informal language definition
   (eg "even number of a's followed by any number of b's" or
   $\{w \in \{a,b\}^* \mid w = a^{2n} b^m,\ n, m \geq 0\}$.
   or $\{a^{2n} b^m \mid n, m \geq 0\}$)

   b) DFA

   c) NFA

   d) regular expression.

2. Prove that a given language is NOT regular. (Pumping lemma)

3. Prove class RL ("regular languages") is closed under various operations.

2. Context-Free Languages

1. Given one of these, find the others:
   a) formal / informal language defn.
   b) PDA
   c) CFG
2. Determine if a given CFG is ambiguous
3. Prove class CFL is closed under various operations.
4. Know that: - can always convert a CFG to CNF.
   - Cannot always remove the nondeterminism from a PDA.

3. Turing Machines, Decidability, Recognizability

1. Prove a set is countably infinite by giving an enumeration scheme.
2. Prove a set (like infinite bit strings) is NOT countable using diagonalization.
3. Prove $\exists$ Enumerator-TM for L $\Leftrightarrow$ $\exists$ a Recognizer-TM for L.
4. Given that Halt, A_{TM} are undecidable, prove other languages are
   - undecidable OR unrecognizable.
5. Give a very small TM for a little problem.
6. Know enough about how to convert
   multitape $\Rightarrow$ single tape
   Non-det $\Rightarrow$ det
7. Know that anything we can do in C++ we can do with a TM.

4. Complexity Theory: P, NP, NP-c

1. Prove that a given language $\in$ NP.
2. Prove that a given language $\in$ NP-c
3. Poly-time reductions and their consequences.
4. Convert a SAT instance to 3SAT.
5. Reduce UHamPath to UHamCycle
   and UHamCycle to UHamPath.
   ... and perhaps some other reductions.