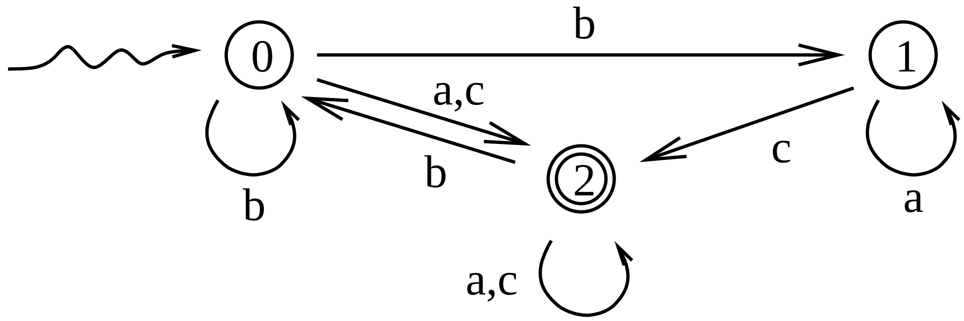
University of Nevada, Las Vegas Computer Science 456/656 Spring 2021

Practice Problems for the Examination on February 8, 2023

1. Review answers to homework1:
   `http://web.cs.unlv.edu/larmore/Courses/CSC456/S23/Assignments/hw1ans.pdf`

2. Review answers to homework2:
   `http://web.cs.unlv.edu/larmore/Courses/CSC456/S23/Assignments/hw2ans.pdf`

3. Find a minimal DFA equivalent to the NFA shown below.



4. True or False. If the question is currently open, write "O" or "Open."

   (i) ________ The complement of every regular language is regular.

   (ii) ________ The complement of every context-free language is context-free.

   (iii) ________ The complement of any $\mathcal{P}$-TIME language is $\mathcal{P}$-TIME.

   (iv) ________ ~~The complement of any $\mathcal{NP}$ language is $\mathcal{NP}$.~~

   (v) ________ ~~The complement of any $\mathcal{P}$-SPACE language is $\mathcal{P}$-SPACE.~~

   (vi) ________ The complement of every recursive language is recursive.

   (vii) ________ The complement of every recursively enumerable language is recursively enumerable.

   (viii) ________ ~~Every language which is generated by a general grammar is recursively enumerable.~~

   (ix) ________ ~~The context-free membership problem is undecidable.~~

   (x) ________ The factoring problem, where inputs are written in binary notation, is co-$\mathcal{NP}$.

   (xi) ________ ~~If L_1 reduces to L_2 in polynomial time, and if L_2 is $\mathcal{NP}$, and if L_1 is $\mathcal{NP}$-complete, then L_2 must be $\mathcal{NP}$-complete.~~

   (xii) ________ Given any context-free grammar G and any string $w \in L(G)$, there is always a unique leftmost derivation of w using G.

   (xiii) ________ For any deterministic finite automaton, there is always a unique minimal non-deterministic finite automaton equivalent to it.

   ________ ~~The question of whether two regular expressions are equivalent is known to be $\mathcal{NP}$-complete.~~

(xiv) ________ ~~The halting problem is recursively enumerable.~~

(xv) ________ The union of any two context-free languages is context-free.

(xvi) ________ ~~The question of whether a given Turing Machine halts with empty input is decidable.~~

(xvii) ________ The class of languages accepted by non-deterministic finite automata is the same as the class of languages accepted by deterministic finite automata.

(xviii) ________ ~~The class of languages accepted by non-deterministic push-down automata is the same as the class of languages accepted by deterministic push-down automata.~~

(xix) ________ The intersection of any two context-free languages is context-free.

(xx) ________ ~~If L_1 reduces to L_2 in polynomial time, and if L_2 is $\mathcal{NP}$, then L_1 must be $\mathcal{NP}$.~~

(xxi) ________ The language of all regular expressions over the binary alphabet is a regular language.

(xxii) ________ ~~Let π be the ratio of the circumference of a circle to its diameter. The problem of whether the n^{th} digit of the decimal expansion of π for a given n is equal to a given digit is decidable.~~

(xxiii) ________ ~~There cannot exist any computer program that can decide whether any two C++ programs are equivalent.~~

(xxiv) ________ ~~An undecidable language is necessarily $\mathcal{NP}$-complete.~~

(xxv) ________ ~~Every context-free language is in the class $\mathcal{P}$-TIME.~~

(xxvi) ________ ~~Every regular language is in the class $\mathcal{NC}$~~

(xxvii) ________ ~~Every Function that can be mathematically defined is recursive.~~

(xxviii) ________ ~~The language of all binary strings which are the binary numerals for prime numbers is context-free.~~

(xxix) ________ The language of all binary strings which are the binary numerals for prime numbers is regular.

(xxx) ________ ~~Every bounded function from integers to integers is Turing-computable. (We say that f is bounded if there is some B such that $|f(n)| \leq B$ for all n.)~~

(xxxi) ________ ~~The language of all palindromes over $\{0, 1\}$ is inherently ambiguous.~~

(xxxii) ________ ~~Every context-free grammar can be parsed by some deterministic top-down parser.~~

(xxxiii) ________ ~~Every context-free grammar can be parsed by some non-deterministic top-down parser.~~

(xxxiv) ________ ~~Commercially available parsers cannot use the LALR technique, since most modern programming languages are not context-free.~~

(xxxv) ________ ~~The boolean satisfiability problem is undecidable.~~

(xxxvi) ________ ~~If anyone ever proves that $\mathcal{P} = \mathcal{NP}$, then all one-way encoding systems will be insecure.~~

(xxxvii) ________ If a string w is generated by a context-free grammer G, then w has a unique leftmost derivation if and only if it has a unique rightmost derivation.

(xxxviii) ________ ~~A language L is in $\mathcal{NP}$ if and only if there is a polynomial time reduction of L to SAT.~~

(xxxix) ________ Every subset of a regular language is regular.

(xl) ________ ~~The intersection of any context-free language with any regular language is context-free.~~

(xli) ________ ~~Every language which is generated by a general grammar is recursively enumerable.~~

(xlii) ________ ~~The question of whether two context-free grammars generate the same language is undecidable.~~

(xliii) ________ ~~There exists some proposition which is true but which has no proof.~~

(xliv) ________ The set of all binary numerals for prime numbers is in the class $\mathcal{P}$.

(xlv) ________ ~~If L_1 reduces to L_2 in polynomial time, and if L_2 is $\mathcal{NP}$, and if L_1 is $\mathcal{NP}$-complete, then L_2 must be $\mathcal{NP}$-complete.~~

(xlvi) Given any context-free grammar G and any string $w \in L(G)$, there is always a unique leftmost derivation of w using G.

(xlvii) ________ For any deterministic finite automaton, there is always a unique minimal non-deterministic finite automaton equivalent to it.

(xlviii) ________ ~~The question of whether two regular expressions are equivalent is $\mathcal{NP}$-complete.~~

(xlix) ________ ~~No language which has an ambiguous context-free grammar can be accepted by a DPDA.~~

(l) ________ The class of languages accepted by non-deterministic push-down automata is the same as the class of languages accepted by deterministic push-down automata.

(li) ________ The intersection of any two regular languages is regular.

(lii) ________ The intersection of any two context-free languages is context-free.

(liii) ________ If L_1 reduces to L_2 in polynomial time, and if L_2 is $\mathcal{NP}$, then L_1 must be $\mathcal{NP}$.

(liv) ________ Let $F(0) = 1$, and let $F(n) = 2^{F(n-1)}$ for $n > 0$. Then F is recursive.

(lv) ________ Every language which is accepted by some non-deterministic machine is accepted by some deterministic machine.

(lvi) ________ The language of all regular expressions over the binary alphabet is a regular language.

(lvii) ________ Let π be the ratio of the circumference of a circle to its diameter. (That's the usual meaning of π you learned in school.) The problem of whether the n^{th} digit of π, for a given n, is equal to a given digit is decidable.

(lviii) ________ There cannot exist any computer program that decides whether any two given C++ programs are equivalent.

(lix) ________ An undecidable language is necessarily $\mathcal{NP}$-complete.

(lx) Every context-free language is in the class $\mathcal{P}$-TIME.

(lxi) ________ Every function that can be mathematically defined is recursive.

(lxii) ________ Every bounded function from integers to integers is Turing-computable. (We say that f is bounded if there is some B such that $|f(n)| \leq B$ for all n.)

(lxiii) Every context-free language is in the class $\mathcal{P}$-TIME.

(lxiv) ________ Every function that can be mathematically defined is recursive.

(lxv) ________ The language of all binary strings which are the binary numerals for multiples of 23 is regular.

(lxvi) ________ ~~Every bounded function from integers to integers is Turing-computable. (We say that f is bounded if there is some B such that $|f(n)| \leq B$ for all n.)~~

(lxvii) Commercially available parsers cannot use the LALR technique, since most modern programming languages are not context-free.

(lxviii) ________ ~~If anyone ever proves that $\mathcal{P} = \mathcal{NP}$, then all public key/private key encryption systems will be known to be insecure.~~

(lxix) ________ ~~If a sequence of fractions converges to a real number x, then x must be a recursive real number.~~

________ ~~If a machine outputs a sequence of fractions which converges to a real number x, then x must be a recursive real number.~~