

University of Nevada, Las Vegas Computer Science 456/656 Spring 2022

Topics Covered on Examination February 23, 2022

1. Fundamentals.
 - (a) What is an alphabet?
 - (b) What is a symbol?
 - (c) What is a language?
 - (d) Decidable and undecidable languages.
 - (e) Computable and uncomputable functions.
 - (f) Proof by contradiction.
2. Finite state automata, and their relationship with regular languages.
 - (a) Draw a state diagram.
 - (b) Minimize a DFA.
 - (c) Find a DFA equivalent to an NFA.
 - (d) What language does this DFA, or NFA, accept?
 - (e) T/F or fill-in-the blank questions.
3. Regular expressions.
 - (a) Find a regular expression.
 - (b) The language described by a regular expression.
 - (c) T/F or fill-in-the blank questions.
4. State the pumping lemma accurately. The quantifiers must be properly expressed. If you have all the right words in some wrong order you might get no credit.
5. Regular grammars.
 - (a) Left-regular (left-linear) or right-regular (right-linear).
 - (b) A grammar that generates the language accepted by an NFA.
 - (c) T/F or fill-in-the blank questions.
6. Other questions about regular languages.
 - (a) The empty string.
 - (b) Kleene closure.
 - (c) Closure properties of the class of regular languages.
 - (d) Homomorphism.
 - (e) Every finite language is regular.
 - (f) Regular sets of numbers.
 - Is the set of terms of an arithmetic sequence regular?

- Is the set of prime numbers regular?
- (g) T/F or fill-in-the blank questions.
7. Context-free grammars and languages.
- (a) Derivations.
- i. Derivation of a string.
 - ii. Left-most and right-most derivations.
 - iii. Parse trees.
 - iv. Ambiguity and uniqueness of derivations.
 - v. T/F or fill-in-the blank questions.
- (b) Equivalence of grammars.
- i. The CF grammar equivalence problem is undecidable.
- (c) Chomsky Normal Form.
- i. The CYK algorithm.
- (d) Push-down automata. (PDAs)
- i. Diagram of a PDA
 - ii. Deterministic push-down automata. (DPDAs)
 - What does that mean?
 - End-of-file symbol.
 - iii. How does a PDA accept a string?
 - Input file must be empty.
 - Empty stack.
 - Final state.
 - Empty stack and final state.
 - iv. T/F or fill-in-the blank questions.
8. Logic
- (a) Truth tables.
- (b) Universal and existential quantifiers.
9. Computational Complexity
- (a) Polynomial functions.
- (b) Polynomial language classes.
- i. The language class \mathcal{P} -TIME, usually just called \mathcal{P} .
 - ii. The language class \mathcal{NP} . Two definitions.
 - Polynomially many steps of a non-deterministic machine.
 - Deterministic verification in polynomial time, if the answer is **true**.
 - iii. \mathcal{NP} -completeness.
 - iv. Some \mathcal{NP} -complete languages/ problems: