

Computer Science 4602
Fall 2022
Practice Quiz 1

You have 50 minutes. Answer all of the questions. You may use one prepared 8.5×11 sheet of paper during the exam. **Check your work.**

1. Write a clearly legible **T** to the **left** of each of the following that is true, and a clearly legible **F** to the **left** of each that is false. An illegible or ambiguous answer is automatically wrong.
 - (a) Every alphabet is finite.
 - (b) Every alphabet is nonempty.
 - (c) Every language is infinite.
 - (d) Every language is nonempty.
 - (e) A string over alphabet Σ can be infinitely long.
 - (f) If M is a DFA then $L(M)$ must be a finite set.
 - (g) If M is a DFA then $L(M)$ must be a regular language.
 - (h) If X is a regular language then there must exist a deterministic finite-state machine M where $L(M) = X$.
 - (i) The empty set is a regular language.
 - (j) Language $\{abcd\}$ is a regular language.
 - (k) No infinite language is regular.
 - (l) Every finite language is regular.
 - (m) $\emptyset \cup S = S$ for every set S .
 - (n) $\emptyset \cap S = S$ for every set S .
 - (o) $\emptyset \in S$ for every set S .
 - (p) $\emptyset \subseteq S$ for every set S .
 - (q) $S \cap S = \emptyset$ for every set S .
 - (r) $S - S = \emptyset$ for every set S .

2. Draw a state transition diagram of a deterministic finite-state machine that recognizes language $\{aba\}$ over alphabet $\{a,b\}$. Notice that language $\{aba\}$ has exactly one member.

3. Draw a state transition diagram of a deterministic finite-state machine with alphabet $\{a, b, c\}$ that accepts all strings that contain $cacab$ as a contiguous substring, and that rejects all other strings. For example, it should accept $cacaccacacabab$ but reject $acbabbcab$.

4. Write a regular expression that describes set $\{w \in \{a, b, c\}^* \mid w \text{ contains "ccbc" as a contiguous substring}\}$. For example, it should generate "abccbc" but not "acbaccb". Use the regular expression notation defined in class.

5. Write a regular expression that describes the set $\{w \in \{a, b, c\}^* \mid \text{the length of } w \text{ is at least 2 and most 4}\}$. Use the regular expression notation defined in class. The length of your regular expression must be no more than 100 total characters. (Don't take that as a suggestion that you need that many characters. You don't.)

6. Prove that language $A = \{a^m b^n \mid n > m\}$ over alphabet $\{a, b\}$ is not regular. Make your proof clear and readable. Do not expect the reader to guess what you are doing. Follow this outline.
- (a) The proof is by contradiction. Suppose that A is regular. That means there is a DFA M that solves A . Do an experiment on A by running it on a sequence of strings. *What is the sequence of strings that you run A on?*

- (b) What can you conclude from the experiment in part (a)?

- (c) Using the information from part (b), show that M does not solve A . That contradicts the assumption that M solves A .