Computer Science 4602
Fall 2021
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 "*cacacccacacabab*" but reject "*acbabccab*".

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

5. Write a regular expression that describes the set $\{w \in \{a, b, c\}^* \mid$ the length of w 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.