Quiz 2

Instructions: Succinctly answer each question. No justification is needed for True/False questions.

1. Complete the following definition: a CFG \( G = (V, \Sigma, R, S) \) is regular if:

2. Complete the following start of a proof for showing \( L_5 = \{x \in \{a, b\}^*: 0 \leq |x| \leq 4\} \) cannot be accepted by any 5-state DFA: Assume for contradiction that there is a 5-state DFA \( M = (Q, \Sigma, \delta, q_0, F) \) that accepts \( L_5 \). Consider then the strings

   and the corresponding states of \( M \)

   By the pigeonhole principle, we know that

   for some \( 0 \leq i < j \leq \)

   [The proof continues, you are not asked how.]

3. According to the conventions of your text, a Turing machine is a 7-tuple \( M = (Q, \Sigma, \Gamma, \delta, q_0, q_{\text{accept}}, q_{\text{reject}}) \) where

   \[ \delta : \] (Fill in the domain and range of the function \( \delta \).)
4. Explain what is the difference in meanings between “Turing machine $M$ accepts the language $L$” and “Turing machine $M$ decides the language $L$.”

5. In a sentence or two, state the Church-Turing thesis.

6. True or False: The language $L_n = \{0^n1^n\}$ is always regular.

7. True or False: Language $L = \{w \in \{0, 1\}^* : w$ has an equal number of 01’s and 10’s$\}$ is regular.

8. True or False: Let $\text{noPrefix}(L) = \{w \in L \mid$ no proper prefix of $w$ is in $L\}$. Then $\text{noPrefix}(L)$ is finite.

9. True or False: Deterministic and nondeterministic TMs accept exactly the same languages.

10. True or False: It is possible to convert a TM $M$ into an unrestricted grammar $G$ the language of which is $L(M)$.

11. True or False: If $L$ is r.e. then $L^*$ is r.e.

12. True or False: If $L^*$ is decidable then $L$ is decidable.

13. True or False: The language $A = \{\langle M, w \rangle :$ TM $M$ rejects $w\}$ is r.e.

14. True or False: The language $B = \{\langle M \rangle :$ TM $M$ rejects some string $w\}$ is r.e.

15. True or False: The language $C = \{\langle M \rangle : L(M)$ is finite $\}$ is r.e.