

CONCORDIA UNIVERSITY
Dept. of Computer Science and Software Engineering
COMP 335 – Introduction to Theoretical Computer Science
Fall 2023

Assignment 1

Submission through moodle is due by Sunday, September 17th at 23:59

1. [10 Points] Let L be any language over an alphabet Σ . Prove or disprove each of the following statements about L^+ ?
 - (a) L^+ is finite only if $L = \emptyset$.
 - (b) $L^+ = L^* - L^0$.
2. [15 Points] Let G be a grammar with the start variable S and the following productions:
$$S \rightarrow aaA \mid \lambda$$
$$A \rightarrow bS$$
 - (a) Give a simple description of the language $L(G)$ generated by grammar G above.
 - (b) Show a derivation of the string $w = aabaab$ from G .
 - (c) Suppose $L = \{w : w \in L(G) \text{ and } |w| \leq 10\}$. What is L^R , the reverse of L ?
3. [15 Points] For each of the following languages over $\{0, 1\}$, give a DFA that accepts it.
 - (a) $L_a = \{w : w \text{ begins with } 0\}$
 - (b) $L_b = \{w : w \text{ ends with } 11\}$
 - (c) $L_c = \{w : w \text{ either begins with } 0 \text{ or ends with } 00, \text{ but not both}\}$
4. [10 Points] Design a DFA that accepts every string w over $\{a, b\}$ in which every a is followed by one or two b 's but not more.
5. [10 Points] Design a DFA that accepts every string w over the alphabet $\{a, b, c\}$ in which no two consecutive symbols are the same.
6. [10 Points] Design a DFA that accepts all positive decimal integers that are not divisible by 3. The positive decimal integers considered in this context is defined as a sequence of decimal digits that do not start with 0. Examples of strings that are accepted by this DFA include: 1, 4, 88, \dots , and examples of strings that are not accepted include: 0, 3, 12, 999, 00, 001, 003, \dots .