University of Central Florida
School of Computer Science
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T2

1. Put the following grammar in Chomsky Normal Form.

$$\begin{aligned} S &\rightarrow SS + AA \\ A &\rightarrow AB + a \\ B &\rightarrow BS + b + \lambda \end{aligned}$$

2. Write a context-free grammar for the following language

$$L = \{a^n b^k a^m \mid m = n + k, m, n, k \geq 0\}.$$

3. Let M be the following DFA.

Write left-linear and right-linear grammars for the language accepted by M.

4. Eliminate left-recursion from the following grammar

$$\begin{aligned} S &\rightarrow SB + A \\ A &\rightarrow AB + a \\ B &\rightarrow Ba + b \end{aligned}$$

5. Consider the following languages

$$\begin{aligned} L &= \{\omega\omega^r\omega \mid \omega \in (a+b)^*\} \\ R &= \{\omega \mid \omega \in (a+b)^* \text{ and } \omega \text{ has exactly 6 b's }\} \\ T &= L \cap R \end{aligned}$$

   (a) Give a string in T of length 12.

   (b) Find a string $\omega \in b(a+b)^*b$ of length 6 such that $\omega\omega\omega \in T$.

   (c) Give a convincing argument that L is not context-free. Your argument should

   - use the fact that R is regular;
   - use the fact that the intersection between a regular language and a CFL is a CFL;
   - define a string $z \in T$ for which the pumping lemma for CFL's does not hold;
   - a concise and convincing explanation of why z cannot be "pumped".