

Assignment 4

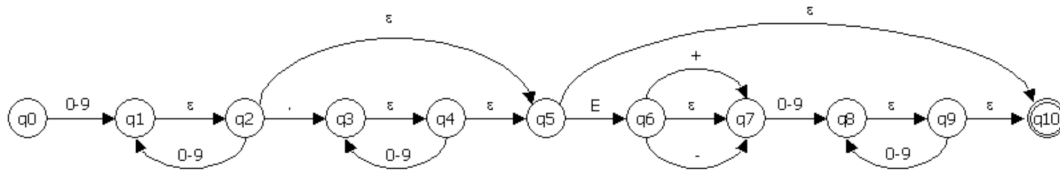
COS30023 - Languages in Software Development

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1. Problem 1

1.1. Finite Automaton



1.2. Equations and Rules

$$(S_1 \cdot S_2) \cdot S_3 = S_1 \cdot (S_2 \cdot S_3)$$

$$(S_1 | S_2) \cdot T = S_1 \cdot T | S_2 \cdot T$$

$$T \cdot (S_1 | S_2) = T \cdot S_1 | T \cdot S_2$$

$$S \cdot \epsilon = S$$

$$S \cdot \emptyset = \emptyset$$

$$S \cdot (T \cdot S)^* = (S \cdot T)^* \cdot S$$

1.2.1. Arden's Rule

$$X = S \cdot X | T \text{ has solution } S^* \cdot T$$

1.3. Equation Set

$$\begin{aligned}q_0 &= 0 - 9 \oplus q_1 \\q_1 &= \epsilon \oplus q_2 \\q_2 &= 0 - 9 \oplus q_1 \mid \cdot \oplus q_3 \mid \epsilon \oplus q_5 \\q_3 &= \epsilon \oplus q_4 \\q_4 &= 0 - 9 \oplus q_3 \mid \epsilon \oplus q_5 \\q_5 &= E \oplus q_6 \mid \epsilon \oplus q_{10} \\q_6 &= + \oplus q_7 \mid - \oplus q_7 \mid \epsilon \oplus q_7 \\q_7 &= 0 - 9 \oplus q_8 \\q_8 &= \epsilon \oplus q_9 \\q_9 &= 0 - 9 \oplus q_8 \mid \epsilon \oplus q_{10} \\q_{10} &= \epsilon\end{aligned}$$

1.3.1. Simplified Sets

$$\begin{aligned}q_0 &= 0 - 9 \oplus q_1 \\q_1 &= q_2 \\q_2 &= 0 - 9 \oplus q_1 \mid \cdot \oplus q_3 \mid q_5 \\q_3 &= q_4 \\q_4 &= 0 - 9 \oplus q_3 \mid q_5 \\q_5 &= E \oplus q_6 \mid q_{10} \\q_6 &= (+ \mid - \mid \epsilon) \oplus q_7 \\q_7 &= 0 - 9 \oplus q_8 \\q_8 &= q_9 \\q_9 &= 0 - 9 \oplus q_8 \mid q_{10} \\q_{10} &= \epsilon\end{aligned}$$

1.3.2. Substitute q_{10}

$$\begin{aligned}q_5 &= E \oplus q_6 \mid q_{10} \\&= E \oplus q_6 \mid \epsilon\end{aligned}$$

$$\begin{aligned}q_9 &= 0 - 9 \oplus q_8 \mid q_{10} \\&= 0 - 9 \oplus q_8 \mid \epsilon\end{aligned}$$

1.3.3. Substitute q_9

$$\begin{aligned} q_8 &= 0 - 9 \oplus q_8 \mid \epsilon \\ &= (0 - 9)^* \oplus \epsilon \quad \text{Arden's Rule} \\ &= (0 - 9)^* \end{aligned}$$

1.3.4. Substitute q_8

$$q_7 = 0 - 9 \oplus (0 - 9)^*$$

1.3.5. Substitute q_7

$$q_6 = (+ \mid - \mid \epsilon) \oplus (0 - 9 \oplus (0 - 9)^*)$$

1.3.6. Substitute q_6

$$q_5 = E \oplus ((+ \mid - \mid \epsilon) \oplus (0 - 9 \oplus (0 - 9)^*)) \mid \epsilon$$

1.3.7. Substitute q_5

$$q_4 = 0 - 9 \oplus q_3 \mid (E \oplus ((+ \mid - \mid \epsilon) \oplus (0 - 9 \oplus (0 - 9)^*)) \mid \epsilon)$$

$$q_2 = 0 - 9 \oplus q_1 \mid . \oplus q_3 \mid (E \oplus ((+ \mid - \mid \epsilon) \oplus (0 - 9 \oplus (0 - 9)^*)) \mid \epsilon)$$

1.3.8. Substitute q_4

$$\begin{aligned} q_3 &= 0 - 9 \oplus q_3 \mid (E \oplus ((+ \mid - \mid \epsilon) \oplus (0 - 9 \oplus (0 - 9)^*)) \mid \epsilon) \\ &= (0 - 9)^* \oplus (E \oplus ((+ \mid - \mid \epsilon) \oplus (0 - 9 \oplus (0 - 9)^*)) \mid \epsilon) \quad \text{Arden's Rule} \end{aligned}$$

1.3.9. Substitute q_3

$$\begin{aligned} q_2 &= 0 - 9 \oplus q_1 \\ &\mid . \oplus ((0 - 9)^* \oplus (E \oplus ((+ \mid - \mid \epsilon) \oplus (0 - 9 \oplus (0 - 9)^*)) \mid \epsilon)) \\ &\mid (E \oplus ((+ \mid - \mid \epsilon) \oplus (0 - 9 \oplus (0 - 9)^*)) \mid \epsilon) \end{aligned}$$

1.3.10. Substitute q_2

$$\begin{aligned} q_1 &= 0 - 9 \oplus q_1 \\ &| \cdot \oplus ((0 - 9)^* \oplus (E \oplus ((+| - |\epsilon) \oplus (0 - 9 \oplus (0 - 9)^*)) | \epsilon)) \\ &| (E \oplus ((+| - |\epsilon) \oplus (0 - 9 \oplus (0 - 9)^*)) | \epsilon) \\ &= (0 - 9)^* \oplus (\cdot \oplus ((0 - 9)^* \oplus (E \oplus ((+| - |\epsilon) \oplus (0 - 9 \oplus (0 - 9)^*)) | \epsilon)) \\ &| (E \oplus ((+| - |\epsilon) \oplus (0 - 9 \oplus (0 - 9)^*)) | \epsilon)) \end{aligned}$$

1.3.11. Substitute q_1

$$\begin{aligned} q_0 &= 0 - 9 \oplus ((0 - 9)^* \oplus (\cdot \oplus ((0 - 9)^* \oplus (E \oplus ((+| - |\epsilon) \oplus (0 - 9 \oplus (0 - 9)^*)) | \epsilon)) \\ &| (E \oplus ((+| - |\epsilon) \oplus (0 - 9 \oplus (0 - 9)^*)) | \epsilon))) \end{aligned}$$

1.4. Regular Expression

$$^{[0 - 9]^+ \setminus . ? [0 - 9]^* (E [+ -] ? [0 - 9]^+) ? \$}$$