Branch : CSE & IT Batch:Hinglish

Theory of Computation

Finite Automata - Regular Language Identification Part-1

DPP-11

[MSQ]

1. Which of the following language is/are regular?

(a) $L = \{a^m b^n\} \mid m \not< n \text{ and } m \not> n\}$

(b) $L = \{a^n b^n c^n \mid n \geq 100\}$

(c) $L = \{a^m b^n \mid LCM\ (m, n) = 100\}$

(d) $L = \{aaa^n b^n bb \mid n \geq 1\}$

[MCQ]

2. Consider the following two language L_1 and L_2.

$L_1 = \{www \mid w \in \{a\}^*\}$

$L_2 = \left\{\{a^{n^n}\}^* \middle| n \geq 1\right\}$

Which of the following is correct?

(a) L_1 is regular.

(b) L_2 is regular.

(c) Both L_1 and L_2 are regular.

(d) None of these.

[MCQ]

3. Which of the following language is non-regular?

(a) $L = \{wxw^R \mid x, w \in \{a, b\}^*\}$.

(b) $L = \{wxw \mid w, x \in \{a, b\}^*\}$.

(c) $L = \{wxwx \mid w, x \in \{a, b\}^+\}$.

(d) None of these

[MCQ]

4. Consider the following grammar G_1 and G_2:

G_1: $S \to aAb$

$A \to aB \mid \in$

$B \to Ab$

G_2: $S \to aABb$

$A \to aA \mid \in$

$B \to bB \mid \in$

Which of the following grammar generates a regular language?

(a) G_1 only (b) G_2 only

(c) Both G_1 and G_2 (d) None of these

[NAT]

5. Consider the following three languages:

(1) $L = \left\{a^{n^n} \middle| n \geq 1\right\}$

(2) $L = \left\{a^{m^n} \middle| m = n^2, n \geq 1\right\}$

(3) $L = \left\{a^{m^n} \middle| n \geq 1, m > n\right\}$

Total number of regular languages is/are_____.

[MCQ]

6. Consider the following grammar

G:

$G = S \to AB \mid CD$

$A \to aaA \mid \in$

$B \to bB \mid \in$

$C \to aaC \mid \in$

$D \to bD \mid \in$

The language generated by above grammar is:

(a) Finite (b) Infinite but regular

(c) Non-regular (d) None of these

[MCQ]

7. Which of the following language is non-regular?

(a) $L = \{a^{2m} b^n b^n \mid m, n \geq 1\}$

(b) $L = \{a^m b^n X \mid m, n \geq 1, X \in \{a,b\}^*\}$

(c) $L = \left\{\{a^{n^2}\}^* \middle| n \geq 0\right\}$

(d) None of these

Answer Key

1. **(a)**
2. **(c)**
3. **(d)**
4. **(b)**
5. **(1)**
6. **(b)**
7. **(d)**

Hints and Solutions

1. (a)

(a) $L = \{a^m b^n \mid m \not< n \text{ and } m \not> n\}$

$L = \{a^m b^n \mid m = n\}$

= not regular

(b) $L = \{a^m b^n c^n \mid n \geq 100\}$

Not regular

(c) $L = \{a^m b^n \mid LCM(m, n) = 100\}$

Finite $\rightarrow$ Regular

(d) $L = \{aaa^n b^m bb \mid m, n \geq 1\}$

$L = aa(a)^n bb(b)^n$

Not regular

Hence, option (c) is correct.

2. (c)

$L_1 = \{wxw \mid w \in \{a\}^*\}$

$L_1 = (aaa)^*$

Regular language

$L_2 = \left\{\left\{a^{n^n}\right\}^* \middle| n \geq 1\right\}$

$L_2 = \{a^1\}^*$

$= a^*$

= Regular.

3. (d)

(a) $L = \{wxw^R \mid x, w \in \{a, b\}^*\}$

Minimal string $= \in \cdot (a + b)^* \in$

$= (a + b)^*$

Regular

(b) $L = \{wx\, w \mid w, x\ \{a, b\}^*\}$

$L = \in \cdot (a + b)^* \cdot \in$

$= (a + b)^*$

Regular

(c) $L = \{wxwx \mid w, x \in \{a, b\}^+\}$

Minimal string $= a(a + b)^+ a\ (a + b)^+$ **or**

$b(a + b)^+ b\ (a + b)^+$

$ab\ (a + b)^+ ab\ (a + b)^+$ cover by minimal string

$ba\ (a + b)^+ ba\ (a + b)^+$ cover by minimal string

$aa\ (a + b)^+ aa\ (a + b)^+$ cover by minimal string

$bb\ (a + b)^+ bb\ (a + b)^+$ cover by minimal string

Regular

Hence option (d) is correct.

4. (b)

G_1: $S \rightarrow aAb$

$A \rightarrow aB \mid \in$

$B \rightarrow Ab$

$L = a\ A\ b$

$= ab$

$L = a\ A\ b$

$= a\ a\ B\ b$

$= a\ a\ A\ b\ b$

$= a\ a\ a\ B\ b\ b$

$= a\ a\ a\ A\ b\ b\ b$

$= a\ a\ a\ b\ b\ b$

Number of a's equal to number of b's. Comparision not possible in DFA(regular).

G_2: $S \rightarrow aABb$

$A \rightarrow aA \mid \in = a^*$

$B \rightarrow bB \mid \in = b^*$

$L = aa^*\ b^*b$

= Regular

G_2 is regular

Hence option (b) is correct.

5. (1)

(1) $L = \left\{a^{n^n} \middle| n \geq 1\right\}$

$L = \{a, a^4, a^{27}, \ldots.\}$ Non-regular

(2) $L = \left\{a^{m^n} \middle| m = n^2, n \geq 1\right\}$

$L = \left\{a^{1^1}, a^{4^2}, a^{9^3} \ldots.\right\}$

$= \left\{a, a^{16}, a^{43} \ldots.\right\}$

Non-regular

(3) $L = \left\{a^{m^n} \middle| n \geq 1, m > n\right\}$

$L = \left\{a^{2^1}, a^{3^1}, a^{4^1} \ldots.\right\}$

$= \left\{a^2, a^3, a^4 \ldots.\right\}$

$= aa(a)^*$

Regular

6. (b)

$S \rightarrow AB \mid CD = (aa)^*b^* + (aa)^*b^*$

$A \rightarrow aaA \mid \in = (aa)^*$

$B \rightarrow bB \mid \in = (b)^*$

$C \rightarrow aaC \mid \in = (aa)^*$

$D \rightarrow bD \mid \in = b^*$

L = Regular (infinite regular)

Hence, option (b) is correct.

7. (d)

(a) $L = \{a^{2m} b^n b^n \mid m, n \geq 1\}$

$= (aa)^+ b^{2n}$

$= (aa)^+ (bb)^+$ Regular

(b) $L = \{a^m b^n X \mid X \in \{a, b\}^* m, n \geq 1\}$

$= (a)^+ (b)^+ (a + b)^*$

= Regular

(c) $L = \left\{\left\{a^{n^2}\right\}^* \middle| n \geq 0\right\}$

$L = \{\in, a, aa, aaa \ldots\}$

$= a^*$

= Regular

Hence, option (d) is correct.