

Theory of Computation

Finite Automata

DPP-11

[MSQ]

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

- (a) $L = \{a^m b^n \mid m < n \text{ and } m > n\}$
- (b) $L = \{a^n b^n c^n \mid n \geq 100\}$
- (c) $L = \{a^m b^n \mid \text{LCM}(m, n) = 100\}$
- (d) $L = \{aaa^n b^n bb \mid n \geq 1\}$

[MCQ]2. Consider the following two language L_1 and L_2 .

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

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

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 :

$$G_1: S \rightarrow aAb$$

$$A \rightarrow aB \mid \epsilon$$

$$B \rightarrow Ab$$

$$G_2: S \rightarrow aABb$$

$$A \rightarrow aA \mid \epsilon$$

$$B \rightarrow bB \mid \epsilon$$

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

Total number of regular languages is/are _____.

[MCQ]

6. Consider the following grammar

G:

$$G = S \rightarrow AB \mid CD$$

$$A \rightarrow aaA \mid \epsilon$$

$$B \rightarrow bB \mid \epsilon$$

$$C \rightarrow aaC \mid \epsilon$$

$$D \rightarrow bD \mid \epsilon$$

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) $L = \left\{ \left\{ a^{n^2} \right\}^* \mid n \geq 0 \right\}$
- (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)

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

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

= not regular

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

Not regular

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

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

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

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

$$= a^*$$

= Regular.

3. (d)

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

$$\text{Minimal string} = \epsilon \cdot (a+b)^* \in$$

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

Regular

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

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

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

Regular

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

$$\text{Minimal string} = a(a+b)^+ a(a+b)^+ \text{ or } b(a+b)^+ b(a+b)^+$$

$ab(a+b)^+ ab(a+b)^+$ 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)

$$G_1: S \rightarrow aAb$$

$$A \rightarrow aB \mid \epsilon$$

$$B \rightarrow Ab$$

$$L = a A b$$

$$= ab$$

$$L = a A b$$

$$= a a B b$$

$$= a a A b b$$

$$= a a a B b b$$

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

$$= a a a b b b$$

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

$$G_2: S \rightarrow aABb$$

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

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

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

= Regular

G_2 is regular

Hence option (b) is correct.

5. (1)

$$(1) L = \{a^{n^n} \mid n \geq 1\}$$

$$L = \{a, a^4, a^{27}, \dots\} \text{ Non-regular}$$

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

$$L = \{a^{1^1}, a^{4^2}, a^{9^3}, \dots\}$$

$$= \{a, a^{16}, a^{43}, \dots\}$$

Non-regular

$$(3) L = \{a^{m^n} \mid n \geq 1, m > n\}$$

$$L = \{a^{2^1}, a^{3^1}, a^{4^1}, \dots\}$$

$$= \{a^2, a^3, a^4, \dots\}$$

$$= aa(a)^*$$

Regular

6. (b)

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

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

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

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

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

$L = \text{Regular (infinite regular)}$

Hence, option (b) is correct.

7. (d)

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

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

$$= (aa)^+ (bb)^+ \text{ Regular}$$

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

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

$$= \text{Regular}$$

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

$$L = \{\epsilon, a, aa, aaa \dots\}$$

$$= a^*$$

$$= \text{Regular}$$

Hence, option (d) is correct.



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