

Computer Science & Information Technology

Theory Of Computation

DPP: 1

Pushdown Automaton

- Q1** Suppose L_1 is a finite language and L_2 is non-regular language then $L_1 \cap L_2$ will be:
 (A) Regular but infinite.
 (B) Non-regular.
 (C) Finite and regular.
 (D) None of these.
- Q2** Consider the following statements:
 (i) All finite languages are context free language.
 (ii) All regular languages are finite.
 (iii) All DCFLs are finite.
 (iv) All regular languages are DCFL
 (v) There exists some language which are finite and irregular.
 The number of correct statements from the above statements are _____.
- Q3** Consider the following languages.
 $L_1 = \{a^n b^n \mid n \geq 0\}$
 $L_2 = \{a^n b^m c^k \mid n, m, k \geq 0 \wedge n \neq m \vee m \neq k\}$
 Which of the following statements is correct?
 (A) L_1 is CFL and L_2 is DCFL
 (B) L_1 is DCFL and L_2 is CFL
 (C) L_1 and L_2 both are DCFL
 (D) None of these
- Q4** Which of the following grammar is/are generating DCFL but not regular language?
 (A) $S \rightarrow aaSbb \mid \epsilon$
 (B) $S \rightarrow aSbb \mid \epsilon$
 (C) $S \rightarrow aaSb \mid \epsilon$
 (D) $S \rightarrow abS \mid \epsilon$
- Q5** Consider the following languages:
 $L_1 = \{a^m b^n c^k \mid \text{if } (m = \text{even}) \text{ then } (n = k)\}$
 $L_2 = \{a^n c b^n\} \cup \{a^n d b^n\}$
 Which of the following is correct statement?
 (A) Only L_1 is DCFL.
 (B) Only L_2 is DCFL.
 (C) Both L_1 and L_2 are CFL but not DCFL.
 (D) Both L_1 and L_2 are DCFL but not regular.
- Q6** Consider the following grammar:
 $S \rightarrow AB$
 $A \rightarrow aAa \mid bAb \mid \epsilon$
 $B \rightarrow aBa \mid bBb \mid \epsilon$
 Which of the following is correct regarding above grammar?
 (A) Language produced by S is $L = \{xx^R yy^R \mid x, y \in \{a, b\}^*\}$ and L is DCFL but not regular.
 (B) Language produced by S is $L = \{xx^R yy^R \mid x, y \in \{a, b\}^*\}$ and L is CFL but not DCFL.
 (C) Language produced by S is $L = \{xx^R yy^R \mid x, y \in \{a, b\}^*\}$ and L is DCFL.
 (D) None of the above.
- Q7** The intersection of CFL and a regular language will be
 (A) Always regular
 (B) Always CFL
 (C) Always not regular
 (D) None of these
- Q8** Consider the following grammars G_1 , G_2 and G_3 :
 $G_1: S \rightarrow PQ$
 $P \rightarrow 0P1 \mid \epsilon$



$$Q \rightarrow 1 Q 2 \mid \epsilon$$

$$G_1: S \rightarrow 0 S 1 \mid Q$$

$$P \rightarrow 1 Q 2 \mid \epsilon$$

$$G_1: S \rightarrow P Q \mid Q \mid P$$

$$P \rightarrow 0 P 1 \mid 0 1 \mid \epsilon$$

$$Q \rightarrow 1 Q 2 \mid \epsilon$$

Here, $\{S, P, Q\}$ are variables where S is start symbol. $\{0, 1, 2\}$ are terminals.

Which of the following is true?

- (A) G_1 and G_1 are equivalent.
- (B) G_1 and G_3 are equivalent
- (C) G_2 and G_3 are equivalent
- (D) None of these.

Q9 Consider the following language.

L_1 = Context free language.

L_2 = Deterministic context free language.

L_3 = Context sensitive language.

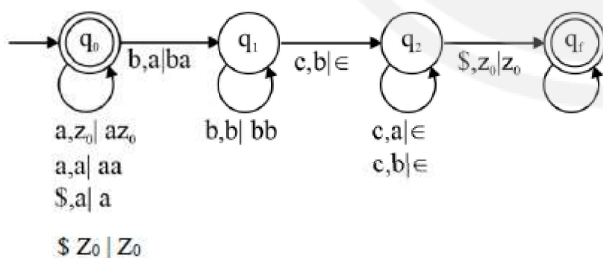
L_4 = Regular

Which of the following is incorrect?

- (A) $L_2 \cdot L_4$ is always DCFL.
- (B) $L_1 \cap L_3$ is CSL.
- (C) $\Sigma^* - L_3$ is CSL.
- (D) None of the above.

Q10 Consider the following push down automata.

$PDA = \{Q, \Sigma, \delta, \Gamma, q_0, Z_0, q_f\}$



Which of the following language is accepted by above PDA?

- (A) $L = \{a^*\} \cup \{a^p b^q c^r \mid p, q, r \geq 1, p + q = r\}$
- (B) $L = \{a^{p+q} b^{q+r} \mid p, q, r \geq 0\}$
- (C) $L = \{a^p b^q c^r \mid p, q, r \geq 1\}$
- (D) None of the above

Q11 Consider the following language:

$$L_1 = \{ab^n a^{2n} \mid n \geq 1\}$$

$$L_2 = \{aab^n a^{3n} \mid n \geq 1\}$$

Which of the following is correct?

- (A) $L_1 \cup L_2$ is DCFL but not regular.
- (B) $L_1 \cup L_2$ is CFL but not DCFL.
- (C) $L_1 \cup L_2$ is CSL but not CFL.
- (D) $L_1 \cup L_2$ is DCFL and also CFL.

Q12 Suppose, L is any CFL language on alphabet Σ

$= \{a, b\}$, and the following language:

$$L_1 = L - \{w x w^R \mid w, x \in \{a, b\}^*\}$$

$$L_2 = L_1 \cdot L$$

$$L_3 = \overline{L_1} \cup L$$

Which of the following is/are correct?

- (A) L_1 is regular.
- (B) L_2 is CFL.
- (C) L_3 is regular.
- (D) None of these.



Answer Key

Q1 (C)

Q2 2

Q3 (B)

Q4 (A, B, C)

Q5 (D)

Q6 (B)

Q7 (B)

Q8 (B)

Q9 (A)

Q10 (A)

Q11 (A, D)

Q12 (A, B, D)

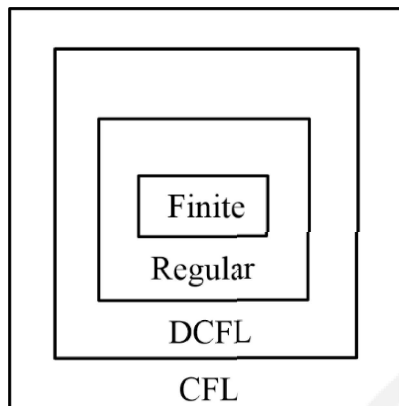


Hints & Solutions

Q1 Text Solution:

Finite \cap non-regular always finite.

Hence, option (c) is correct.

Q2 Text Solution:


From above diagram, we can say that statement (i), (iv) are correct.

Q3 Text Solution:

L_1 is DCFL and L_2 is CFL. So, option (b) is correct

Q4 Text Solution:

a, b, c are DCFL as they have comparison between number of a's & b's.

Q5 Text Solution:

Both L_1 & L_2 are DCFL but not regular.

Q6 Text Solution:

The given grammar will produce language

$L = \{xx^R yy^R \mid x, y \in \{a, b\}^*\}$ and the language is CFL

but not DCFL.

Q7 Text Solution:

- CFL \cap Regular
- Always CFL

Hence, option (b) is correct.

Q8 Text Solution:

$$\begin{aligned} L(G_1) &= \{0^n 1^n 1^m 2^m \mid m, n \geq 0\} \\ &= \{0^n 1^{m+n} 2^m \mid m, n \geq 0\} \end{aligned}$$

$$L(G_2) = \{0^m 1^n 2^n 1^m \mid m, n \geq 0\}$$

$$L(G_3) = \{0^n 1^{m+n} 2^m \mid m, n \geq 0\}$$

Hence, option (b) is correct.

Q9 Text Solution:

(a) DCFL \cdot Regular \uparrow

DCFL \cdot DCFL

CFL (False)

(b) CFL \cap CSL

CSL \cap CSL

CSL (True)

(c) $\Sigma^* - \text{CSL}$

$\Sigma^* \cap \text{CSL}$

CSL

Hence, option (a) is correct.

Q10 Text Solution:

- State q_0 will accept all the a's i.e. a^*

At state q_f

Number of C = number of a's + number of b's

So, $L = \{a^*\} \cup \{a^p b^q c^r \mid p + q = r, p, q, r \geq 1\}$

Hence, option (a) is correct.

Q11 Text Solution:

- $L_1 = \{ab^n a^{2n} \mid n \geq 1\}$ is DCFL

$L_2 = \{aab^n a^{3n} \mid n \geq 1\}$ is DCFL

- $L_1 \cup L_2$ will be DCFL for

L_1 skip first a and for L_2 skip

2 a's. Push and pop are clear so

$L_1 \cup L_2$ will be DCFL but not regular

- Every DCFL is CFL also.

Hence, option (a, d) is correct

Q12 Text Solution:

$$L_1 = \text{CFL} - (a + b)^*$$

$$= \text{CFL} \cap [(a+b)^*]^C$$

$$= \phi$$

$$L_2 = \phi \cdot \text{CFL}$$

$$= \phi$$



$L_3 = \phi \cup \text{CFL}$
 $= (a + b)^* \cup \text{CFL}$
 $= (a + b)^*$
(a) $L_1 = \text{finite true}$
 $L_2 = \phi$

(b) L_2 is CFL
 $L_2 = \phi$ is regular and every regular is CFL.
(c) L_3 is regular
 $L_3 = (a + b)^*$
Hence, (a, b, c) are correct option



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