

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) $S \rightarrow aa S bb \mid \epsilon$
- (B) $S \rightarrow a S bb \mid \epsilon$
- (C) $S \rightarrow aa S b \mid \epsilon$
- (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:

$$S \rightarrow AB$$

$$A \rightarrow a A a \mid b A b \mid \epsilon$$

$$B \rightarrow a B a \mid b B b \mid \epsilon$$

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 :

$$G_1 : S \rightarrow P Q$$

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



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$Q \rightarrow 1 Q 2 | \epsilon$

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

$P \rightarrow 1 Q 2 | \epsilon$

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

$P \rightarrow 0 P 1 | 0 1 | \epsilon$

$Q \rightarrow 1 Q 2 | \epsilon$

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.

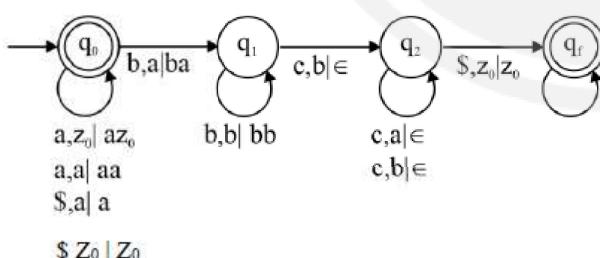
L_4 = Regular

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.



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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)

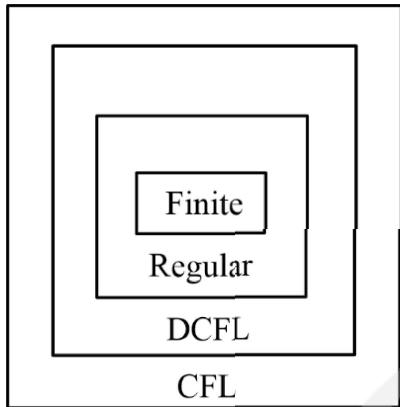


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Hints & Solutions

Q1 Text Solution:

$\text{Finite} \cap \text{non-regular}$ 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:

$$(a) \text{DCFL} \cdot \text{Regular} \uparrow$$

$$\text{DCFL} \cdot \text{DCFL}$$

$$\text{CFL} \text{ (False)}$$

$$(b) \text{CFL} \cap \text{CSL}$$

$$\text{CSL} \cap \text{CSL}$$

$$\text{CSL} \text{ (True)}$$

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

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

$$\text{CSL}$$

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

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

Hence, option (a) is correct.

Q11 Text Solution:

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

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

$$\bullet L_1 \cup L_2 \text{ will be DCFL for}$$

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

$$\bullet \text{Every DCFL is CFL also.}$$

Hence, option (a, d) is correct

Q12 Text Solution:

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

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

$$= \emptyset$$

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

$$= \emptyset$$



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

(b) L_2 is CFL
 $L_2 = \emptyset$ 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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