Branch : CSE & IT **Batch : Hinglish**

Theory of Computation

Push Down Automata

DPP-05

[MCQ]

1. The intersection of CFL and a regular language will be

(a) Always regular
(b) Always CFL
(c) Always not regular
(d) None of these

[MCQ]

2. Consider the following grammars G_1, G_2 and G_3:

G_1 : $S \to P\,Q$
$P \to 0\,P\,1 | \in$
$Q \to 1\,Q\,2 | \in$

G_2 : $S \to 0\,S1 | Q$
$P \to 1Q\,2 | \in$

G_3 : $S \to P\,Q \,|\, Q$
$P \to 0\,P\,1 | \,01$
$Q \to 1\,Q\,2 | \in$

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_2 are equivalent.
(b) G_1 and G_3 are equivalent.
(c) G_2 and G_3 are equivalent.
(d) None of these.

[MSQ]

3. Consider the following regular expressions P, Q and R over $\Sigma = \{a, b\}$:

P = ab + aQ + bR
Q = baQ + bR
R = Raba + a

Which of the following regular expression will produce all the strings accepted by above regular expression?

(a) $ab + ba(aba)^* [\in + a(ba)^*]$
(b) $ab + [\in + a(ba)^*]\, ba(aba)^*$
(c) $ab + a(ba)^+\, ba(aba)^*$
(d) $ab + a(ba)^+\, (aba)^* + ba(aba)^*$

[MCQ]

4. Consider the following language.

L_1 = Context free language.
L_2 = Deterministic context free language.
L_3 = Context sensitive language.
L_4 = Regular

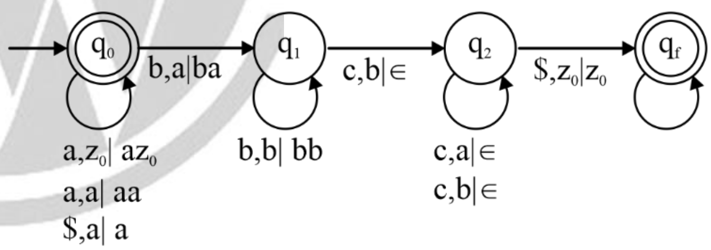
Which of the following is incorrect?

(a) $L_2 \,.\, L_4$ is always DCFL.
(b) $L_1 \cap L_3$ is CSL.
(c) $\Sigma^* - L_3$ is CSL.
(d) None of the above.

[MCQ]

5. Consider the following push down automata.

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



$\$\ Z_0 \,|\, Z_0$

Which of the following language is accepted by above PDA?

(a) $L = \{a^*\} \cup \{a^p\, b^q\, c^r \,|\, p, q, r \geq 1, p + q = r\}$
(b) $L = \{a^{p+q}\, b^{q+r} \,|\, p, q, r \geq 0\}$
(c) $L = \{a^p\, b^q\, c^r \,|\, p, q, r \geq 1\}$
(d) None of the above

[MSQ]

6. Consider the following language:

$L_1 = \{ab^n\, a^{2n} \,|\, n \geq 1\}$
$L_2 = \{aab^n\, a^{3n} \,|\, n \geq 1\}$

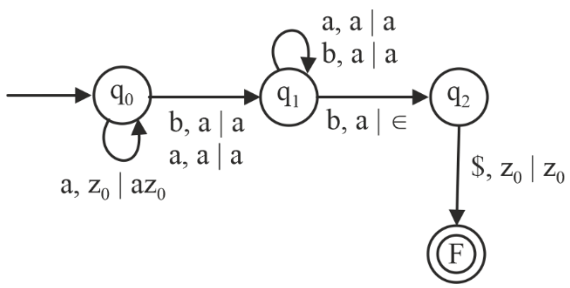
Which of the following is correct?

(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.

[MCQ]

7. Consider the following PDA:



Here q_0 is a starting state and F is a final state. Then the language accepted by above PDA is?

(a) Regular but finite

(b) Regular but infinite

(c) CFL but not regular

(d) None of these

[MSQ]

8. Suppose, L is any CFL language on alphabet $\Sigma = \{a, b\}$, 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 finite.

(b) L_2 is CFL.

(c) L_3 is regular.

(d) None of these.

Answer Key

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

Hints and Solutions

1. (b)

- CFL $\cap$ Regular
- Always CFL

Hence, option (b) is correct.

2. (b)

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

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

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

Hence, option (b) is correct.

3. (b, d)

$P = ab + aQ + bR$

$Q = baQ + bR$

$R = Raba + a$

Apply Arden's Theorem:

$R = a(aba)^*$

$Q = (ba)^* bR$

$Q = (ba)^* ba(aba)^*$

$P = ab + aQ + bR$

$P = aQ \mid bR \mid ab$

$= a[(ba)^* ba(aba)^*] + ba(aba)^* + ab$

$r * r = r^+$

$(ba)^* ba = (ba)^+$

$P = a(ba) + (aba)^* + ba(aba)^* + ab$

Exactly match with option (d)

$P = a[(ba)^* \underline{ba(aba)^*}] + \underline{ba(aba)^*} + ab$

$P = [a(ba)^* + \in]ba(aba)^* + ab$

$= ab + [\in + a(ba)^*]ba(aba)^*$

Exactly match with opetion (b)

Hence, option (b, d) are correct.

4. (a)

(a) DCFL·Regular $\uparrow$

DCFL· DCFL

CFL **(False)**

(b) CFL $\cap$ CSL

CSL $\cap$ CSL

CSL **(True)**

(c) $\Sigma^* - CSL$

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

CSL

Hence, option (a) is correct.

5. (a)

- 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.

6. (a, d)

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

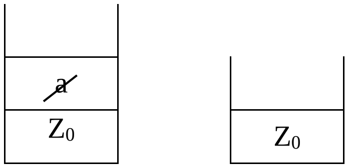
Hence, option (a, d) is correct

7. (b)

- In given PDA first a will be pushed into stack

a
Z_0

- After first 'a' it will skip all the a's and b's
- And it will be pop 'a' on last input b.



empty stack

Regular expression = a (a + b)* b (regular but infinite)

Hence, option (b) is correct.

8. (a, b, c)

$L_1 = CFL - (a + b)^*$

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

$= \phi$

$L_2 = \phi \, . \, CFL$

$= \phi$

$L_3 = \overline{\phi} \cup CFL$

$= (a + b)^* \cup CFL$

$= (a + b)^*$

(a) L_1 = finite true

$L_1 = \phi$

(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

Any issue with DPP, please report by clicking here:- https://forms.gle/t2SzQVvQcs638c4r5

For more questions, kindly visit the library section: Link for web: https://smart.link/sdfez8ejd80if

PW Mobile APP: https://smart.link/7wwosivoicgd4