

CS & IT ENGINEERING

Theory of Computation
Push Down Automata

DPP 05 (Discussion
Notes)



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A stylized laptop with a blue frame and an orange base. The screen is white and contains the text 'TOPICS TO BE COVERED'.

TOPICS TO BE COVERED

A dashed orange line with arrowheads pointing right, connecting the laptop screen to the list items.

01 Question

02 Discussion

Q.1

The intersection of CFL and a regular language will be

[MCQ]

- ☐ A. Always regular
- ☒ B. Always CFL
- ☐ C. Always not regular
- ☐ D. None of these

$$\text{CFL} \cap \text{Reg} \Rightarrow \text{CFL}$$

(may or may not reg)

Q.2

Consider the following grammars G_1 , G_2 and G_3 : $G_1: S \rightarrow P Q$ $P \rightarrow 0 P 1 \mid \epsilon$ $Q \rightarrow 1 Q 2 \mid \epsilon$ $G_2: S \rightarrow 0 S 1 \mid Q$ $P \rightarrow 1 Q 2 \mid \epsilon$ $G_3: S \rightarrow P Q \mid Q$ $P \rightarrow 0 P 1 \mid 0 1$ $Q \rightarrow 1 Q 2 \mid \epsilon$ 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_2 are equivalent.

B.

 G_1 and G_3 are equivalent.

C.

 G_2 and G_3 are equivalent.

D.

None of these.

$$L_1 = \{0^m 1^n 2^n \mid m, n \geq 0\}$$

$$L_2 = \{0^m 1^n 2^n 1^m \mid m, n \geq 0\}$$

$$L_3 = \{0^m 0 1^n 2^n \mid m, n \geq 0\} \cup \{1^n 2^n \mid n \geq 0\}$$

$$= \{0^{m+1} 1^n 2^n \mid m, n \geq 0\} \cup \{1^n 2^n \mid n \geq 0\}$$

$$= (0 \cup \epsilon) 1^n 2^n$$

Q.3

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

$$P = ab + aQ + bR$$

$$Q = baQ + bR$$

$$R = Raba + a$$

$$R \rightarrow Raba + a$$

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

$$x)^* = x^+ \\ x^+ x = x^+$$



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



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



$$\underline{ab} + \underline{a(ba)^* ba(aba)^*}$$



$$\underline{ab} + \underline{a(ba)^* (aba)^*} + \underline{ba(aba)^*}$$

$$R = a(aba)^*$$

$$Q = (ba)^* \underline{ba(aba)^*}$$

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

Q.4

[MCQ]



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. \rightarrow TRUE

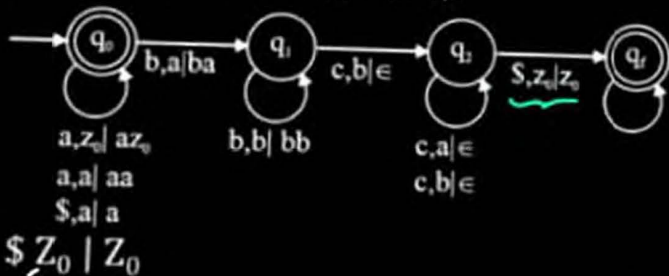
B. $L_1 \cap L_3$ is CSL.

C. $\Sigma^* - L_3$ is CSL.

~~D. None of the above.~~

Q.5

Consider the following push down automata.

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

[MCQ]

Handwritten notes:

- Diagram showing the stack operations: p (push), q (push), r (pop), ϵ (pop), ϵ (pop), ϵ (pop).
- Equation: $r = p + q$.
- Text: "\$ is end of ip".
- Text: "push a's", "push b's", "pop b's", "pop a's".

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 these.

Handwritten note: $q_0: a^*$

Q.6

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?

[MSQ]

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



ab . . .
aa . . .

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.

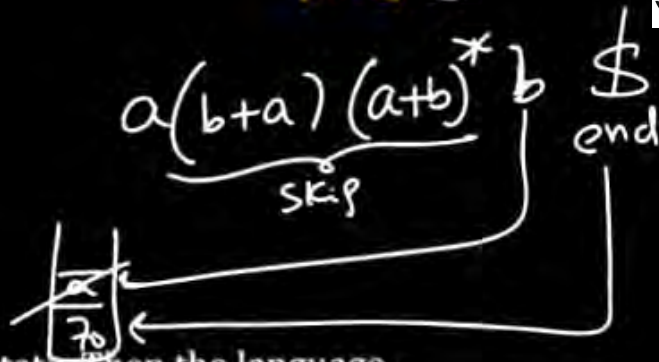
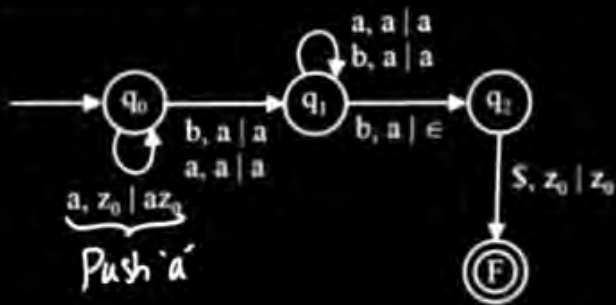
D.

 $L_1 \cup L_2$ is DCFL and also CFL.

Q.7

Consider the following PDA:

[MCQ]



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

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

Q.8

Suppose, L is any CFL language on alphabet $\Sigma = \{a, b\}$, and the following language:

[MSQ]

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

$$L_2 = L_1 \cdot L$$

$$L_3 = \bar{L} \cup L = \Sigma^*$$

$$L_1 = L - (a+b)^* = \phi$$

$$L_2 = L_1 \cdot L = \phi \cdot L = \phi$$

$$L_3 = \Sigma^*$$

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.

