

Q.66 Consider the following statements about the context-free grammar

$$G = \{S \rightarrow SS, S \rightarrow ab, S \rightarrow ba, S \rightarrow \epsilon\}$$

1. G is ambiguous
2. G produces all strings with equal number of a's and b's
3. G can be accepted by a deterministic PDA.

Which combination below expresses all the true statements about G?

GATE 2006

- (A) 1 only (B) 1 and 3 only (C) 2 and 3 only (D) 1, 2 and 3

Q.67 Which one of the following grammars generates the language $L = \{a^i b^j \mid i \neq j\}$

GATE 20006

- | | | |
|-----------------------------|-------------------------------|----------------------------------|
| $S \rightarrow AC CB$ | $S \rightarrow AC CB$ | $S \rightarrow AC CB$ |
| (A) $C \rightarrow aCb a b$ | (B) $S \rightarrow aS Sb a b$ | (C) $C \rightarrow aCb \epsilon$ |
| $A \rightarrow aA \epsilon$ | | $A \rightarrow aA \epsilon$ |
| $B \rightarrow Bb \epsilon$ | | $B \rightarrow Bb \epsilon$ |
| | | (D) $C \rightarrow aCb \epsilon$ |
| | | $A \rightarrow aA a$ |
| | | $B \rightarrow Bb b$ |

Q.68 Consider the languages :

$$L_1 = \{a^n b^n c^m \mid n, m > 0\} \text{ and}$$

$$L_2 = \{a^n b^n c^m \mid n, m > 0\}$$

Which one of the following statement is FALSE?

GATE 2005

- (A) $L_1 \cap L_2$ is a context-free language (B) $L_1 \cup L_2$ is a context-free language
- (C) L_1 and L_2 are context-free languages (D) $L_1 \cap L_2$ is a context sensitive language

Q.69 Consider the languages :

$$L_1 = \{w w^R \mid w \in \{0,1\}^*\}$$

$$L_2 = \{w \# w^R \mid w \in \{0,1\}^*\} \text{ where } \# \text{ is a special symbol}$$

$$L_3 = \{w w \mid w \in \{0,1\}^*\}$$

Which one of the following is TRUE?

GATE 2005

- (A) L_1 is a deterministic CFL (B) L_2 is a deterministic CFL
- (C) L_3 is a CFL, but not a deterministic CFL (D) L_3 is a deterministic CFL

Context Free Grammar

66 →

$$G = \{S \rightarrow SS, S \rightarrow ab, S \rightarrow ba, S \rightarrow \epsilon\}$$

B

✓ (1) G is ambiguous.

✗ (2) G produce all strings with equal no. of a 's
→ b 's

✓ (3) G can be accepted by a DPDA

(B) ⇒ (1) & (3) only

67 →

Generate Language $L = \{a^i b^j \mid i \neq j\}$

D

Solⁿ $L = \{ \underline{a} \underline{b} \underline{b}, \underline{a} \underline{a} \underline{b}, \underline{a} \underline{a} \underline{a} \underline{b}, \underline{a} \underline{b} \underline{b} \underline{b}, \underline{a}, \underline{b}, \dots \}$

D

$$S \rightarrow AC \mid CB$$

$$C \rightarrow acb \mid \epsilon$$

$$A \rightarrow aA \mid a$$

$$B \rightarrow Bb \mid b$$

68 →

$$L_1 = \{a^n b^n c^m \mid n, m > 0\}$$

$$L_2 = \{a^n b^m c^m \mid n, m > 0\}$$

False - ?

$L_1 \cap L_2 = \{a^n\}$ is CFL

→ False

697 $L_1 = \{ w w^R \mid w \in \{0,1\}^* \} \Rightarrow \text{CFL}$
 $L_2 = \{ w \# w^R \mid w \in \{0,1\}^* \} \Rightarrow \text{DCFL}$
 $L_3 = \{ w w \mid w \in \{0,1\}^* \} \Rightarrow \text{CFL}$

True :-

(B) $\rightarrow L_2$ is DCFL.

Q.70 The language $\{a^m b^n c^{m+n} \mid m, n \geq 1\}$ is

GATE 2004

- (A) Regular (B) Context free but not regular
(C) Context sensitive but not context free (D) Type-0 but not context sensitive

Q.71 Let $G = (\{S\}, \{a, b\}, R, S)$ be a context free grammar where the rule set R is

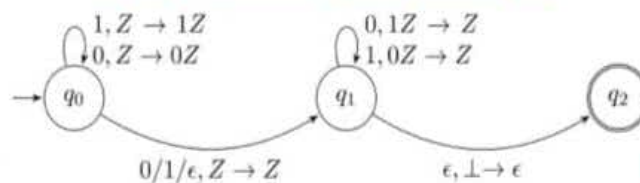
$$S \rightarrow aSb \mid SS \mid \epsilon$$

Which of the following statements is true?

GATE 2003

- (A) G is not ambiguous
(B) There exist $x, y \in L(G)$ such that $xy \notin L(G)$
(C) There is a deterministic pushdown automaton that accepts $L(G)$
(D) We can find a deterministic finite state automaton that accepts $L(G)$

Q.72 Consider the NPDA where (as per usual convention) Q is the set of states, Σ is the input alphabet, Γ is the stack alphabet, δ is the state transition function, q_0 is the initial state, \perp is the initial stack symbol, and F is the set of accepting states. The state transition is as follows :



Which one of the following sequences must follow the string 101100 so that the overall string is accepted by the automaton?

GATE 2015

- (A) 10110 (B) 10010 (C) 01010 (D) 01001

Q.73 Which of the following languages are context-free?

$$L_1 = \{a^m b^n a^m b^m \mid m, n \geq 1\}$$

$$L_2 = \{a^m b^n a^m b^n \mid m, n \geq 1\}$$

$$L_3 = \{a^m b^n \mid m = 2n + 1\}$$

GATE 2015

- (A) L_1 and L_2 only (B) L_1 and L_3 only (C) L_2 and L_3 only (D) L_3 only

Q.74 Consider the following context-free grammars :

$$G_1 : S \rightarrow aS \mid B, B \rightarrow b \mid bB$$

$$G_2 : S \rightarrow aA \mid bB, A \rightarrow aA \mid B \mid \epsilon, B \rightarrow bB \mid \epsilon$$

Which one of the following pairs of languages is generated by G_1 and G_2 , respectively? **GATE 2016**

- (A) $\{a^m b^n \mid m > 0 \text{ or } n > 0\}$ and $\{a^m b^n \mid m > 0 \text{ and } n > 0\}$
(B) $\{a^m b^n \mid m > 0 \text{ and } n > 0\}$ and $\{a^m b^n \mid m > 0 \text{ or } n \geq 0\}$
(C) $\{a^m b^n \mid m \geq 0 \text{ or } n > 0\}$ and $\{a^m b^n \mid m > 0 \text{ and } n > 0\}$
(D) $\{a^m b^n \mid m \geq 0 \text{ and } n > 0\}$ and $\{a^m b^n \mid m > 0 \text{ or } n > 0\}$

70 ⇒ $L = \{ a^m b^n c^{m+n} \mid m, n \geq 1 \}$

(B)

Compare a^m, c^m | b^n, c^n → CFL but not regular.

(B) ⇒ Context free but not regular.

71 ⇒

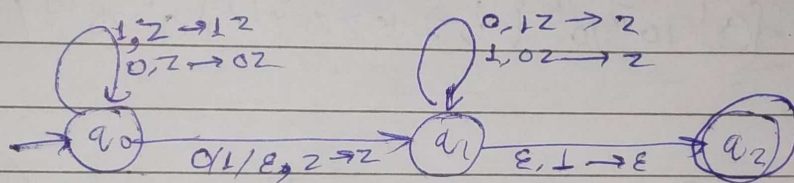
$G = (\{S\}, \{a, b\}, R, S) \rightarrow \text{CFG}$

$S \rightarrow aSb \mid SS \mid \epsilon$

(C)

True - ?

(C) There is DPDA accept $L(G)$.



72 ⇒

(B)

Given string 101100 has 6 letters & we are given 5 letters

Not done, 10110

$x^r x = (01001)_2 = 10010_{10}$ Ans

(B)

Teacher's Signature

73 →

CFL = {

$$L_1 = \{a^m b^n a^n b^m \mid m, n \geq 1\}$$

$$L_2 = \{a^m b^n a^m b^n \mid m, n \geq 1\}$$

$$L_3 = \{a^m b^n \mid m = 2n + 1\}$$

Build PD

✓

X

✓

⊗ $\Rightarrow L_1 \not\subseteq L_3$

74 →

$$G_1: S \rightarrow aS \mid B, B \rightarrow b \mid bB$$

$$G_2: S \rightarrow aA \mid bB, A \rightarrow aA \mid B \mid \epsilon, B \rightarrow bB \mid \epsilon$$

Generate $G_1 \not\subseteq G_2$

$$\{a^m b^n \mid m \geq 0, n \geq 0\}$$

$$\{b, ab, bb, aab, abb, \dots\}$$

$$\{a^m b^n \mid m, n \geq 0\}$$

$$\{a, b, aa, bb, aab, bba, \dots\}$$

Q.75 Consider a CFG with the following productions.

$$S \rightarrow AA \mid B$$

$$A \rightarrow 0A \mid A0 \mid 1$$

$$B \rightarrow 0B00 \mid 1$$

S is the start symbol, A and B are non-terminals and 0 and 1 are the terminals. The language generated by this grammar is **GATE 2008**

(A) $\{0^n 10^{2n} \mid n \geq 1\}$

(B) $\{0^i 10^j 10^k \mid i, j, k \geq 0\} \cup \{0^n 10^{2n} \mid n \geq 1\}$

(C) $\{0^i 10^j \mid i, j \geq 0\} \cup \{0^n 10^{2n} \mid n \geq 1\}$

(D) The set of all strings over $\{0, 1\}$ containing at least two 0's

Q.76 If L_1 is a context free language and L_2 as a regular language, which of the following is/are False?

a. $L_1 - L_2$ is not context free

b. $L_1 \cap L_2$ is context free

c. $\sim L_1$ is context free

d. $\sim L_2$ is regular

GATE 1999

(A) Only b

(B) Only c

(C) Both a and c

(D) Both b and c

Q.77 Which of the following languages over $\{a, b, c\}$ is accepted by a deterministic pushdown automata?

a. $\{wcw^R \mid w \in \{a, b\}^*\}$

b. $\{ww^R \mid w \in \{a, b, c\}^*\}$

c. $\{a^n b^n c^n \mid n \geq 0\}$

d. $\{w \mid w \text{ is a palindrome over } \{a, b, c\}\}$

Note: w^R is the string obtained by reversing 'w'

GATE 1997

(A) a

(B) b

(C) c

(D) d

Q.78 If L_1 and L_2 are context free languages and R is a regular set, one of the languages below is not necessarily a context free language. Which one? **GATE 1996**

(A) $L_1.L_2$

(B) $L_1 \cap L_2$

(C) $L_1 \cap R$

(D) $L_1 \cup L_2$

Q.79 Consider the following context-free grammar over the alphabet $\Sigma = \{a, b\}$ with S as the start symbol:

$$S \rightarrow AT$$

$$A \rightarrow aAa \mid bAb \mid \#T$$

$$T \rightarrow aT \mid bT \mid \lambda$$

Which of the following represents the language generated by the above grammar?

MOCK GATE 2018

(A) $\{w\#x \mid w^R \text{ is a substring of } x, \text{ where } w, x \in \{a, b\}^*\}$

(B) $\{w\#x \mid w \text{ is a substring of } x, \text{ where } w, x \in \{a, b\}^*\}$

(C) $\{x\#w \mid w^R \text{ is a substring of } x, \text{ where } w, x \in \{a, b\}^*\}$

(D) $\{w\#x \mid w, x \in \{a, b\}^*\}$

753 CFG

$S \rightarrow AA/B$

$A \rightarrow 0A^+ (A0)^+$

$B \rightarrow 0B00^+ 1$

Generated by grammar is —

$\{0^i 10^j 10^k \mid i, j, k \geq 0\} \cup \{0^n 10^{2n} \mid n \geq 1\}$

763

$L_1 \rightarrow CFL$

$L_2 \rightarrow RL$

False

~~(a)~~ $L_1 - L_2$ is not CFL

(c) $\sim L_1$ is CFL

(b) $L_1 \cap L_2$ is CFL

~~(d)~~ $\sim L_2$ is KL

(c) A & C False

Teacher's Signature

77.5

$\Sigma = \{a, b, c\}$

accepted

DPDA

A

(a)

$\{w w^R \mid w \in \{a, b, c\}^*\}$

(b)

$\{w w^R \mid w \in \{a, b, c\}^*\}$

(c)

$\{a^n b^n c^n \mid n \geq 0\}$

(d)

$\{w \mid w \text{ is palindromic over } \{a, b, c\}\}$

78.5

$L_1, L_2 \rightarrow CFL$

$R \rightarrow \text{Regular set}$

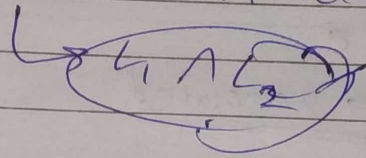
not necessarily for

CFL

B

(B)

$\rightarrow CFL$ not under closed intersection



79.5

79.5

$S \rightarrow AT$

$A \rightarrow aAa \mid bAb \mid \#T$

$T \rightarrow aT \mid bT \mid \lambda$

A

\rightarrow represent

$\rightarrow \{w \# x \mid w^R \text{ is substring of } x, w, x \in \{a, b\}^*\}$

Q.80 Consider the following languages:

- I. $\{a^m b^n c^p d^q \mid m + p = n + q, \text{ where } m, n, p, q \geq 0\}$
- II. $\{a^m b^n c^p d^q \mid m = n \text{ and } p = q, \text{ where } m, n, p, q \geq 0\}$

III. $\{a^m b^n c^p d^q \mid m = n = p \text{ and } p \neq q, \text{ where } m, n, p, q \geq 0\}$

IV. $\{a^m b^n c^p d^q \mid mn = p + q, \text{ where } m, n, p, q \geq 0\}$

Which of the above languages are context-free?

GATE 2018

(A) I and IV only

(B) I and II only

(C) II and III only

(D) II and IV only

Q.81 Identify the language generated by the following grammar

$S \rightarrow XY$

$X \rightarrow aX|a$

$Y \rightarrow aYb|e$

GATE 2017

(A) $\{a^m b^n \mid m \geq n, n > 0\}$

(B) $\{a^m b^n \mid m \geq n, n \geq 0\}$

(C) $\{a^m b^n \mid m > n, n > 0\}$

(D) $\{a^m b^n \mid m > n, n \geq 0\}$

Q.82 Consider the following languages:

$L_1 = \{a^m b^n \mid m \neq n\}$

$L_2 = \{a^m b^n \mid m = 2n + 1\}$

$L_3 = \{a^m b^m \mid m \neq 2n\}$

Which one of the following statement is correct ?

UGC-NET 2017

(A) Only L_1 and L_2 are context free languages

(B) Only L_1 and L_3 are context free languages

(C) Only L_2 and L_3 are context free languages

(D) L_1, L_2 and L_3 are context free languages

Q.83 Which one of the following is FALSE?

GATE 2009

(A) There is a unique minimal DFA for every regular language

(B) Every NFA can be converted to an equivalent PDA

(C) Complement of every context free language is recursive

(D) Every non deterministic PDA can be converted to an equivalent deterministic PDA

Q.84 The context free grammar given by

$S \rightarrow XYX$

$X \rightarrow aX|bX|\lambda$

$Y \rightarrow bbb$

generates the language which is defined by regular expression :

UGC-NET 2015

(A) $(a + b)^* bbb$

(B) $abbb(a + b)^*$

(C) $(a + b)^* (bbb)(a + b)^*$

(D) $(a + b)(bbb)(a + b)^*$

Q.85 Given the following two languages:

$L_1 = \{a^n b a^n \mid n > 0\}$

$L_2 = \{a^n b a^n b^{n+1} \mid n > 0\}$

Which of the following is correct ?

UGC-NET 2015

(A) L_1 is context free language and L_2 is not context free language

(B) L_1 is not context free language and L_2 is context free language

(C) Both L_1 and L_2 are context free languages

(D) Both L_1 and L_2 are not context free languages

80 \Rightarrow I $\rightarrow \{a^m b^n c^p d^q \mid m+p = n+q, m, n, p, q \geq 0\}$
II $\rightarrow \{a^m b^n c^p d^q \mid m=n \text{ \& } p=q, m, n, p, q \geq 0\}$
III $\rightarrow \{a^m b^n c^p d^q \mid m=n=0, p \neq q\}$
IV $\rightarrow \{a^m b^n c^p d^q \mid m+n = p+q\}$

CFL =

I \& II are CFL

81 \Rightarrow

$S \rightarrow XY$

$X \rightarrow aX \mid a$

$Y \rightarrow aYb \mid \epsilon$

\hookrightarrow generated

$L = \{a, ab, aab, aabb, \dots\}$

C $\rightarrow \{a^m b^n \mid m > n, n \geq 0\}$

82 \Rightarrow

$L_1 = \{a^m b^n \mid m \neq n\}$

\rightarrow CFL

$L_2 = \{a^m b^n \mid m = 2n+1\}$

\rightarrow SCFL

$L_3 = \{a^m b^m \mid m \neq 2n\}$

\rightarrow CFL

True

D $\rightarrow L_1, L_2, \& L_3$ are CFL.

83→

FalseD

→ Every NDPDA can be converted to an equivalent DPDA.

84→

CFG by

 $S \rightarrow XYX$ $X \rightarrow aX | bX | \lambda$ $Y \rightarrow bbb$ C

→ $RE = (a+b)^* (bbb) (a+b)^*$

85→

 $L_1 = \{a^n b a^n \mid n \geq 0\}$ → D CFL, not RL $L_2 = \{a^n b a^n b^{n+1} \mid n \geq 0\}$

→ CSL.

ATrue -

→ L_1 is CFL & L_2 is not CFL.