Q.53 Let N be an NFA with n states. Let k be the number of states of a minimal DFA which is equivalent to N. Which one of the following is necessarily true? **GATE 2018**

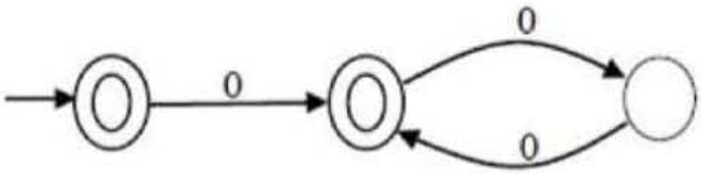
(A) $k \geq 2^n$ (B) $k \geq n$ (C) $k \leq n^2$ (D) $k \leq 2^n$

Q.54 Given a language L, define L^i as follows :

$L^0 = \{\varepsilon\}$

$L^i = L^{i-1} \cdot L$ for all $i>0$

The order of a language L is defined as the smallest k such that $L^k = L^{k+1}$. Consider the language L_1 (over alphabet 0) accepted by the following automaton.



The order of L_1 is ____ **GATE 2018**

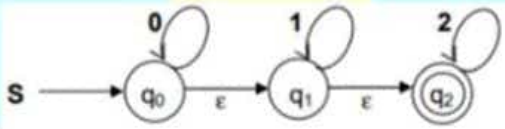
(A) 2 (B) 3 (C) 1 (D) None

Q.55 Let $\Sigma = \{a, b\}$ and language $L = \{aa, bb\}$. Then, the complement of L is **UGC-NET 2016**

(A) $\{\lambda, a, b, ab, ba\} \cup \{w \in \{a, b\}^* \mid |w| > 3\}$ (B) $\{a, b, ab, ba\} \cup \{w \in \{a, b\}^* \mid |w| > 3\}$

(C) $\{w \in \{a, b\}^* \mid |w| > 3\} \cup \{a, b, ab, ba\}$ (D) $\{\lambda, a, b, ab, ba\} \cup \{w \in \{a, b\}^* \mid |w| \geq 3\}$

Q.56 What are the final states of the DFA generated from the following NFA?



ISRO 2013

(A) q_0, q_1, q_2 (B) $[q_0, q_1], [q_0, q_2], [\,]$ (C) $q_0, [q_1, q_2]$ (D) $[q_0, q_1], q_2$

Q.57 Consider the following languages

$L_1 = \{0^p 1^q 0^r \mid p, q, r \geq 0\}$

$L_2 = \{0^p 1^q 0^r \mid p, q, r \geq 0, p \neq r\}$

Which one of the following statements is **FALSE**? **GATE 2013**

(A) L_2 is context-free

(B) $L_1 \cap L_2$ is context-free

(C) Complement of L_2 is recursive

(D) Complement of L_1 is context-free but not regular

Q.58 Let P be a regular language and Q be context-free language such that Q P. (For example, let P be the language represented by the regular expression p*q* and Q be $\{p^n q^n \mid n$ N$\}$). Then which of the following is ALWAYS regular? **GATE 2011**

(A) $P \cap Q$ (B) $P - Q$ (C) $\Sigma^* - P$ (D) $\Sigma^* - Q$

53⇒ N → NFA → n

K ⟷ DFA → K

(D)

$K \leq 2^n$

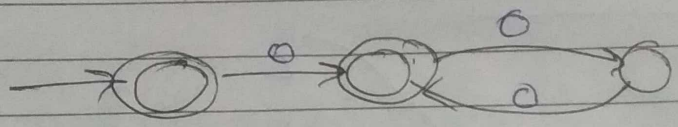
Ans

54⇒ $L^0 = \{\varepsilon\}$

$L^i = L^{i-1} \cdot L$

$L^K = L^{K+1}$, $\varepsilon = \{0\}$

(A)



$L_1 = \varepsilon + 0(00)^*$

$L_1^0 = \{\varepsilon\}$

$L_1^1 = \{\varepsilon\}\{\varepsilon + 0(00)^*\} = \{\varepsilon + 0(00)^*\} \neq L_1^0$

$L_1^2 = \{\varepsilon + 0(00)^*\}\{\varepsilon + 0(00)^*\}$

$= \{\varepsilon + 0(00)^* + 0(00)^*0(00)^*\} = \{0^*\} \neq L_1$

$L_1^3 = \{0^*\}\{\varepsilon + 0(00)^*\} = \{0^* + 0^*0(00)^*\} = \{0^*\}$

$L_1^3 = L_1^2$, So $O(L_1) = 2$

(A) → 2

Teacher's Signature .....

55) $\Sigma = \{a, b\}$, $L = \{aa, bb\}$

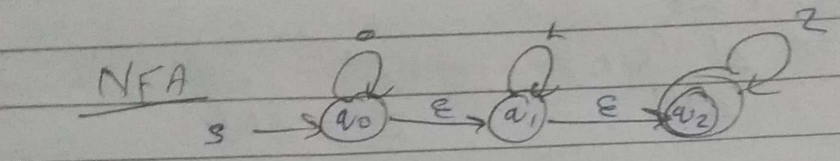
$L^c = ?$

(D)

Sol^n $L^c = \Sigma^* - L$

$= \{\epsilon, a, b, ab, ba\} \cup \{w \in (a,b)^* , |w| \geq 3\}$

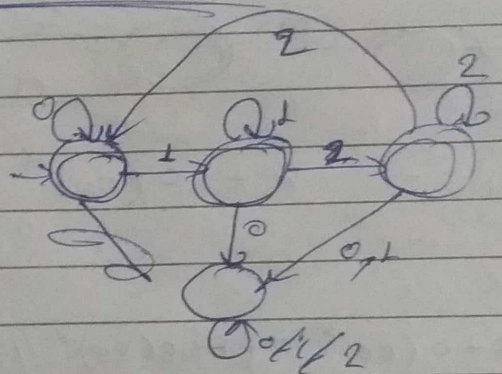
56) NFA



(A)

Final state of DFA

DFA



Final state — q_0, q_1, q_2

57) $L_1 = \{0^p 1^q 0^r \mid p, q, r \geq 0\}$

$L_2 = \{0^p 1^q 0^r \mid p, q, r \geq 0, p \neq r\}$

(D)

False —

(D) Complement of L_1 is context free but not ~~not~~ regular

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P → Regular → RE = $P^* Q^*$ | $Q \subseteq P$

Q → Context free

(c)

Always regular

- Complement of Regular is Regular.

(c) $P^c = \Sigma^* - P$

Q.59 Consider the languages L_1, L_2 and L_3 as given below.

$L_1 = \{0^p1^q \mid p, q \in N\}$

$L_2 = \{0^p1^q \mid p, q \in N \text{ and } p = q\}$ and

$L_3 = \{0^p1^q0^r \mid p, q, r \in N \text{ and } p = q = r\}$

Which of the following statements is not TRUE? **GATE 2011**

(A) Pushdown automata (PDA) can be used to recognize L_1 and L_2

(B) L_1 is a regular language

(C) All the three languages are context free

(D) Turing machines can be used to recognize all the languages.

Q.60 $S \rightarrow aSa \mid bSb \mid a \mid b$

The language generated by the above grammar over the alphabets {a, b} is the set of **GATE 2009**

(A) All palindromes

(B) All odd length palindromes

(C) Strings that begin and end with the same symbol

(D) All even length palindromes

Q.61 Let $L = L_1 \cap L_2$, where L_1 and L_1 are languages defined as follows,

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

$L_2 = \{a^i b^j c^k \mid i, j, k \geq 0\}$

Then L is **GATE 2009**

(A) Not recursive (B) Regular

(C) Context free but not regular (D) Recursively enumerable but not context free

Q.62 The language $L = \{0^i2^i1^i \mid i \geq 0\}$ over the alphabet {0, 1, 2} is **GATE 2007**

(A) Not recursive. (B) Is recursive and is a deterministic CFL.

(C) Is a regular language. (D) Is not a deterministic CFL but a CFL.

Q.63 Consider the CFG with {S,A,B) as the non-terminal alphabet, {a,b) as the terminal alphabet, S as the start symbol and the following set of production rules

$S \rightarrow aB \quad S \rightarrow bA$

$B \rightarrow b \quad A \rightarrow a$

$B \rightarrow bS \quad A \rightarrow aS$

$B \rightarrow aBB \quad A \rightarrow bAA$

Which of the following strings is generated by the grammar? **GATE 2007**

(A) aaaabb (B) aabbbb (C) aabbab (D) abbbba

Q.64 Consider the following languages over the alphabet $\Sigma = \{0,1,c\}$:

$L_1 = \{0^n1^n \mid n \geq 0\}$

$L_2 = \{wcw^r \mid w \in \{0,1\}^*\}$

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

Here, w^r is the reverse of the string w. Which of these language are deterministic context-free languages? **GATE 2014**

(A) None of the languages

(B) Only L_1

(C) Only L_1 and L_2

(D) All the three languages.

Q.65 Let $L_1 = \{0^{n+m}1^n0^m \mid n, m \geq 0\}$,

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

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

Which of these languages are NOT context free? **GATE 2006**

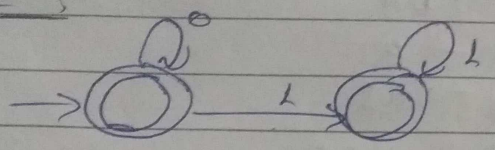
(A) L_1 only (B) L_3 only (C) L_1 and L_2 (D) L_2 and L_3

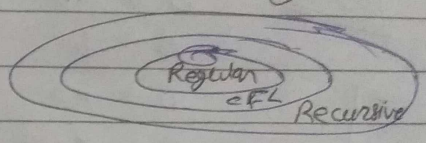
59⇒ $L_1 = \{0^p 1^q \mid p, q \in N\}$

$L_2 = \{0^p 1^q \mid p, q \in N, p = q\}$

(C) $L_3 = \{0^p 1^q 0^r \mid p, q, r \in N, p = q = r\}$

not-True ?





(C)⇒ All 3 languages are context free.

60⇒ $S \rightarrow aSa \mid bSb \mid a \mid b$

(B) (B)⇒ All odd length palindrom.

$\{a, b, aba, bbb \text{ --- } \text{---} \}$

Q1 ⇒ (G)

$L = L_1 \cap L_2$

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

$L_2 = \{ a^i b^j c^k \mid i, j, k \geq 0 \}$

L_1 is context free but not regular.

Q2 ⇒ (B)

$L = \{ 0^i 2^i 1^i \mid i \geq 0 \}$, $\Sigma = \{0, 1, 2\}$

L is recursive ∵ it is a deterministic CFL.

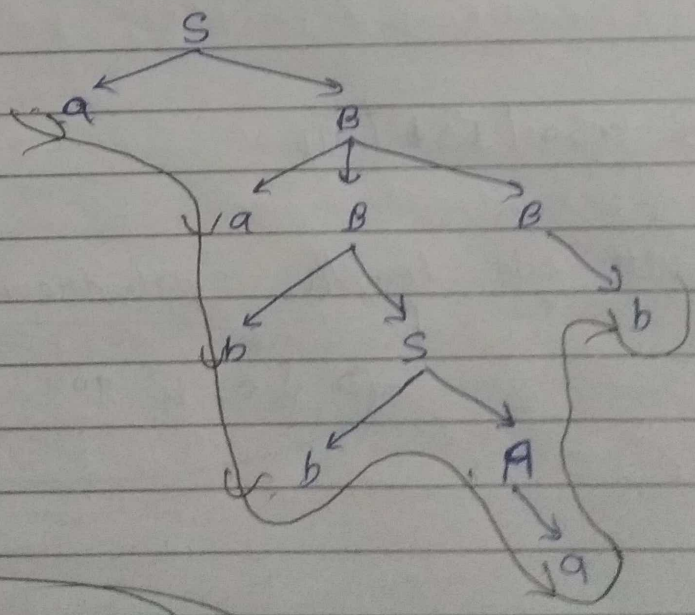
Q3 ⇒ (C)

$S \to aB$ $\quad S \to bA$

$B \to b$ $\quad A \to a$

$B \to bS$ $\quad A \to aS$

$B \to aBB$ $\quad A \to bAA$



e ⇒ a a b b a b

Teacher's Signature

Q4 ⇒ $\Sigma = \{0, 1, c\}$

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

$L_2 = \{w c w^R \mid w \in \{0,1\}^*\}$

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

deterministic context free language (DCFL) are

L_3 is CFL but not DCFL

only L_1 & L_2 are DCFL.

Q5 ⇒ $L_1 = \{0^{n+m} 1^n 0^m \mid n, m \geq 0\}$

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

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

Not CFL = ?

Only L_1 is CFL

So And L_2 & L_3 is not CFL.