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Course: GATE
Computer Science Engineering(CS)

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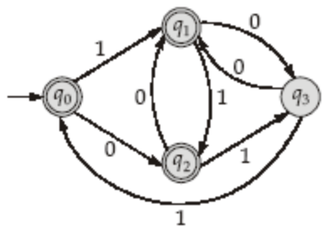
TOPICWISE : THEORY OF COMPUTATION-1 (GATE - 2019) - REPORTS

OVERALL ANALYSIS | COMPARISON REPORT | SOLUTION REPORT

ALL(17) | CORRECT(2) | INCORRECT(11) | SKIPPED(4)

Q. 1

Consider the following DFA:



Which of the following string is not accepted by above DFA?

FAQ | Solution Video | Have any Doubt ?

A 011001110

B 11011011001

C 1010101011 — Your answer is **Correct**

Solution :
(c)
(a) Accepted
(b) Accepted
(c) Not accepted
(d) Accepted

D 1001110

QUESTION ANALYTICS +

Q. 2

Which of the following language is regular?

FAQ | Solution Video | Have any Doubt ?

A $\{wxw^R \mid w \in (a + b)^*, x \in \{a, b\}\}$

B $\{wxw^R \mid w, x \in (a + b)^+\}$ — Your answer is **Correct**

Solution :
(b)

- Option (a) represents DCFL since string matching is done i.e. before 'x' and after 'x'.
- Option (b) represents regular for which regular expression $a(a + b)^+ a + b(a + b)^+ b$.
- Option (c) represents CFL since ww^R is done first, hence needs a comparison, which cannot be done via finite automata.
- Option (d) represents CFL since ww^R contains string matching, which can not be done via finite automata.

C $\{ww^Rx \mid w, x \in (a + b)^+\}$

D $\{ww^R \mid w \in (a + b)^*\}$

QUESTION ANALYTICS +

Q. 3

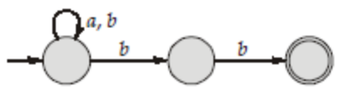
Let w be any string of length n in $\{a, b\}^*$. Consider L be the set of all strings ending with atleast n b's. What is the minimum number of states in a non-deterministic finite automata that accept L?

FAQ | Solution Video | Have any Doubt ?

A n

B $n + 1$ — Correct Option

Solution :
(b)
The number of states for minimum NFA for end with atleast $2b$'s is 2 + 1 i.e. regular expression $= (a + b)^* bb$.



So, number of states needed will be n + 1.

C $n + 2$ — Your answer is **Wrong**

D 2^n

QUESTION ANALYTICS +

Q. 4

Consider the following statements:
S_1: DFA for language which contain '$\in$' must have initial state as final state.
S_2: For any language either a language L or its complement L′ must be finite.
S_3: If L is set of all string ending with atleast n b's then minimum number of states in non deterministic finite automata that accept L is $n + 2$.
S_4: Non deterministic finite automata is more powerful than deterministic finite automata.
Which of the above statement is true?

FAQ | Solution Video | Have any Doubt ?

A S_1 only — Correct Option

Solution :
(a)

- If DFA accept a null, then initial state must be final state.
- Consider a language L = $\{a^n\}$ on alphabet {a, b} and its complement $\Sigma^* - \{a^n\}$ both are infinite. Hence false.
- If L is set of all string ending with atleast n b's then minimum number of states in non deterministic finite automata that accept L is $n + 1$. Hence false.
- Since every language accepted by a NFA is also accepted by some DFA, hence non deterministic finite automata has same power as deterministic finite automata. Hence false.

B S_2, S_3 only

C S_2, S_3, S_4 only

D S_1, S_3 only — Your answer is **Wrong**

QUESTION ANALYTICS +

Q. 5

Which one of the following regular expression describes the language over {a, b} consist of no pair of consecutive a's?

FAQ | Solution Video | Have any Doubt ?

A $(b^*abb^*)\ (a + \in)$ — Your answer is **Wrong**

B $(b + ab)^*\ (a + \in)$ — Correct Option

Solution :
(b)
Option 'a' does not contain 'b' or '$\in$'.
Option 'c' does not contain 'ba' or 'bba'.
Option 'b' contain $\in$, b, a, ab, ba ..... i.e. no string of pair of consecutive a's.
Option 'd' contain 'aa' i.e. not allowed.

C $(b^*abb^*)^*\ (a + \in) + b^*$

D $(b^*ab^*)^*\ (a + \in) + b^*\ (a + \in)$

QUESTION ANALYTICS +

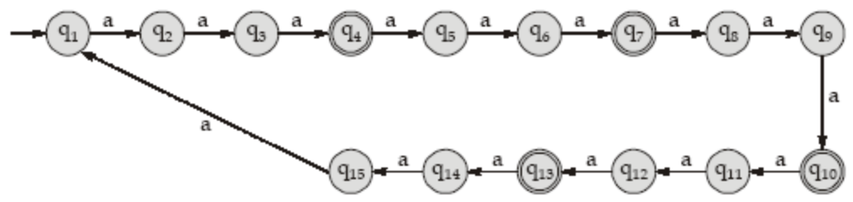
Q. 6

The minimum number of states required for DFA that accept the language L = $\{a^n \mid n$ is multiple of 3 but not multiple of 5$\}$ are _____.

FAQ | Solution Video | Have any Doubt ?

15 — Correct Option

Solution :
15
L = $\{a^n \mid n$ is multiple of 3 but not multiple of 5$\}$ will contain all strings of a which are divisible by 3 bit not a multiple of 15.
So, DFA will be:



So, 15 states are required.

QUESTION ANALYTICS +

Q. 7

The length of the shortest string not in the language (over $\Sigma = \{0, 1\}$) for regular expression $1^*(0 + 10)^*1^*$ is_____.

FAQ | Solution Video | Have any Doubt ?

4 — Correct Option

Solution :
4
Check the string one by one starting from $\in$, 0, 1, 00, 01,... until we reach the first string that is not generated by the given regular expression. In this case, smallest string not generated by the given regular expression is '0110' whose length is 4.

Your Answer is 2

QUESTION ANALYTICS +

Q. 8

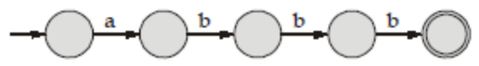
The number of states in minimal deterministic finite automata for strings starting with ab^2 and ending with b over the alphabet $\{a, b\}$ is _____.

Solution Video | Have any Doubt ?

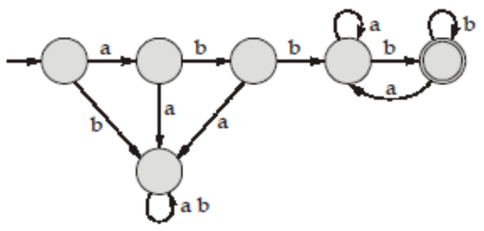
6 — Correct Option

Solution :
6

Minimum length string accepted by DFA will be $ab^2\,b$



Now fill up the left cases, i.e.



Your Answer is 4

QUESTION ANALYTICS +

Q. 9

The number of DFA's with four states which can be constructed over the alphabet $\Sigma = \{a, b\}$ with designated initial state are 2^n, then the value of n is _____.

FAQ | Solution Video | Have any Doubt ?

20 — Correct Option

Solution :
20

	a	b
q_0	(1 of 4)	(1 of 4)
q_1	(1 of 4)	(1 of 4)
q_2	(1 of 4)	(1 of 4)
q_3	(1 of 4)	(1 of 4)

The number of DFA's without any final state are $4^8 \Rightarrow 2^{16}$
and now we consider final states to

$$= ({}^4C_0 + {}^4C_1 + {}^4C_2 + {}^4C_3 + {}^4C_4) \times 2^{16}$$
$$= 2^4 \times 2^{16}$$
$$= 2^{20}$$

So, n will be 20.

Your Answer is 12

QUESTION ANALYTICS +

Q. 10

Consider L_{DF} set of all languages accepted by DPDA by final state and L_{DE} be set of all langauges accepted by DPDA by empty stack. Which of the following is true?

FAQ | Solution Video | Have any Doubt ?

A $L_{DF} \subset L_{DE}$

B $L_{DF} = L_{DE}$ — Your answer is **Wrong**

C $L_{DF} \supset L_{DE}$ — Correct Option

Solution :
(c)

The set of languages accepted by final state DPDA is proper super set of languages accepted by empty stack DPDA i.e. regular language a*b* is accepted by final state but not empty stack.

So, $L_{DF} \supset L_{DE}$.

D None of these

QUESTION ANALYTICS +

Q. 11

Consider P and Q be language over $\Sigma = \{0, 1\}$ represented by the regular expression $0^*\,(10^*)^*$ and $(0^* + 1^*)^*$ respectively. Which of the following is true?

FAQ | Solution Video | Have any Doubt ?

A $P \subset Q$

B $Q \subset P$ — Your answer is **Wrong**

C $P = Q$ — Correct Option

Solution :
(c)

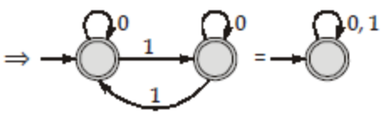
$$L(P) = 0^*\,(10^*)^*$$
$$= \{\in, 0, 1, 10, 01, 00, 11, ...\}$$

D None of these

QUESTION ANALYTICS +

$L(Q) = (0^* + 1^*)^*$

$= \{\in, 0, 1, 10, 01, 00, 11, ...\}$

DFA for L(P) ⇒ 

DFA for L(Q) ⇒ 

So, both language are equivalent to each other.

D $P \cap Q = 0^*1^*$

QUESTION ANALYTICS +

Q. 12

Consider the following statements:

$S_1 : \{(a^n)^m \mid n \le m \ge 0\}$

$S_2 : \{a^n b^n \mid n \ge 1\} \cup \{a^n b^m \mid n \ge 1, m \ge 1\}$

Which of the following is regular?

FAQ Solution Video Have any Doubt ?

A Only S_1 Your answer is **Wrong**

B Only S_2

C Both S_1 and S_2 Correct Option

Solution :

(c)

Put $n = 1$ in S_1 we get $\{(a^1)^m \mid 1 \le m\} \cup \{\in\}$

$= \{a^m \mid m \ge 0\} = a^*$

- Therefore S_1 is regular.
- S_2 represents $a^n b^n \cup a^+ b^+ = a^+ b^+$ which is regular. Hence regular.

D Neither S_1 nor S_2

QUESTION ANALYTICS +

Q. 13

Consider a push down automata (PDA) below which runs over the input alphabet (a, b). It has the stack alphabet $\{z_0, X\}$ where z_0 is the bottom of stack marker. The set of states of PDA is $\{q_0, q_1\}$ where q_0 is the start state.

$\delta\{q_0, b, z_0\} = \{(q_0, Xz_0)\}$

$\delta\{q_0, b, X\} = \{(q_0, XX)\}$

$\delta\{q_0, a, X\} = \{(q_1, X)\}$

$\delta\{q_0, \in, z_0\} = \{(q_0, \in)\}$

$\delta\{q_1, b, X\} = \{(q_1, \in)\}$

$\delta\{q_1, a, z_0\} = \{(q_0, z_0)\}$

The language accepted by PDA is

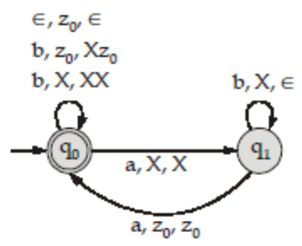
FAQ Solution Video Have any Doubt ?

A $L = \{(b^n ab^n a)^m \mid m, n \ge 0\}$ Correct Option

Solution :

(a)

The PDA for given transition function is:



$L = \{(b^n ab^n a)^m \mid m, n \ge 0\}$

For clearer understanding, kindly refer the solution video of this question.

B $L = \{(b^n ab^n a)^m \mid n, m \ge 0\} \cup \{b^n \mid n \ge 0\}$

C $L = \{(b^n ab^n)^m a \mid n, m \ge 0\}$

D None of the above

QUESTION ANALYTICS +

Q. 14

Consider the following three languages:

- $L_1 = \{w \mid w \in \{a, b\}^* \text{ and } w = w^R\}$
- $L_2 = \{ww^R \mid w \in \{a, b\}^*\}$
- $L_3 = \{w\ (a + b)\ w^R \mid w \in \{a, b\}^*\}$

What is the relation between L_1, L_2 and L_3?

FAQ Solution Video Have any Doubt ?

A $L_2 \subset L_1$ and $L_3 \subset L_1$ and $L_1 = L_2 \cup L_3$ Correct Option

Solution :

(a)

L_2 is even palindrome on {a, b}*
L_3 is odd palindrome on {a, b}*
L_1 is any palindrome on {a, b}*
Clearly, $L_2 \subset L_1$ and $L_3 \subset L_1$ and $L_1 = L_2 \cup L_3$

B $(L_2 = L_3) \subset L_1$

C $L_2 \cap L_1 = L_3$

D $L_2 \subset L_1$ and $L_3 \subset L_1$ but $L_1 \neq L_2 \cup L_3$ Your answer is **Wrong**

QUESTION ANALYTICS +

Q. 15

The number of states in the minimal deterministic finite automata corresponding to the regular expression (0 + 1)* (000 + 001) is _____.

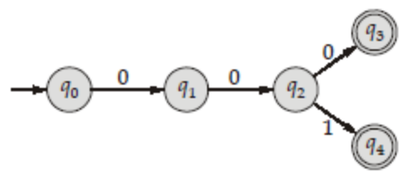
FAQ Solution Video Have any Doubt ?

5 Correct Option

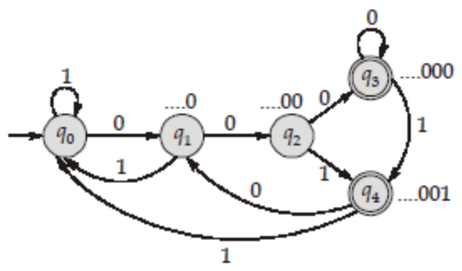
Solution :

5

Regular expression: (0 + 1)* (000 + 001)
So minimum string will be 000 and 001



Now fill the rest of transition:



Your Answer is 7

QUESTION ANALYTICS +

Q. 16

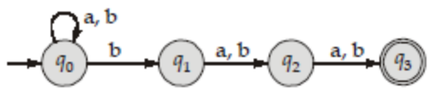
The number of states in minimal NFA, which accepts all strings in which the 3rd last bit is b is _____. [Assume $\Sigma = \{a, b\}$]

FAQ Solution Video Have any Doubt ?

4 Correct Option

Solution :
4

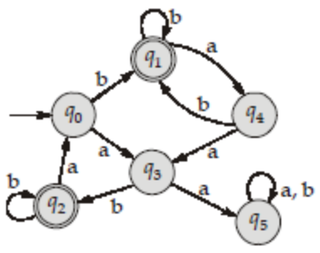
Minimal NFA:



QUESTION ANALYTICS +

Q. 17

Consider the following DFA:



The number of states in the minimal DFA obtained by applying minimization algorithm on the above DFA is equal to _____.

FAQ Solution Video Have any Doubt ?

4 Correct Option

Solution :
4

Partition-1: $\{q_1, q_2\}, \{q_0, q_3, q_4, q_5\}$

Partition-2: $\{q_1, q_2\}, \{q_0, q_3, q_4\}, \{q_5\}$

Partition-3: $\{q_1, q_2\}, \{q_0, q_4\}, \{q_3\}\{q_5\}$

Partition-4: $\{q_1, q_2\}, \{q_0, q_4\}, \{q_3\}\{q_5\}$

Therefore 4 states will be required.

QUESTION ANALYTICS +