Kunal Jha
Course: GATE
Computer Science Engineering(CS)

HOME
MY TEST
BOOKMARKS
MY PROFILE
REPORTS
BUY PACKAGE
NEWS
TEST SCHEDULE

TOPICWISE : THEORY OF COMPUTATION-1 (GATE - 2020) - REPORTS

OVERALL ANALYSIS | COMPARISON REPORT | SOLUTION REPORT

ALL(17) | CORRECT(5) | INCORRECT(12) | SKIPPED(0)

Q. 1 Solution Video | Have any Doubt ?

Consider the following grammar:
$S \rightarrow Ab$
$A \rightarrow aAb$
$A \rightarrow \epsilon$
Where {S, A} are non-terminals and {a, b, ϵ} are terminals then which of the following language is generated by the above grammar?

A. $L = \{a^n b^m : n, m \geq 0\}$

B. $L = \{a^m b^n : n \geq 1; m \geq 0\}$ — Your answer is **Wrong**

C. $L = \{a^n b^n : n \geq 0\}$

D. None of the above — Correct Option

Solution :
(d)

$$\left.\begin{array}{l} A \rightarrow aAb \\ A \rightarrow \epsilon \end{array}\right\} \text{ generates } \{a^n b^n : n \geq 0\}$$

Now, $S \rightarrow Ab$
$\rightarrow a^n b^n b$
$L = \{a^n b^{n+1} : n \geq 0\}$
So, option (d) is the correct answer.

QUESTION ANALYTICS +

Q. 2 Solution Video | Have any Doubt ?

Consider the following grammar G:
$S \rightarrow ABA$
$A \rightarrow aA \mid bA \mid \epsilon$
$B \rightarrow bb \mid bbB$
The regular language for the above grammar G is

A. $(a + b)^* (bb)^* (a + b)^+$

B. $(a + b)^* (bb)^* (a + b)^*$

C. $(a + b)^* (bb)^+ (a + b)^*$ — Your answer is **Correct**

Solution :
(c)

$S \rightarrow ABA$
$A \rightarrow aA \mid bA \mid \epsilon$
$B \rightarrow bb \mid bbB$

- A generates $(a + b)^*$
- B generates $(bb)^+$

So, $S \rightarrow (a + b)^* (bb)^* (a + b)^*$
So, correct option is (c).

D. $abb\,(a + b)^*$

QUESTION ANALYTICS +

Q. 3 Solution Video | Have any Doubt ?

The deterministic finite automata for the language $L = \{1^m \mid m \geq 0 \text{ and } m \neq 3\}$ will have

A. 5 states and 1 final states

B. 6 states and 5 final states

C. 4 states and 3 final states

D. 5 states and 4 final states — Your answer is **Correct**

Solution :
(d)

$\left.\begin{array}{l} A \to aAb \\ A \to \in \end{array}\right\}$ generates $\{a^n b^n : n \geq 0\}$

Now, $S \to Ab$

$\to a^n b^n b$

$L = \{a^n b^{n+1} : n \geq 0\}$

So, option (d) is the correct answer.

QUESTION ANALYTICS +

Q. 4 Solution Video | Have any Doubt ?

Given, $L = \{w \mid n_0(w) < n_1(w)\}$

The context free grammar for the above L is

A $S \to 0?0S?1SS$

B $S \to 1?1S?SS0?S0S?0SS$

C $S \to 01?1?1S?S0S$ — Your answer is **Wrong**

D $S \to 0S?1S?S0S?S1S$

QUESTION ANALYTICS +

Q. 5 Solution Video | Have any Doubt ?

The regular expression for the language $L = \{x \in \{0, 1\}^+\}$ such that x ends with 0 and does not contain substring 11 is

A (10 + 01)* 10

B (1 + 01)* 10

C (1 + 10)* (10 + 01)

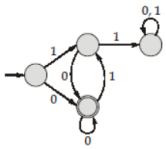
D $(0 + 10)^+$ — Your answer is **Correct**

Solution :
(d)

$L = \{x \in \{0, 1\}^* \mid x \text{ ends with 0 and not contains 2 consecutive 1's}\}$

R.E. $= (0 + 10)^* (0 + 10)$

$= (0 + 10)^+$



So, option (d) is correct.

QUESTION ANALYTICS +

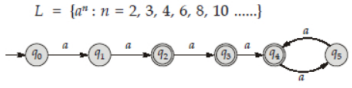
Q. 6 Solution Video | Have any Doubt ?

How many number of DFA states required which accepts the language $L = \{a^n : n = 3 \text{ or } n = 2m \text{ for all } m \geq 1\}$ _____.

6 — Correct Option

Solution :
6

$L = \{a^n : n = 2, 3, 4, 6, 8, 10 \ldots\ldots\}$



DFA

Total 6 states are required.

Your Answer is 4

QUESTION ANALYTICS +

Q. 7 Solution Video | Have any Doubt ?

Let $L = \{baba\}$. Prefix is the set of all prefix string and suffix is the set of all suffix string over the language L is used to perform the following.

$A = \{\text{Prefix } (L)\} \cap \{\text{Suffix } (L)\}$

The number of strings exist in the language A are _____.

3 — Correct Option

Solution :
3

$$\text{Prefix } (L) = \{\in, b, ba, bab, baba\}$$
$$\text{Suffix } (L) = \{\in, a, ba, aba, baba\}$$
$$A = \{\in, b, ba, bab, baba\} \cap \{\in, a, ba, aba, baba\}$$
$$A = \{\in, ba, baba\}$$

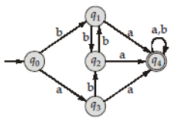
There are 3 strings present in language A.

Your Answer is 4

QUESTION ANALYTICS +

Q. 8 Solution Video | Have any Doubt ?

Consider the following DFA D.

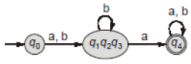


The number of states in the minimization of D are _____.

3 — Correct Option

Solution :
3

The minimized DFA after combining the q_1, q_2 and q_3 are given below.



Your Answer is 4

QUESTION ANALYTICS +

Q. 9 Solution Video | Have any Doubt ?

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

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 1

QUESTION ANALYTICS +

Q. 10 Solution Video | Have any Doubt ?

Given L = $\{a^n b^m | n \geq 4; m \leq 3\}$
Regular expression for the complement of the above language L is

A a^*bbbb^*

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

C $(\in + a + aa + aaa)b^* + a^*bbbbb^* + (a + b)^* ba(a + b)^*$ — Correct Option

Solution :
(c)

$$L = \{a^n b^m | n \geq 4; m \leq 3\}$$
$$L^c = \{a^n b^m | n < 4 \text{ or } m > 3\} \cup \{x\ ba\ x | x \in (a + b)^*\}$$
$$\text{or}$$
$$\text{So, } L^c = (\in + a + aa + aaa)b^* + a^*bbbbb^* + (a + b)^* ba(a + b)^*$$

D None of the above Your answer is **Wrong**

QUESTION ANALYTICS +

Kunal Jha
Course: GATE
Computer Science Engineering(CS)

TOPICWISE : THEORY OF COMPUTATION-1 (GATE - 2020) - REPORTS

OVERALL ANALYSIS | COMPARISON REPORT | SOLUTION REPORT

ALL(17) | CORRECT(5) | INCORRECT(12) | SKIPPED(0)

Q. 11

Solution Video | Have any Doubt ?

Let A be a NFA with epsilon transitions such that there are no transitions into q_0 (start state) and no transitions out of q_f (the accepting state). Let L be the language recognized by A. The above automata 'A' is modified by adding an epsilon-transition from Q_f to Q_0. The language accepted by the modified 'A' in terms of 'L' will be :

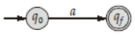
A. Same as L

B. Accepts null — Your answer is **Wrong**

C. Accepts universal language

D. Accept L^+ — Correct Option

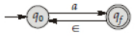
Solution :
(d)
Consider the following automata A :



Above automata satisfies the condition as there is no transition into q_0 and no transition out of q_f
.

$$L = \{a\}$$

Modified Automata:



By adding this null transition in the automata. Now in this string 'a' can occur in a string multiple times and the automata will accept it.
Hence, it accepts L^+.

QUESTION ANALYTICS +

Q. 12

Solution Video | Have any Doubt ?

The regular grammar for the language $L = \{w | n_a(w)$ and $n_b(w)$ are both even, $w \in \{a, b\}^*\}$ is given by: (Assume, P, Q, R and S are states and P is the initial states)

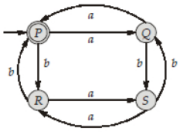
A. $P \to aQ|bR|\in, Q \to bS|aP$
$R \to aS|bP, S \to aR|bQ|\in$

B. $P \to aQ|bR, Q \to bS|aP$
$R \to aS|bP, S \to aR|bQ|\in$ — Your answer is **Wrong**

C. $P \to aQ|bR|\in, Q \to bS|aP$
$R \to aS|bP, S \to aR|bQ$ — Correct Option

Solution :
(c)

- In option (a) both P and S are final states and cannot generate language L hence not correct.
- In option (b) S is the final state and cannot generate language L hence not correct.
- In option (c) P is the final state as well as initial state and correctly generates the language L.
  $P \to aQ \,|bR|\in$
  $Q \to bS \,|aP$
  $R \to aS \,|bP$
  $S \to aR \,|bQ$
  The machine will be



- Option (d) is wrong because there is no final state.

D. $P \to aQ|bR, Q \to bS|aP$
$R \to aS|bP, S \to aR|bQ$

QUESTION ANALYTICS +

Q. 13

Solution Video | Have any Doubt ?

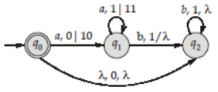
The pushdown automation M = ({q_0, q_1, q_2}, {a, b}, {0, 1}, δ, q_0, 0, {q_0}) with

$\delta(q_0, a, 0) = \{(q_1, 10)\}$
$\delta(q_1, a, 1) = \{(q_1, 11)\}$
$\delta(q_1, b, 1) = \{(q_2, \lambda)\}$
$\delta(q_2, b, 1) = \{(q_2, \lambda)\}$
$\delta(q_2, \lambda, 0) = \{(q_0, \lambda)\}$
Accepts the language

A $L = \{a^n b^m ? n, m \geq 0\}$

B $L = \{a^n b^n ? n \geq 0\}$ Correct Option

Solution :
(b)
The given PDA, $M = (\{q_0, q_1, q_2\}, \{a, b\}, \{0, 1\}, \delta, q_0, 0, \{q_0\})$ where 6th tuple represents the start stack symbol. So here in this case 0 is start stack symbol



This depicts that on every 'a' in the string '1' is pushed on the stack and stack is popped on every 'b'. Hence we need $a^n b^n$. Now since initial state is also the final state.
So, $L = \{a^n b^n \mid n \geq 0\}$

C $L = \{a^n b^m ? n, m > 0\}$ Your answer is **Wrong**

D $L = \{a^n b^n ? n > 0\}$

QUESTION ANALYTICS +

Q. 14 Solution Video Have any Doubt ?

The regular grammar for the language $L = \{a^n b^m \mid n + m$ is even$\}$ is given by

A
$S \rightarrow S_1 | S_2$
$S_1 \rightarrow aS_1 | A_1$
$A_1 \rightarrow bA_1 | \lambda$
$S_2 \rightarrow aaS_2 | A_2$
$A_2 \rightarrow bA_2 | \lambda$

B
$S \rightarrow S_1 | S_2$
$S_1 \rightarrow aS_1 | aA_1$
$S_2 \rightarrow aaS_2 | A_2$
$A_1 \rightarrow bA_1 | \lambda$
$A_2 \rightarrow bA2 | \lambda$

C
$S \rightarrow S_1 | S_2$
$S_1 \rightarrow aaaS_1 | aA_1$
$S_2 \rightarrow aaS2 | A_2$
$A_1 \rightarrow bA_1 | \lambda$
$A_2 \rightarrow bA2 | \lambda$

D
$S \rightarrow S_1 | S_2$
$S_1 \rightarrow aaS_1 | A_1$
$S_2 \rightarrow aaS_2 | aA_2$
$A_1 \rightarrow bbA_1 | \lambda$
$A_2 \rightarrow bbA_2 | b$
Your answer is **Correct**

Solution :
(d)
Given, $L = \{a^n b^m \mid (n + m)$ is even$\}$
For $(n + m)$ to be even either n and m both are even or n and m both are odd.
Therefore the Regular Expression (R.E.) = $\{(aa)^* (bb)^* + (aa)^* a (bb)^* b\}$
- So, for n and m to be even, grammar is:
  $S_1 \rightarrow aaS_1 | A_1$
  $A_1 \rightarrow bbA_1 | \epsilon$
- For n and m odd, grammar is:
  $S_2 \rightarrow aaS_2 | aA_2$
  $A_2 \rightarrow bbA_2 | b$

Now, combine both; then resultant grammar is:
$S \rightarrow S_1 | S_2$
$S_1 \rightarrow aaS_1 | A_1$
$A_1 \rightarrow bbA_1 | \epsilon$
$S_2 \rightarrow aaS_2 | aA_2$
$A_2 \rightarrow bbA_2 | b$

QUESTION ANALYTICS +

Q. 15 Solution Video Have any Doubt ?

Consider the following language:

(i) $L = \{a^m b^n \mid n + m \text{ is even}\}$
(ii) $L = \{axb \mid x \in \{1, 0\}^*\}$
(iii) $L = \{uww^R v \mid u, v, w \in \{a, b\}^+\}$
(iv) $L = \{uww^R v \mid u, v, w \in \{a, b\}^+ \mid u| = |v|\}$
The number of regular language of the above language is _____.

3 — Correct Option

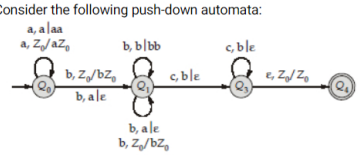
Solution :
3
(i) $L = \{a^m b^n \mid n + m \text{ is even}\}$ is regular because RE = $\{(aa)^* (bb)^* + (aa)^* a (bb)^* b\}$.
(ii) $L = \{axb \mid x \in \{1, 0\}^*\}$ is regular because RE = $a (0 + 1)^* b$
(iii) $L = \{uww^R v \mid u, v, w \in \{a, b\}^+\}$ is regular because the regular expression will be
$$L = (a + b)^+ (aa + bb) (a + b)^+$$
(iv) $L = \{uww^R v \mid u, v, w \in \{a, b\}^+ \mid u| = |v|\}$ is not regular because we need a stack to compare length of $|u| = |v|$.

Your Answer is 2

QUESTION ANALYTICS +

Q. 16 — Solution Video — Have any Doubt ?

Consider the following push-down automata:



Q_0 is the initial state and Q_4 is the final state. Stack alphabet $\Gamma = \{a, b, c, Z_0\}$. Input alphabet $\Sigma = \{a, b, c\}$. Let the following string 'aabbb – c' is accepted by the above PDA. How many of the following operation best suited the vacant space in the above string?
(i) bbcc (ii) abbc
(iii) aacc (iv) bbbb
(v) bbbc

1 — Correct Option

Solution :
1
The PDA drawn above is describing the language:
$$L = \{a^n b^{n+m} c^m \mid n \geq 0, m \geq 1\}$$
Out of the above five string for the blank spaces only the string 'bbcc' i.e., 'aabbbbbccc'.

Your Answer is 4

QUESTION ANALYTICS +

Q. 17 — Solution Video — Have any Doubt ?

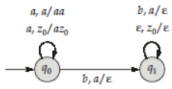
Consider the following transition table from PDA.

δ	Σ		
	a	b	ε
→ q_0	$(q_0, z_0/az_0)$ $(q_0, a/aa)$	$(q_1, a/\epsilon)$	$(q_0, \epsilon/z_0)$
q_1	–	$(q_1, a/\epsilon)$	$(q_1, z_0/\epsilon)$

PDA = $(Q, \Sigma, \delta, \Gamma, q_0, z_0, \phi)$ where $Q = (q_0, q_1)$ and $\delta : Q \times \Sigma_\epsilon \times \Gamma_\epsilon \to Q \times \Gamma_\epsilon$.
$\delta(q_0, a) \to (q_0, z_0/az_0)$ on input 'a': a is pushed to the stack having 'z_0' at the top.
Consider the following languages.
$L_1 = \{a^n b^m \mid m, n \geq 0\}$,
$L_2 = \{a^n b^n \mid n \geq 1\}$
$L_3 = \{a^m b^n \mid m > n\}$
$L_4 = \{a^m b^n \mid m < n\}$
The number of the above languages L_1, L_2, L_3 and L_4 are subset of the language L where L is the language accepted by the given PDA is _____.

1 — Your answer is Correct1

Solution :
1
A PDA with final state ϕ means empty stack method. Therefore PDA with empty stack will never accept NULL. So the language L will always have $n \geq 1$.



It accepts $L = \{a^n b^n \mid n \geq 1\}$ and $L = L_2$.
Only L_2 is the subset of L.

QUESTION ANALYTICS +

Kunal Jha
Course: GATE
Computer Science Engineering(CS)

SINGLE SUBJECT : THEORY OF COMPUTATION(GATE - 2020) - REPORTS

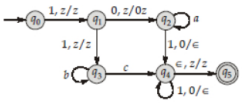
OVERALL ANALYSIS | COMPARISON REPORT | SOLUTION REPORT

ALL(33) | CORRECT(8) | INCORRECT(10) | SKIPPED(15)

Q. 1

Solution Video | Have any Doubt ?

Consider the following PDA where z is stack symbol.



What will be the value of a, b, c if above PDA is generating language

$$\{10^n 1^n | n > 0\} \cup \{110^n 1^{2n} | n > 0\}$$

A $a = 0, 0|00 \quad b = 0, z|00z \quad 0, 0|000 \quad c = 1, 0|\in$

Your answer is **Correct**

Solution :
(a)
At state q_2, since this for $10^n 1^n$, so we need to push all 0's in the stack, hence it becomes $(0, 0|00)$.
Next, at state q_3 since this is for $110^n 1^{2n}$, so every single 0, we push two 0's, hence $0, z|00z$, then for add 0's 0, $0|000$, then for c, now all 0's have been pushed in q_3 now to check the comparison between 1 and 0's need to be pop.
Hence at $c = (1, 0|\in)$.

B $a = 1, 0|\in \quad b = 0, z|00z \quad 0, 0|00 \quad c = 1, 1|\in$

C $a = 0, 0|00 \quad b = 0, z|000z \quad 0, 0|00 \quad c = 0, 0|00$

D $a = 0, z|0z \quad b = 0, z|00z \quad 0, 0|000 \quad c = 1, 0|\in$

QUESTION ANALYTICS +

Q. 2

Solution Video | Have any Doubt ?

Let L = {language of all CFG's that are ambiguous}. Let L' be the complement of language L.
Which of the following is true?

A L is RE and L' is RE

B L is not RE and L' is RE

C L is not RE, and L' is not RE

D L is RE and L' is not RE — Correct Option

Solution :
(d)
We can determine that a CFG in ambiguous by finding a single string which has an ambiguous derivation, hence is RE, but we can't determine if a CFG is unambiguous when we try every string in it.
Since L is RE but not REC so, L' is not RE.

QUESTION ANALYTICS +

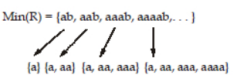
Q. 3

Solution Video | Have any Doubt ?

Let R be any regular set. Let Min(R) is a set of all strings 'w' in R, where every proper prefix of 'w' is not in R. Then, to which class of language Min(R) belongs?

A Regular — Correct Option

Solution :
(a)
Regular set is closed under Min(R) operation.
OR
Let regular set be $\{a^n b^m | n, m \geq 0\}$



Minimum of R does not contain $\{a, aa, aaa, aaaa, \ldots\}$ alone because these are prefix of string

present in the Min(R).
So, $\text{Min}(R) = \{a^n b \mid n > 0\} \rightarrow$ Regular set.

B Context free language

C Case sensitive language

D Recursive enumerable

QUESTION ANALYTICS +

Q. 4 Solution Video | Have any Doubt ? | Bookmark

Consider the following languages over the alphabet $\Sigma = \{0, b, a\}$:
$L_1 = \{a^n 0 b^n \mid n \geq 1\}$
$L_2 = \{0^p (ab)^* \mid p \text{ is prime numbers}\}$
$L_3 = \{w0w \mid w \in (0, b, a)^*\}$
Which of these languages are deterministic context free language?

A Only L_1 — Your answer is **Correct**

Solution :
(a)

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

All a's are push until 0 is not encounter. When 0 is come skip it and after the 0 for every b pop the a's present in stack.
So, language is DCFL.

$$L_2 = \{0^p (ab)^* \mid p \text{ is prime numbers}\}$$

Since we can not create PDA for language 0^p where p is prime numbers. By using pumping lemma we can prove that above language is not CFL.

$$L_3 = \{w\,0\,w \mid w \in (0,b,a)^*\}$$

String matching is done in CSL.

B Both L_1 and L_2

C Both L_1 and L_3

D All of the above

QUESTION ANALYTICS +

Q. 5 Solution Video | Have any Doubt ? | Bookmark

Which of the following language is not having an equivalent Deterministic PDA?

A $\{0^p 1^{q+p} 2^q \mid q, p \geq 1\}$

B $\{0^q 1^p 0^p 1^q \mid q, p \geq 1\}$

C $\{0^{q+p} 1^{q+p} 2^k \mid q, p, k \geq 1\}$

D $\{0^q 1^p 0^q 1^p \mid q, p \geq 1\}$ — Your answer is **Correct**

Solution :
(d)

(a) $\{0^p 1^{q+p} 2^q \mid q, p \geq 1\}$

$= \{0^p 1^p \; 1^q 2^q \mid q, p \geq 1\}$ is DCFL

(b) $\{0^q 1^p 0^p 1^q \mid q, p \geq 1\}$ is DCFL

(c) $\{0^{q+p} 1^{q+p} 2^k \mid q, p, k \geq 1\} = \{0^i 1^i 2^k\}$ is DCFL

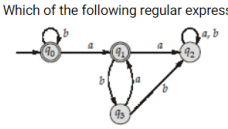
(d) $\{0^q 1^p 0^q 1^p \mid q, p \geq 1\}$ is not DCFL

$\therefore$ Option (d) is correct, which not contains an equivalent PDA.

QUESTION ANALYTICS +

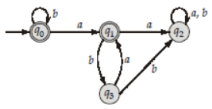
Q. 6 Solution Video | Have any Doubt ? | Bookmark

Which of the following regular expression represents the language accepted by given DFA.



A $b^* + b^*a\,(ba)^*$ — Your answer is **Correct**

Solution :
(a)



$q_0 = b^*$ ...(0)
$q_1 = q_0a + q_3a$ ...(1)
$q_2 = q_1b$ ...(2)

Put equation (0) and (2) in (1)

$q_1 = b^*a + q_1ba$
$q_1 = b^*a\,(ba)^*$

Since two final states
So, final expression is = $b^* + b^*a\,(ba)^*$

B $b + b^*a\,(ba)^*$

C $b^* + ba\,(ba)^*$

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

QUESTION ANALYTICS +

Q. 7 Solution Video | Have any Doubt ?

Let L_1 be a regular language over $\Sigma = \{a, b, c\}$ and $L_2 = \{a^n b^n c^n\}$. Concatenation of L_1 and L_2 is _____ (i.e., $L_1.L_2$)

A Regular language

B Non-regular language

C Context sensitive language — Your answer is **Correct**

Solution :
(c)

$L_1.L_2$ = (Regular) . (CSL)

L_2 is $a^n b^n c^n$, but L_1 can be any regular language.

Case 1: If $L_1 = \phi$,

$\Rightarrow$ $L_1.L_2 = \phi.\{a^n b^n c^n\} = \phi$ is regular, which is also CSL.

Case 2: If $L_1 = \{\varepsilon\}$

$\Rightarrow$ $L_1.L_2 = \{\varepsilon\}.\{a^n b^n c^n\} = \{a^n b^n c^n\}$ is CSL.

$L_1.L_2$ is always CSL but it may or may not be regular.

D None of these

QUESTION ANALYTICS +

Q. 8 Solution Video | Have any Doubt ?

Consider the following languages L_1 and L_2 on $\Sigma = (a, b)$

$L_1 = \{a^m b^n \mid m, n \geq 0\}$
$L_2 = \{a^m b^n \mid m = n\}$

If $(L_1 \cup \bar{L}_2) = L$ then what is the language L?

A $L = (a + b)^*$ — Correct Option

Solution :
(a)

$L_2 = \{a^n b^n\}$, $L_1 = \{a^*b^*\}$

$L = (a^*b^*) \cup ((a + b)^* - \{a^n b^n\})$
$= a^*b^* + \{a^m b^n \mid m \neq n\} + (a + b)^*\,ba\,(a + b)^*$
$= (a + b)^* + \{a^m b^n \mid m \neq n\}$
$= (a + b)^*$

B $L = \{a^m b^n \mid m! = n\}$

C $L = (a + b)^* - \{a^n b^n\}$ — Your answer is **Wrong**

D $L = (a + b)^* - \{a^m b^n \mid m! = n\}$

QUESTION ANALYTICS +

Q. 9 Solution Video | Have any Doubt ?

Which of the following statement is false?

A Languages accepted by push down automata are not closed under complementation.

B Turing decidable languages are closed under union and Kleen star operation.

C Turing recognizable languages are closed under complementation and union. Correct Option

Solution :
(c)
• Languages accepted by push down automata are not closed under complementation.
• Turing decidable languages are closed under union and Kleen star operation.
• Recursive enumerable languages are not closed under complementation.

D None of these

QUESTION ANALYTICS +

Q. 10 Solution Video Have any Doubt ?

Which of the following statement is true?

A Every subset of a regular set in regular. Your answer is **Wrong**

B Every language has a regular superset. Correct Option

Solution :
(b)
Considering each statements
- Let $L_1 = \{a^n b^n \mid n \geq 1\}$, $L_2 = \{w \mid w \in \{a + b\}^*\}$
  $L_1 \subset L_2$,
  L_2 is regular
  But L_1 is not regular
- Σ^* is a superset of every language.
- Regular languages are not closed under infinite intersection.

C Intersection of infinitely many regular languages must be regular.

D None of these

QUESTION ANALYTICS +

Kunal Jha
Course: GATE
Computer Science Engineering(CS)

SINGLE SUBJECT : THEORY OF COMPUTATION(GATE - 2020) - REPORTS

OVERALL ANALYSIS | COMPARISON REPORT | SOLUTION REPORT

ALL(33) CORRECT(8) INCORRECT(10) SKIPPED(15)

Q. 11 Solution Video | Have any Doubt ?

Assume L be the set of all binary strings where on every odd position a is present. The number of states in minimal state deterministic finite automaton accepting L is _____.

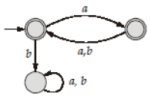
3 — Your answer is Correct3

Solution :
3

Regular expression for given language is $L = (a + b)^*(\epsilon + a)$

i.e., $L = \{\epsilon, a, aa, ab, aaa, aba, \ldots\}$

DFA for above regular expression is:



$\because$ 3 states are present in minimal deterministic finite automaton.

QUESTION ANALYTICS +

Q. 12 Solution Video | Have any Doubt ?

Consider the following CFG G. Where E is start symbol.

$E \rightarrow 0A|1B|AB|\epsilon$

$A \rightarrow 0A1|\epsilon$

$B \rightarrow 1B0|\epsilon$

$L(G)$ is a language generated by grammar G. If $L = \{w|w \in L(G), |w| \leq 4\}$. The minimum length string which not present in above language is _____.

2 — Correct Option

Solution :
2

$E \rightarrow 0A|1B|AB|\epsilon$

$A \rightarrow 0A1|\epsilon$

$B \rightarrow 1B0|\epsilon$

In above language minimum string '00' not present, whose length is 2.

QUESTION ANALYTICS +

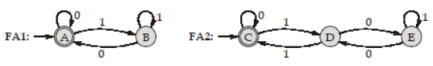
Q. 13 Solution Video | Have any Doubt ?

Assume that FA1 be the DFA which accept all the binary number which are not divisible by 2 and FA2 be the DFA which accept all the binary number which are not divisible by 3. The number of state in minimal DFA which represent FA1 $\cup$ FA2 is _____.

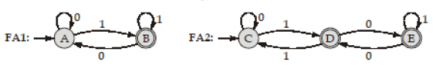
6 — Correct Option

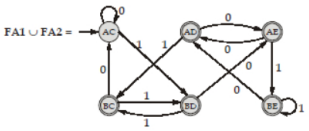
Solution :
6

FA1: Binary number which are divisible by 2
FA2: Binary number which are divisible by 3.



FA1: Binary number which are not divisible by 2
FA2: Binary number which are not divisible by 3.





Your Answer is 5

QUESTION ANALYTICS +

Q. 14 Solution Video | Have any Doubt ?

Let $L = \{bab\}$. Prefix is the set of all prefix string and suffix is the set of all suffix string over the language L:

$A = \{\text{Prefix } (L)\} \cap \{\text{Suffix } (L)\}$

The number of strings exist in the language A is _____.

3 — Correct Option

Solution :

3

$$\text{Prefix } (L) = \{\epsilon, b, ba, bab\}$$
$$\text{Suffix } (L) = \{\epsilon, b, ab, bab\}$$
$$A = \{\epsilon, b, ba, bab\} \cap \{\epsilon, b, ab, bab\}$$
$$A = \{\epsilon, b, bab\}$$

There are 3 strings present in language A.

Your Answer is 2

QUESTION ANALYTICS +

Q. 15 Solution Video | Have any Doubt ?

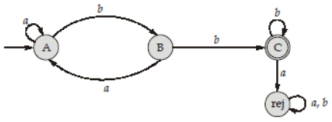
The minimum number of states in DFA constructed for the language represented by the regular expression $a^*b\,(aa^*b)^*bb^*$ _____.

4 — Your answer is Correct4

Solution :

4

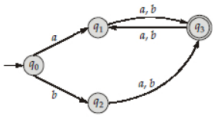
The DFA for the regular expression $a^*b\,(aa^*b)^*bb^*$ will be,



QUESTION ANALYTICS +

Q. 16 Solution Video | Have any Doubt ?

Consider the following finite automata with $\Sigma = \{a, b\}$:



The number of states in the minimized DFA constructed for the language accepted by given automata is _____.

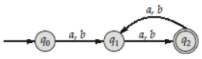
3 — Your answer is Correct3

Solution :

3

Above DFA is accepting the language 'L' which have even number of characters with length ≥ 2.

Minimized DFA will be,



$\therefore$ Number of states are 3.

QUESTION ANALYTICS +

Q. 17 Solution Video | Have any Doubt ?

Consider the following language:

$L_1 = \{<M> | M \text{ is TM, } M_0 \text{ is TM that halts on all inputs, and } M \in L(M_0)\}$

$L_2 = \{<M> | M \text{ is TM, } M_0 \text{ is TM that halts on all inputs, and } M_0 \in L(M)\}$

Which of the following is correct above languages?

A L_1 is recursive language

B L_2 is recursive enumerable language

C Both (a) and (b) — Correct Option

Solution :

(c)

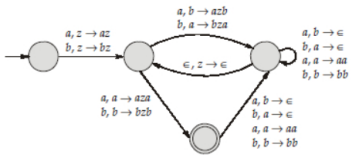
L_1 is recursive, since M_0 is halts on every inputs. So, when we run M.
Then If M_0 halt and accept the string then M accepts the string.
Else if M_0 halt and reject the string then M rejects the string.
So, M is always halt i.e., recursive language.
L_2 is recursive enumerable, since M halts only for strings that accepted by TM M_0.
So M is semidecidable.
Hence L_2 is recursively enumerable language.
Both (a) and (b) are true.

D Both are not recursive enumerable

QUESTION ANALYTICS +

Q. 18 Solution Video | Have any Doubt ?

Consider the following PDA:



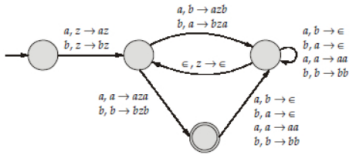
Which of the following language accepted by above PDA?

A All string that start and end with same symbol.

B All string that contain same number of 'a' and 'b'.

C Contain same numbers of 'a' and 'b' and start and end with same symbol. Correct Option

Solution :
(c)



Above PDA accepts all strings where number of 'a' and number of 'b' are same and start and end with same symbol.
L = {abba, aabba . . . } etc.

D None of the above

QUESTION ANALYTICS +

Q. 19 Solution Video | Have any Doubt ?

Let L be some regular set in which all strings happen to have length equal to a multiple of three. Let $M(L)$, be the set of strings in L where every three symbols are reversed.
For eg: If L = {aab, ababba ...}
$M(L)$ = {baa, ababb ...}
Which of the following is $M(L)$?

A Context free language Correct Option

Solution :
(a)
Regular language is closed under all operation except infinite $\cap$, infinite $\cup$, subset, superset.
So $M(L)$ is regular hence it is CFL.

B Context sensitive but not context free Your answer is **Wrong**

C Recursive enumerable only

D None of these

QUESTION ANALYTICS +

Q. 20 Solution Video | Have any Doubt ?

Consider the following context free language:
L : $\{w\#x | w^R$ is a substring for x, where $w, x \in \{a, b\}^*\}$
Which of the following CFG will represents the above language

A $S \to PQ$
$P \to aPa \mid bPb \mid \#Q$
$Q \to aQ \mid bQ \mid \varepsilon$

Correct Option

Solution :
(a)

$S \to PQ$
$P \to aPa \mid bPb \mid \#Q$
$Q \to aQ \mid bQ \mid \varepsilon$

The strings in the language have in form of $w\#uw^Rv$, where u and v are strings of form $(a + b)^*$. The variable Q generates strings u and v, while variable P generates strings $w\#uw^R$ and the variable S generates desired strings $w\#uw^Rv$.

B $S \to QP$
$P \to aPa \mid bPb \mid \#Q$
$Q \to aQ \mid bQ \mid \varepsilon$

C Both (a) and (b)

D None of these

QUESTION ANALYTICS +

Kunal Jha
Course: GATE
Computer Science Engineering(CS)

SINGLE SUBJECT : THEORY OF COMPUTATION(GATE - 2020) - REPORTS

Q. 21

Solution Video | Have any Doubt ?

Consider the following language:

$L(G) = \{a^n b^m c^m d^{2n} \mid n \geq 0, m > 0\}$

Which of the following grammar generate given language $L(G)$?

A $S \to aSdd \mid A$
$A \to bAc \mid bc$

Correct Option

Solution :
(a)

The relationship between the number of leading a's and trailing d's in the language indicates that recursive rule is needed to generate them. The same is true for b's and c's. Derivations in the grammar.

$S \to aSdd \mid A$
$A \to bAc \mid bc$

generate strings in an outside-to-inside manner.
Option (b) generate "$\in$" which is not present in $L(G)$.
Option (c) generate "add" which is not present in $L(G)$.
Option (d) generate "$\in$" which is not present in $L(G)$.
Option (a) contain all strings present in $L(G)$.

B $S \to aSdd \mid A$
$A \to bAc \mid \in$

C $S \to aSdd \mid A \mid add$
$A \to bAc \mid bc$

D $S \to aSdd \mid A$
$A \to bAc \mid bc \mid \in$

QUESTION ANALYTICS +

Q. 22

Solution Video | Have any Doubt ?

Which of the following languages over the alphabet $\Sigma = \{a, b, 0\}$ is regular?

$L_1 = \{a^n 0 b^n \mid n \geq 0\}$
$L_2 = \{0ww^R \mid w \in (a,b)^*\}$
$L_3 = \{w 0w^R \mid w \in (a,b)^*\}$
$L_4 = \{w_1 w_2^R 0 \mid w \in (a,b)^*\}$

A L_1 and L_2

B Only L_4

Correct Option

Solution :
(b)

L_1: is CFL since their is comparison between a and b. To make same number of b we have to the remember number of a's. So it is CFL (DCFL).
L_2: is CFL since their is comparison between w and w^R.
L_3: is CFL more appropriately said DCFL.

C Only L_3

D Only L_2

QUESTION ANALYTICS +

Q. 23

Solution Video | Have any Doubt ?

Which of the following represents regular language?

A $L = \{x \mid x = a^m (bc^k)^n, n, m, k \text{ are positive integers}\}$

B $L = \{wxwx \mid x \text{ is the reversal of } w \text{ and } x, w \in (a+b)^*\}$

C Both (a) and (b)

D None of the above — Correct Option

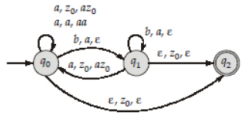
Solution :
(d)

- L is not regular since we need to remember the value of K for all value of m, n. Which is not possible with DFA. So non-regular.
- L is ww^rww^r, if we put $w = \epsilon$ then whole language is null, since we need to remember 'w' for every w^r. Which is not possible with DFA. So non-regular.

QUESTION ANALYTICS +

Q. 24 Solution Video | Have any Doubt ?

Consider the following PDA given below:



Which of the following represents language for above PDA?

A $L = \{(a^n\, b^n) \mid n \geq 0\}$

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

C $L = \{(a^n\, b^n)^* \mid n \geq 0\}$ — Correct Option

Solution :
(c)
Given PDA contain strings ϵ, $abab$, $aabbaabb$ which is represented by only $L = \{(a^n\, b^n)^* \mid n \geq 0\}$.

D $L = \{(a^*\, b^*)^n \mid n > 0\}$

QUESTION ANALYTICS +

Q. 25 Solution Video | Have any Doubt ?

Consider languages L_1 and L_2 over alphabet $\Sigma = \{a, b\}$.
L_1 is known to be a context-free language.
$L_2 = \{w \mid w$ is prefix of $w' \in L_1\}$
Which of the following is true?

A L_2 need not be CFL

B L_2 will be regular

C L_2 will be CFL — Correct Option

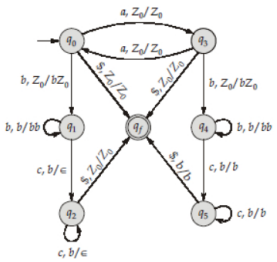
Solution :
(c)
Let $L_2 = \text{INIT}(L_1)$
Both regular and CFL are closed under INIT operation.
Therefore L_2 will be CFL.
Hence option (c) is correct.

D None of the above

QUESTION ANALYTICS +

Q. 26 Solution Video | Have any Doubt ?

Consider the following PDA:



Which of the following languages is represented by the above PDA?

A $L = \{a^m b^n c^k | \text{if } (m \text{ is even}) \text{ then } n = k\}$ Correct Option

Solution :
(a)
The above PDA represents the language,

$$L = \{a^m b^n c^k | \text{if } (m \text{ is even}) \text{ then } n = k\}$$

B $L = \{a^m b^n c^k | \text{if } (n \text{ is even}) \text{ then } m = k\}$

C $L = \{a^m b^n c^k | \text{if } (m \text{ is odd}) \text{ then } n = k\}$

D None of these

QUESTION ANALYTICS +

Q. 27 Solution Video Have any Doubt ?

Assume there are $(n + 2)$ languages over the same input alphabet Σ used in the composition with union as follows and result is represented by Y.
$Y = A \cup L_1 \cup L_2 \cup .... \cup L_n \cup B$
Given that $A = \Sigma^*$ and $B = \Phi$. All languages are defined over the same alphabet $\Sigma = \{a, b\}$. What is the language represented by Y?

A $Y = \Sigma^*$ Correct Option

Solution :
(a)

$$Y = A \cup L_1 \cup L_2 \cup ... \cup L_n \cup B$$
$$Y = \Sigma^* \cup L_1 \cup L_2 \cup ... \cup L_n \cup \phi \quad (\because \text{ union with } \Sigma^* = \Sigma^*)$$
$$Y = \Sigma^*$$

B $Y = \Phi$

C Y is regular and $Y \neq \Sigma^*$ and $Y \neq \Phi$

D Y is non-regular

QUESTION ANALYTICS +

Q. 28 Solution Video Have any Doubt ?

Consider the following languages:
$L_1 : \{< M, q > | M \text{ is a Turing Machine that visits state } q \text{ on some input within 15 steps}\}$.
$L_2 : \{< M > | M \text{ is a Turing Machine, } |M| < 200 \text{ where } |M| \text{ is number of states in machine}\}$.
Which of the following is correct ?

A L_1 is decidable but L_2 is not decidable

B L_2 is decidable but L_1 is not decidable

C Both L_1 and L_2 is decidable Correct Option

Solution :
(c)
1. M is a Turing Machine that visits state q on some input within 15 steps : yes we can run all string in language till 15 steps if it visit state q on any input then say yes but can't say no. [RUN only 15 steps so no Loop is formed]. Hence it is decidable.
2. Since every Turing Machine can be assigned a unique binary number so with state less then 200 finite Turing Machine is possible so L_2 has finite set of Turing Machine hence it is decidable.

D Neither L_1 nor L_2 is decidable

QUESTION ANALYTICS +

Q. 29 Solution Video Have any Doubt ?

Consider the following languages:
$L_1 = \{a^i b^j c^k | i = j, j < k\}$
$L_2 = \{a^i b^j c^k | (i \leq j) \text{ or } (j \leq i)\}$
$L_3 = \{a^m b^n c^n d^m | m \neq n\}$
$L_4 = \{a^i b^j c^k | \text{ if } (i = j) \text{ then } k \text{ is even}\}$
The number of Context Free Languages are _____.

2 Correct Option

Solution :
2

$L_1 = \{a^i b^j c^k | i = j, j < k\}$ is not CFL — ∵ 2 comparisons occurring
$L_2 = \{a^i b^j c^k | (i \le j) \text{ or } (j \le i)\}$ — Only 1 comparison
$L_3 = \{a^m b^n c^n d^m | m \ne n\}$ is not CFL — Cannot be done using PDA
$L_4 = \{a^i b^j c^k |$ if $(i = j)$ then k is even$\}$ is CFL — Only 1 comparison
$\therefore$ L_2 and L_4 are CFLs.

Your Answer is 1

QUESTION ANALYTICS +

Q. 30

Solution Video | Have any Doubt ? | Bookmark

Consider the following languages:
$L_1 : \{a^p b^p b^q a^q | p, q > 0\}$
$L_2 : \{a^p b^q a^q b^p | p, q > 0\}$
Consider the following statements with respect to above languages.
S_1 : Complement of L_1 is DCFL.
S_2 : Reverse of L_2 is not CSL.
S_3 : Intersection of L_1 and L_2 is CFL but not regular.
S_4 : Both L_1 and L_2 are CSL.
The nubmer of correct statements are _____.

2 — Correct Option

Solution :
2

$L_1 : \{a^p b^p b^q a^q | p, q > 0\} = \{a^p b^{p+q} a^q | p, q > 0\} = \{a^p b^t a^q | t = p + q\}$
Here push, pop are clear i.e. when to push and when to pop and contain only 1 comparison i.e.
$t = p + q$ so it is DCFL.
$L_2 : \{a^p b^q a^q b^p | p, q > 0\}$
L_2 is DCFL.
Considering the statements,
S_1 : $(DCFL)^C$ = DCFL, so S_1 is true.
S_2 : $(DCFL)^R = (CFL)^R$ = CFL (by closer property). Every CFL is CSL so S_2 is false.
S_3 : $L_1 \cap L_2 = \{a^p b^p b^q a^q\} \cap \{a^p b^q a^q b^p\} = \phi \Rightarrow$ Regular. So S_3 is false.
S_4 : Both L_1 and L_2 is DCFL and hence CSL too. So S_4 is true.

Your Answer is 1

QUESTION ANALYTICS +

Kunal Jha
Course: GATE
Computer Science Engineering(CS)

HOME
MY TEST
BOOKMARKS
MY PROFILE
REPORTS
BUY PACKAGE
NEWS
TEST SCHEDULE

SINGLE SUBJECT : THEORY OF COMPUTATION(GATE - 2020) - REPORTS

OVERALL ANALYSIS | COMPARISON REPORT | SOLUTION REPORT

ALL(33) CORRECT(8) INCORRECT(10) SKIPPED(15)

Q. 31 Solution Video | Have any Doubt ?

Consider the following language $L = \{w \in (a + b)^* \mid w$ has atleast as many occurrences of (bba)'s as (abb)'s$\}$. Consider the following statements.
S_1 : Language L is regular
S_2 : Complement of L is CFL
S_3 : Complement of L is CSL
S_4 : Reversal of L is CFL
The number of correct statements are _____.

4 — Correct Option

Solution :
4
Machine which accept L needs only finite amount of memory. Since there is no need to keep the number of bba's in the memory because whenever two abb's comes together (adjacent), then one bba's always come between them. So language L is regular. Since regular language is closed under complement, reversal and regular language are subset of CSL and CFL.
So all the statements are correct.

Your Answer is 2

QUESTION ANALYTICS +

Q. 32 Solution Video | Have any Doubt ?

Consider the following statements:
S_1 : Multi tape Turing Machine has more power than Multi-Track Turing Machine.
S_2 : Multi tape multihead Turing Machine has more power than Multitape Turing Machine.
The number of correct statements are _____.

0 — Correct Option

Solution :
0
Multi tape TM ≅ multi tape multi-head TM ≅ Multi track TM.
⇒ All given TM's are equally expressive.

Your Answer is 2

QUESTION ANALYTICS +

Q. 33 Solution Video | Have any Doubt ?

Consider the following languages:
L_1 : Set of all strings of form $\{a^p b^q \mid p + q = 500\}$ over alphabet $\Sigma = \{a, b\}$.
L_2 : Set of all strings of form $\{a^p b^q \mid p - q = 500\}$ over alphabet $\Sigma = \{a, b\}$.
The number of the above languages regular are _____.

1 — Correct Option

Solution :
1
L_1: Set of all strings of from $\{a^p b^q \mid p + q = 500\}$ over $\Sigma = \{a, b\}$ since $p + q = 500$, there are finite values of 'p' and 'q' which satisfy the condition, it will have finite number of state so it is regular.
L_2: Set of all strings of from $\{a^p b^q \mid p - q = 500\}$ over alpphabet $\Sigma = \{a, b\}$. Since $p - q = 500$, there are infinite value of 'p' and 'q'. So it is not regular.

Your Answer is 0

QUESTION ANALYTICS +

Kunal Jha
Course: GATE
Computer Science Engineering(CS)

TOPICWISE : THEORY OF COMPUTATION-2 (GATE - 2020) - REPORTS

OVERALL ANALYSIS | COMPARISON REPORT | SOLUTION REPORT

ALL(17) | CORRECT(9) | INCORRECT(6) | SKIPPED(2)

Q. 1 Solution Video | Have any Doubt ?

Consider the following 3 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?

A $L_2 \subset L_1$ and $L_3 \subset L_1$ and $L_1 = L_2 \cup L_3$ — Your answer is Correct

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 $L_1 \neq L_2 \cup L_3$

QUESTION ANALYTICS +

Q. 2 Solution Video | Have any Doubt ?

Consider the following statements:
S_1 : Infinite union of regular languages can be context-free.
S_2 : Language obtained after applying Kleen closure on a regular language will always be regular and infinite.
Which of the above statement is true?

A S_1 only — Your answer is Correct

Solution :
(a)

- Let $L_1 = \varepsilon, L_2 = \{ab\}, L_3 = \{a^2 b^2\}, L_4 = \{a^4 b^4\}$ ... so on.
  $L = L_1 \cup L_2 \cup L_3 \ldots L_n$
  $= \{\varepsilon\} \cup \{ab\} \cup \{a^2 b^2\} \cup \ldots$
  $= a^n b^n$ that is CFL
- Let L be ϕ which is regular language.
  $L^* = \phi^* = \varepsilon$, that is regular but finite.

B S_2 only

C Both S_1 and S_2

D Neither S_1 nor S_2

QUESTION ANALYTICS +

Q. 3 Solution Video | Have any Doubt ?

Consider the following statements:
S_1 : The set of context sensitive languages are closed under intersection.
S_2 : Turing decidable languages are closed under union and Kleene star operation.
S_3 : Turing recognizable languages are closed under complementation and union.
Which of the following option is correct ?

A Both S_2 and S_3 are false

B Both S_1 and S_2 are false

C All are false

D Only S_3 is false — Your answer is Correct

Solution :
(d)

Considering each statement:
CSL are closed under intersection therefore S_1 is true.
Turing decidable language are closed under union and Kleene star operation therefore S_2 is true.
Turing recognizable languages are not closed under complementation therefore S_3 is false.

QUESTION ANALYTICS +

Q. 4 Solution Video | Have any Doubt ?

For any two languages L_1 and L_2 such that L_1 is DCFL and L_2 is context sensitive language. Which of the following is/are necessarily true?

1. $\overline{L_1}$ (complement of L_1) is DCFL
2. $\overline{L_2}$ (complement of L_2) is CSL
3. $L_1 \cap L_2$ is CSL
4. $L_1^C \cap L_2^C$ is CSL

A 1 only

B 2 only

C 1, 2 and 3 only

D 1, 2, 3 and 4 — Your answer is **Correct**

Solution :
(d)

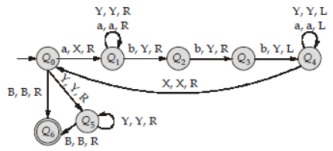
1. L_1 = DCFL and complement of DCFL is DCFL because DCFL is closed under complementation.
2. L_2 = CSL and complement of CSL is CSL because CSL is closed under complementation.
3. $L_1 \cap L_2$ = DCFL $\cap$ CSL
   = DCFL$\uparrow$ $\cap$ CSL(Push DCFL upto CSL in Chomsky hierarchy because operation performed between same language)
   = CSL $\cap$ CSL = CSL
4. $L_1^C \cap L_2^C$ = (DCFL)^C $\cap$ (CSL)^C
   = DCFL $\cap$ CSL
   = CSL $\cap$ CSL = CSL

So all statements are true.

QUESTION ANALYTICS +

Q. 5 Solution Video | Have any Doubt ?

Consider the following Turing Machine:



Identify the language accepted by Turing Machine:

A $L = \{a^m b^n \mid m < n;\ m, n \geq 0\}$

B $L = \{a^m b^n \mid m = 3n;\ m, n \geq 0\}$ — Your answer is **Wrong**

C $L = \{a^m b^n \mid 3m = n;\ m, n \geq 0\}$ — Correct Option

Solution :
(c)
Traversing the states of the Turing Machine, it can be seen that for every 'a' as the input, it is accepting 3 b's. For every 'a' machine writes 'X' on the tape, then take right moves till it reaches 'b'. For every 3 b's it writes symbol Y.
Hence accepting the language $L = \{a^m b^n \mid 3m = n;\ m, n \geq 0\}$.

D $L = \{a^m b^n \mid m \leq n;\ m, n \geq 0\}$

QUESTION ANALYTICS +

Q. 6 Solution Video | Have any Doubt ?

Consider the following statements:
S_1 : A student want to prove a relation between the "hello" and "world" where "hello" and "world" are two problems. If, the student proves that "hello" is reducible to "world" and "world" is decidable then "hello" is decidable.
S_2 : $L = \{(\text{top})^{2020}\ (\text{gate})^n\ (\text{exam})^q \mid n \leq 10,\ q < n\}$ where $\Sigma = \{t, o, p, e, g, a, x, m\}$ then L is CFL.
The number of correct statements is/are _____

2 — Your answer is **Correct2**

Solution :
2

Considering each option:
S_1 : Since "hello" is reducible to "world" and "world" is decidable, then "hello" is also decidable.
S_2 : Since, language specifies that, $n \leq 10$ and $q < n$ and 2020 is a finite number that means L is regular, hence CFL too.

QUESTION ANALYTICS +

Q. 7 Solution Video | Have any Doubt ?

Consider the following statements:
S_1 : Finiteness property of a CFG is not decidable.
S_2 : If a language is context-free it can always be accepted by a deterministic push-down automata.
S_3 : The complement of a deterministic CFL is recursive.
S_4 : The union of two deterministic context-free languages is deterministic context-free.
The number of correct statements are _____.

1 Your answer is **Correct**1

Solution :
1
Only S_3 is true:
- Finiteness property of a CFG is decidable, which can be decidable with the help of variable dependency graph.
- Push-down automata need not be always deterministic. In fact power of non-deterministic PDA is greater than the deterministic.
- Deterministic CFL are closed under complement, hence recursive too.
- DCFL is not closed under union.

QUESTION ANALYTICS +

Q. 8 Solution Video | Have any Doubt ?

Consider $L_1 = \{0^n \mid n \geq 0\}$, $L_2 = \{1^n \mid n \geq 0\}$, $L_3 = \{2^n \mid n \geq 0\}$
S_1 : $L_1 \cdot L_2 \cdot L_3$ is a context-sensitive language.
S_2 : $L_1 \cdot L_2 \cdot L_3 \neq \{0^n 1^n 2^n \mid n \geq 0\}$
S_3 : Complement of $L_1 \cdot L_2 \cdot L_3$ is context free language.
The number of the correct statements is/are _____.

3 Correct Option

Solution :
3
- $L_1 \cdot L_2 \cdot L_3 = \{0^p 1^q 2^r \mid p, q, r \geq 0\} = 0^* 1^* 2^*$ is regular.
  Since regular, hence context-sensitive too.
- $L_1 \cdot L_2 \cdot L_3 \neq \{0^n 1^n 2^n \mid n \geq 0\}$
- Since it is a regular language and regular languages are closed under complement, hence complement of $L_1 \cdot L_2 \cdot L_3$ is regular language. So it is also context free.

Your Answer is 2

QUESTION ANALYTICS +

Q. 9 Solution Video | Have any Doubt ?

Consider the following problems:
P_1 : Determining whether two non-deterministic finite automata accept the same language.
P_2 : Determining whether two context-free grammars represent exactly the same language.
P_3 : Determining whether a given Turing Machine will halt for given input.
The number of problems that are decidable are _____.

1 Correct Option

Solution :
1
Consider each problem:
P_1 : Equality is decidable for finite automata and hence the problem is decidable.
P_2 : The problem of determining whether two given CFGs represent the same language is undecidable.
P_3 : Halting problem is undecidable but semidecidable.

QUESTION ANALYTICS +

Q. 10 Solution Video | Have any Doubt ?

Let $L = \{a^m b^n b^k d^l \mid (n + k = \text{odd}) \text{ only if } m = l; m, n, k, l > 0\}$. Which of the following is true about L?

A L is CFL but not DCFL — Your answer is **Wrong**

B L is regular but not CFL

C L is DCFL but not regular — Correct Option

Solution :
(c)

$$L = \{a^m b^n b^k d^l | (n + k = \text{odd}) \text{ only if } m = l\}$$

If, we check the condition carefully, the condition is actually logical implication.

$$L = \{a^m b^n b^k d^l | (n + k = \text{odd}) \rightarrow m = l\}$$

Either $n + k$ will be odd or it will be even, if $(n + k)$ is odd, then it's necessary that m should be equal to l, if $(n + k)$ is even then l can be any number.

$$L = \{a^m b^{2n+1} d^l \text{ and } l = m\} \text{ or } \{a^m b^{2n} d^l\}$$

$$= \{a^m b^{2n+1} d^m\} \cup \{a^m b^{2n} d^l\}$$

$\Rightarrow$ DCFL $\cup$ regular = DCFL but here L is not regular because $\{a^m b^{2n+1} d^m\}$ has a infinite comparison which is not allowed in regular language.

D None of these

QUESTION ANALYTICS +

Kunal Jha
Course: GATE
Computer Science Engineering(CS)

HOME
MY TEST
BOOKMARKS
MY PROFILE
REPORTS
BUY PACKAGE
NEWS
TEST SCHEDULE

TOPICWISE : THEORY OF COMPUTATION-2 (GATE - 2020) - REPORTS

OVERALL ANALYSIS | COMPARISON REPORT | SOLUTION REPORT

ALL(17) | CORRECT(9) | INCORRECT(6) | SKIPPED(2)

Q. 11 Solution Video | Have any Doubt ?

Consider the following statements:
S_1 : Pumping lemma can be used to prove the regularity of a language.
S_2 : Given a grammar, checking if the grammar is not regular is decidable problem.
S_3 : If L is a regular and M is not a regular language then L.M is necessarily not regular.
Which of the following statement is correct ?

A Only S_1, S_3 is correct

B Only S_2 is correct — Your answer is **Correct**

Solution :
(b)
S_1 : Pumping lemma can prove that language is not regular but can't prove that the language is regular. Hence this is false.
S_2 : We can check regular grammar by following productions $V \to T^* V + T^*$ or $V \to V T^* + T^*$.
S_3 : Consider 'L' to be ϕ and 'M' to $\{a^n b^n \mid n \le 0\}$
L.M. = ϕ, which is regular

C Only S_3 is correct

D Only S_2, S_3 is correct

QUESTION ANALYTICS +

Q. 12 Solution Video | Have any Doubt ?

Which of the following languages is CFL?

A $L = \{a^n b^n c^m \mid m! = n, m, n \ge 1\}$

B $L = \{a^m b^n c^k \mid m > n \text{ or } n < k; m, n, k > 1\}$ — Correct Option

Solution :
(b)
- $L = \{a^n b^n c^m \mid m! = n, m, n \ge 1\}$ is CSL since there is double comparison.
- It can be written as, $L = \{a^m b^n c^k \mid m > n\} \cup \{a^m b^n c^k \mid n < k\}$
  $= \text{CFL} \cup \text{CFL} = \text{CFL}$
- $L = \{a^m b^n c^k \mid \text{if } (m == n) \text{ then } n! = k\} = \{a^m b^n c^k \mid m \ne n \text{ or } m = n \text{ and } n! = k\}$
  $= \{a^m b^n c^k \mid m \ne n\} \text{ or } \{a^m b^n c^k \mid m = n \text{ and } n! = k\}$
  $= \text{CFL} \cup \text{CSL} = \text{CSL}$

C $L = \{a^m b^n c^k \mid \text{if } (m == n) \text{ then } n! = k, m, n, k \ge 1\}$

D Both (a) and (b)

QUESTION ANALYTICS +

Q. 13 Solution Video | Have any Doubt ?

The number of steps required to derive any string (w) of length 'n', if grammar is in CNF and GNF form respectively.

A $2n - 1$ and n — Your answer is **Correct**

Solution :
(a)
When grammar is in CNF i.e., when the production are of the form S → AB, S → a.
Then, length of every derivation is $(2n - 1)$.
When grammar is in GNF i.e., when the production are of the form S → VT*. Then length of every derivation is n.

B $2n$ and n

C $[\log_2 n] + 1$ and $2n - 1$

D $2^n - 1$ and n

QUESTION ANALYTICS +

Q. 14 Solution Video | Have any Doubt ?

Consider the language L:

$L = \{< M > | M \text{ is a Turing Machine and } L(M) \leq_p \{0^p 1^{2^p} | p > 0\}\}$

Where the symbol '$\leq_p$' refers to polynomial time reducible which of the following is true regarding the above language?

A L is undecidable — Correct Option

Solution :
(a)
The language $\{0^p 1^{2^p}\}$ is context-free language, hence it is recursive also. Since $L(M) \leq_p$ REC, so $L(M)$ also recursive, now given input (i.e. recursive language) to turing machine and finding it is accept or not is non-trival property so it is undecidable by Rice's theorem.

B L is decidable — Your answer is **Wrong**

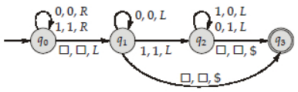
C L is regular

D None of these

QUESTION ANALYTICS +

Q. 15 Solution Video | Have any Doubt ?

Consider the following Turing Machine (where , , $ is represent accept the string).



If the input string is 01010 then output is _____.

10110 — Your answer is **Correct**10110

Solution :
10110
The given Turing Machine perform 2's complement of the given input.

So output will be $01010 \xrightarrow{\text{1's complement}} 10101 \xrightarrow{+1} 10110$

QUESTION ANALYTICS +

Q. 16 Solution Video | Have any Doubt ?

Consider L_1 and L_2 be two context-free languages over Σ*:

$L = \Sigma^* - ((\Sigma^* - L_1) \cup (\Sigma^* - L_2))$

Consider the following statements:
S_1 : L is necessarily CFL
S_2 : L may or may not be CFL
S_3 : $L \subseteq L_1$
The number of statements are true about given language L _____ .

2 — Correct Option

Solution :
2

$$\begin{aligned} L &= \Sigma^* - (L_1' \cup L_2') \\ &= (L_1' \cup L_2')' \\ &= L_1 \cap L_2 \end{aligned}$$

Since, CFL's are not closed under intersection therefore (i) is false and (ii) is true.
Since $L = L_1 \cap L_2 \subseteq L$
Hence (iii) is true.

Your Answer is 1

QUESTION ANALYTICS +

Q. 17 Solution Video | Have any Doubt ?

Consider the following languages:
L_1: The language $\{w | \text{the length of } w \text{ is odd and its middle symbol is 0, } w \in \{0, 1\}^*\}$
L_2: $L = \{0^i 1^j 2^k\}$ where $i \neq j$ or $j \neq k$
L_3: $L = \{a^i b^j a^i | i \neq j\}$

The number of context free languages are _____.

2 Correct Option

Solution :
2

- Since, the machine needs to remember that the middle symbol is 0, hence needs a stack, so CFL.
- $L = \{0^i 1^j 2^k\}$ where $i \neq j$ or $j \neq k$
  can be, $L = \{0^i 1^j 2^k \mid i \neq j\} \cup \{0^i 1^j 2^k \mid j \neq k\}$
  $= \text{CFL} \cup \text{CFL} = \text{CFL}$
  $\therefore$ CFL are closed under union.
- This language isn't CFL, since a single stack isn't sufficient to remember the number of a's. Because a's pushed i times, now at 'b' every 'a' is popped, but again there is a comparison between two a's.

Your Answer is 1

QUESTION ANALYTICS +