CS & IT ENGINEERING

Theory of Computation

Lecture No.- 07

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Recap of Previous Lecture

Topic Regular Languages

Topic Context Free Languages

Topics to be Covered

Topic Regular Languages

Topic Context Free Languages

[MCQ]

#Q86. Consider the following grammars on $\Sigma = \{0, 1, 2\}$

G_1: $S \to AB$
$A \to 0A1 \mid \in$ $\Rightarrow 0^n 1^n$
$B \to 1B2 \mid \in$ $\Rightarrow 1^k 2^k$
$\Big\} L_1 = 0^n 1^n 1^k 2^k$

G_2: $S \to 0S1 \mid B$
$B \to 1\,B2 \mid \in$ $\Rightarrow 1^k 2^k$ $\Big\} L_2 = 0^n B 1^n = 0^n 1^k 2^k 1^n$

G_3: $S \to AB \mid B$
$A \to 0A1 \mid 01$ $\Rightarrow 0^n 01^n$
$B \to 1B2 \mid \in$ $\Rightarrow 1^k 2^k$
$\Big\} L_3 = (A+\varepsilon)B = 0^n 1^n \cdot 1^k 2^k$

Which of the following grammars are equivalent?

A G_1 and G_2 only

B G_2 and G_3 only

C G_1 and G_3 only

D G_1 and G_2 only

[MCQ]

#Q87. Consider the following statements:

S_1: Pumping lemma can be used to prove that some of the languages are not regular using contradition. T

S_2: Language L satisfies the pumping lemma iff L is regular. T

Which of the following is correct?

A S_1 only

B S_2 only

C Both S_1 and S_2

D None of these

[MCQ]

#Q88. Finite automata can be used in which of the following?

A String matching

C Text editing

B Lexical analysis

D Infix to prefix conversion

[MSQ]

⇒ Regular

#Q89. Let L consist of all binary strings start with 1 and decimal value of binary number is divisible by 3. Which of the following is true?

A L can be recognized by NPDA ✓

C L can be recognized by DPDA ✓

B L can be recognized by DFA ✓

D L can be recognized by NFA ✓

[MSQ]

$S \Rightarrow P \Rightarrow \varepsilon$

$S \Rightarrow Q \Rightarrow \varepsilon$

#Q90. Consider the following grammar G:

$S \rightarrow P \mid Q$

$P \rightarrow aPb \mid \lambda \Rightarrow a^k b^k$

$Q \rightarrow aaQb \mid \lambda \Rightarrow a^{2n} b^n$

$L = \{a^k b^k\} \cup \{a^{2n} b^n\}$ ⇒ not DCFL

Which of the following is/are True?

empty string

ε

λ

Unambig CFG

$S \rightarrow P \mid Q$

$P \rightarrow aPb \mid ab$

$Q \rightarrow aaQb \mid \varepsilon$

A G is ambiguous and {λ} has two parse tree. T

C L(G) is accepted by PDA but not by DPDA. T

B L(G) is inherently ambiguous. F

D None of these.

L is Inherently ambiguous

iff

Every CFG that generates L is Ambiguous CFG.
(L has no equivalent unamb CFG)

$L = \{ a^m b^n c^k \mid m=n \text{ OR } n=k \}$ is Inherently Amb lang

[NAT]

#Q91. Consider the following grammar G:

$S \rightarrow aSa \mid bSb \mid a \mid b \mid \in$

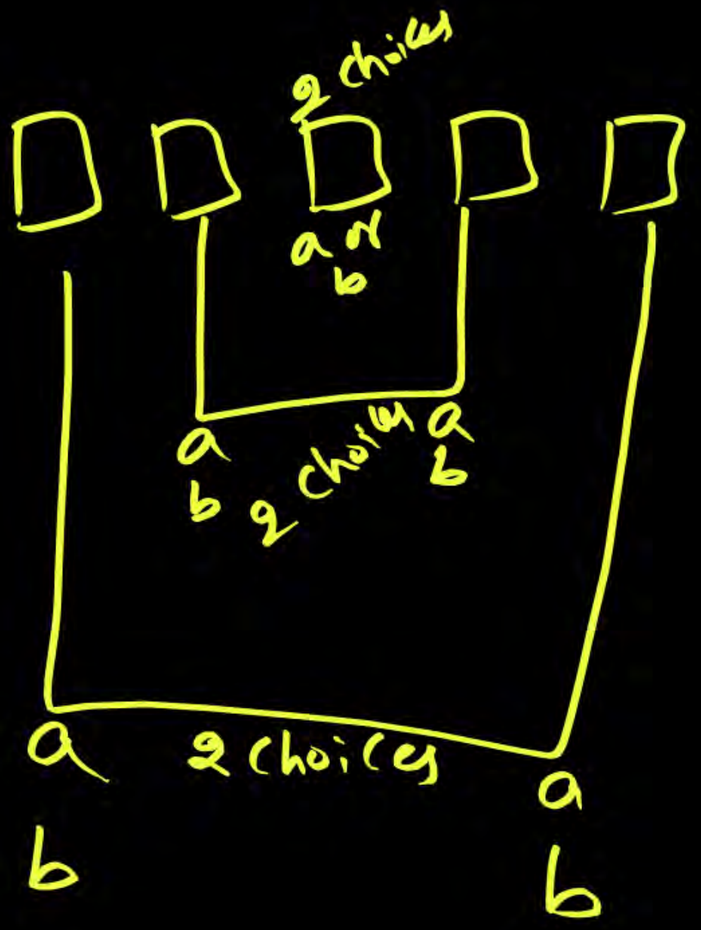
How many strings x belong to L(G) where $|x| \leq 11$? _____.

How many palindromes upto 11 length!

length	No. of strings
0	1
1	2
2	2
3	4
4	4
5	8 strings
6	8 strings
7	16 strings
8	16 strings
9	32 strings
10	32 strings
11	64 strings

$1+2+2+4+4+8+8+16+16+32+32+64$

$= 189$



8 strings

b b b b b
a a a a a
a a b a a
a b a b a
a b b b a
a a a a b
b a a a b
b a b a b
b b a b
b

[NAT]

#Q92. The length of the shortest string not in the language over $\Sigma = \{a, b\}$ for regular expression $a^*(b + ab)^* a^*$ is _____.

ε ✓
a ✓
b ✓
aa ✓
ab ✓
ba ✓
bb ✓

aaa ✓
aab ✓
aba ✓
abb ✓
baa ✓
bab ✓
bba ✓
bbb ✓

aaaa ✓
aaab ✓
aaba ✓
aabb ✓
abaa ✓
abab ✓
abba ✓
abbb ✓
baaa ✓
baab ✗

[NAT]

No. of DFAs $= 2^P$

#Q93. The number of DFA's with 5 states which can be constructed over the alphabet $\Sigma = \{0, 1\}$ with designated initial state [redacted], then the value of P is $= 5$.

is $2^P \times 5^{10}$

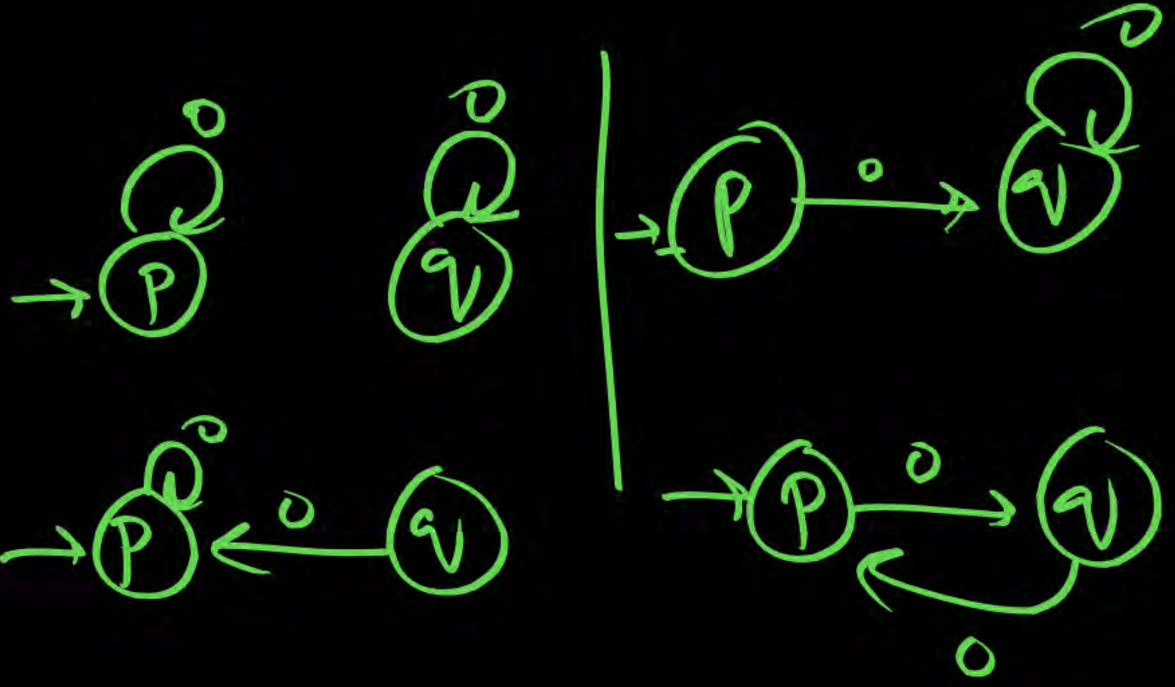
		0	1
2 choices →	P	S	S
2 choices	q	S	S
2	r	S	S
2	S	S	S
2	t	S	S

$5^{10} \times 2^5$ DFAs

		0
2	→ p	2
2	q	2

$\Sigma = \{0\}$

$Q = \{p, q\}$



$2^2 \times 2^2 = 2^4 = 16$ DFAs

ϕ

$\{p\}$

$\{q\}$

$\{p, q\}$

[MCQ]

$L = \{2, 02, 021, 002, 0021, 00211, \ldots\}$

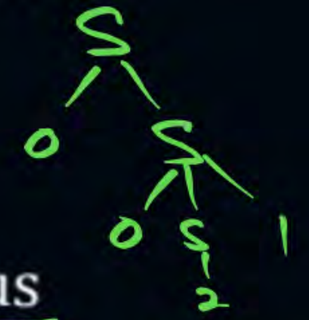
$= \{0^{m+n} 2 1^n\} = \{0^i 2 1^j \mid i \geq j\}$

#Q94. Consider the following CFG G over $\Sigma = \{0, 1, 2\}$:

G: $S \rightarrow 2 \mid 0S \mid 0S1$

Which of the following is/are true?

A. G is ambiguous

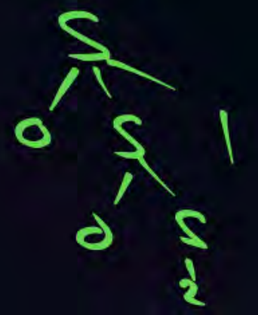


B. L (G) is inherently ambiguous

iff there no unamb CFG for L(G).

C. Both (a) and (b)

D. None of these.



$S \rightarrow 0S1 \mid A$

$A \rightarrow 0A \mid 2$

$A = 0^* 2$

$S = 0^n 0^* 2 1^n$

CFG is Ambiguous

iff

$\exists w$, > 1 PT

L is Inherently Ambiguous

iff

Every CFG that generates L is Amb

[NAT]

$S \to SS \mid a$

#Q95. Consider the following statements:

S_1: only unambiguous context free grammar can be converted into Chomsky normal form. False

S_2: A context free grammar can generate many languages but vice-versa is not true. False

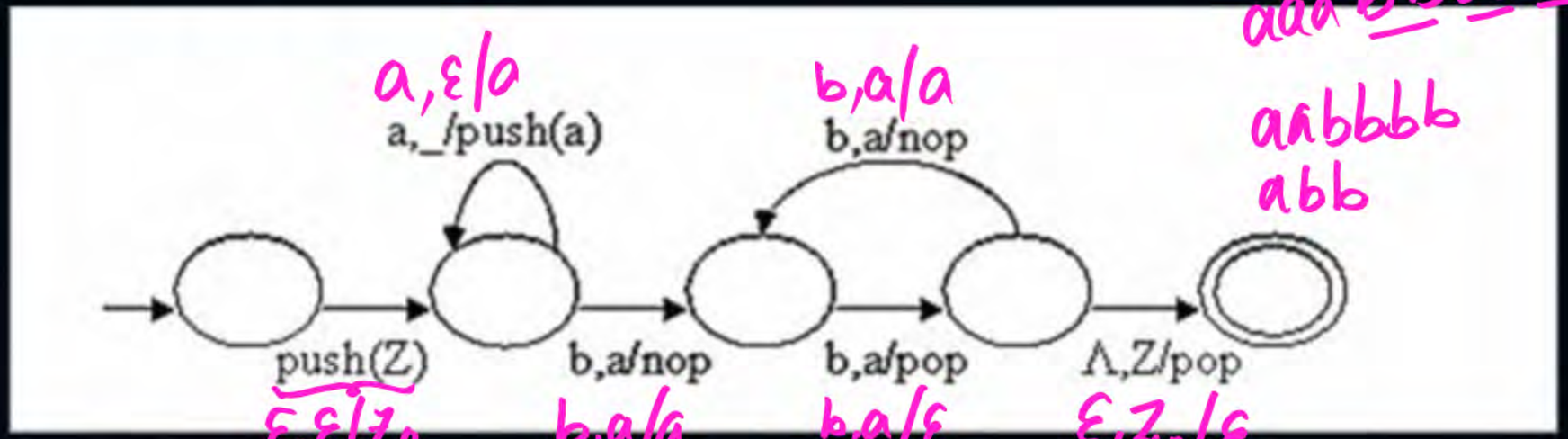
*** S_3: For every CFL, there exist a PDA with one state. True

How many statements are INCORRECT? $= 2$

CFL $\Rightarrow$ CFG $\Rightarrow$ PDA with only 1 state

[NAT]
MCQ

#Q96. Assume stack is empty initially.



Which of the following is accepted by above PDA?

A $\{a^n b^n \mid n>0\}$

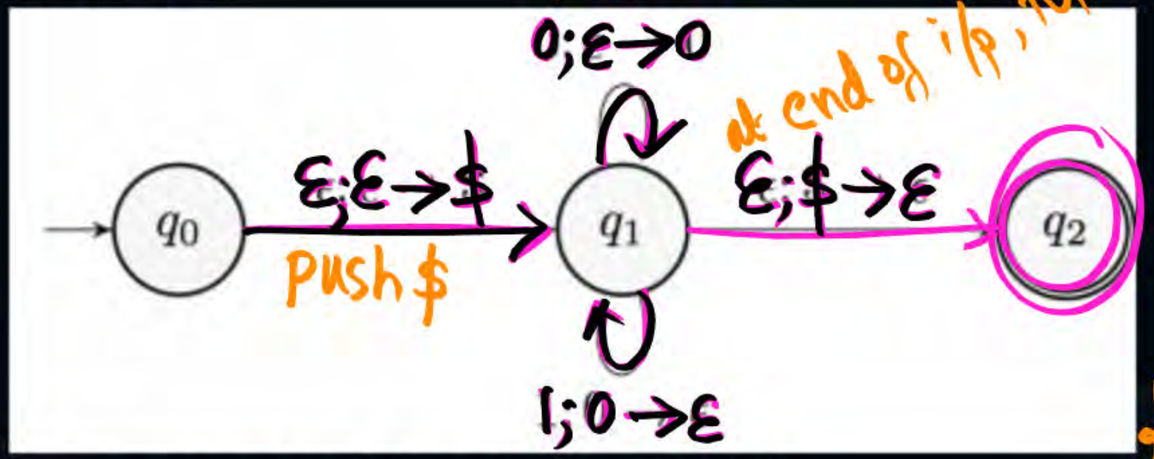
B $\{a^n b^{2n} \mid n>0\}$

C $\{a^{2n} b^n \mid n>0\}$

D None of these

[MCQ]

#Q97. Consider the following PDA:



Which of the following is accepted by above PDA?

A {w| w∈{0,1}*, $n_0(w) >= n_1(w)$}

B {w| w∈{0,1}*, $n_1(w) >= n_0(w)$}

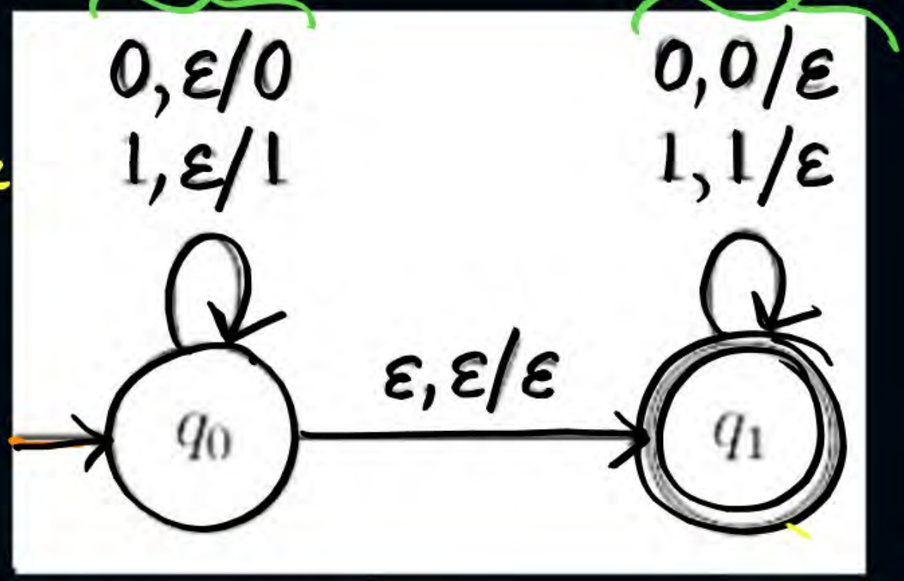
C {w| w∈{0,1}*, $n_0(w) = n_1(w)$}

D None of these

[MCQ]

Initially stack is empty.

#Q98. Consider the following PDA:



Method I : If PDA uses Final state

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

Method II: If PDA uses Empty stack

then $L = ww^R$

Which of the following is accepted by above PDA?

A {ww| w∈{0,1}*}

B {w| w∈{0,1}*}

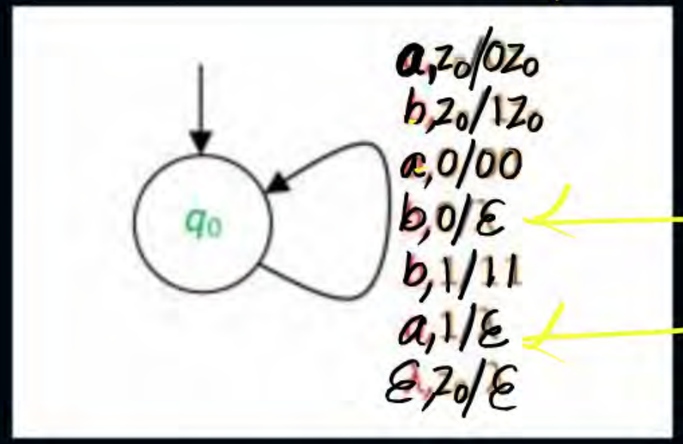
C {ww^R| w∈{0,1}*}

D None of these

[NAT]

#Q99. Consider the following PDA:

a, z0 / a z0
b, z0 / b z0
a, a / a a
b, b / b b
a, b / ε
b, a / ε
ε, z0 / ε



a, 0
a, a

λ = ε

Which of the following is accepted by above PDA if it uses empty stack mechanism?

A {w| w∈{a,b}*}

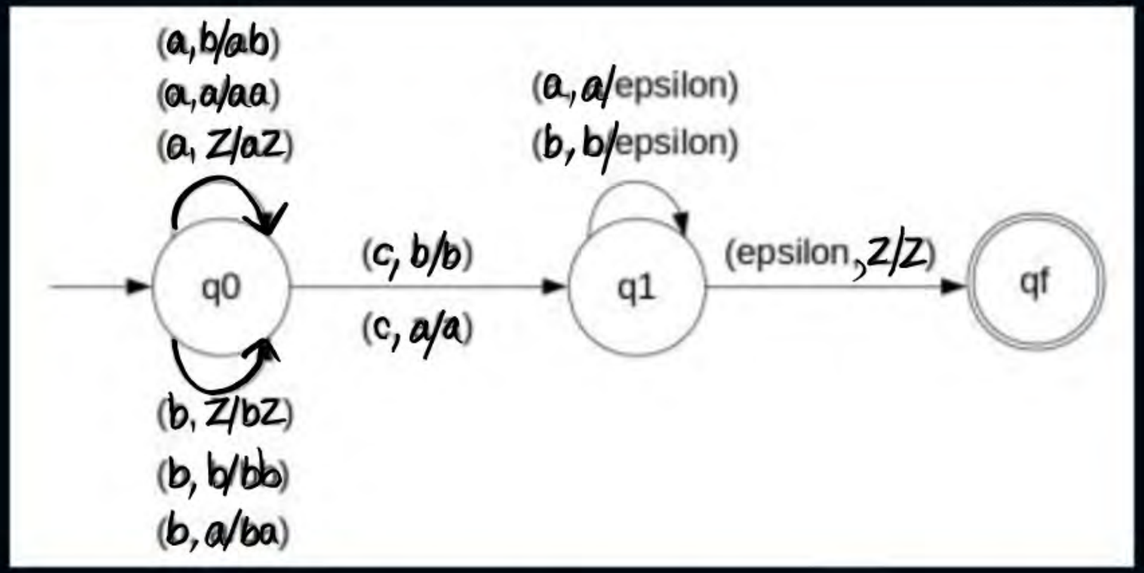
B {w| w∈{a,b}*, $n_a(w)=n_b(w)$}

C {w| w∈{a,b}*, $n_a(w)!=n_b(w)$}

D None of these

[NAT]

#Q100. Consider the following PDA:



Which of the following is accepted by above PDA if it uses empty stack mechanism?

A $\{wcw|\ w \in \{a,b\}^*\}$

B $\{wcw^R|\ w \in \{a,b\}^*\}$

C $\{ww^R|\ w \in \{a,b,c\}^*\}$

D None of these

[NAT]

#Q101. Consider the following CFG:

$$S \to S_1 | S_2$$
$$S_1 \to X | X X S_1$$
$$S_2 \to T_a T_b | T_b T_a$$
$$T_a \to X T_a X | a$$
$$T_b \to X T_b X | b$$
$$X \to a | b$$

Which of the following is represented by above CFG?

A Complement of $\{ww | w \in \{a,b\}^*\}$

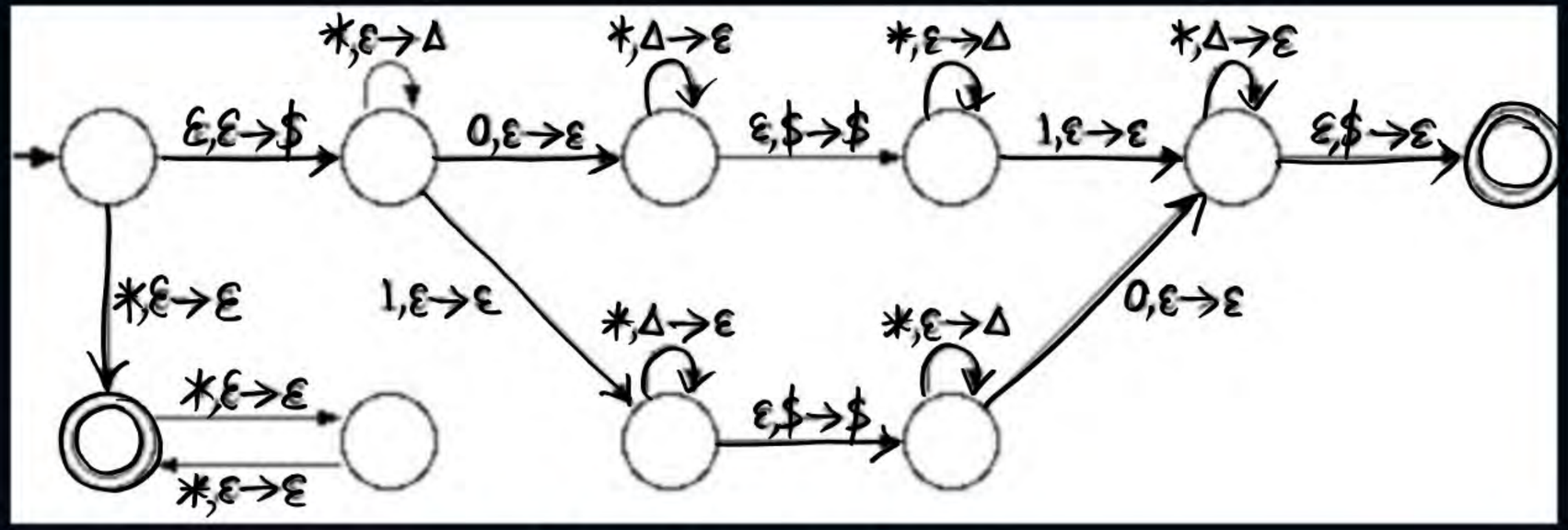
B Complement of $\{ww^R | w \in \{a,b\}^*\}$

C $\{ww^R | w \in \{a,b,c\}^*\}$

D None of these

[NAT]

#Q102. Consider the following CFG: $ is bottom of stack symbol. * is either 0 or 1.



Which of the following is represented by above CFG?

A Complement of {ww| w∈{a,b}*}

B Complement of {ww^R| w∈{a,b}*}

C {ww^R| w∈{a,b,c}*}

D None of these

[NAT]

#Q103. Consider the following CFG..

$$S \rightarrow 0S1S1S \mid 1S0S1S \mid 1S1S0S \mid \in$$

Which of the following strings are generated by above CFG?

A. Binary strings with twice as many 1's as 0's.

B. Binary strings with twice as many 11's as 00's.

C. Binary strings with twice as many 0's as 1's.

D. None of these

[NAT]

#Q104. Consider the following CFG..

$S \rightarrow AB \mid BA$
$A \rightarrow CAC \mid a$
$B \rightarrow CBC \mid b$
$C \rightarrow a \mid b$

Which of the following strings are generated by above CFG?

A $\{xy \mid x,y \in \{0,1\}^*, |x|=|y|, x \neq y\}$.

B $\{xy \mid x,y \in \{0,1\}^*, |x|=|y|\}$.

C $\{xy \mid x,y \in \{0,1\}^*, x=y\}$.

D $\{xy \mid x,y \in \{0,1\}^*, |x|=|y|, x=y\}$.

[NAT]

#Q105. Consider the following CFG..

$S \rightarrow 0A \mid 1B$
$A \rightarrow 0AA \mid 1S \mid 1$
$B \rightarrow 1BB \mid 0S \mid 0$

Which of the following language is generated by above CFG?

A $\{w \mid w \in \{0,1\}^*, n_0(w) = n_1(w)\}$.

B $\{w \mid w \in \{0,1\}^*, n_0(w) \neq n_1(w)\}$.

C $\{w \mid w \in \{0,1\}^*, n_0(w) < n_1(w)\}$.

D $\{w \mid w \in \{0,1\}^*, n_0(w) > n_1(w)\}$.

THANK - YOU