1. Write regular expressions for language that accept all strings of letters in which the letters are in ascending lexicographic order.

Solution:

(A|a)*(B|b)*(C|c)* (D|d)*..... (Y|y)* (Z|z)*

2. *Consider the grammar:*

S -> (L) | a

L -> L,S | S

Find parse trees for the following sentences:

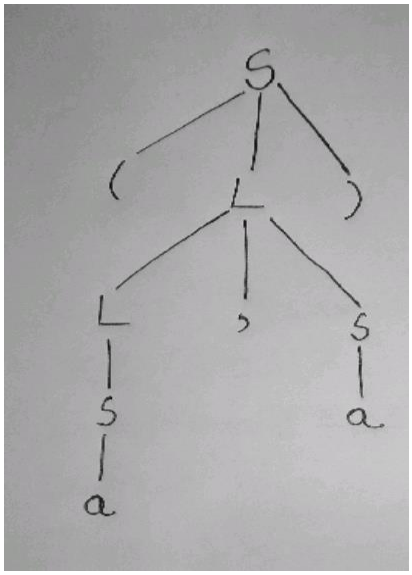
i) (a, a),

ii) (a,(a,a)),

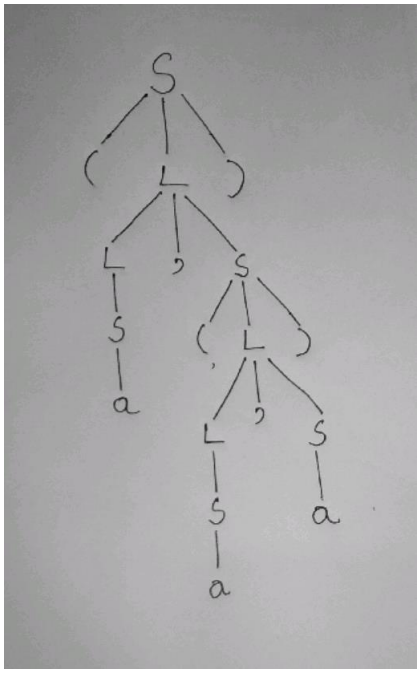
iii) (a,((a,a),(a,a)))

Solution:

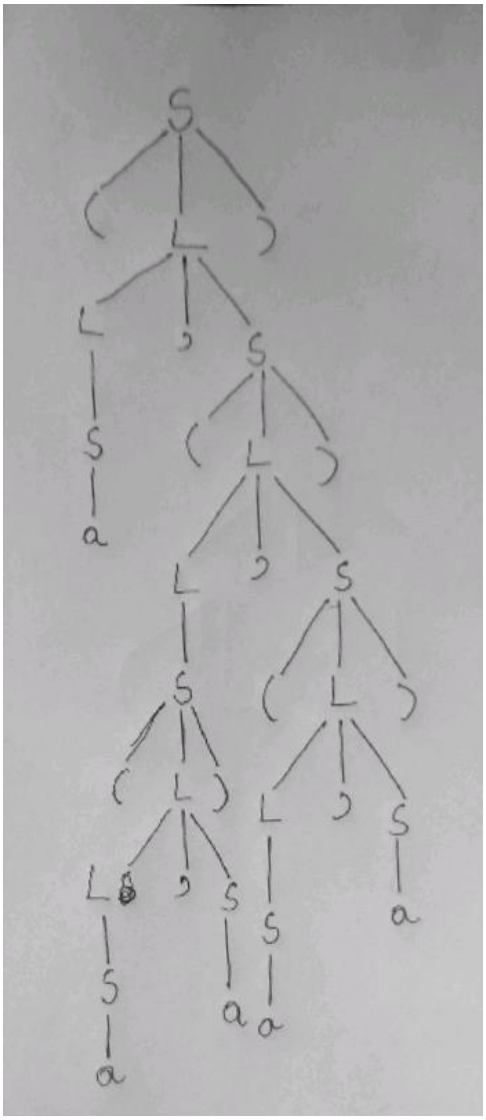
i)



ii)



iii)



3. What language is generated by the following grammar:

S-> +SS | -SS | a

Solution:

Prefix expression consisting of plus and minus signs

4. Show that the grammar S-> aSbS | bSaS| ε

i) Is ambiguous by constructing two different leftmost derivations for the string abab.

ii) Construct the corresponding rightmost derivation for abab.

iii) Construct the parse tree for abab.

Solution:

i) The two different leftmost deviation is constructed below with deviation tree for each of them:

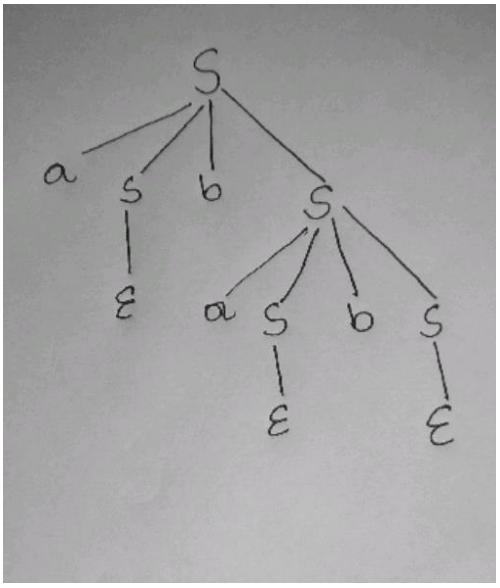
[1] S-> aSbS

-> abS (by S −> ε)

-> abaSbS (by S −> aSbS)

-> ababS (by S −> ε)

-> abab (by S −> ε)



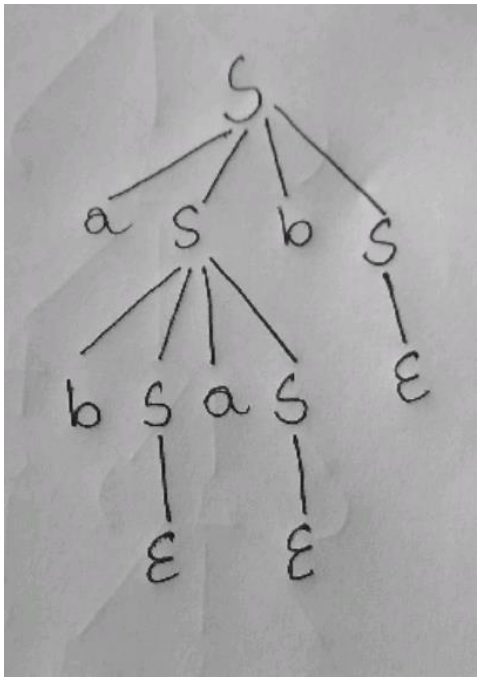
[2] S-> aSbS

-> abSaSbS (by S −> bSaS)

-> abaSbS (by S −> ε)

-> ababS (by S −> ε)

-> abab (by S −> ε)



As, the string **abab** constructs two different trees, the grammar S −>aSbS |bSaS |ε is ambiguous.

ii) For rightmost derivation, derivation should be started from right side. For the string **abab**, this can be done in two ways –

a) S −> aSbS

−> aSbaSbS (by S −>aSbS)

−>aSbaSb (by S −>ε)

−>aSbab (by S −>ε)

−>abab (by S −>ε)

b) S −> aSbS

−> aSb (by S −> ε)

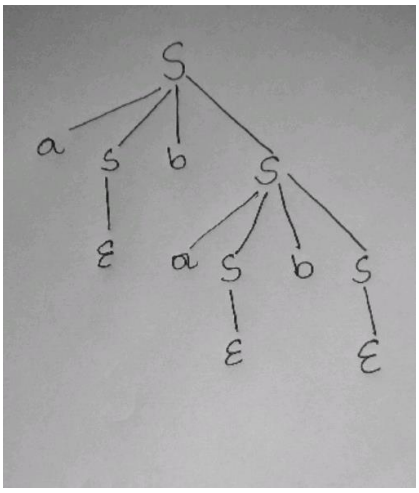
−>abSaSb (by S −> bSaS)

−>aSab (by S −>ε)

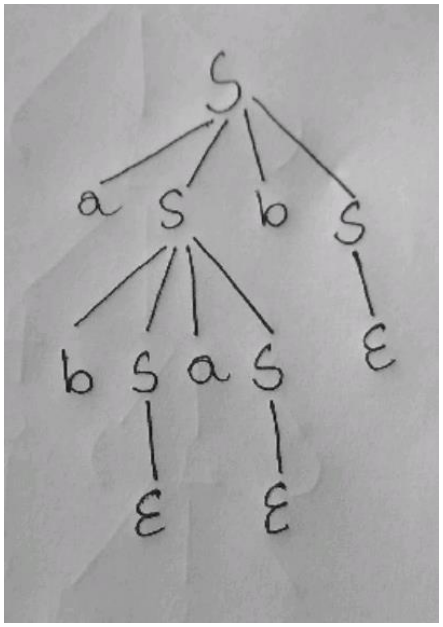
−>abab (by S −>ε)

iii) Parse tree for the string **abab** –

a)



b)



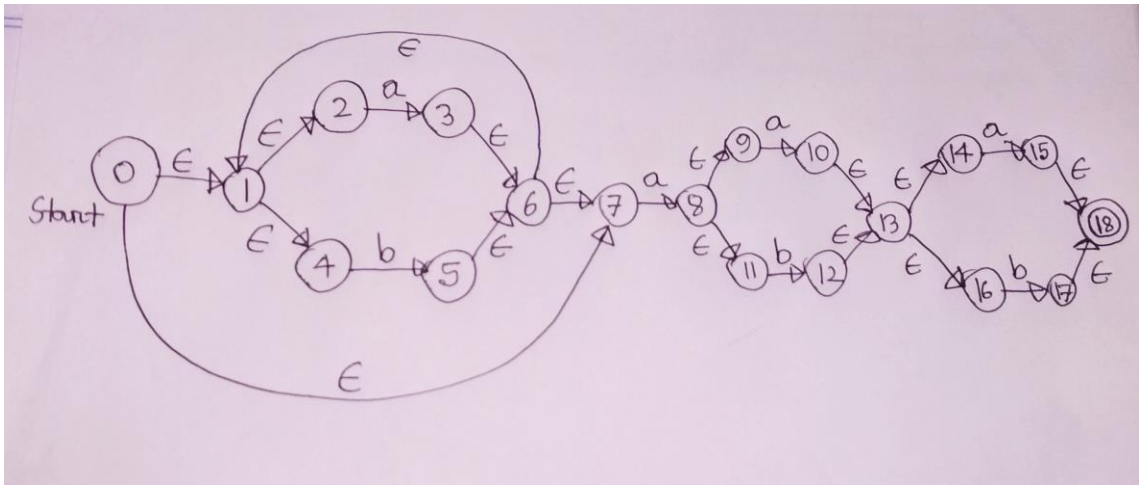
5. Construct an NFA using Thompson's construction from the following regular expression:

*(a|b)*a(a|b)(a|b)*

Convert the resulting NFA to DFA using Subset construction rule.

Solution:

NFA:



DFA:

∈-closure {0} = {0,1,2,4,7} = A

Move (A, a) = {3,8}

∈ -closure {3,8} = {1,2,3,4,6,7,8,9,11} = B

Move (A, b) = {5}

∈ -closure {5} = {1,2,4,5,6,7} = C

Move (B, a) = {3,8,10}

∈ -closure {3,8,10} = {1,2,3,4,6,7,8,9,10,11,13,14,16} = D

Move (B, b) = {5,12}

∈ -closure {5,12} = {1,2,4,5,6,7,12,13,14,16} =E

Move (C, a) = {3,8}

∈ -closure {3,8} = B

Move (C, b) = {5}

∈ -closure {5} = C

Move (D, a) = {3,8,10,15}

∈ -closure {3,8,10,15} = {1,2,3,4,6,7,8,9,10,11,13,14,15,16,18} = F

Move (D, b) = {5,12,17}

∈ -closure {5,12,17} = {1,2,4, 5,6,7,12,13,14,16,17,18} = G

Move (E, a) = {3,8,15}

∈ -closure {3,8,15} = {1,2,3,4,6,7,8,9,11,15,18} = H

Move (E, b) = {5,17}

∈ -closure {5,17} = {1,2,4,5,6,7,17,18} = I

Move (F, a) = {3,8,10,15}

∈ -closure {3,8,10,15} = F

Move (F, b) = {5,12,17}

∈ -closure {5,12,17} = G

Move (G, a) = {3,8,15}

∈ -closure {3,8,15} = H

Move (G, b) = {5,17}

∈ -closure {5,17} = I

Move (H, a) = {3,8,10}

∈ -closure {3,8,10} = D

Move (H, b) = {5,12}

∈ -closure {5,12} = E

Move (I, a) = {3,8}

∈ -closure {3,8} = B

Move (I, b) = {5}

∈ -closure {5} = C

Transition Table

State	**a**	**b**
A	B	C
B	D	E
C	B	C
D	F	G
E	H	I
F	F	G
G	H	I
H	D	E

I	B	C