PES UNIVERSITY, Bangalore
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Department of Computer Science & Engineering

Automata Formal Languages & Logic

1) *Convert the following grammar to Chomsky Normal Form*

$S \rightarrow a \mid aA \mid B \mid C, \ A \rightarrow aB \mid \lambda, B \ Aa, \ C \rightarrow cCD, \ D \rightarrow$ add

Solution:

LHS		RHS
S	$\rightarrow$	a
S	$\rightarrow$	CA
S	$\rightarrow$	AC
A	$\rightarrow$	CB
B	$\rightarrow$	AC
C	$\rightarrow$	a
B	$\rightarrow$	a

2) *Convert the following grammar to Greibach Normal From*
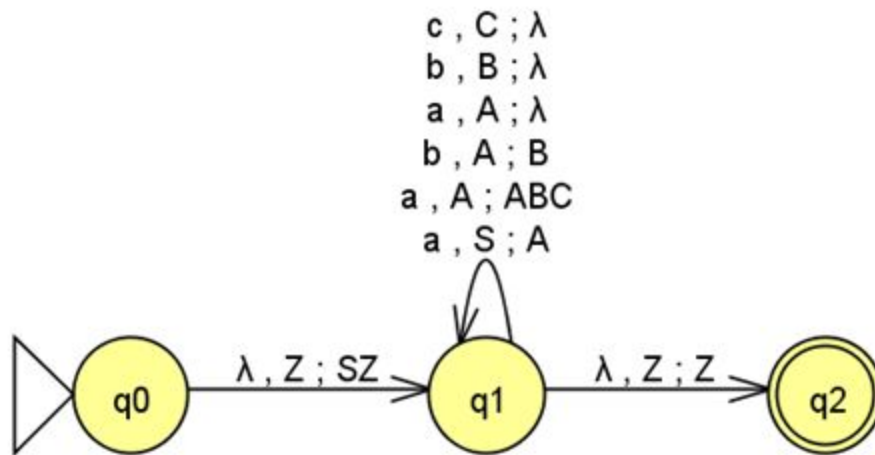$S \rightarrow AB, A \rightarrow aA \mid bB \mid b, B \rightarrow b$

Solution: Only the *S* production is not in GNF. Substituting for *A*, we get:

$S \rightarrow aAB \mid bBB \mid bB, A \rightarrow aA \mid bB \mid b, B \rightarrow b$

3) Convert the following CFG to PDA
$S \rightarrow aA, A \rightarrow aABC \mid bB \mid a, B \rightarrow b, C \rightarrow c$. Show how aaabc is accepted.

Solution:

The string *aaabc* is accepted via:

$(q_0, aaabc, Z), (q_1, aaabc, SZ), (q_1, aabc, AZ), (q_1, abc, ABCZ), (q_1, bc, BCZ), (q_1, c, CZ),$

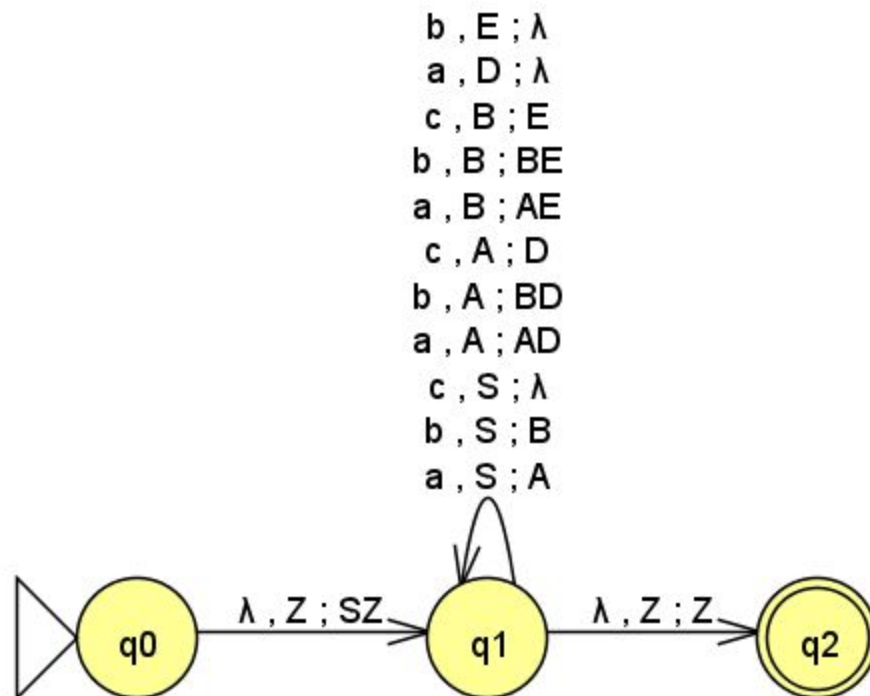$(q_1, \lambda, Z), (q_2, \lambda, Z)$

4) Convert the following CFG to PDA
   $S \rightarrow aA \mid bB \mid cC, A \rightarrow Sa, B \rightarrow Sb, C \rightarrow \lambda$
   Solution:
   First we need to convert the given grammar to GNF:
   $S \rightarrow aA \mid bB \mid c, A \rightarrow aAD \mid bBD \mid cD, B \rightarrow aAE \mid bBE \mid cE, D \rightarrow a, E \rightarrow b$

$$b , E ; \lambda$$
$$a , D ; \lambda$$
$$c , B ; E$$
$$b , B ; BE$$
$$a , B ; AE$$
$$c , A ; D$$
$$b , A ; BD$$
$$a , A ; AD$$
$$c , S ; \lambda$$
$$b , S ; B$$
$$a , S ; A$$

q0 →(λ , Z ; SZ) q1 →(λ , Z ; Z) q2

5) Apply CYK - algorithm to verify the given string (s) can be derived from the below grammar

$S \rightarrow AB \mid BC$, $A \rightarrow BA \mid a$, B $CC \mid b$, C $AB \mid a$, w is baaba

5	S,A				
4	Ø	S,A,C			
3	Ø	B	B		
2	S,A	B	S,C	S,A	
1	B	A,C	A,C	B	A,C
	b	a	a	b	a

baaba belongs to the grammar
We can see the table
the cell X15 = (S, A, C) then
if S $\in$ X15 then baaba $\in$ L(G)