

Q1) Convert the given grammar to

(i) CNF (Chomsky Normal Form):

 $S \rightarrow ASB \mid a, A \rightarrow aAS \mid \lambda, B \rightarrow SbS \mid A \mid bb \mid \lambda$ 

(ii) GNF (Greibach Normal Form):

 $S \rightarrow AB \mid aB, A \rightarrow aab \mid \lambda, B \rightarrow bBA$ 

A(i) CNF (Chomsky Normal Form):

 $S \rightarrow ASB \mid a, A \rightarrow aAS \mid \lambda, B \rightarrow SbS \mid A \mid bb \mid \lambda$ 

Follow the step to convert to CNF

1. Eliminate  $\lambda$  production $\rightarrow$  This grammar has  $\lambda$  production  $A \rightarrow \lambda$  &  $B \rightarrow \lambda$   
we need to remove these ruleswe get  $S \rightarrow ASB \mid AS \mid SB \mid AB \mid a$  $A \rightarrow aAS \mid a$  $B \rightarrow SbS \mid AS \mid AB \mid bb$ The terminals  $\rightarrow \{a\}$  and  $\{b\}$ . Non Terminals are  $S, A$  and  $B$  since grammar already contains rules with pair of terminals so no needs of conversion $\therefore S \rightarrow ASB \mid AS \mid SB \mid AB \mid a$  $A \rightarrow aAS \mid a$  $B \rightarrow SbS \mid AS \mid AB \mid bb$ 

(ii) GNF (Greibach Normal Form):

 $S \rightarrow AB \mid aB, A \rightarrow aab \mid \lambda, B \rightarrow bBA$ 

Consider the rules

① Eliminate  $\lambda$  production.

It has 1 production  $A \rightarrow \lambda$  we need to remove this rule, so we get  $S \rightarrow AB | aB$

$$A \Rightarrow aab$$

$$B \Rightarrow bBA | bB$$

② convert terminals to right hand sides

It's already available so no need to change

$$\text{resulting : } S \rightarrow AB | aB$$

$$A \rightarrow aab$$

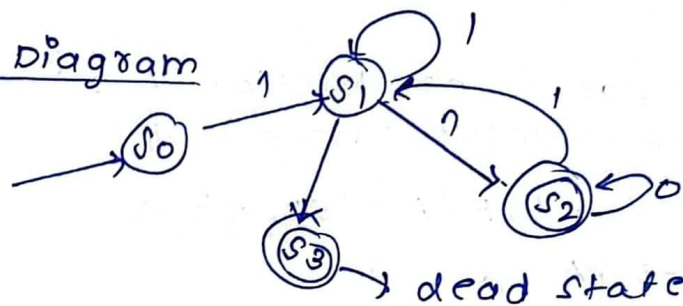
$$B \rightarrow bBA | bB$$

Q2) For a given grammar,  $G$  with rules  $S \rightarrow aSS, S \rightarrow b$ . Identify and prove that it is ambiguous or not.

A2) Let us consider  $1/p$  as 's' separated by a, '0' for both A and B

For EX:- If  $A=4$   ~~$B=4^2$~~   $B=2$  then  $1/p = '1110111'$

Transition Diagram



The above transducer will compute the diff b/w A and B, where  $A > B$  by outputting the remaining is of A

Q3) For the given language  $L = \{1^n 0 1^m \mid n \geq 1\}$ . Construct the grammar, push Down Automata with transitions for the strings 110110.

A3) Given:-  $L = \{a^i b^j c^k \mid i, j, k \geq 0 \text{ and } i=j \text{ or } j=k\}$

1.  $Q \Rightarrow$  set of states  
 $\Sigma \Rightarrow$  o/p Alphabet  
 $\Gamma \Rightarrow$  Stack Alphabet  
 $\delta \rightarrow$  Transition function  
 $q_0 \rightarrow$  Initial state  
 $F \rightarrow$  set of accept state

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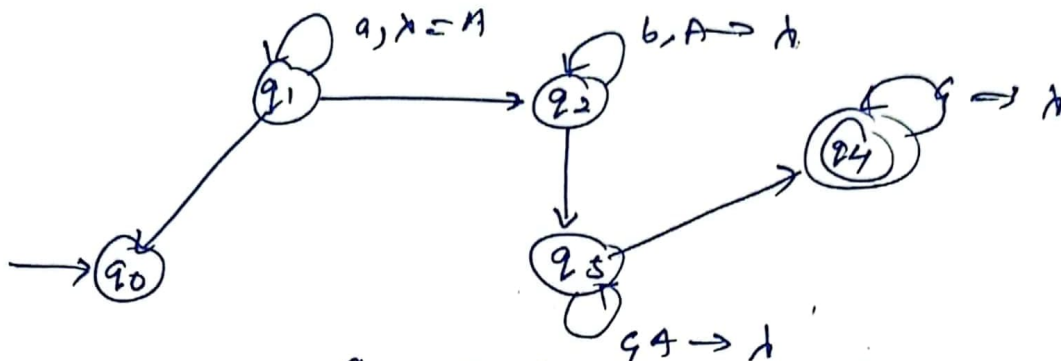
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So here  $Q = \{q_0, q_1, q_2, q_3, q_4\}$

$\Sigma = \{a, b, c\}$

$\Gamma = \{A, B, Z\}$  ( $\because z$  is initial stack symbol)



$q_0 = q_0$  (initial state)

$F = \{q_4\}$  (Accept state)

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