18/10/21

TOC Tutorial

Astha Thakur
19140702
A4

Page No. / /

Q1. Convert the given into CNF

i) P: $S \to SS \mid aSb \mid bSa \mid \epsilon$

1) since S appears in RHS, we add a new state S'

$S' \to S$

P: $S' \to S$ $\quad S \to SS \mid aSb \mid bSa \mid \epsilon$

2) removing null production $S \to \epsilon$ $\quad S' \to \epsilon$

$S' \to S$ $\quad S \to SS \mid aSb \mid bSa \mid S \mid ab \mid ba$

3) removing the unit production $S' \to S$, $S \to S$

$S' \to SS \mid aSb \mid bSa \mid ab \mid ba$

$S \to SS \mid aSb \mid bSa \mid ab \mid ba$

4) Making longer production shorter ($A \to Sb$, $B \to Sa$)

$S' \to SS \mid aA \mid bB \mid aD \mid bBa$

$S \to SS \mid aA \mid bB \mid aD \mid bBa$

$A \to Sb$, $B \to Sa$

5) Taking terminals to RHS ($C \to b$, $D \to a$)

$S' \to SS \mid aA \mid bB \mid aC \mid bD$

$S \to SS \mid aA \mid bB \mid aC \mid bD$

$A \to Sb$, $B \to Sa$, $C \to b$, $D \to a$

∴ now it is in CNF

2. ii) $S \to TW$

$T \to Uc$

$U \to aUcc \mid V$

$V \to Vb \mid \epsilon$

$W \to Wd \mid \epsilon$

i) removing null production ($V \to \epsilon$, $U \to \epsilon$, $U \to V \to \epsilon$, $W \to \epsilon$)

i) to eliminate $V \to \epsilon$

$S \to TW$

$T \to Uc$

$U \to aUacc \mid \epsilon \mid V$

$V \to Vb \mid b$

$W \to Wd \mid \epsilon$

ii) to eliminate $U \to \epsilon$

$S \to TW$

$T \to Uc \mid c$

$U \to aUcc \mid acc \mid V$

$V \to Vb \mid b$

$W \to Wd \mid \epsilon$

iii) to eliminate $W \to \epsilon$

$S \to TW \mid T$

$T \to Uc \mid c$

$U \to aUcc \mid acc \mid V$

$V \to Vb \mid b$

$W \to Wd \mid d$

Date / /

2) removing unit production (S → T, T → V, V → V, W → W)

eliminating (S → T)

S → TW | Vc | c
T → Vc | c
V → aVcc | acc | V
V → Vb | b
W → Wd | d

eliminating (V → V)

S → TW | Vc | c
T → Vc | c
V → aVcc | acc | Vb | b
V → Vb | b
W → Wd | b

3) making longer production shorter and taking all terminal to X

A → Vcc , B → c , D → b , C → d
E → cc

S → TW | VB | c
T → VB | c
V → aA | acE | VD | b
V → VD | b
W → WC | b
A → Vcc or A → VBB or A → VE
c → B B → c
b → D D → b
d → C C → d
E → cc or BB

4) taking all terminal to RHS

S → FBB

S → TW | UB | c
T → UB | c
U → aA | aE | VD | b
V → VD | b
W → Wc | b
A → UF
B → c
D → b
C → d
E → BB

∴ in CNF

Q2. Differentiate between CNF and GNF

CNF (Chomsky's Normal Form)	GNF (Greibach Normal Form)
1) No of steps required to generate a string of length 'n' is $2n-1$	1) No of steps required to generate a string of length n is n
2) used in derivation for parse tree obtained from CNF is always binary tree	2) derivation obtained from GNF is not always a binary tree
3) used in membership algorithm	3) used to convert CFG to PDA