COMPUTER ENGINEERING DEPARTMENT

ASSIGNMENT NO-07

Sub: Theory of Computer Science

COURSE: T.E. Year: 2020-2021 Semester: V

DEPT: Computer Engineering

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Class: TE-Comps B Date of Submission: 23/11/2020

Tutorial 7

1. Give the context-free grammar which generates a string containing only a's

2. Give CFG for generating an alternating sequence of 0 and 1

3. Write a CFG to generate the language of all strings that have more a's than b's (not necessary only on more, but any number of more a's than b's)

4. Convert the following grammar in GNF

 $S \rightarrow AB$

A → BSB | BB |b

B→a

5. Convert the following grammar in CNF

S→ bA laB

A → bAAlaSl a

B → aBB|bS|b

| Q.1 Give the context free grammar which generates a string |
|---|
| containing only a's. |
| Ans: |
| Context Feee Grammar is defined by 4 tuples as |
| $G = \{ V, \Sigma, S, P \},$ |
| where, |
| V = Set of Variables or Non-Terminal symbols |
| Σ = Set of Terminal symbols. |
| Σ = Set of Terminal symbols. S = Start symbol. (2) (3) |
| P = Production Rule |
| (9) (2) |
| Now, CFG which generates a string containing only a's. |
| $G = \{(s), (a), (s), (s \rightarrow as a)\}$ |
| |
| $S \rightarrow aS$ |
| $\rightarrow \alpha \alpha S \qquad (S \rightarrow \alpha S)$ |
| $(s \rightarrow a)$ |
| |
| Q.2. Give CFG for generating an alternating sequence of |
| O and 1. |
| Ans! (0) |
| G= \((S,A,B), (0,1), (s), (5 -> 0A 1B, A -> 1B 6, B -> 0A 6)\) |
| |
| 5 → `OA S → 1B |
| $\rightarrow OIB$ $(A \rightarrow IB) \rightarrow IOA (B \rightarrow OA)$ |
| → 010A (B→0A) → 101B (A→1B) |
| - 0101B (A -> 1B) -> 1010A (B -> 0A) |
| → 0101 (B→ E) → 1010 (A→E) |
| |

G.3. Write a CFG to generate the language of all strings

that have more a's that b's (not necessary only on

more, but any number of more a's than b's)

Ans:

G = {(5,A), (a,b), (s), (5 \rightarrow a5b1A, A \rightarrow aA1a)}

5 \rightarrow a5b

\rightarrow aAb (5 \rightarrow A)

\rightarrow aAb (A \rightarrow A)

\rightarrow aaab (A \rightarrow A)

\rightarrow aaab (A \rightarrow A)

| Q.4. Convert the following gra | ammar in GTNF | |
|----------------------------------|---|----------|
| $S \rightarrow AB$ | 727 NT 28 NO SECTION 18 18 18 18 18 18 18 18 18 18 18 18 18 | |
| | व लगार रक लेका १३००म) | |
| | 80148 - 2 - | |
| Ans: 8 1 1 4 1 2 | 901Ad == 2 | |
| Greibach Normal Form | (GNE) A | |
| A CFG is in GNF ; f t | | |
| AA O XA -> b | 1 | |
| | Cn. | (v) |
| where A, C, Cn are | | Terminal |
| , , | Hereloging with approximate inte | (v) |
| 1) Since S appears in RHS | , we add a new stope | S' enc |
| S' -> S is added to the | production | |
| $P: S' \rightarrow S$ | then we give 7 | |
| $S \rightarrow AB$ | 211 AV 6-12 19 | |
| A -> BSB BB 16 | 301 AV 4- 2 | |
| $B \rightarrow \alpha$ | oliviry - A | |
| | 312V1VU - 3 | |
| (1) Remove the Wall Production | ons. | |
| (Note: No Null Productions | J. 3. 7 - 1 | |
| p; s' → s | D 1- U | |
| S -> AB | d 1' | |
| A -> BSB BB | 8 | |
| $B \rightarrow \alpha$ year or | D Karmer and at the | 114 |
| | 240 as via sate. | 04 |
| (11) Remove the Unit Productions | | |
| After removing s' -> s: P | - | |
| | S -> AB, | |
| | A -> BSB BB b | |
| | $B \rightarrow Q$ | |
| | | • |

| W Now find out the productions that has more than |
|---|
| TNO variables in KMS. |
| A BSR |
| After removing this we get: P: S -> AB |
| 2 UB |
| A -> BZ BB b |
| Construction And Bank |
| A-A-A-A-A-A-A-A-A-A-A-A-A-A-A-A-A-A-A- |
| 21 ch 11 - A ch 2 A o 1 - A ch 12 4 c 13 |
| Willow the grammar is in CNF |
| P: S' -> AB |
| $s \rightarrow AB$ |
| A -> BZ BB b |
| $B \rightarrow a$ |
| Z -> SB/ shoks to istable of the |
| |
| W Change the names of the Non Terminal symbols into some |
| At in ascending order of: |
| 3 1 3 1 5 1 5 1 5 1 5 1 |
| |
| reside 2 with m |
| |
| - 5 WITH AT3 |
| The Act of |
| 072 .088 |
| We get! |
| $A_1 \rightarrow A_2 A_3$ |
| $A_2 \rightarrow A_3 A_4 \mid A_3 A_3 \mid b$ |
| $A_3 \rightarrow \alpha$ |
| $A_4 \longrightarrow A_1 A_3$ |
| 1 1113 |

| (VII) Alter the rules so that the non-Terminals are in |
|--|
| ascending order, such that |
| If the production is of the form A: - Aix, then, |
| :< j' and should never be i ≥ j' |
| $A \rightarrow A, A3$ |
| A4 -> A2 A3 A3 ("A1 -> A2 A3) |
| A4 -> A3 A4 A3 A3 \ A3 |
| A4 -> a A4 A3 A3 1 a A3 A3 1 b A3 A3 |
| The same of the sa |
| (VIII) Now the grammar ?5 |
| $A_1 \rightarrow A_2 A_3$ |
| $A_2 \rightarrow A_3 A_4 \mid A_3 A_3 \mid b$ |
| $A_3 \rightarrow \alpha$ |
| A4 -> a A4 A3 A3 a A3 A3 A3 b A3 A3 |
| |
| The state of recognition of the contract of the state of |
| $A_1 \rightarrow b A_3$ |
| $A_2 \rightarrow a A_4 \mid a A_3 \mid b$ |
| $A3 \rightarrow Q$ |
| A4 -> a A4A3A3 a A3 A3 b A3A3 |
| 6 |
| Which is the required Chreibach Normal Form for the |
| given CFG. |
| |

| Q.B. Convert the following grammar in CNF. |
|--|
| no place of balaby and post are men init |
| A -> bAAlasla de donne por la ser |
| B → aBB 1 b21 b |
| Ans: (3/A), (3), (3), (6-2056), A-2016) (20, A) |
| Chornsky Normal Form (CNF) |
| a CEG is in CNE if the productions are - |
| $(1) H \implies Q$ |
| |
| Where A, B and c are non-terminal and a is terminal. |
| |
| O Since S appears in RHS, we add a new state st and |
| 5' -> S is added to the production. |
| $p: s' \rightarrow s$, |
| $s \rightarrow bA/aB$ |
| A -> bAAlaSla |
| $B \rightarrow \alpha B B b S b$ |
| |
| 11) Remove the Null Productions. |
| (Note: No Null Productions) |
| $p: S' \rightarrow S,$ |
| $s \rightarrow bA \mid aB$ |
| A -> bAA as a |
| $B \rightarrow \alpha BB P P P$ |
| |
| (11) Remove the Unit Productions: SI>S |
| After removing s' -> s: P: s' -> bA aB, |
| $s \rightarrow bA \mid \alpha B$ |
| $A \rightarrow bAA as a$ |
| $B \longrightarrow aBB bs b$ |
| |

| (1) Now find out the productions that has more than |
|---|
| TWO variables in RHs. |
| A -> bAA and B-> aBB: |
| After removing these, we get ! P : s' -> bAlaB. |
| S -> bAlaB |
| $A \rightarrow b \times as a$ |
| B -> a/1 bs/b |
| X -> AA, |
| $\Lambda \to BB$ |
| |
| W Now change the productions |
| S' -> bA s' -> aB s -> bA, s -> aB, |
| A -> bx, A -> as, B-> a1, B-> bs. |
| Finally we get! |
| P: s' -> VA TUB. |
| S -> VAIUB, |
| A -> VXIUSIa, |
| B-DUYIVSIB |
| × → AA , |
| Y → BB |
| $V \rightarrow a$ |
| $V \rightarrow P$ |
| |
| Which is the required Chomsky Normal Form |
| Which is the required Chomsky Normal Form for the given CFG |
| |
| |