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CSE-322
Assignment (CA-3)

1. Check whether the language is CFL or not, using pumping lemma. $L = \{a^{3i} . b^{2i} . c^{3i} \mid i >= 0\}$

Ans: $L = \{a^{3i} . b^{2i} . c^{3i}\}$

Let $i = 2$, Hence $S = a^6 b^4 c^6$

dividing $S = uvxyz$

Case ① v and y each contain only one kind of symbol

aaaaaa bbbb cccccc
u v x y z

$v = a$, $u = aaaaa$, $x = bbbb$, $y = cc$, $z = cccc$

Let $k = 3$ ⇒ $uv^k xy^k z = uv^3 xy^3 z$

⇒ aaaaa aaa bbbb cccc cccccc

⇒ $a^8 b^4 c^{10} \notin L$

Case ② v or y has more than 1 kind of symbol.

aaaaaa bbbb cccccc
u v x y z

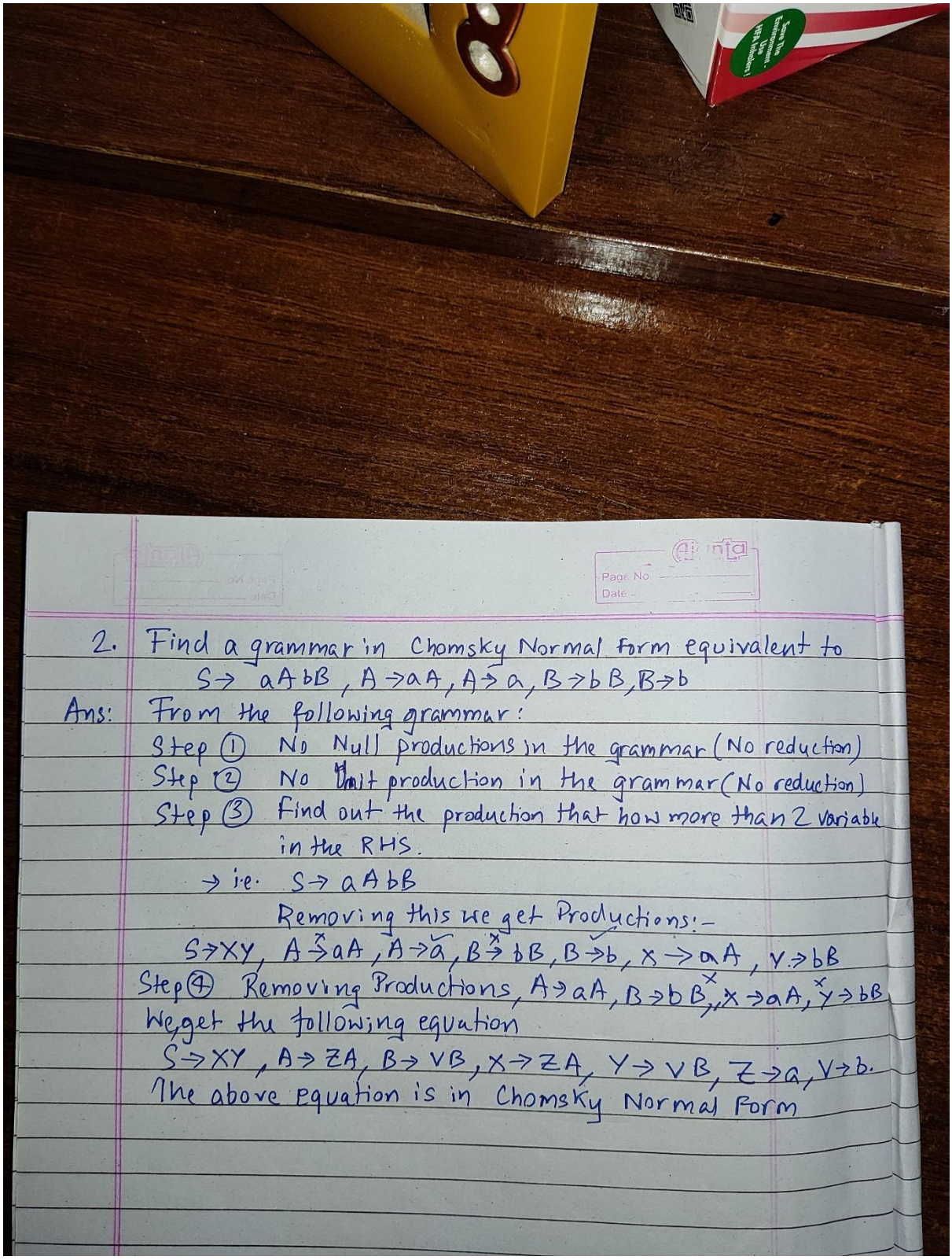
$u = aaaaa$, $v = ab$, $x = bbb$, $y = c$, $z = ccccc$

Let $k = 3$, $uv^k xy^k z = uv^3 xy^3 z$

= aaaaaababab bbb ccc ccccc

$\notin L$

As, we can observe that language does not satisfy the first property of pumping lemma. Hence not a CFL.



2. Find a grammar in Chomsky Normal form equivalent to
$S \to aAbB$, $A \to aA$, $A \to a$, $B \to bB$, $B \to b$

Ans: From the following grammar:

Step ① No Null productions in the grammar (No reduction)

Step ② No Unit production in the grammar (No reduction)

Step ③ Find out the production that how more than 2 variable in the RHS.

→ i.e. $S \to aAbB$

Removing this we get Productions:-

$S \to XY$, $A \to aA$, $A \to a$, $B \to bB$, $B \to b$, $X \to aA$, $Y \to bB$

Step ④ Removing Productions, $A \to aA$, $B \to bB$, $X \to aA$, $Y \to bB$

We get the following equation

$S \to XY$, $A \to ZA$, $B \to VB$, $X \to ZA$, $Y \to VB$, $Z \to a$, $V \to b$.

The above equation is in Chomsky Normal Form

3. Reduce the following grammars to Greibach normal form:
$S \to AB,\ A \to BSB,\ A \to BB,\ B \to aAb,\ B \to a,\ A \to b.$

Ans→ As we can see above grammar is already in CNF so we skip step 1.

Step ② $S = A_1,\ A = A_2,\ B = A_3$

$S \to AB,\ A \to BS \mid b \mid,\ A_1 \to A_2 A_3,$

$A_2 \to A_3 A_1 \mid b,\ A_3 \to A_1 A_2 \mid a$

Resulting Production are –

$A_3 \to A_2 A_3 A_2$

$A_3 = A_3 A_1 A_3 A_2 \mid b A_3 A_2$

Step ③: $A_3 \to a \mid b A_3 A_2,\ A_3 \to a Z_3 \mid b A_3,\ Z_3 \to A_1 A_3 A_2,$

$Z_3 \to A_1 A_3 A_2 Z_3$

Step ④: (i) The $A_3 \to$ Productions are

$A_3 \to a \mid b A_3 A_2 \mid a Z_3 \mid b A_3 A_2 Z_3$

(ii) The resulting production

$A_2 \to a A_1 \mid b A_3 A_2 A_1 \mid a Z_3 A \mid b A_3 A_2 Z_3 A_1$

The modified A_2 productions

$A_2 \to b \mid a A_1 \mid b A_3 A_2 A_1 \mid a Z_3 A_1 \mid b A_3 A_2 Z_3 A_1$

~~(iii) $A_1 \to b A_3 \mid b A_1 A_3 \mid b A_3 A_2 A_1 A_3 \mid a A$~~

(iii) $A_1 \to b A_3 \mid a A_1 A_3 \mid b A_3 A_2 A_1 A_3 \mid a Z_3 A_1 A_3 \mid$

$b A_3 A_2 Z_3 A_1 A_3$

Step ⑤: The Z_3 production to be modified are:

$Z_3 \to A_1 A_3 A_2 \mid A_1 A_3 A_2 Z_3$

$Z_3 \to b A_3 A_3 A_2 \mid b A_3 A_2 Z_3$

$Z_3 \to b A_3 A_2 a A_1 A_3 A_3 A_2 \mid a A_1 A_3 A_3 A_2 Z_3$

$Z_3 \to b A_3 A_2 A_1 A_3 A_3 A_2 \mid b A_3 A_2 A_1 A_3 A_3 A_2 Z_3$

$Z_3 \to a Z_3 A_1 A_3 A_3 A_2 \mid a Z_3 A_1 A_3 A_3 A_2 Z_3$

$Z_3 \to b A_3 A_2 Z_3 A_1 A_3 A_3 A_2 \mid b A_3 A_2 Z_3 A_1 A_3 A_3 A_2 Z_3$

Hence reduced to Greibach Normal Form