

Project 6

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- 1 Let $L = \{a^n b^m c^{2n+m} \mid n, m \geq 0\}$. Construct a context-free grammar, G , that generates L .**

Our context free grammar, G , that generates L , starts with string S :

$$\begin{aligned} S &\Rightarrow AB \\ A &\Rightarrow aABCC \mid aACC \mid \lambda \\ B &\Rightarrow bBC \mid \lambda \\ C &\Rightarrow cC \mid \lambda \end{aligned}$$

2 Chomsky Normal Form

2.1 State the rules for Chomsky Normal Form (CNF).

A CFG is in CNF if every rule is of the form:

$$A \Rightarrow BC$$

$$A \Rightarrow a$$

$$S \Rightarrow \lambda$$

Where:

$$a \in \Sigma$$

$$A, B, C \in V$$

S is the start variable

2.2 Convert the following grammar to CNF.

$$S \Rightarrow aA \mid ABA$$

$$A \Rightarrow AA \mid a$$

$$B \Rightarrow AbA \mid bb$$

2.2.1 Guarantee Start Variable is only on LHS.

No action needed

2.2.2 Eliminate all rules of $A \Rightarrow \lambda$ where $A \neq S$.

No action needed

2.2.3 Eliminate all unit rules.

No action needed

2.2.4 Fix remaining rules.

Let $U_1 \Rightarrow a$ and $U_2 \Rightarrow b$

$$S \Rightarrow U_1 A | A B A$$

$$A \Rightarrow A A | a$$

$$B \Rightarrow A U_2 A | b b$$

$$U_1 \Rightarrow a$$

$$U_2 \Rightarrow b$$

Let $B_1 \Rightarrow B A$ and $B_2 \Rightarrow U_2 A$

$$S \Rightarrow U_1 A | A B_1$$

$$A \Rightarrow A A | a$$

$$B \Rightarrow A B_2 | U_2 U_2$$

$$B_1 \Rightarrow B A$$

$$B_2 \Rightarrow U_2 A$$

$$U_1 \Rightarrow a$$

$$U_2 \Rightarrow b$$

This grammar is now in Chomsky Normal Form.

3 Using Example 2.14, show that the machine, M1 in Figure 2.15 recognizes 0011.

Input String	Stack Content	Rule	Description
ϵ	\$	$\epsilon, \epsilon \Rightarrow \$$	Input ϵ , pop ϵ from stack, push \$.
0	0\$	$0, \epsilon \Rightarrow 0$	Input 0, pop ϵ from stack, push 0.
0	00\$	$0, \epsilon \Rightarrow 0$	Input 0, pop ϵ from stack, push 0.
1	0\$	$1, 0 \Rightarrow \epsilon$	Input 1, pop 0 from stack, push ϵ .
1	\$	$1, 0 \Rightarrow \epsilon$	Input 1, pop 0 from stack, push ϵ .
ϵ		$\epsilon, \$ \Rightarrow \epsilon$	Input 1, pop \$ from stack, push ϵ .