Khuyen Le Thi Minh – s5128

Homework 09

1. *Convert the following context – free grammar to Chomsky normal form:*

$S \to SS|SaP|P$
$P \to bbPa|\varepsilon$
Remove null productions $P \to \varepsilon$.
$S \to SS|SaP|P|Sa|\varepsilon$
$P \to bbPa|bba$
Remove null productions $S \to \varepsilon$.
$S \to SS|SaP|P|Sa|S|aP|a$
$P \to bbPa|bba$
Remove unit productions $S \to S$.
$S \to SS|SaP|P|Sa|aP|a$
$P \to bbPa|bba$
Remove unit productions $S \to P$.
$S \to SS|\ SaP|Sa|\ aP|a\ |\ bbPa\ |bba$
$P \to bbPa|bba$
Substituting nonterminal A *and* B *with existing terminal* a *and* b.
$S \to SS|\ SAP|SA|\ AP|a\ |\ BBPA\ |BBA$
$P \to BBPA|BBA$
$A \to a$
$B \to b$
Split the production $S \to SAP$
$S \to SS|\ SX|SA|\ AP|a\ |\ BBPA\ |BBA$
$P \to BBPA|BBA$
$X \to AP$
$A \to a$
$B \to b$
Split the production $S \to BBA$ *and* $S \to BBPA$
$S \to SS|\ SX|SA|\ AP|a\ |\ YZ\ |YA$
$P \to YZ|YA$
$Z \to PA$
$Y \to BB$
$X \to AP$
$A \to a$
$B \to b$

2. *For the following context – free grammar in Chomsky normal form and the word 'abaabb' simulate the CYK algorithm. Give the contents of the T array and the exemplary derivation tree.*

$S \to AB|\ BA$
$A \to AA\ |\ BB\ |a$
$B \to SB\ |\ b$

A	S	$-$	$-$	S	A,B,S
	B	S	S	B	A,B,S
		A	A	S	A,B,S
			A	S	A,B
				B	A
					B

We concider the strings with length of 2.
$ab \to S$
$ba \to S$
$aa \to A$
$ab \to S$
$bb \to A$
We concider the strings with length of 3.

$$aba \to a\otimes ba\ \cup ab\otimes a \to A\otimes S\ \cup S\otimes A \to \begin{cases} AS \to\ - \\ SA \to\ - \end{cases}$$

$$baa \to b\otimes aa\ \cup\ ba\otimes a \to B\otimes A\ \cup S\otimes A \to \begin{cases} BA \to S \\ SA \to\ - \end{cases}$$

$$aab \to a\otimes ab\ \cup\ aa\otimes b \to\ A\otimes S\ \cup A\otimes B \to \begin{cases} AS \to\ - \\ AB \to S \end{cases}$$

$$abb \to\ a\otimes bb\ \cup\ ab\otimes b \to\ A\otimes A\ \cup S\otimes B \to \begin{cases} AA \to A \\ SB \to B \end{cases}$$

We concider the strings with length of 4.

$$abaa \to a\otimes baa \cup ab\otimes aa \cup aba\otimes a \to A\otimes S \cup S\otimes A \cup -\otimes A \to \begin{cases} AS \to - \\ SA \to - \\ - \end{cases}$$

$$baab \to b\otimes aab \cup ba\otimes ab \cup baa\otimes b \to B\otimes S \cup S\otimes S \cup S\otimes B \to \begin{cases} BS \to - \\ SS \to - \\ SB \to B \end{cases}$$

$$aabb \to a\otimes abb \cup aa\otimes bb \cup aab\otimes b \to A\otimes\{A,B\} \cup A\otimes A \cup S\otimes B \to \begin{cases} AA \to A \\ AB \to S \\ AA \to A \\ SB \to B \end{cases}$$

We concider the strings with length of 5.

$$abaab \to a\otimes baab \cup ab\otimes aab \cup aba\otimes ab \cup abaa\otimes b \to A\otimes B \cup S\otimes S \cup -\otimes S \cup -\otimes B$$

$$\to \begin{cases} AB \to S \\ SS \to - \\ - \\ - \end{cases}$$

$$baabb \to b\otimes aabb \cup ba\otimes abb \cup baa\otimes bb \cup baab\otimes b \to B\otimes\{A,B,S\} \cup S\otimes\{A,B\} \cup S\otimes A \cup B\otimes B$$

$$\to \begin{cases} BA \to S \\ BB \to A \\ BS \to - \\ SA \to - \\ SB \to B \\ SA \to - \\ BB \to A \end{cases}$$

We concider the strings with length of 6.

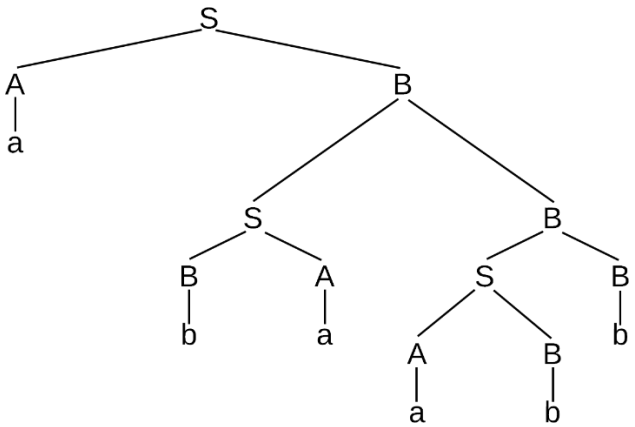
$$abaabb \to a\otimes baabb \cup ab\otimes aabb \cup aba\otimes abb \cup abaa\otimes bb \cup abaab\otimes b$$

$$\to A\otimes\{A,B,S\} \cup S\otimes\{A,B,S\} \cup -\otimes\{A,B\} \cup -\otimes A \cup S\otimes B$$

$$\to \begin{cases} AA \to A \\ AB \to S \\ AS \to - \\ SA \to - \\ SB \to B \\ SS \to - \\ - \\ - \\ SB \to B \end{cases}$$

A	S	$-$	$-$	S	$A,B,\mathbf{S}$
	B	***S***	S	B	$A,\mathbf{B},S$
		A	A	S	A,B,S
			A	***S***	$A,\mathbf{B}$
				B	A
					B

The bolded font show the how derivation tree has been built



Testing: $S \to AB \to aB \to aSB \to aBAB \to abaB \to abaSB \to abaSb \to abaABb \to abaabb$