CSE331
ASSIGNMENT 4

Submitted by: Masiat Hasin Rodoshi
ID: 19201089
Section: 1
Date: 22.12.2022

(1)

a) Variables of G_1: R, X, S, T

b) Terminals of G_1: a, b

c) Strings in $L(G_1)$: ab, ba, abb

d) Strings not in $L(G_1)$: aa, bb, baab

e)

$P \rightarrow CX \mid DB \mid EA \mid AB \mid BA$
$R \rightarrow CX \mid DB \mid EA \mid AB \mid BA$
$T \rightarrow FX \mid a \mid b \mid XX$
$A \rightarrow a$
$B \rightarrow b$
$C \rightarrow XR$
$D \rightarrow AT$
$E \rightarrow BT$
$F \rightarrow XT$
$X \rightarrow a \mid b$

(2)

a) Contains even number of 0s but odd number of 1s.

$S \rightarrow A1 \mid 1A \mid \varepsilon$
$A \rightarrow 0A1 \mid 1A0 \mid AA \mid \varepsilon$

b) Has equal number of 0s and 1s

$S \rightarrow 0S1 \mid 1S0 \mid SS \mid \varepsilon$

c) Has more 0s than 1s.

$S \rightarrow 0BA \mid A0B$
$A \rightarrow 0BA1 \mid 1AB0 \mid AA \mid \varepsilon$
$B \rightarrow 0B \mid \varepsilon$

d) Is a palindrome

$S \rightarrow 0S0 \mid 1S1 \mid 0A0 \mid 1A1 \mid \varepsilon$
$A \rightarrow 1 \mid 0$

e) Not a palindrome

$S \rightarrow 0S1 \mid 1S0 \mid 0A1 \mid 1A0 \mid 10 \mid 01$
$A \rightarrow 1 \mid 0$

f) Has exactly one more 0 than the number of 1s.

$S \rightarrow A0 \mid 0A$
$A \rightarrow 0A1 \mid 1A0 \mid AA \mid \varepsilon$

(3)

a) $P \to TT \mid XZ \mid \#$
$S \to TT \mid XZ \mid \#$
$T \to XT \mid TX \mid \#$
$U \to XZ \mid \#$
$X \to 0$
$Y \to 00$
$Z \to UY$

b) $S \to CB \mid 00 \mid BB \mid XX \mid \varepsilon$
$A \to CB \mid 00 \mid BB \mid XX \mid \varepsilon$
$B \to XX \mid \varepsilon$
$C \to BA$
$X \to 0$

c) $P \to DB \mid AB \mid FB \mid CB$
$R \to DB \mid AB \mid FB \mid CB$
$S \to DB \mid AB$
$T \to FB \mid CB$
$A \to a$
$B \to b$
$C \to AB$
$D \to AS$
$E \to AT$
$F \to EB$

(4)

$S \rightarrow SS \mid T$

$T \rightarrow aTb \mid ab$

Left-most derivation:

(I) S
$\Rightarrow SS$
$\Rightarrow SSS$
$\Rightarrow TSS$
$\Rightarrow abSS$
$\Rightarrow abTS$
$\Rightarrow abaTbS$
$\Rightarrow abaabbT$
$\Rightarrow abaabbab$

(II) S
$\Rightarrow SS$
$\Rightarrow TS$
$\Rightarrow abS$
$\Rightarrow abSS$
$\Rightarrow abTS$
$\Rightarrow abaTbS$
$\Rightarrow abaabbS$
$\Rightarrow abaabbT$
$\Rightarrow abaabbab$

Since there are two derivations for the string, the grammar is ambiguous.

A string that has only one leftmost derivation is 'aaabbbab'

Derivation :-

S
$\Rightarrow Ss$
$\Rightarrow Ts$
$\Rightarrow aTbS$
$\Rightarrow aaTbbS$
$\Rightarrow aaabbbT$
$\Rightarrow aaabbbab$