

1. (a) $S \rightarrow OS \mid OS \mid \epsilon$; (regular)

(b) $S \rightarrow S_1 \mid S_2$; $S_1 \rightarrow TOS_1 \mid TOT$, $S_2 \rightarrow UIS_2 \mid UIU$
 $T \rightarrow OT1 \mid 1TO \mid TT \mid \epsilon$, $U \rightarrow OU1 \mid 1UO \mid UU \mid \epsilon$

(c) $S \rightarrow OS \mid 1S \mid 1$; (regular) ; (not regular)

(d) $S \rightarrow OS \mid 1T \mid \epsilon$
 $T \rightarrow 1T \mid OU \mid \epsilon$; (regular)

$U \rightarrow OS \mid 1V \mid \epsilon$

$V \rightarrow 1T \mid \epsilon$

(e) $S \rightarrow T1V \mid UOV \mid W$

$T \rightarrow ZTZ \mid OV01$

$U \rightarrow ZUZ \mid 1V01$

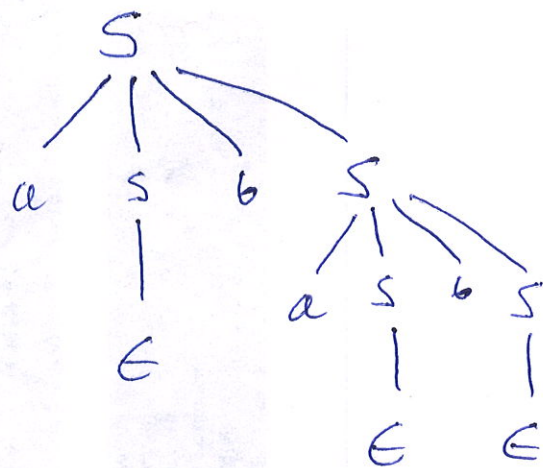
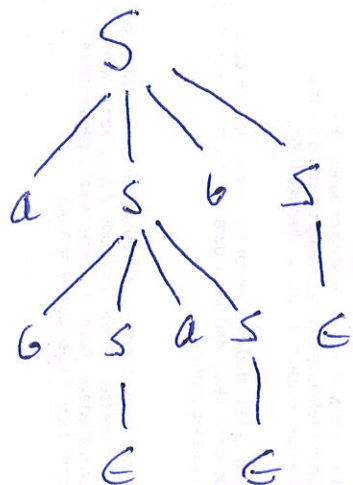
$V \rightarrow ZV \mid \epsilon$

$W \rightarrow ZWZ \mid 01ZV \mid ZV01$

$Z \rightarrow 0 \mid 1$

; (not regular)

2. (a) Yes, consider the sentence 'abab'



(b) All strings on the alphabet $\{a, b\}$ that have an equal number of a's and b's.

$$2.(c) \text{ FIRST}(s) = \{a, b, \epsilon\}$$

$$\text{FOLLOW}(s) = \{a, b, \$\}$$

Parse table:

	a	b	\$
S	$S \rightarrow aSbS$ $S \rightarrow \epsilon$	$S \rightarrow bSas$ $S \rightarrow \epsilon$	$S \rightarrow \epsilon$

Thus we cannot do predictive parsing, and the grammar is not LL(1).

$$3.(c) \quad abc + d * + e -$$