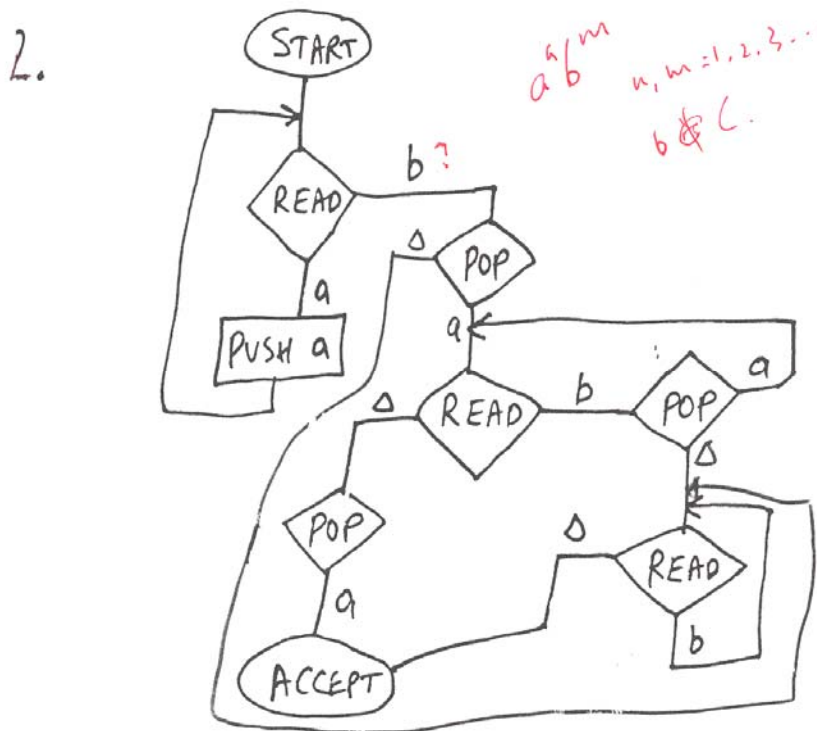
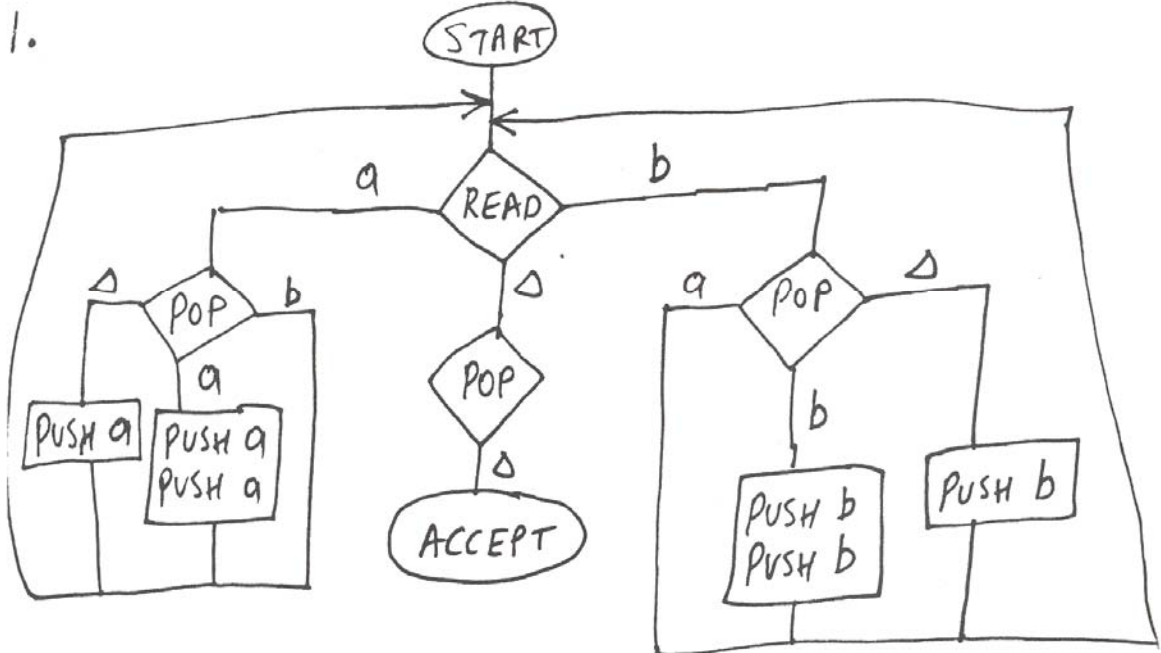
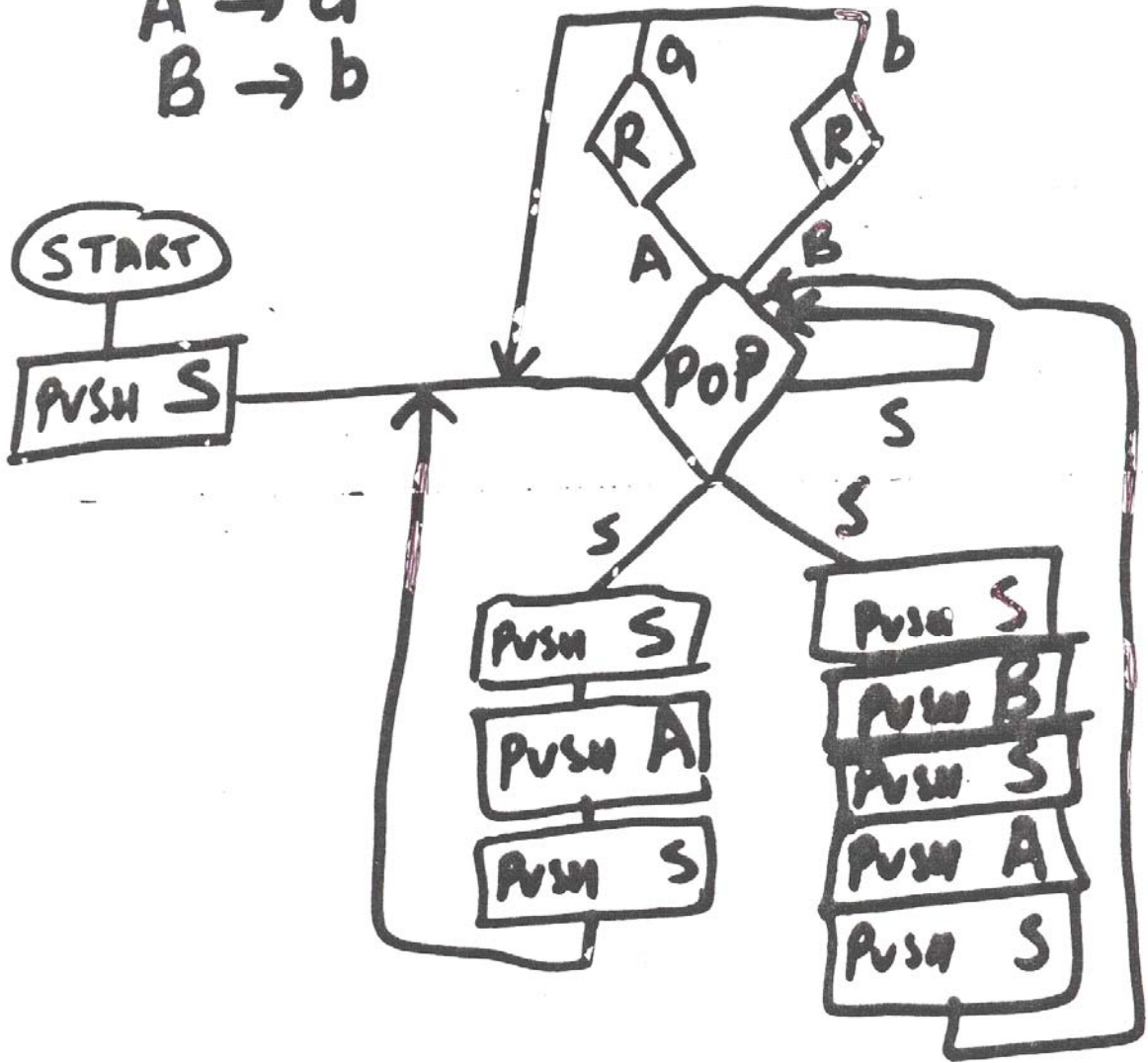


CSI 3104: Introduction to Formal Languages
 Winter 2007
 Assignment 4 Solution



3. $S \rightarrow SAS \mid SASBS \mid \Lambda$

$A \rightarrow a$
 $B \rightarrow b$



$$4.2) S \rightarrow S_1 | S_2 | S_3$$

$$(m=n) S_1 \rightarrow aX_1 bY_1 \quad X_1 \rightarrow aX_1 b | \Lambda \quad Y_1 \rightarrow \overset{a}{b}Y_1 | \overset{a}{b}$$

$$(n=p) S_2 \rightarrow aS_2 a | X_2 \quad X_2 \rightarrow bX_2 | b$$

$$(m=p) S_3 \rightarrow Y_3 bX_3 a \quad X_3 \rightarrow bX_3 a | \Lambda \quad Y_3 \rightarrow aY_3 | a$$

$$b) S \rightarrow A_1 S B_2 | P | Q$$

$$P \rightarrow A_1 P A_2 | R$$

$$R \rightarrow B_1 R A_2 | \Lambda$$

$$Q \rightarrow B_1 Q B_2 | T$$

$$T \rightarrow B_1 T A_2 | \Lambda$$

$$A_1 \rightarrow a \quad A_2 \rightarrow a \quad B_1 \rightarrow b \quad B_2 \rightarrow b$$

$$5. uvxyz \rightarrow uv^mxy^mz$$

IF v OR y CONTAINS ab OR ba THEN uv^mxy^mz HAS
 m SUCH PAIRS - TOO MANY ($a^n b^n a^n b^n$ HAS TWO ab
 ONE ba)

IF $v = a^p$ OR b^p AND $y = a^q$ OR b^q THEN
 AT MOST TWO OUT OF FOUR a/b IN $a^n b^n a^n b^n$ WILL
 GROW AND OTHER TWO WILL REMAIN SAME AND
 POWERS BECOME DIFFERENT IN $a^n b^n a^n b^n$.

6.

$E \rightarrow F_1 E$

$E \rightarrow F_2 E$

$E \rightarrow F_3 T_4$

$F_1 \rightarrow E T_1$

$F_2 \rightarrow E T_2$

$F_3 \rightarrow T_3 E$

$T_1 \rightarrow +$

$T_2 \rightarrow *$

$T_3 \rightarrow ($

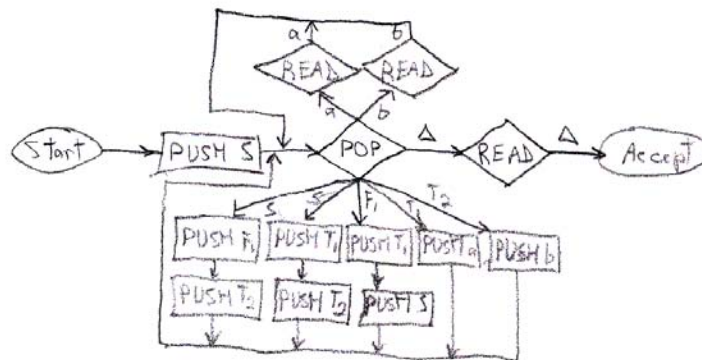
$T_4 \rightarrow)$

$E \rightarrow 7$

Problem 7

- i) $S \rightarrow F_1 T_2$
- $S \rightarrow T_1 T_2$
- $F_1 \rightarrow T_1 S$
- $T_1 \rightarrow a$
- $T_2 \rightarrow b$

ii)



8.

If we assume that this language is context free, then there exist words $uvxyz$ where $x \neq \Lambda$ and at least the v or the y is not Λ such that $uv^nxy^n z \in L$ for $n \geq 1$. All the words in this language are of the form s reverse(s) s , then the length of all words is multiple of 3.

When we pump, we may have the following scenarios:

$$\underline{ba} \underline{ab} \underline{ba} \Rightarrow babaabbaba \Rightarrow \text{not a multiple of 3 and not of the form } s \text{ reverse}(s) s$$

$$\underline{ba} \underline{ab} \underline{ba} \Rightarrow baabbabba \Rightarrow \text{not of the form } s \text{ reverse}(s) s$$

$$\underline{ba} \underline{ab} \underline{ba} \Rightarrow baabaabba \Rightarrow \text{not a multiple of 3 and not of the form } s \text{ reverse}(s) s$$

When we pump a string generated by this language, the resulting word is not in L , then the condition $uv^nxy^n z \in L$ is not satisfied, then we have a contradiction, and therefore this language is non-context free.

9.

$S \rightarrow AB \rightarrow bCD \rightarrow bDAa \rightarrow baba$

Yes, it does. For example, $baba$ can be generated.