

# CSCI 340 — Homework 8

Professor Killian

Due: March 31, 2019 @ 11:59PM

1. Find CFGs that generate the following regular languages. Assume  $\Sigma = \{a, b\}$ 
  - (a) All strings that end in  $b$  and have an even number of  $b$ 's in total
  - (b) All strings without the substring  $aaa$
2. For the following CFG, find a regular expression that defines the language. Also describe the language.  
 $S \rightarrow aS \mid bX \mid a$   
 $X \rightarrow aX \mid bY \mid bZ \mid a$   
 $Y \rightarrow aY \mid a$   
 $Z \rightarrow aZ \mid bW$   
 $W \rightarrow aW \mid a$
3. Starting with the alphabet  $\Sigma = \{a, b, (, ) +, *\}$ , find a CFG that generates all regular expressions. Is this language regular?
4. Find a regular form of the following CFG:  
 $S \rightarrow XY$   
 $X \rightarrow aX \mid Xa \mid a$   
 $Y \rightarrow bY \mid b$
5. Remove all  $\Lambda$ -productions from the following CFG:  
 $S \rightarrow XaX \mid bX$   
 $X \rightarrow XaX \mid XbX \mid \Lambda$
6. Remove all unit productions from the following CFG:  
 $S \rightarrow aX \mid Yb$   
 $X \rightarrow S$   
 $Y \rightarrow bY \mid b$

7. Convert the following CFG to CNF

$$E \rightarrow E + E$$

$$E \rightarrow E * E$$

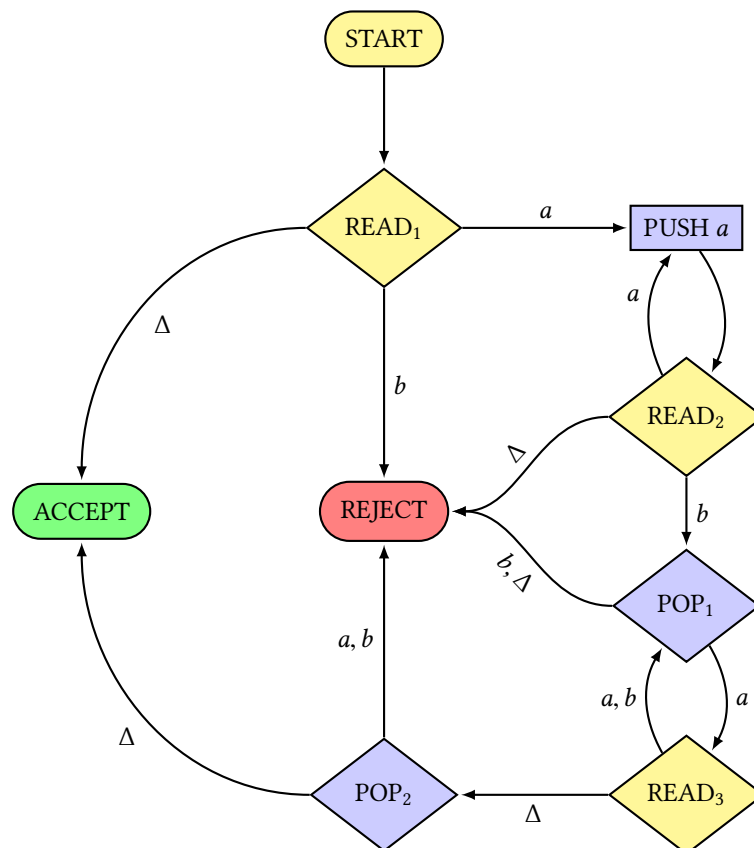
$$E \rightarrow (E)$$

$$E \rightarrow 7$$

8. Create a PDA for EVEN-EVEN

9. Build a deterministic PDA that accepts the language  $a^n b^{n+1}$  (Assume  $n > 0$ )

10. Consider the following PDA (Assume  $\Sigma = \{a, b\}$ )



(a) Trace the following words on the PDA (show STACK and TAPE and STATE)  
 $aaabbb$  and  $aaaabb$

(b) Find a CFG that defines the language accepted by the PDA

(c) Describe the language in English