

**Assignment #4** **Due date: Friday, March 23, 2006 at 20:00**

- Construct a PDA that accepts only words in the language EQUAL-EQUAL = {words containing the same number of  $a$ 's and  $b$ 's} =  $\{\Lambda, ab, ba, aabb, abba, abab, baa, baabba, \dots\}$ .
- Find a PDA that accepts the language  $\{a^n b^m, \text{ where } n, m = 1, 2, 3, \dots, n \neq m\}$ .
- Construct a PDA for the following CFG:  

$$S \rightarrow SaS \mid SaSbS \mid \Lambda$$
- Find a CFG for the following language:  
 TWO-EQUAL =  $\{a^n b^m a^p \mid m, n, p \geq 1 \text{ and } n=m \text{ or } n=p \text{ or } m=p, \text{ that is, at least two of the exponents } m, n, \text{ or } p \text{ must be equal}\}$ .
- Prove that the language  $\{a^n b^n a^n b^n \text{ for } n=1, 2, 3, 4, \dots\} = \{abab, aabbaabb, \dots\}$  is non-context free.
- Exercise # 14(iv) page 287  
 Convert the following CFG to CNF:  

$$E \rightarrow E + E$$

$$E \rightarrow E * E$$

$$E \rightarrow (E)$$

$$E \rightarrow 7$$
 The terminals here are  $+ * ( ) 7$ .
- Exercise # 15 page 349  
 Starting with the CFG for  $\{anbn\}$   

$$S \rightarrow aSb \mid ab$$
  - Put this CFG into CNF.
  - Take this CNF and make a PDA that accepts this language.
- Exercise # 17 page 375  
 The language EVENPALINDROME can be defined as all words of the form  

$$s \text{ reverse}(s)$$
 where  $s$  is any string of letters from  $(a+b)^*$ . Let us define the language UPDOWNUP as  

$$L = \{ \text{all words of the form } s \text{ reverse}(s) s \text{ where } s \text{ is in } (a+b)^* \} = \{aaa, bbb, aaaaaa, abbaab baabba bbbbbb \dots aaabbaaaaaab \dots\}$$
 Prove that  $L$  is non-context free.
- Exercise # 1 (iii) page 429  
 Decide whether or not the following grammar generates any word:  

$$S \rightarrow AB \quad A \rightarrow BC \quad C \rightarrow DA \quad B \rightarrow CD \quad D \rightarrow a \quad A \rightarrow b$$