

CSE 322: Introduction to Formal Models in Computer Science  
Assignment #7  
November 29, 2006  
due: Wednesday, December 6

1. In Assignment 5 you converted the context-free grammar  $G_4$  given in Example 2.4 [1st Ed: Example 2.3] into Chomsky normal form. Show the final Chomsky normal form grammar  $G$  again, corrected if necessary, for the grader. For this grammar  $G$ , apply the dynamic programming procedure from the handout “Membership Testing in Context-Free Languages” to the input string  $(a + a) \times a$ . Fill in the  $7 \times 7$  table, and explain how you can tell at the end whether or not the input string is in the language.
2. Let  $B$  be the language of all palindromes over  $\{0, 1\}$  containing an equal number of 0s and 1s. Show that  $B$  is not context-free.
3. Let  $P = \{a^n \mid n \text{ is a prime number}\}$  over the alphabet  $\Sigma = \{a\}$ . Prove that  $P$  is not context-free. (Hint: as in Assignment 4, the challenge is to make the right choice for  $i$  in the pumping lemma. A correct solution to that problem will be helpful here.)
4. Let  $D$  be the language of Example 2.38 [1st Ed: Example 2.22].
  - (a) What is the complement of  $D$ ? (Hint: be careful; it is an easy mistake to miss some of the strings in the complement.)
  - (b) Show that the complement of  $D$  is a context-free language. This, together with Example 2.38 [1st Ed: Example 2.22], gives an explicit example that the context-free languages are not closed under complement.