

Computer Science 411
Homework 10: Grammars
Fall 2015
Due 11/16/2015

1. Give an unrestricted grammar for each of the following languages:
 - (a) (5 points) $L = \{a^n b^n c^n d^n : n \geq 0\}$. For example, $\epsilon, abcd, aabbccdd, aaabbccddd \in L$
 - (b) (5 points) $L = \{a^{2^n} : n \geq 0\}$. For example, $a, aa, aaaa, aaaaaaaaa \in L$
2. Give a 1-counter machine for each of the following languages.
 - (a) (5 points) $L =$ all strings in $(a + b + c)^*$ that have the same number of a s as b s. For example, $abc, acbbac, bbaaaa \in L$
 - (b) (5 points) $L = \{a^n b^{3n}\}$. For example, $abb, aabbbbbb \in L$