CS3133
HW#8 SOLUTIONS

1. $M = \left(\{q_0, q_1, q_f\}, \{0,1\}, \{0,1,B\}, d, q_0, B, \{q_f\}\right)$ where $d(q_0, 0) = (q_1, 0, R)$, $d(q_0, 1) = (q_0, 1, R)$, $d(q_1, 0) = (q_f, 0, R)$, $d(q_1, 1) = (q_0, 1, R)$

2. **a** $q_0 00 \mid\!- Xq_1 0 \mid\!- X0q_1$

b

$q_0 000111 \mid\!- Xq_1 00111 \mid\!- X0q_1 0111 \mid\!- X00q_1 111 \mid\!- X0q_2 0Y11 \mid\!- Xq_2 00Y11 \mid\!- q_2 X00Y11$
$\mid\!- Xq_0 00Y11 \mid\!- XXq_1 0Y11 \mid\!- XX0q_1 Y11 \mid\!- XX0Yq_1 11 \mid\!- XX0q_2 YY1 \mid\!- XXq_2 0YY1$
$\mid\!- Xq_2 X0YY1 \mid\!- XXq_0 0YY1 \mid\!- XXXq_1 YY1 \mid\!- XXXYq_1 Y1 \mid\!- XXXYYq_1 1 \mid\!- XXXYq_2 YY \mid\!- XXXq_2 YYY$
$\mid\!- XXq_2 XYYY \mid\!- XXXq_0 YYY \mid\!- XXXYq_3 YY \mid\!- XXXYYq_3 Y \mid\!- XXXYYYq_3 B \mid\!- XXXYYYBq_4 B$

3. **a**) $(01)^* 0$ **b**) $0^* 11^*$

4. We can write a program using the algorithms from class or our text to

- Remove unit productions from G
- Remove e-productions from G
- Remove useless productions from G
- Convert G to Chomsky Normal Form
- Apply the CYK algorithm to test if $w \in L(G)$

The time for the first four steps is bounded by a polynomial function of $|V| + |T| + |P|$. The time for the fifth step is bounded by $O\left(|w|^3\right)$. So the program's execution time is bounded by a polynomial function of $|V| + |T| + |P| + |w|$. As stated in class (or using **Theorem 8.18** on page 363 of our text), there must be a Turing Machine to accomplish the same task with a number of steps bounded by a polynomial function of $|V| + |T| + |P| + |w|$.