Due February 24

1. Use the Pumping Lemma to show that the following languages are not regular:
   (a) \{0^n1^m0^n1^m|n, m \geq 0\};
   (b) \{w\#u|w, u \in \{0, 1\}^* and |w| = |u|\};
   (c) \{a^ib^i|i > 3j\};
   (d) \{x_1\#x_2\#x_3| x_1, x_2, x_3 \in \{a, b\}^* and either x_1 = x_2^R or x_1 = x_3^R\}.

2. Let \(A\) be the language consisting of those strings \(w\) in \(\{0, 1, \#\}^*\) such that either \(w\) starts with 0 or \(w = u\#u\) for some \(u \in \{0, 1\}^*\). \(A\) is not regular. In a Pumping Lemma proof of this, you are given \(p\) and you choose \(s\). For each of the following possible choices of \(s\), state whether or not the choice is a good one. If the choice is bad, provide the decomposition that allows the string to be pumped.
   (a) \(s = 0^p1^p\#0^p1^p\);
   (b) \(s = 1^p0^p\#1^p0^p\);
   (c) \(s = (10)^p\#(10)^p\).

3. Read the discussion of minimum pumping length given in Problem 1.55 of the text (third US edition) and then give the minimum pumping length for the following languages. Justify your answers.
   (a) \(0^*1^*\);
   (b) \(\{0^n1^m|n and m are even\}\);
   (c) \(\{a, aba\}\).

4. Problem 1.54. (3rd edition)