Sample Assignment # 5

1. For each of the following, prove it is not regular by using the Pumping Lemma or Myhill-Nerode. You must do at least one of these using the Pumping Lemma and at least one using Myhill-Nerode.

   a. \{ a^{2^k+1} | k \geq 0 \} (note: 2^{k+1}, so get \{a^2, a^3, a^5, a^9, a^{17}, \ldots \})
   
   b. \{ a^i b^j c^k | i \geq 0, j \geq 0, k \geq 0, \text{ if } i = 0 \text{ then } j = 2k \}

   c. \{ xyz | x,y,z \in \{a, b\}^* \text{ and } y = xz \}

2. Write a regular (right linear) grammar that generates the set of strings denoted by the regular expression \(((01 + 10)^+)(11))^* (00)^*\). You may use extended grammars where rules are of form \( A \rightarrow \alpha \) and \( A \rightarrow \alpha B \), \( \alpha \in \Sigma^* \) and \( A,B \) non-terminals

3. Write a Mealy finite state machine that produces the 2's complement result of subtracting 1101 from a binary input stream (assuming at least 3 bits of input)