CS3231 : Tutorial - 2

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1. Give state diagrams for DFA as required for recognizing the following languages. In all parts the alphabet is $\{0, 1\}$.
   (a) $\{w|\ w$ does not contain the substring 110$\}$.
   (b) $\{\varepsilon, 0\}$.
   (c) The empty set.
   (d) All strings except the empty string (also give a formal description of this last DFA).
   (e) $\{w|\ w$ contains at least two zeros$\}$.
2. For language A, let $A^R = \{w^R\ |w \in A\}$ (recall w^R is the reverse of w). Show that if A is regular then A^R is regular.
3. Let $D = \{w|\ w$ contains an even number of a's and an odd number of b's and does not contain the substring $ab\}$. Give a DFA with five states that recognizes D.
4. Let F be the language of all strings over $\{0, 1\}$ that do not contain a pair of 1s that are separated by an odd number of symbols. Give the state diagram of a DFA with 5 states that recognizes F.
5. Let $C = \{x|\ x$ is a binary number that is a multiple of 3$\}$. Show that C is a regular language.
6. For languages A and B, let the perfect-shuffle of A and B be the language:

   $$\{w|\ w = a_1 b_1 \cdots a_k b_k,\ \text{where } a_1 \cdots a_k \in A \text{ and } b_1 \cdots b_k \in B,\ \text{each } a_i, b_i \in \Sigma\}\ .$$

   Show that the class of regular languages is closed under perfect-shuffle.