DFA design

1. For each of the following languages in $\{0,1\}^*$, describe a deterministic finite automaton that accepts that language. There are infinitely many correct answers for each language.

    a) Only the string 0110.

    b) Every string except 0110.

    c) Strings that contain the substring 010.

    d) Strings that do not contain the substring 010.

    e) Strings that contain the subsequence 010.

    f) Strings that do not contain the subsequence 010.

    g) Strings that contain at least three 1s.

    h) Strings with length at least 3 such that the third symbol is a 0.

    i) Strings that start with 0 and have odd length or strings that start with 1 and have even length.

    j) Strings that have 1 on every odd position.

    k) Strings containing an even number of 0's.

2. Consider the alphabet $\Sigma = \{0,1\}$. For any integer $k \geq 1$ we define the language $L_k = (0+1)^* 0^{k-1} 0^*$.

    a) Give an English language description for L_k.

    b) Describe a DFA with k states that recognizes L_k.

    c) Prove that any DFA which recognizes L_k must have at least k states.