================ Part A =================

1. Let L be a set of strings over {0, 1} which
    * do not contain the substring “00” in the start or in the middle (it may appear at the end — so, “00” is itself in L, but 000 is not in L)
    * do not end with “01”

Show that L is regular.

2*. Construct an NFA that accepts all strings over the alphabet {a,b} that contains at most one occurrence of aa. The string aaa has two occurrences of aa. Prove correctness (write only the level-1 claims).T

3*. Prove that this language is regular: {0^k u 0^k : k >= 1 and u belongs to {0,1}* }.

================= Part B ================

4. Define Switch1(L) = { flip every odd bit of w : w in L }. Show that regular languages are closed under Switch1. *Hint: Since L is regular, there is a DFA D accepting L. Start with that D. If 110010 is in L, then 011000 is in Switch1(L).*

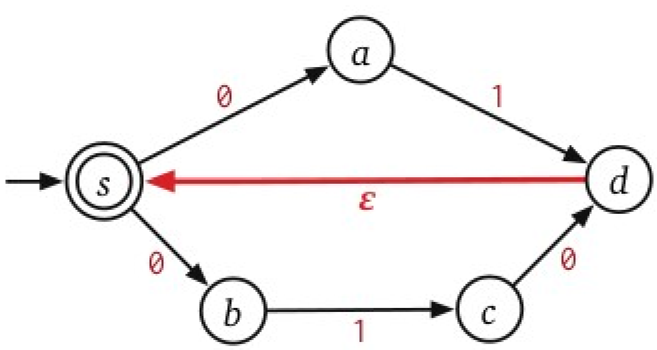
5. Define Switch2(L) = { w such that L contains w’ where w’ is a version of w in which every alternate 1 is switched to zero, starting from the first 1}. For example, if 10101010 is in L, then 00100010 is in Switch2(L). Show that regular languages are closed under Switch2.

6!. Define Switch3(L) = { w such that L contains w’ and w is a version of w’ in which every alternate 1 is switched to zero, starting from the first 1}. Show that regular languages are closed under Switch3.

7*. Zerofy(L)={0^{|w|} : w is in L} which are unary languages over {0}. Prove that the regular languages are closed under Zerofy.

================ Part C ==================

8* (easy). Construct an equivalent DFA for this NFA. *Hint: Create the states of the DFA as you need (by following the transitions), instead of first creating one for each subset of states.*



A table like this will be helpful. You need not show the transitions going to the {} (empty set) state, as long as you mention that “transitions that go to the stop state {} are not shown”. Verify that the DFA is correct by taking some examples.

q : A state of DFA / A subset of NFA states	Is this a final state of DFA?	d(q,0)	d(q,1)