

Describe deterministic finite-state automata that accept each of the following languages over the alphabet $\Sigma = \{0, 1\}$. Give the states of your DFAs mnemonic names, and describe briefly *in English* the meaning or purpose of each state.

Either drawings or formal descriptions are acceptable, as long as the states Q , the start state s , the accept states A , and the transition function δ are all clear. Try not to use too many states, but *don't* try to use as few states as possible. Clarity is more important than brevity.

Yes, these are exactly the same languages that you saw last Friday. Weird, huh?

- o. All strings.
 1. All strings containing the substring 000.
 2. All strings *not* containing the substring 000.
 3. All strings in which every run of 0s has length at least 3.
 4. All strings in which the last 1 (if any) appears before the first substring 000 (if any).
 5. All strings containing at least three 0s.
 6. Every string except 000. [Hint: Don't try to be clever.]
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More difficult problems to think about later:

7. All strings w such that *in every prefix of w* , the number of 0s and 1s differ by at most 1.
8. All strings containing at least two 0s and at least one 1.
9. All strings w such that *in every prefix of w* , the number of 0s and 1s differ by at most 2.
10. All strings in which every run has odd length. (For example, 0001 and 100000111 and the empty string ε are in this language, but 000000 and 001000 are not.)
- *11. All strings in which the substring 000 appears an even number of times. (For example, 01100 and 000000 and the empty string ε are in this language, but 00000 and 001000 are not.)