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.

0. 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 every 1 appears before every substring 000.

5. All strings containing at least three 0s.

6. Every string except 000. *[Hint: Don't try to be clever.]*

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.)