Describe deterministic finite-state automata that accept each of the following languages over the alphabet $\Sigma = \{0, 1\}$. Describe briefly what each state in your DFAs means.

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 $\delta$ are all clear. Try to keep the number of states small.

1. All strings containing the substring $000$.

2. All strings not containing the substring $000$.

3. All strings in which every run of $0$s has length at least $3$.

4. All strings in which $1$ does not appear after a substring $000$.

5. All strings containing at least three $0$s.

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

Work on these later:

7. All strings $w$ such that in every prefix of $w$, the number of $0$s and $1$s differ by at most $1$.

8. All strings containing at least two $0$s and at least one $1$.

9. All strings $w$ such that in every prefix of $w$, the number of $0$s and $1$s differ by at most $2$.

*10. All strings in which the substring $000$ appears an even number of times.

(For example, $0001000$ and $0000$ are in this language, but $000000$ is not.)