This lab gives practice at constructing NFAs and understanding their power and flexibility.

1. Design an NFA for the set of strings that consist of 01 repeated one or more times, or 010 repeated one or more times.

2. Let $M = (Q, \Sigma, \delta, q_0, F)$ be a DFA recognizing language L. Show that $L^R = \{w^R \mid w \in L\}$ is also regular by constructing an NFA $N = (Q_N, \Sigma, \delta_N, q_0^N, F_N)$ that recognizes L^R. You should completely, formally, specify each component of N in terms of M. *Hint:* reverse the edges of the graph representing M?

3. **To think at home ?** Let $L = \{w \in \{a, b\}^* \mid$ an a appears in some position i of w, and a b appears in position $i + 2\}$.

   (a) Create an NFA N for L with at most four states.

   (b) Using the “power-set” construction, create a DFA M from N. Rather than writing down the sixteen states and trying to fill in the transitions, build the states as needed, because you won’t end up with unreachable or otherwise superfluous states.

   (c) Now directly design a DFA M' for L with only five states, and explain the relationship between M and M'.

4. **To think at home:** Here are some more DFA construction exercises.

   (a) i. $(0 + 1)^*$
       ii. $\emptyset$
       iii. $\{\epsilon\}$

   (b) Every string except **`000`**.

   (c) All strings containing the substring **`000`**.

   (d) All strings *not* containing the substring **`000`**.

   (e) All strings in which the reverse of the string is the binary representation of a integer divisible by 3.

   (f) All strings w such that *in every prefix of* w, the number of **`0`**s and **`1`**s differ by at most 2.