**Finite Automata: in principle**

Suppose that $\Sigma$ is a finite alphabet.

1. Briefly describe how a **deterministic finite automaton** (DFA) over $\Sigma$ acts, in terms of an edge-labeled digraph:
   (a) What in the graph corresponds to the finite set of **states** of the DFA?
   (b) What in the graph corresponds to the **transitions** of the DFA, and what rules apply to those transitions?
   (c) How do we mark the unique **start state** of the graph?
   (d) What special designation can each state have (or not have)?
   (e) Given a **string** of characters from $\Sigma$, describe how the DFA operates one character at a time, and what it means for the DFA to **accept** or **reject** the string.

2. Taking a step back, as an input/output machine, what does a DFA over $\Sigma$ take as input? What are its possible outputs? Viewing this as a **function**, what are its domain and codomain?

3. Briefly explain why each string $x \in \Sigma^*$ must be either accepted or rejected (but not both!) by a DFA. What do we mean by the **language accepted by** a DFA?

4. Taking a further step back, how can we think of this whole process as giving us a function from the set of all DFA’s to $\mathcal{P}(\Sigma^*)$?

... and in practice

5. Consider the DFA labeled $A$ on the back of this page.
   (a) Will this DFA accept or reject: 
      (i) a string $x$ that starts with 101;
      (ii) a string $y$ that starts with 100;
      (iii) a string $z$ that starts with 11;
      (iv) a string $w$ that starts with 0?
   (b) Find a regular expression that produces the language accepted by $A$.

6. Consider the DFA labeled $B$ on the back of this page.
   (a) Will this DFA accept or reject: 
      (i) the string $\varepsilon$;
      (ii) the string 1000100;
      (iii) the string 00100100;
      (iv) the string 11100011?
   (b) Find a regular expression that produces the language accepted by $B$.

7. Consider the DFA labeled $C$ on the back of this page.
   (a) Will this DFA accept or reject: 
      (i) the string $\varepsilon$;
      (ii) the string 001;
      (iii) the string 001001;
      (iv) the string 00100100?
   (b) Find a regular expression that produces the language accepted by $C$.

8. Consider the DFA labeled $D$ on the back of this page.
   (a) Will this DFA accept or reject: 
      (i) the string $\varepsilon$;
      (ii) the string 1111;
      (iii) the string 00011;
      (iv) the string 001110?
   (b) Find a regular expression that produces the language accepted by $D$.  
