Assignment 3

Submissions due: 20 September, 12:00 p.m.
Corrections due: 22 September, 12:00 p.m.

Exercise 1

Convert the following NFA (with ε-transitions) to an equivalent DFA. First compute the ε-closure for each of the states in the NFA and then use the subset construction to create a DFA, either in tabular representation or using the elements of the formal 5-tuple.

Don't design a new DFA from scratch; I want to see that you understand the conversion process that we used to prove that an equivalent DFA exists for every NFA.
Exercise 2

In class, we saw that if you take the DFA for a language $L$ and flip which states accept and which don’t, you have a DFA for its complement, $\overline{L}$.

a. Prove by contradiction that the same is not true for NFAs. That is, draw a simple NFA for a language $L$ where flipping the accept and non-accept states does not produce an NFA for $\overline{L}$. Briefly (in 1–2 sentences) justify your answer.

b. Explain why the proof from part (a) doesn’t contradict the fact that the regular languages are closed under complementation.
Exercise 3

In class, we’ve seen that the regular languages are closed under complement, union, intersection, and concatenation.

The proofs of these closure properties either directly convert automata for some languages into an automaton for the desired language or they work by combining other closure properties, as we did for intersection.

Use one of these approaches to show that the regular languages are closed under reversal.

**Definition** For any string $w = w_1 w_2 \cdots w_n$, the reverse of $w$, written $w^R$, is the string $w$ in reverse order:

$$w^R = w_n \cdots w_2 w_1$$

**Definition** For any language $L$, the reverse of $L$, written $L^R$, is

$$L^R = \{ w^R \mid w \in L \}$$

For example, if $L = \{ \text{cat}, \text{dog} \}$, then $L^R = \{ \text{cat}^R, \text{dog}^R \} = \{ \text{tac}, \text{god} \}$. 