You shall receive feedback on these problems *only if*:

1. You submit to one of the TAs by **2359 hrs on Thursday, August 15**, 2019, and
2. **Submit each problem in a separate sheet** with your name on each sheet. This is essential because the TAs divide correction duties by problem.

"Appearances are not reality; but they often can be a convincing alternative to it." – Dean Koontz

1. For a word $w \in \Sigma^*, w = a_1 \cdots a_n, a_1, \ldots, a_n \in \Sigma$, define the *reverse* word $w^R = a_n \cdots a_1$. For a language $L \subseteq \Sigma^*$, define the reverse language L^R of L as

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

   Consider some L that is recognizable. Show that L^R is recognizable.

2. We shall define the *Kleene star* operation. For a language L,

   $$L^* = \{w_1 \cdots w_n \mid n \geq 0, w_1, \ldots, w_n \in L\}$$

   If L is recognizable, show that L^* is recognizable.

3. Show that recognizable languages are closed under :

   (a) *two-stutter*, where for a language L,

   $$\text{two-stutter}(L) = \{a_1 a_1 \cdots a_n a_n \mid a_1 \cdots a_n \in L\}$$

   (b) *stutter*, where for a language L,

   $$\text{stutter}(L) = \{a_1^{m_1} \cdots a_n^{m_n} \mid a_1 \cdots a_n \in L, m_1, \ldots, m_n > 0\}$$

4. Show by giving an example that, if A is an NFA that recognizes language L, swapping the accept and non-accept states in A doesn't necessarily yield an NFA that recognizes the complement of L.
