COMP 335 Worksheet
Regular expressions and grammars

1. Let $\Sigma = \{a, b\}$. Give regular expressions for the following languages over Σ.

   (a) $L_1 = \{w \mid w$ ends with the string $ab\}$

   (b) $L_2 = \{w \mid w$ contains the string $aba\}$

   (c) $L_3 = \{w \mid w$ contains exactly one $a\}$

   (d) $L_4 = \{a^n b^m \mid n + m$ is even $\}$

   (e) $L_5 = \{a^n b^m \mid n \geq 3, m$ is even $\}$

   (f) $L_6 = \{w \mid |w| \bmod 3 = 1\}$

   (g) $L_7 = \{w \mid w$ has no consecutive a's$\}$

   (h) $L_8 = \{w \mid w$ has at least one pair of consecutive a's$\}$

   (i) $L_9 = \{w \mid w$ has exactly one pair of consecutive a's $\}$

   (j) $L_{10} = \{w \mid w$ has no runs of a's of length $> 2\}$

2. Given a regular expression r, find a regular expression for $reverse(r)$.

3. Find NFAs for the languages below:

   (a) $L(ab(a + ab)^\star (a + aa))$

   (b) $L((a + b)^\star b(a + bb)^\star)$

4. Find DFAs for the languages below and then convert each of them into a regular expression or vice versa:

   (a) $\{w \in (a + b)^\star \mid n_a(w)$ and $n_b(w)$ are both odd.$\}$

   (b) $\{w \in (a + b)^\star \mid$ the leftmost two symbols of w are the same as the rightmost two symbols $\}$

5. Give right-linear grammars for all the languages in Q1.

6. Consider the language $L = \{w \in (a + b)^\star \mid$ the string aba does not appear in $w\}$.

   (a) Give a DFA that accepts L.

   (b) Convert it into an equivalent right regular grammar.

   (c) Find a regular expression for $\overline{L} = \{a, b\}^\star - L$.