CONCORDIA UNIVERSITY
Dept. of Computer Science and Software Engineering
COMP 335 – Introduction to Theoretical Computer Science

**Assignment 1 – Revised**

Electronic Submission Due on ~~Thursday May 14~~ Friday May 15th at 23:59

**Note 1:** This is a **revised** assignment; the 2 questions related to grammars in the original assignment are moved to Assignment 2.
**Note 2:** This is a theoretical course. That means, while the WHAT is important, the WHY is absolutely essential. Show "enough" details of your solution for the full mark.

Consider the following regular languages over the alphabet $\Sigma = \{a, b\}$:

- $L_1 = \{w \in \{a,b\}^* : w = bxyaz \text{ and } x, y, z \in \Sigma^*\}$.
- $L_2 = \{w \in \Sigma^* : |w| = 2k + 1 \text{ and } k \geq 0\}$.
- $L_3 = \{w \in \Sigma^* : (n_a(w) + n_b(w)) \ mod \ 3 < 2\}$.
- $L_4 = \{a^n b^m : m, n \geq 0 \text{ and } (n \neq 1 \text{ or } m \neq 1)\} \cup \{ba\}$.

1. [20 Points] Design a DFA for each of the above languages.
2. [15 Points] Give regular expressions for $L_1$, $L_2$, and $L_3$.
3. [5 Points] Give a DFA for the complement of $L_5 = \{a^n b^m : m, n \geq 0\}$.
4. [5 Points] Give a regular expression for the FA: $M = \langle\{q_0, q_1, q_2\}, \{0, 1\}, \delta, q_0, \{q_1\}\rangle$, with the following transitions:

   $\delta(q_0, 0) = q_1$; $\delta(q_0, 1) = q_1$;
   $\delta(q_1, 0) = q_0$; $\delta(q_1, 0) = q_2$; $\delta(q_1, 1) = q_1$; $\delta(q_1, \lambda) = q_2$;
   $\delta(q_2, 1) = q_1$.

5. [5 Points] Minimize the DFA $M = \langle\{q_0, q_1, q_2, q_3, q_4, q_5\}, \{a, b\}, \delta, q_0, \{q_2, q_4\}\rangle$, where $\delta$ includes the following transitions:

   $\delta(q_0, a) = q_1$; $\delta(q_0, b) = q_2$; $\delta(q_1, a) = q_0$;
   $\delta(q_1, b) = q_2$; $\delta(q_2, a) = q_4$; $\delta(q_2, b) = q_4$;
   $\delta(q_3, a) = q_1$; $\delta(q_3, b) = q_5$; $\delta(q_4, a) = q_4$;
   $\delta(q_4, b) = q_4$; $\delta(q_5, a) = q_2$; $\delta(q_5, b) = q_4$.