# Concordia University
Dept. of Computer Science and Software Engineering

Introduction to Theoretical Computer Science
COMP335 – Section AA
Summer 2015

**Assignment 2**
Electronic Submission Due on ~~May 21~~ May 25th, 2015 at 23:59

The grade for each part is 5; the maximum grade is 65.

1. Find regular grammars for the following languages.
   (a) $L = \{w \in \{a,b\}^* : |n_a(w) - n_b(w)| \text{ is odd}\}$.
   (b) $L(aa + ab + ba + bb)^*$.
   (c) The language $L_2$ in Assignment 1.
2. Give a left-linear grammar for $L_1$ in Assignment 1.
3. Consider the language $L = \{w \in \{a,b\}^* : w \text{ does not have } ba \text{ as a substring}\}$.
   (a) Give a regular grammar $G$ for $L$.
   (b) Give a regular expression $r$ for $L$.
4. For each of following languages, find a FA that accepts it.
   (a) $L(((aa^*)^*b)^*)$.
   (b) $L(ab^*a^*) \cap L((ab)^*ba)$.
5. Find a regular expresion for the FA $M$ with the following transitions:
   $\delta(q_0, a) = \{q_0\}$ $\quad$ $\delta(q_0, b) = \{q_1, q_2\}$
   $\delta(q_1, a) = \{q_2\}$ $\quad$ $\delta(q_2, a) = \{q_1\}$
   where $q_0$ is the initial state and $q_1$ and $q_2$ are the final states.
6. For each of the following languages, prove or disprove that the given language is regular.
   (a) $L_a = \{uav : uv \in L\}$, where $L$ is a given regular language over $\Sigma = \{a,b\}$.
   (b) $L_b = \{w \in \{a,b\}^* : w = w^R\}$.
   (c) $L_c = \{b^k a^n b^n : n, k \geq 0\}$.
   (d) $L_d = \{a^n : n \text{ is a prime number}\}$.