CS3331 – Assignment 1
due Oct. 14, 2014 (latest to submit: Oct. 17)

1. (20pt) Build DFSMs for the following languages. Explain why your construction is correct.
   (a) $\{w \in \{a,b\}^* \mid$ every a in w is immediately preceded and followed by $b\}$.
   (b) $\{w \in \{a,b\}^* \mid$ w does not end in $ba\}$.
   (c) $\{w \in \{0,1\}^* \mid$ none of the prefixes of w ends in $0\}$.
   (d) $\{w \in \{a,b\}^* \mid (\#_a(w) + 2\#_b(w)) \equiv 0 \pmod 5\}$. ($\#_a(w)$ is the number of a's in w).
   (e) C++ comments: `/* ... comment ... */` or `// ... comment ... \n`.

2. (20pt) Consider the language:

$$L = \{w \in \{a,b,c\}^* \mid \text{ the third from the last character is } b\}$$

   (a) Build a NDFSM for L.
   (b) Transform it into a DFSM.
   (c) Build an equivalent regular expression from one of the two FSM above. (*Hint:* It makes a big difference which FSM you choose.)

3. (15pt) For the following languages L, describe the equivalence classes of $\approx_L$. If there are finitely many classes, then build a minimal DFSM that accepts L.
   (a) $L = \{ww^R \mid w \in \{a,b\}^*\}$
   (b) $L = \{w \in \{0,1\}^* \mid \#_0(w)$ and $\#_1(w)$ are both even or both odd$\}$

4. (20pt) Consider the regular expression $\alpha = ((a \cup b)^* a)^*$.
   (a) Construct a NDFSM that accepts $L(\alpha)$. (You can use Thompson's construction but you don't have to.)
   (b) Transform it into a DFSM.
   (c) Minimize it.

5. (15pt) For each of the following languages L, prove whether L is regular or not:
   (a) $\{a^i b^j \mid i, j \geq 0$ and $i - j = 5\}$.
   (b) $\{w = xyzy^R x \mid x, y, z \in \{a,b\}^*\}$.

6. (10pt) Show that the following problem is decidable: Given $\Sigma = \{a,b\}$ and α a regular expression, does the language defined by α contain all the even length strings in Σ^*?

Note Submit your solution as a pdf file on `owl.uwo.ca`.