Computer Science 411
Homework 4: More Finite Automata
Fall 2015
Due Friday, September 25th, 2015

1. For each of the following languages, first give an NFA, and then find an equivalent regular expression using the method discussed in class. Show the resulting machine after each state has been removed. Finally, simplify the resulting regular expression as much as possible.

   (a) (8 points) L = All strings over {a, b} that contain the substring bb **or** end in aa.

   (b) (8 points) L = All strings over {0,1} that do not contain the substring 011

2. For each of the following languages, give a DFA.

   (a) (6 points) L = All strings over {a, b} contain at most one occurence of the substring aa and at most one occurence of the substring bb. So, bababb, aabb, abba, bababababb $\in L$, while aaa, bbaabb, aabaa $\notin L$

   (b) (6 points) L = All strings over {0, 1} that represent binary numbers *without leading zeroes* that are evenly divisible by 3. So: 11, 110, 1001, 1100, 1111, 10010 $\in L$, while 1, 10, 011, 111, 1011 $\notin L$

3. For each of the following languages, prove that the language is regular, or prove that the language is not regular. Recall that you prove a langauge is regular by creating either a DFA, NFA, or regular expression for that language. Careful, some of these are tricky ...

   (a) (4 points) $L = \{a^n(a+b)^*b^n, n \geq 2\}$

   (b) (4 points) $L = \{ww^R : w \in \{a,b\}^*\}$

   (c) (4 points) $L = \{wxw^R : w \in \{a,b\}^*, x \in \{a,b\}^*\}$

   (d) (4 points) $L = \{a^nb^l : n/l$ is an integer $\}$

   (e) (4 points) $L = \{a^nb^l : n \geq 10, l \leq 10\}$