CS3231
Tutorial 2

1. Construct a DFA for accepting each of the following languages over alphabet $\{a, b\}$.

   (i) $\{w \mid w$ contains even number of b's and even number of a's $\}$.

   (ii) $\{w \mid w$ does not contain $ababba$ as a substring$\}$

   (iii) $\{w \mid w = a_1 b_1 a_2 b_2 \ldots a_n b_n$, for some n, where $a_i, b_i \in \{0, 1\}$ and $a_1 a_2 \ldots a_n > b_1 b_2 \ldots b_n$ (interpreted as binary numbers) $\}$ (that is, we can decide whether one number is bigger than the other using regular automata).

2. Show via definition of regular languages that the following are regular languages. Assume appropriate alphabet set Σ.

   (a) Mathematical expressions over identifiers, $*$, and $+$.

   (b) Fortran Identifiers. (Fortran identifiers are any strings over the alphabet consisting of English characters and decimal digits such that the length of the string is at most 6 and starts with an English character).

3. This is an informal question, so various possible ways to solve it is acceptable. Here we build part of a vending machine. Aim is to have an automata which accepts a sequence of coins (of denominations 1, 5, 10, 50, 100 cents), and dispenses a softdrink can as soon as the sum total exceeds 70 cents. No change is returned. The automata should go back to starting state after dispensing the can. Design basic parts of such an automata.

4. Given the following DFA, determine the regular language accepted by it.

5. For a DFA $A = (Q, \Sigma, \delta, q_0, F)$, let $\hat{\delta}$ be as defined in class. Show that $\hat{\delta}(q, xy) = \hat{\delta}(\hat{\delta}(q, x), y)$, for all strings x, y over Σ^*, and all states $q \in Q$.

6. Construct an NFA accepting strings which end in *bba*. Construct a DFA equivalent to it using the method of converting NFA's to DFA's (do not construct a DFA directly, but only via the method discussed in class).

7. Show that if L is accepted by some ϵ-NFA, then L is also accepted by a DFA.

8. For the following NFA with ϵ-transitions:

   (a) give the transition table

   (b) find ϵ-close(q), for each state q.

   (c) find $\hat{\delta}(q_0, a)$ and $\hat{\delta}(q_0, b)$.

   (d) find a DFA which is equivalent to the given automata (you need not go through the formal method discussed in class).