Homework set 11: Hands-on review of the mid-term exam —
due Wednesday 7 March

Total number of points available is 100, and full credit is equivalent to 100 points.

1. (after Lewis and Papadimitriou) A nondeterministic finite automaton is a quintuple $M = (K, \Sigma, \Delta, s, F)$, where $K$ is a finite set of states, $\Sigma$ is an alphabet, $s \in K$ is the initial (or start) state, $F \subseteq K$ is the set of final states, and $\Delta$, the transition relation, is a finite subset of $K \times \Sigma^* \times K$.

Suppose a triple $(q, u, p)$ is in $\Delta$. This means that the automaton $M$, when in state $q$, may consume a string $u$ from the input string, and enter state $p$. Note that the string $u$ can be arbitrarily long.

The automaton accepts a string if there is a sequence of steps, starting at the initial state, that ends in one of the final states, with the entire input string consumed.

2. Write a set of Prolog predicates to simulate the workings of a nondeterministic finite automaton as described above.

The main predicate accept/1 should be invoked as follows:

?- accepts([a,a,b,b,a,b,a,b,a,a]).

3. You may assume the existence of predicates startstate/1, acceptstate/1, and transition/3, that describe the states and transitions of a particular nondeterministic finite automaton. For example, here is a set of Prolog predicates, in the form as above, that describe a nondeterministic finite automaton for the language of strings over the alphabet \{a,b\} that end in ab:

startstate(s1).
acceptstate(s2).
transition(s1, [a], s1).
transition(s1, [b], s1).
transition(s1, [a,b], s2).

4. You should test your program on at least the following queries, using the nondeterministic finite automaton defined in the example:

?- accepts([a,a,b,b,a,b,a,b,a,a]).
?- accepts([a,a,b,b,a,b,a,b,b,a]).
?- accepts([a,a,b,b,a,b,a,b,a,b]).
?- accepts([a,a,b,b,a,b,a,b,b,b]).