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, Σ is an alphabet, $s \in K$ is the initial (or start) state, $F \subseteq K$ is the set of final states, and Δ, the transition relation, is a finite subset of $K \times \Sigma^\star \times K$.

   Suppose a triple (q, u, p) is in Δ. 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 `accepts/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]).
   ```