Formal Languages

I. We consider an alphabet of input symbols made of the 26 letters of the roman alphabet.

I.a Define a non-deterministic finite state automaton that accepts a sequence of input symbols if and only if it contains the word *star*.

Remark: when labelling the transitions of your automaton, you may possibly use a range notation such as $a..z$.

I.b Define a non-deterministic finite state automaton that accepts a sequence of input symbols if and only if it contains the word *test*.

I.c Turn the non-deterministic finite state automaton defined in I.a into a deterministic finite state automaton (eliminate the states that are not reachable).

Remark: when labelling the transitions of your automaton, you may possibly use the bar notation $\overline{a}$ to mean *every symbol but 'a'*.

I.d Turn the non-deterministic finite state automaton defined in I.b into a deterministic finite state automaton (eliminate the states that are not reachable).

II. Let $A = \langle Q_A, \Sigma, \delta_A, q_A, F_A \rangle$, and $B = \langle Q_B, \Sigma, \delta_B, q_B, F_B \rangle$ be two DFSAs. Define a DFSA, $C = \langle Q_C, \Sigma, \delta_C, q_C, F_C \rangle$, as follows:

- $Q_C = \{(p, q) : p \in Q_A \text{ and } q \in Q_B\}$
- $\delta_C((p, q), a) = (\delta_A(p, a), \delta_B(q, a))$
- $q_C = (q_A, q_B)$
- $F_C = \{(p, q) : p \in F_A \text{ and } q \in F_B\}$

II.a Apply the above construction to the automata obtained in I.c and I.d.

II.b What is the language accepted by the automaton obtained in II.a?