ECE374 SP23 HW2

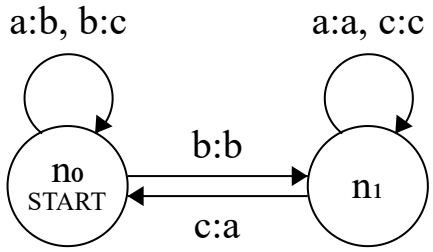
Contributors

Zhirong Chen (zhirong4)

Ziyuan Chen (ziyuanc3)

Problem 4

A *finite-state transducer* (FST) is a type of deterministic finite automaton whose output is a string instead of just *accept* or *reject*. The following is the state diagram of finite state transducer FST_0 .



Each transition of an FST is labeled with at least one input symbol and one output symbol, separated by a colon. There can also be multiple input-output pairs for each transition, separated by a comma. When an FST computes on an input string $s := s_0 s \dots s_{n-1}$ of length n, it starts from the starting state, takes the input symbols s_0, s, . . . , s_{n-1} one by one, and produces the corresponding output symbols.

(a) Assume that an FST has an input alphabet Σ and an output alphabet Γ. Give a formal definition of this model and its computation.

(b) Give a formal description of FST_0.

(c) Give a state diagram of an FST with the following behavior. Its input and output alphabets are $\{\mathrm{T}, \mathrm{F}\}$. Its output string is inverted on the positions with indices divisible by 3 and is identical on all the other positions.

Solution

(a) Formal definition of any FST

$\mathrm{FST} = (Q, \Sigma, \Gamma, \delta, s)$, where

- Q is the set of states,
- Σ is the input alphabet,
- Γ is the output alphabet,
- $\delta : Q \times \Sigma \to Q \times \Gamma$ is the transition function,
- and $s \in Q$ is the starting state.

(b) Formal definition of FST_0

$\mathrm{FST}_0 = (Q_0, \Sigma_0, \Gamma_0, \delta, s_0)$, where

$Q_0 = \{n_0, n_1\}$ $\Sigma_0 = \{a, b, c\}$ $\Gamma_0 = \{a, b, c\}$ $s_0 = n_0$

and δ_0 is described by the table below:

	a	b	c
n_0	(n_0, b)	(n_0, c)	(n_1, a)
n_1	(n_1, a)	(n_0, b)	(n_1, c)

(c) State diagram of the "string inverter" FST