

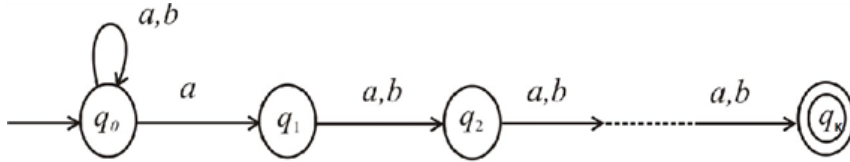
Given language is

$$C_k = \Sigma^* a \Sigma^{k-1} \text{ for each } K \geq 1, \text{ over the alphabet } \Sigma = \{a, b\}$$

$C_k$  is the language consisting of all strings that contains an 'a' exactly  $K$  places from the right – hand end.

Let  $N$  be the NFA with  $K + 1$  states that recognizes  $C_k$

(i) The state diagram of NFA  $N$  is follows:



(ii) The formal description of NFA  $N$  is as follows:

$$N = (Q, \Sigma, \delta, q_0, F)$$

$$Q = \text{set of states} = \{q_0, q_1, \dots, q_k\}$$

$$\Sigma = \text{set of alphabet} = \{a, b\}$$

$$q_0 = \text{start state} = \{q_0\}$$

$$F = \text{set of final states} = \{q_k\}$$

$\delta$  = The transition function is given as follows:

$$\delta(q_i, a) = \begin{cases} \{q_0, q_1\} & \text{if } i = 0 \\ \{q_{i+1}\} & \text{if } 0 < i < k \\ \phi & \text{if } i = k \end{cases}$$

$$\delta(q_i, b) = \begin{cases} \{q_0\} & \text{if } i = 0 \\ \{q_{i+1}\} & \text{if } 0 < i < k \\ \phi & \text{if } i = k \end{cases}$$

$$\delta(q_i, \epsilon) = \phi \forall i.$$