

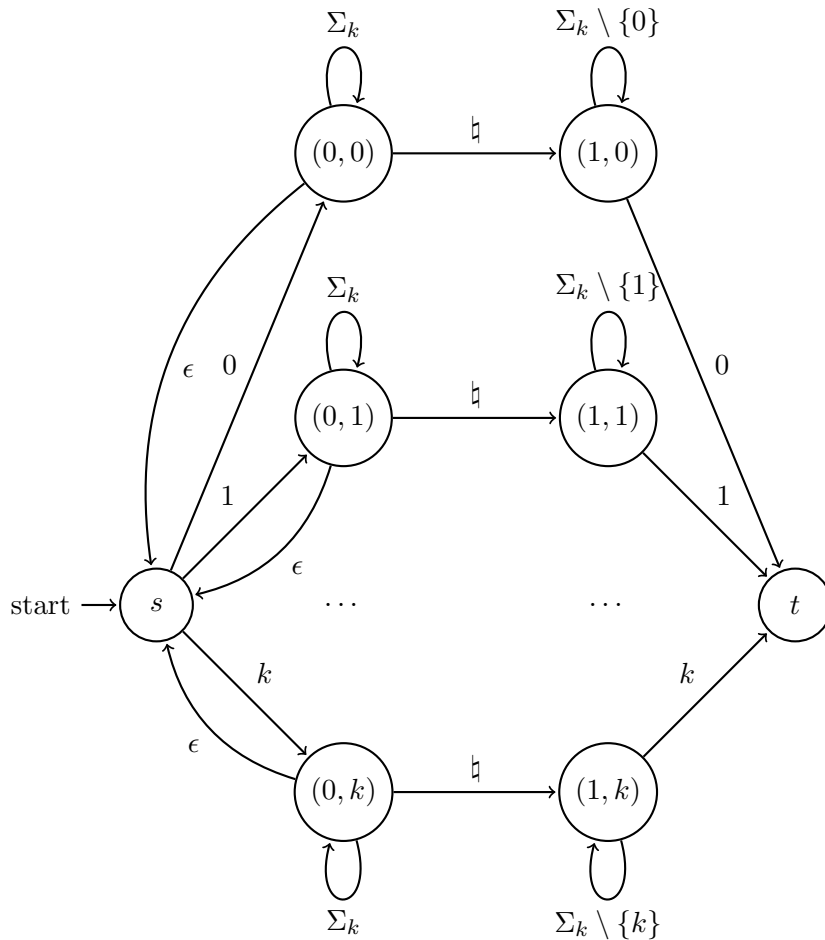
# CS 374 Spring 2018

## Homework 2

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### Problem 3 Solution:

\*NOTE\* The following NFA is not in any way a mathematical definition. It is solely a visual aide. The formal definition of the NFA for language  $T_k$  can be found on the next page.



Let us define NFA  $N = (Q, \Sigma, \delta, s, A)$  such that  $N$  defines the language  $T_k$

- $Q = \{0, 1\} \times \Sigma_k \cup \{t, S\}$
- $\Sigma = \Sigma_k \cup \natural$
- $s = S$
- $A = \{t\}$
- $\delta$  is defined as follows

$$\delta(q, a) = \begin{cases} \{S, (0, a)\} & \text{if } q = S \\ \{(0, j)\} & \text{if } q = (i, j) \text{ where } i = 0 \text{ and } j \in \Sigma_k \\ \{(1, j)\} & \text{if } q = (i, j) \text{ where } i = 0 \text{ and } a = \natural \\ \{(1, j)\} & \text{if } q = (i, j) \text{ where } i = 1 \text{ and } a \neq j \\ \{t\} & \text{if } q = (i, j) \text{ where } i = 1 \text{ and } a = j \\ \{t\} & \text{if } q = t \text{ and } a \in \Sigma_k \end{cases}$$

Reading an input symbol  $a$  from the start state  $S$  where  $a \in \Sigma_k$  will bring the existing thread to state  $a$  where the  $i = 0$  denotes a  $\natural$  has not been seen yet. It will also activate a new thread in  $S$  due to an  $\epsilon$  transition. It will stay in the state  $(0, j)$  if it continues to read input symbols  $j \in \Sigma_k^*$  but has not yet read  $\natural$ . If  $i = 1$ , the  $\natural$  symbol has been read. Then, if  $a \neq j$  that were seen before  $\natural$ , it stays in that state. It moves to an accept state  $\{t\}$  if  $i = 1$  and it reads an input  $a = j$  that is in the set of symbols seen before  $\natural$ . Once a string has been accepted, it will stay in the accept state.