CS 374 Spring 2018
Homework 2

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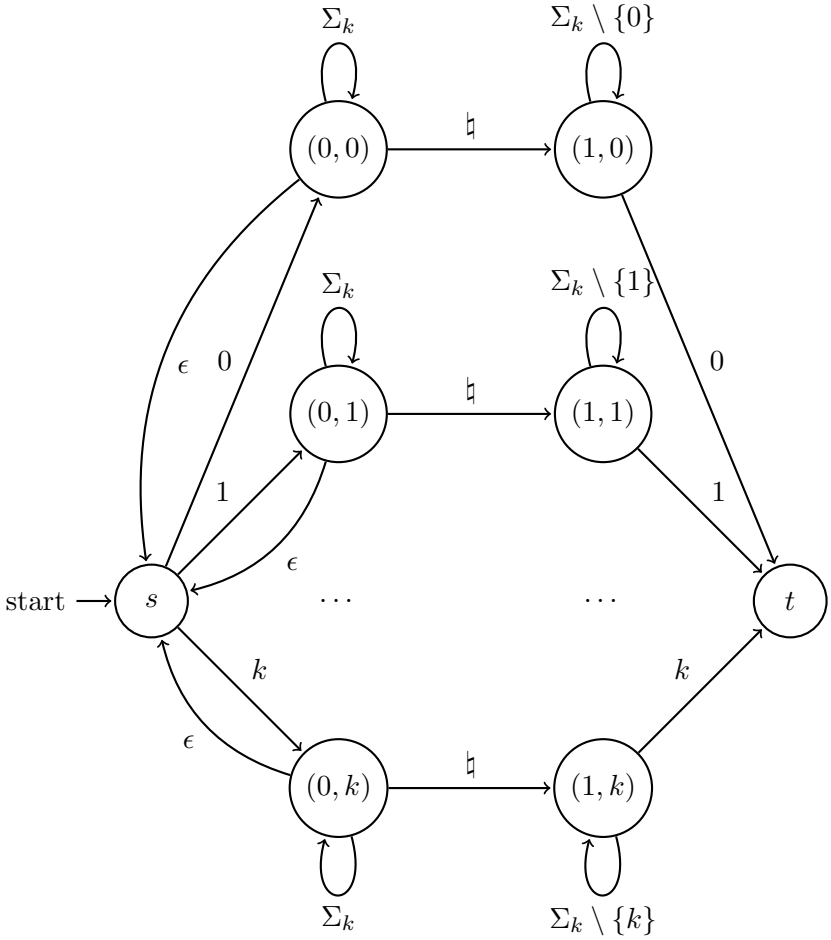
Problem 3 Solution:

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

- $Q = \{0, 1\} \times \Sigma_k \cup \{t, S\}$, where 2^k is the set of all binary strings of length k
- $\Sigma = \Sigma_k$
- $s = \{S\}$
- $A = \{t\}$
- δ is defined as follows

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

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 ϵ 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 $\natural$.