CS 374 Spring 2018
Homework 2

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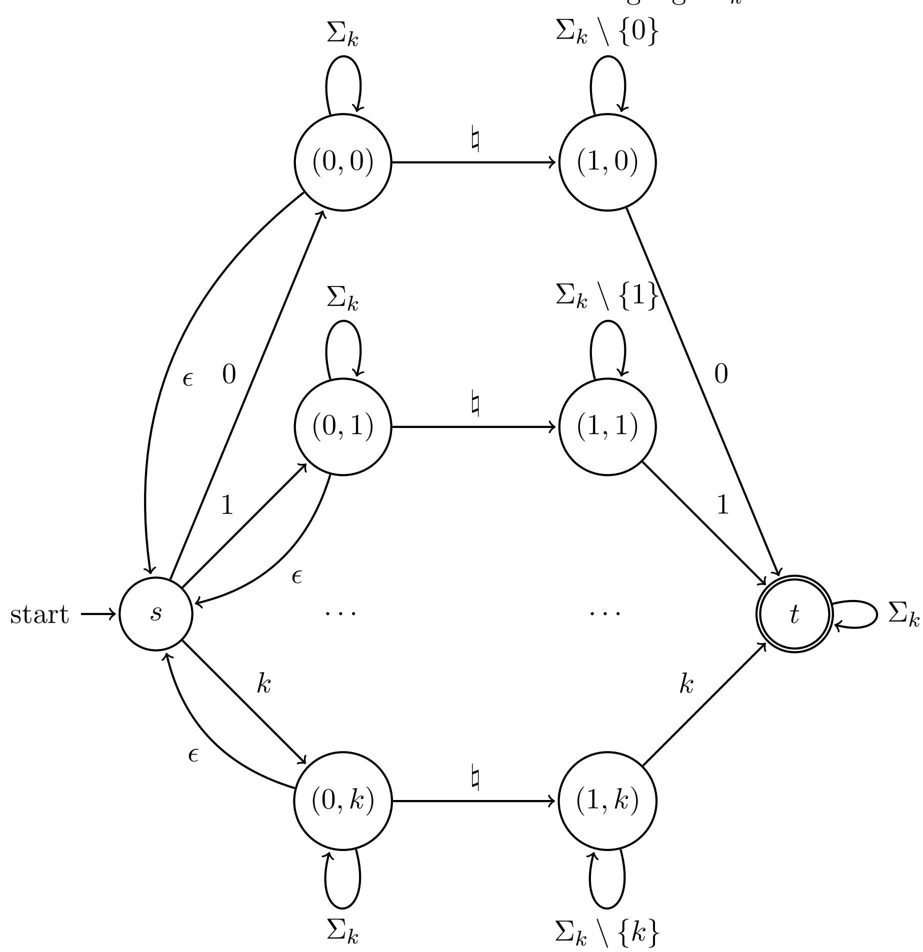
Problem 3 Solution:

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

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

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

Reading an input symbol a from the start state S where $a \in \Sigma_k$ will bring the existing thread to state $(0, a)$ 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 $\natural$. Once a string has been accepted, it will stay in the accept state unless a $\natural$ symbol has been read.