Theory of Computation

Homework 1

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2 Problem 2

Suppose $S = \{S_1, S_2, ..., S_n\}$, we can use 0 and 1 to represent S_n, let $S_n = s_{n1}s_{n2}...s_{nm}$ where $s_{n1}, s_{n2}, ..., s_{nm}$ is 0 or 1. And let length of string "$s_{n1}s_{n2}...s_{nm}$" $= L_n$, the longest length $= L_{max}$, $\Sigma = \{\triangleright, \sqcup, 0, 1\}$, $K = \{s, q_1, q_2, ..., q_{L_{max}}\}$, then we can build a Turing Machine M:

$p \in K$,	$\sigma \in \Sigma$	$\delta(p, \sigma)$
s	$\sqcup$	("no", $\sqcup$, $-$)
s	$\triangleright$	$(s, \triangleright, \rightarrow)$
s	0	If there is $s_{k1} = 0$, k from 1 to n, $(q_1, 0, \rightarrow)$ else ("no", 0, $-$)
s	1	If there is $s_{k1} = 1$, k from 1 to n, $(q_1, 1, \rightarrow)$ else ("no", 1, $-$)
q_1	$\sqcup$	If there is $L_k = 1$, k from 1 to n, ("yes", $\sqcup$, $-$) else("no", $\sqcup$, $-$)
q_1	0	If there is $s_{k2} = 0$, k from 1 to n, $(q_2, 0, \rightarrow)$ else ("no", 0, $-$)
q_1	1	If there is $s_{k2} = 1$, k from 1 to n, $(q_2, 1, \rightarrow)$ else ("no", 1, $-$)
...		
$q_{L_{max}}$	$\sqcup$	("yes", $\sqcup$, $-$)
$q_{L_{max}}$	0	("no", 0, $-$)
$q_{L_{max}}$	1	("no", 1, $-$)

We can find that for every natural number S_n in S, $M(S_n) =$ "yes", and natural numbers that are not in S will reuslt in "no". So S is recursive.