Student Information

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Answer 1

a.

State	Input	Transition
s	$\triangleright$	$(s, \rightarrow)$
s	a	$(q_1, \rightarrow)$
s	b	$(q_1, \rightarrow)$
s	$\sqcup$	$(q_1, \rightarrow)$
q_1	$\triangleright$	$(q_1, \rightarrow)$
q_1	a	$(q_2, \sqcup)$
q_1	b	$(q_3, \sqcup)$
q_1	$\sqcup$	$(h, \sqcup)$
q_2	$\triangleright$	$(q_2, \rightarrow)$
q_2	a	$(q_4, \leftarrow)$
q_2	b	$(q_4, \leftarrow)$
q_2	$\sqcup$	$(q_4, \leftarrow)$
q_3	$\triangleright$	$(q_3, \rightarrow)$
q_3	a	$(q_5, \leftarrow)$
q_3	b	$(q_5, \leftarrow)$
q_3	$\sqcup$	$(q_5, \leftarrow)$
q_4	$\triangleright$	$(q_4, \rightarrow)$
q_4	a	$(q_4, \leftarrow)$
q_4	b	$(q_4, \leftarrow)$
q_4	$\sqcup$	(h, a)
q_5	$\triangleright$	$(q_5, \rightarrow)$
q_5	a	$(q_5, \leftarrow)$
q_5	b	$(q_5, \leftarrow)$
q_5	$\sqcup$	(h, b)

b.

A)
$(s, \triangleright \sqcup \sqcup b(a)b)$
$\vdash (q1, \triangleright \sqcup \sqcup ba(b))$
$\vdash (q3, \triangleright \sqcup \sqcup ba(\sqcup))$
$\vdash (q5, \triangleright \sqcup \sqcup b(a)\sqcup)$

$\vdash (q5, \triangleright \sqcup \sqcup (b) a \sqcup)$
$\vdash (q5, \triangleright \sqcup (\sqcup) ba \sqcup)$
$\vdash (h, \triangleright \sqcup (\sqcup) ba \sqcup)$

B)
$(s, \triangleright a(a)a)$
$\vdash (q1, \triangleright aa(a))$
$\vdash (q2, \triangleright aa(\sqcup))$
$\vdash (q4, \triangleright a(a) \sqcup)$
$\vdash (q4, \triangleright (a) a \sqcup)$
$\vdash (q4, (\triangleright) aa \sqcup)$
$\vdash (q4, \triangleright (a) a \sqcup)$
(Doesn't halt, loops!!!)

C)
$(s, \triangleright (a) \sqcup bb)$
$\vdash (q1, \triangleright a(\sqcup) bb)$
$\vdash (h, \triangleright a(\sqcup) bb)$

Answer 2

-Initially our tape is $\triangleright(\sqcup)babc$.
-First we move our head one square to right. Now our tape is $\triangleright \sqcup (b)abc$.
-We are on square b , so we will use a = b, and our machine will go to right untill it reaches a blank character. When we find it, our head will move one square to left. $\triangleright \sqcup bab(c)$
-Now we read c, so b = c, we move ne square right to write the blank symbol. $\triangleright \sqcup babc(\sqcup)$.
-We go one square to right and write a.(We already found a = b)$\triangleright \sqcup babc \sqcup (b)$.
-We don't change the position of the head and write b.(b=c).$\triangleright \sqcup babc \sqcup (c)$.
-We go one square right and write a blank character.$\triangleright \sqcup babc \sqcup c(\sqcup)$.
- Finally we move one square to right and write a. (a = b as we know from previous steps) $\triangleright \sqcup babc \sqcup c \sqcup (b)$.
- Then our machine halts.

Answer 3

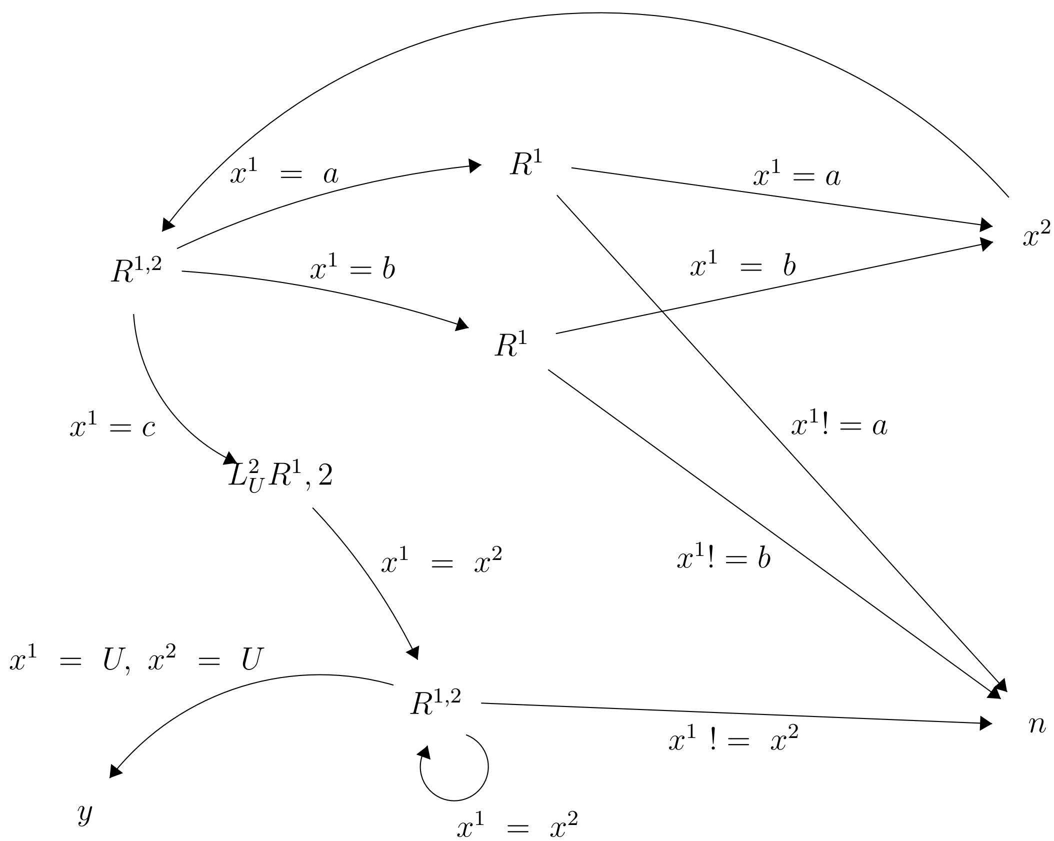
a.

We traverse the machine in order to find the language that the machine semi-decides. When we give an input string to the machine, it transorms the string to a string in which there is various number of a's followed by various number of b's. But as we move throughout the input tape, we can easily observe that there is no condition that would form an infinite loop, as long as there are a's and b's on the input string. So we can define the language that is semidecided by the TM as $(a \cup b)^*$.

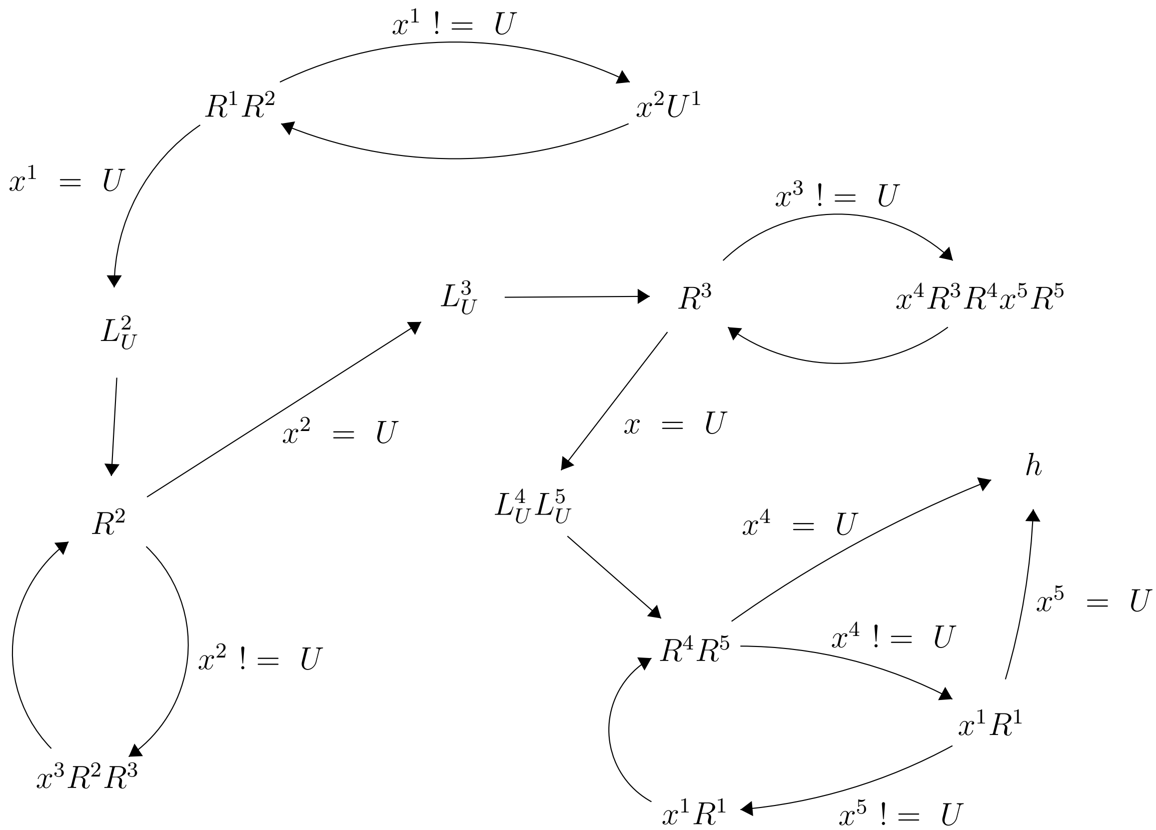
b.

In out machine the output is the string in which the a's are followed by b's in order, but we can see that there is no number change of a's or b's between the input and output. Therefore we can define our function as $f(u) = v$. $v = \{a^m b^n | m \geq 0, n \geq 0\}$. Number of a in u = Number of a in v, and Number of b in u = Number of b in v.

Answer 4



Answer 5



Answer 6

Answer 7

Answer 8

Answer 9

We know that L1, L2, L3 are recursively enumerable languages. So let's look at their TM's.
$M_1 = \{K1, \sum 1, \delta 1, s1, H1\}$
$M_2 = \{K2, \sum 2, \delta 2, s2, H2\}$
$M_3 = \{K3, \sum 3, \delta 3, s3, H3\}$
We can express the L_1L_2 as L_A
$K_A = K_1 \cup K_2$
$\sum_A = \sum_1 \cup \sum_2$

$$\delta_A = \delta_1 \cup \delta_2 \cup \{\delta(H_1, \textstyle\sum_1) = (s_2, \sum_2)\}$$

$s_A = s_1$
$H_A = H_2$

In our TM M_A we start from M_1 and when we go to its halt state, we make a new transition from this state to the start state of M_2. When we go through M_2 we reach its yes halt state. We can see that we started from the start state of M_A and reached its yes halt state, in which we can see that this language is recursively enumberable.
Now we make a new transition in which we make a new transition from the yes halt state of M_A to its starting state, but now we continue from the states and transitions of M_3. As we know M_3 shows a recursively enumberable language, we will reach the yes halt state again, so we can see that by the transitions of the nondeterministic TM, that we described above, we can semi-decide the language L.