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Answer 1

a.

b.

Answer 2

a.

$M = (K, \sum, \varsigma, s, \{h\})$
where $K = \{q_0, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8, q_9, q_{10}, q_{11}, h\}$
$s = q_0$
$\sum = \{1, \sqcup, a, \triangleright\}$
ς is the transition function.

Table 1: transition ς function

$\mathbf{q}$, σ	$\varsigma(\mathbf{q}, \sigma)$
q_0, $\sqcup$	(q_0,$\rightarrow$)
q_1, 1	(q_2,$\rightarrow$)
q_2, 1	(q_3,$\rightarrow$)
q_2, $\sqcup$	(h,1)
q_3, $\sqcup$	(q_4,$\leftarrow$)
q_4, 1	(q_5,$\sqcup$)
q_5, $\sqcup$	(q_6,$\leftarrow$)
q_6, 1	(q_6,$\leftarrow$)
q_6, a	(q_7,$\rightarrow$)
q_6, $\sqcup$	(q_7,$\rightarrow$)
q_7, 1	(q_8,a)
q_8, a	(q_8,$\rightarrow$)
q_8, 1	(q_{11},$\rightarrow$)
q_8, $\sqcup$	(q_9,$\leftarrow$)
q_9, a	(q_{10},1)
q_9, $\sqcup$	(h,$\sqcup$)
q_{10}, 1	(q_9,$\leftarrow$)
q_{11}, 1	(q_{11},$\rightarrow$)
q_{11}, $\sqcup$	(q_4,$\leftarrow$)

Answer 3

Turing machines with stay put instead of left can only recognize regular languages. The idea is that M cannot move left and cannot read anything it has written on the tape as soon as it moves right, and therefore it has only one-way access to its input, much like a DFA. For every DFA D, there clearly exists a Turing machine with stay put instead of left that accepts the same language, since a DFA is simply a Turing machine with a read-only tape and a tape head which only moves to the right.

Answer 4

a.

$M = (K, \sum, \varsigma, s, F)$ the tape has 2 heads and at each state only one of them can move and read/write.
where K is the finite set of states
s is the initial state.
F is the halting state.
$\sum$ is the alphabet, containing blank symbol $\sqcup$ and left end symbol $\triangleright$
ς, the transition function, is a function from $(K - F) \times (H_{head}, H_{tail}) \times \sum$ to $K \times (\sum \cup \{\rightarrow\})$ where which head to be moved is specified and notice that heads cannot move left.

b.

$K \times \triangleright \sum^* \times (\sum^* (\sum - \{\sqcup\}) \cup \{e\}) \times (\sum^* (\sum - \{\sqcup\}) \cup \{e\})$

c.

d.

e.

Answer 5

a.

b.

Answer 6

a.

b.

c.

d.