Practice set: 4 TM

4.1.1. Let $M = (K, \Sigma, \delta, s, \{h\})$, where

$$K = \{q_0, q_1, h\},$$
$$\Sigma = \{a, b, \sqcup, \triangleright\},$$
$$s = q_0,$$

and δ is given by the following table.

q,	σ	$\delta(q, \sigma)$
q_0	a	(q_1, b)
q_0	b	(q_1, a)
q_0	$\sqcup$	$(h, \sqcup)$
q_0	$\triangleright$	$(q_0, \rightarrow)$
q_1	a	$(q_0, \rightarrow)$
q_1	b	$(q_0, \rightarrow)$
q_1	$\sqcup$	$(q_0, \rightarrow)$
q_1	$\triangleright$	$(q_1, \rightarrow)$

(a) Trace the computation of M starting from the configuration $(q_0, \triangleright \underline{a} abbba)$.

(b) Describe informally what M does when started in q_0 on any square of a tape.

4.1.2. Repeat Problem 4.1.1 for the machine $M = (K, \Sigma, \delta, s, \{h\})$, where

$$K = \{q_0, q_1, q_2, h\},$$
$$\Sigma = \{a, b, \sqcup, \triangleright\},$$
$$s = q_0,$$

and δ is given by the following table (the transitions on $\triangleright$ are $\delta(q, \triangleright) = (q, \triangleright)$, and are omitted).

q,	σ	$\delta(q, \sigma)$
q_0	a	$(q_1, \leftarrow)$
q_0	b	$(q_0, \rightarrow)$
q_0	$\sqcup$	$(q_0, \rightarrow)$
q_1	a	$(q_1, \leftarrow)$
q_1	b	$(q_2, \rightarrow)$
q_1	$\sqcup$	$(q_1, \leftarrow)$
q_2	a	$(q_2, \rightarrow)$
q_2	b	$(q_2, \rightarrow)$
q_2	$\sqcup$	$(h, \sqcup)$

Start from the configuration $(q_0, \triangleright a\underline{b}b \sqcup bb \sqcup \sqcup \sqcup aba)$.

4.1.4. Let M be the Turing machine $(K, \Sigma, \delta, s, \{h\})$, where

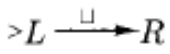
$$\begin{aligned} K &= \{q_0, q_1, q_2, h\}, \\ \Sigma &= \{a, \sqcup, \triangleright\}, \\ s &= q_0, \end{aligned}$$

and δ is given by the following table.

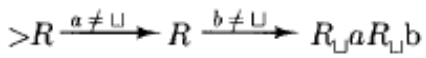
Let $n \geq 0$. Describe carefully what M does when started in the configuration $(q_0, \triangleright \sqcup a^n \underline{a})$.

4.1.7. Design and write out in full a Turing machine that scans to the right until it finds two consecutive a's and then halts. The alphabet of the Turing machine should be $\{a, b, \sqcup, \triangleright\}$.

4.1.8. Give the full details of the Turing machines illustrated.



4.1.10. Explain what this machine does.



4.1.11. Trace the operation of the Turing machine of Example 4.1.8 when started on $\triangleright \sqcup aabb$.