

Ordinary Exercises:

1. Construct Turing machines that *decide* the following languages. Give the answers as machine schemas. (The alphabet is $\{a, b\}$ in all cases):
 a) \emptyset b) $\{e\}$ c) $a^* \cup b^*$
2. Construct a Turing machine that accepts the language ab^*b . Give both transition function and machine schema.
3. Construct a Turing machine that computes the function:

$$f : \mathbb{Z}_{2^n} \rightarrow \mathbb{Z}_{2^n}$$

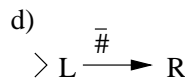
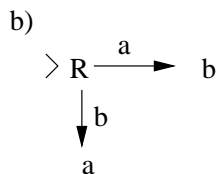
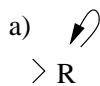
$$x \mapsto x - 1 \pmod{2^n}.$$

The input and output are n -length words of the alphabet $\{0, 1\}$.

An example computation with $n = 3$: $(s, \triangleright \sqcup 010 \sqcup) \vdash_M^* (h, \triangleright \sqcup 001 \sqcup)$.

Demonstration exercises:

4. What do the following Turing machines do:



5. a) Construct a Turing machine that accepts the language a^*ba^*b .
 b) Construct a Turing machine that decides the language $\{ww^R \mid w \in \{a, b\}^*\}$.
 c) Construct a Turing machine that computes the function $f(n, m) = n + m$, where $n, m \in \mathbb{N}$.
6. *difficult* Construct a 3-tape Turing machine that computes the product of two