

Solution to Problem 9

Problem. Design a Turing machine that computes a function $f(n)$ which is equal:

- to $n - 3$ when $n > 0$ and
- to 0 if not.

Assume that the input n is given in unary code.

Solution. We go right until we see the first blank. Then, we go back and delete the last three 1s.

- start, $- \rightarrow R$, moving
- moving, $1 \rightarrow R$
- moving, $- \rightarrow L$, erase1st
- erase1st, $1 \rightarrow -, L$, erase2nd
- erase1st, $- \rightarrow \text{halt}$
- erase2nd, $1 \rightarrow -, L$, erase3rd
- erase2nd, $- \rightarrow \text{halt}$
- erase3rd, $1 \rightarrow -, L$, back
- erase3rd, $- \rightarrow \text{halt}$
- back, $1 \rightarrow L$
- back, $- \rightarrow \text{halt}$