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, $-$ $\rightarrow$ halt
- erase2nd, 1 $\rightarrow$ $-$, L, erase3rd
- erase2nd, $-$ $\rightarrow$ halt
- erase3rd, 1 $\rightarrow$ $-$, L, back
- erase3rd, $-$ $\rightarrow$ halt
- back, 1 $\rightarrow$ L
- back, $-$ $\rightarrow$ halt