

Solution to Homework Problem 17

Homework Problem 17. Design a Turing machine that, given a positive binary number n greater than or equal to 2, subtracts 2 from this number. Test it, step-by-step, on the example of $n = 4$.

Solution. Here are the rules for the Turing machine:

start, $- \rightarrow R$, skip
 skip, $0 \rightarrow R$, moving
 skip, $1 \rightarrow R$, moving
 moving, $0 \rightarrow 1$, R
 moving, $1 \rightarrow 0$, L, back
 back, $1 \rightarrow L$
 back, $0 \rightarrow L$
 back, $- \rightarrow \text{halt}$

Tracing. We start with the number $4_{10} = 100_2$ which is represented as 001.

<u>-</u>	0	0	1	-	...	start
-	<u>0</u>	0	1	-	...	skip
-	0	<u>0</u>	1	-	...	moving
-	0	1	<u>1</u>	-	...	moving
-	0	<u>1</u>	0	-	...	back
-	<u>0</u>	1	0	-	...	back
<u>-</u>	0	1	0	-	...	back
<u>-</u>	0	1	0	-	...	halt