

# TM Building Blocks

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## 1 TM Building Blocks Example

In learning about Turing Machines, you discovered that a TM has a number of standard operations such as read, write, move-left and move-right. We can group these operations into blocks, depending on the algorithm to be constructed. JFLAP offers a feature for building TMs with such blocks. This simplifies the construction and lets you concentrate on the logic at a somewhat higher level.

We study this process with the following example of a TM:

For the alphabet  $\Sigma = \{a\}$ , construct a TM that accepts words of positive even length. Thus a word is accepted iff it has an even number (at least two) *as*. The logic of checking if the input has an even positive length is straightforward. Match the first *a* with the last *a* in the input, the second with the last but one, and so on. If they match then the length is even. Else, it is not. Now, of course, to keep track of where you are in the string, while reading the symbols, we will convert the left *as* to *Xs* and the (matching) right *as* to blanks.

JFLAP provides several built in TM blocks to carry out operations such as the above. E.g. the block `Move_R_Until_Y` makes the TM head move to the right until a *Y* is encountered.

Start JFLAP 8 and select Block Turing Machine. Then build a TM as shown in Figure 1.

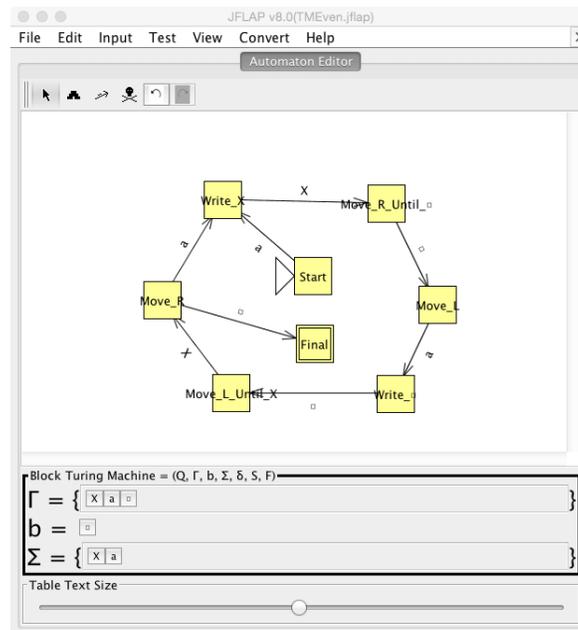


Figure 1: An Example TM with Blocks

We start the TM with the “Start” block and on reading  $a$ , we write an  $X$ . When this  $X$  is read, we move right until a blank is encountered. At this point we move left and expect a matching  $a$ , which is converted to a blank. We then move left until an  $X$  is encountered. We turn around and move right. At this point we should either encounter an  $a$  or a blank. If the former case, we repeat the loop, while in the latter we accept.

Test your TM with multiple inputs as shown in Figure 2.

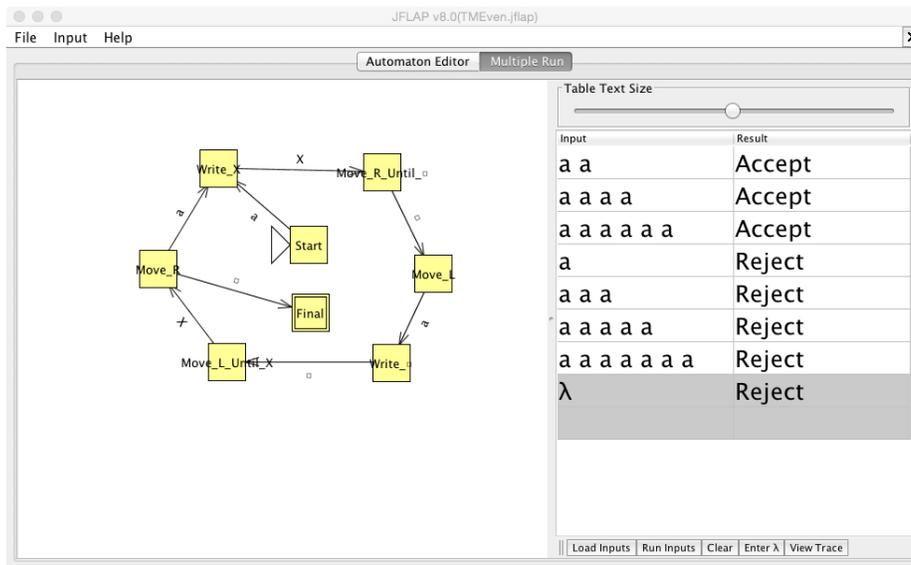


Figure 2: Testing the TM with Blocks

## 2 Exercises for Practice

1. Build a blocks TM that accepts words of odd length.
2. Build a blocks TM that accepts words of length a power of two.

## 3 References

1. Introduction to the Theory of Computation (Third Edition), Michael Sipser. Cengage Learning. 2013.
2. JFLAP - An Interactive Formal Languages and Automata Package, Susan H. Rodger and Thomas W Finley. Jones and Bartlett Publishers. 2006