

## CS250 Lab 13 – Turing Machines

**Objectives:** In this lab you will learn how to

- determine languages described by Turing machines
- construct TMs to recognize specific languages

A TM differs from other automata in its transitions. In a TM, each transition implies reading a single symbol from a tape, overwriting that symbol with a new symbol, and moving the tape head either left, right, or not at all. A transition, therefore, for a TM is defined in JFLAP as  $r;w,d$ . The  $r$  is exactly one symbol to read from the tape. After  $r$  is read, the  $w$  is exactly one symbol to write to the tape over  $r$ , and  $d$  is the direction to move the tape head after writing  $w$ . The symbols  $r$  and  $w$  must be elements of the tape alphabet and  $d$  is either R, L, or S which stand for a move Right, Left, or Stay respectively.

Download the lab13 files and start JFLAP.

### Assignment 1:

Open file file ex13.1 in the Turing Machine editor.

Try Step with Closure with the input **aabbbb**. Does it accept?

Try Step with Closure again with the input **aabb**. Does it accept??

Clearly and succinctly describe the language accepted by this TM.

### Assignment 2:

Build and thoroughly test a TM for the exercise 8g on p 248 of your text.

### Assignment 3:

Build and thoroughly test a TM for the language:

$L = \{w | w \text{ consists of } k \text{ a's where } k \text{ is a power of } 2\}$ .

JFLAP allows multitape machines with two to five tapes. An  $n$ -tape machine requires that each transition read  $n$  symbols, one for each of the tapes, each of which has one read-write head; JFLAP processes a configuration on a transition only if all of the  $n$  read symbols match.

Sections 10.2 and 10.3 of your text describe how multi-tape machines and nondeterministic machines are equivalent to our original TM.

**Assignment 4:**

Open the 2-tape nondeterministic machine ex13.2. This machine accepts if the input on the first tape is a substring of the input on the second tape. Step through the machine with input `abaa` on tape1 and `abbaabaab` on tape2.

Clearly and succinctly describe in your own words how this machine works.

**Assignment 5:**

Build and thoroughly test a 2-tape TM for the language:

$$L = \{ww^R \mid w \text{ in } \{a, b\}^*\}.$$

The TM should start with the input string on tape1 and tape2 blank.

Submit your files in goucherLearn for grading.