

ABSTRACT AUTOMATA

Three Basic Models: Finite-State, Pushdown, and Turing

Always in One of a Finite Number of Internal States (named using capital letters, “A” is normally the initial state)

Scan One Cell of Input Tape per Machine Cycle (input symbols may be upper- or lower-case letters, digits, etc.)

Finite-State Machines

State Transition Based on Current Input Symbol and Current State
Stop at End of Input, Accept if in a Final State

Pushdown Machines

Adds a Pushdown Tape to Finite-State Model
State Transition Based on Input Symbol, State, and Top of Stack
Top Stack Symbol can also be Replaced on Each Machine Cycle
Stop at End of Input, Accept if in a Final State and Stack is Empty

Turing Machines

Adds Ability to move Left as well as Right on Tape, and the Ability to Modify the Symbol on the Tape
State Transition Based on Input Symbol and Current State

Execution Continues until Transition to Special “Halt” State (labeled “#” in the simulator)

RUNNING EXISTING MACHINES

Viewing the State Tables

Next/Previous Machine Buttons
“Machine” Menu lists all Machines for Selection
<⌘-P> to Print out Copy of Screen
Cycling through States (PDM only)

Click Current State Box in upper lefthand corner of State Table

SAMPLE MACHINE DESCRIPTIONS

Finite-State Machines

Odd Parity

Input: string of 0's & 1's
Accept if number of 1's is odd

Pattern Recognition

Input: word over {A,D,E,I,V}
Accept if input contains “DAVE” or “DAVID”

Addition modulo 5

Input: string over {0,1,2,3,4}

Accept if digits add up to 0 mod 5

Pushdown Machines

a's = b's (1 state)

Input: word over {a,b}

Accept if the number of a's = number of b's

Matched Parentheses (1 state)

Input: left and right parentheses

Accept if input is a properly parenthesized expression

aⁱ bⁱ (2 states)

Input: word over {a,b}

Accept if word contains a number of a's followed by same number of b's

Turing Machines

Duplicate

Input: word, w, over {a,b}

Halts with ww on tape

aⁱ bⁱ cⁱ

Input: word over {a,b,c}

Halts with "Y" if word contains the same # of each letter in order

Halts with "N" otherwise

Sorting

Input: string {1,2,3}

Halts after sorting digits into ascending order

Count the a's or b's

Input: "|W|a" or "|W|b", where $W \in \{a,b\}^*$

Counts the number of a's or b's (as specified)

Busy Beaver Machines

Start with read/write head in middle of blank tape

Writes as many 1's as it can before halting

Remainder Function

Input: two unary numbers (string of 1's)

following a space, separated by a space

Computes the remainder on dividing first by second

The <RUN> Button

Continue execution until end of input (FSM & PDM only)

Continue execution until Halt state is reached (TM only)

The <PAUSE> Button suspends execution (in case of infinite loops)

The <STEP> Button

Execute one machine cycle

The Input String

Click on string to change, double-click to highlight

Use normal MAC editing functions

Re-Start

Click on Read Head to Reset

Click to Clear the Stack (PDM only)

CREATING A NEW MACHINE

The <NEW> Button

Presents you with a 2-state, 2-input blank machine (FSM & TM only)

Presents you with a 2-input, 2-stack-symbol blank machine (PDM)

Enter Name for your Machine

States

State Names are restricted to capital letters

Click the <down arrow> to Add More States

Click the <up arrow> to Delete States

Shift-Click State along left edge of table to make final (FSM only)

Shift-Click State above the state table to make final (PDM only)

Click State above table to see next state table (PDM only)

Go to state # to Halt (TM only)

Input Alphabet

Click symbols on top of state table to change

Click <right arrow> attached to table to add new symbols

Click <left arrow> attached to table to delete symbols

The State Table

Click within State Table to Specify Function of Machine:

Next State (FSM)

Next State, Stacktop Replacement (PDM)

Next State, Input Tape Replacement, Direction to Move (TM)