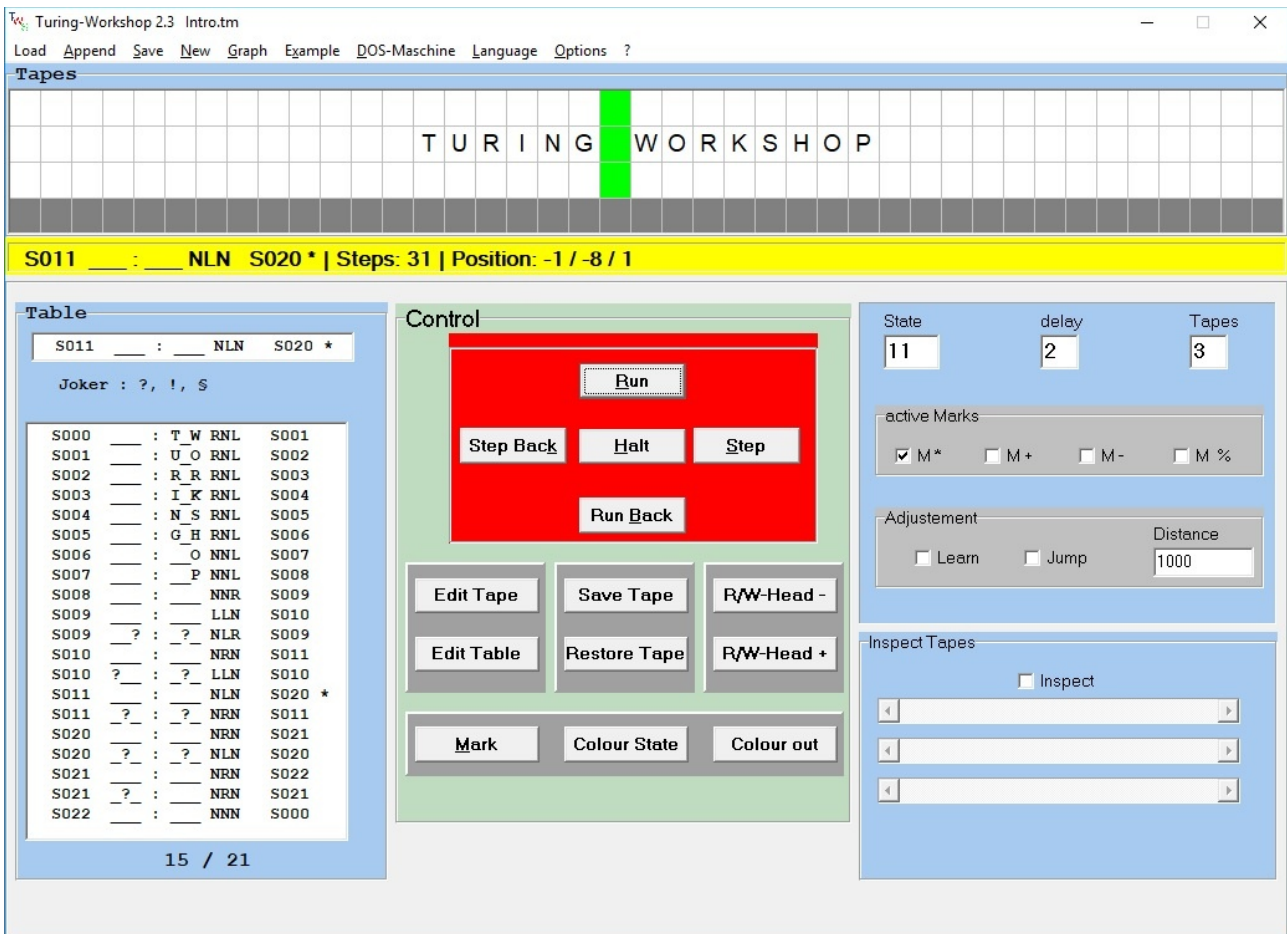# Turing-Workshop 2.3

Main Menu

Load
Loads a machine with all settings

Append
Puts the instructions of a machine M2 at the end of the table of a machine M1.
Now You can combine M1 with M2.

Save
Saves a machine with all settings.
Additionally three textfiles are saved :
machine.txt : contains the description of the machine if existent.
machine.tab : contains the table of the machine.
machine.col : contains colours of coloured states.

New

New 1 ... New 4
Creates a new, empty machine with 1..4 tapes

Graph
opens a form with the graph of the current machine.

Example

shows a machine, that computes the function f:N → N with f(n) = 2n .

Language

English

Switch to user interface in English.

German

Switch to user interface in German.

?

Info

Notes from the author, terms of use

Description

Opens a window, where you can describe the machine

Options

Shortcut State

Select shortcut from Z,z,S,s,Q,q

Control

Step

Executes current instruction.

Run

Executes instructions until 'Halt' or the current instruction has an active mark.

Step back

Undo the last step.

Run back

Undo step by step until the start or the last stop.(You can undo 10000 steps at most)

Halt

Stops the machine.

Jump (visible in jump-mode)

Behaviour like 'Run'. But no actions are performed on the tapes until the machine stops.

Jump back (visible in jump-mode)

Behaviour like 'Run back'. But no actions are performed on the tapes until the machine stops

Tape-Editor

Shows the form tape-editor. You can now specify the content of each tape.

Table-Editor

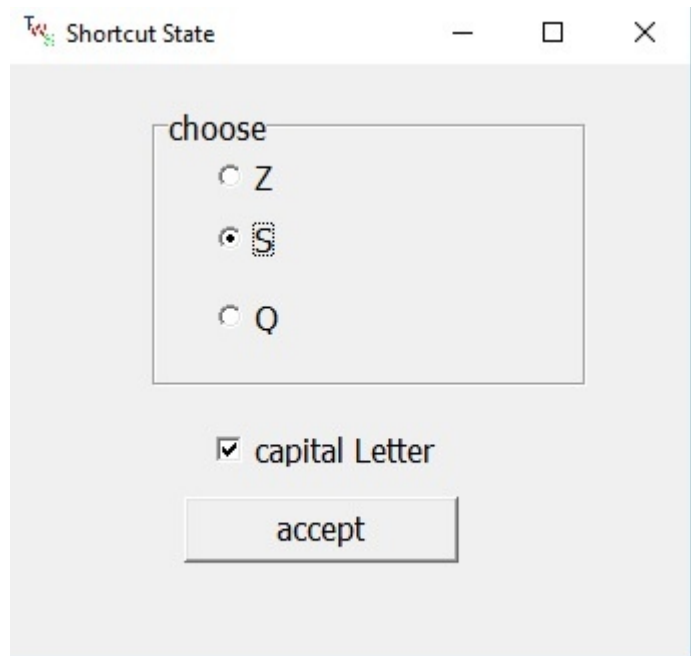*Shows the form table-editor. You can now specify the content of the table.*

Save Tapes

Stores the contents of all tapes.

Bestore Tapes

Stores the contents of all tapes.

R/W-Head –

Moves the read-write-head one step to the left.

R/W-Head +
Moves the read-write-head one step to the right.

Mark
Tags the current instruction with a mark.
*Repeated use of the mark button will change the mark between : * , + , - , % , no mark * .*

Color State
Tags the current state with a colour. Repeated use of the this button will change the colour.

Color on / out
Coloured states are shown in colour / in white.

Status / Settings

State
Shows the current state. You can alter it.

Speed
You can specify a number to set the delay
(0 : no delay, 9 : very slow).

Tapes
The window shows the number of tapes.
If you increase this number up to at most 4, the machine will get additional tapes.

Active Marks M*, M+, M- , M%
You can activate or deactivate each of the marks. If the current instruction has an active mark, the machine will stop on 'Run', 'Run Back', 'Jump' and 'Jump Back'.

Learn
Toggles the learn-mode. If you put the learn-mode on, the table-editor will be shown. Use learn-mode when the table is not complete. Press 'Step' to keep the machine going. If the machine has no suitable instruction the focus will be set to the input-area of the table-editor. Now put in a suitable instruction, send it into the table. Press 'Step'.
Repeat the procedure until the table is complete.

Jump-mode
Toggles the jump-mode. If jump-mode is on, the buttons 'Run' and 'Run back' change to 'Jump' and 'Jump back'.
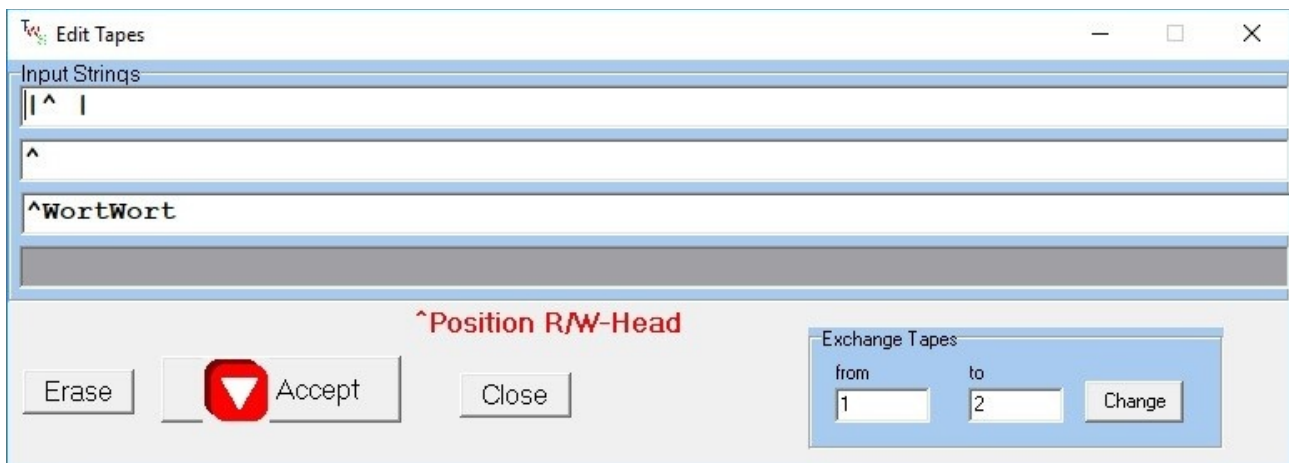
Distance
In order to prevent infinite loops a maximal distance needs to be specified.

Inspect Tapes
If inspection-mode is on, the scrollbars for each tape are activated. Use the scrollbars to inspect all the characters.

Tape-Editor

Erase
  Erases all tapes.*.*

Accept
  The machine loads the new contents for its tapes.

Exchange Tapes
  The contents of two tapes are changed as well as the corresponding characters of the instructions.

From Tape to Tape
  Specify which two tapes are to swap position.

Table-Editor

Input fields for an instruction

State   *Set starting state. (S0 - S999)*

Character   *Set the characters at the beginning for all tapes.*

Character   *Set the new characters for all tapes.*

Move   Specify a move for each tape.

   R to the right, L to the left, N no move, S Stop, P push to the left, H push to the right

State   *Set final state.*

Choose mark
No mark   M* : *set mark **   **M+** : *set mark +*   **M-** : *set mark -*   **M%** : set m*ark %*

Accept
Inserts the contents of the input-area into the table as an instruction.

Clear
Clears all fields from the input-area.

Short Form
only the input area is displayed.

Current Situation
current state and characters on the tapes will be transmitted into the input area.

Selection

Hint : If you want to change an instruction of the table, you first need to bring it to the edit-field below the input-area. Then you can bring the instruction to the input-area. Now you can change it.

Forward
Puts the next instruction of the table into the edit-field below the input-area.

Backward
Puts the previous instruction of the table into the edit-field below the input-area.

Click on an instruction
Puts the clicked instruction into the edit-field below the input-area.

Scroll table
You can scroll the table.

Edit
Brings the instruction of the edit-field below the input-area into the input-area . Simultaneously the instruction will be removed from the table.

Delete
the instruction of the edit-field below the input-area will be removed from the table.

Tools

Insert States
Makes a gap in the sequence of state numbers.

Renumber States
If a machine has n states, then their numbers will run from 0 to n-1.
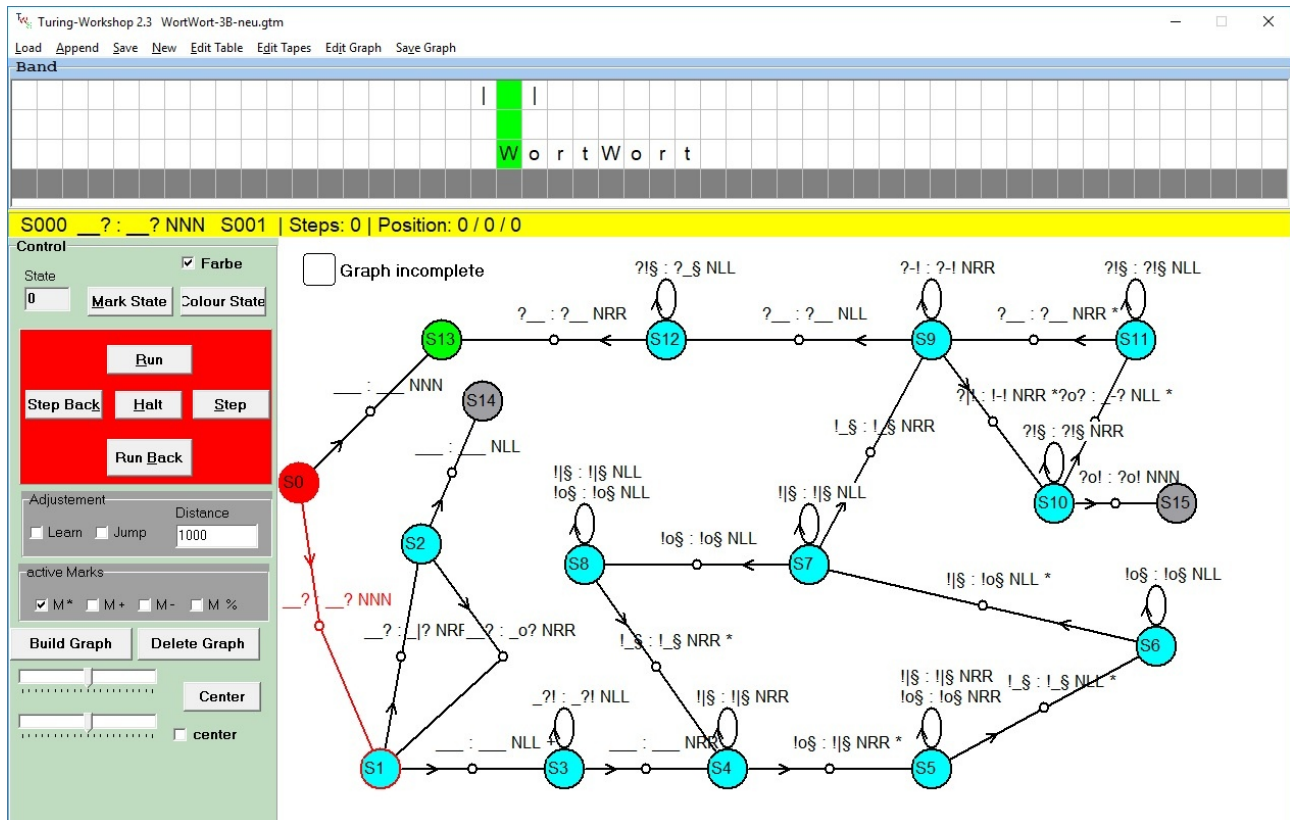
Change characters
Changes a character with another character in all instructions.

Change move
Changes all directions on the selected tapes. R <-> L and P <-> H, S and N unchanged.

Second Main Form with Graph

This Form offers the possibility to draw the graph of a turing-machine and to visualize the changes on the graph during the machine is running. The form is totaly synchronisized with the main form. You can switch from one form to the other at each time. In the following i only will describe features, that are new.

Build Graph - *If the graph is not complete, you will be asked to click into the canvas for the position of each state that is not drawn yet. The state is immediately drawn, altough all links between states already drawn.*

Delete Graph - *deletes the graph.*

Graph speichern - *saves the graph in a JPG- or BMP-file*

Graph-Editor - *the form Graph-Editor is shown*

Button Center - *moves the graph such that the current state is in the center of the canvas*

Checkbox Center - *the current state keep his position on the center of the canvas.*

Scrollbar 1 - *moves the graph horizontaly*

Scrollbar 2 - *moves the graph verticaly*

Graph-Editor

The graph-editor is a tool to improve the graph. For to use a tool you must select a state or an instruction by clicking on it. Then you can move the element. **If no element is selected the whole graph will be moved.**

Move Elements

move - *Click into the canvas to determine a new position for the selected element.*

Straigth line - if this option is true, a transition between states becames a straigth line.

U - *move up one level the selected item .*
D - *move down one level the selected item .*
R - *move right one level the selected item.*
L - *move left one level the selected item.*

Transfer of Coordinates

To align one item under the other, both items must have the same y-coordinate. To align one next to the other, both must have the same x-coordinate.

**x** - *transfer of the x-coordinate.*

y - *Transfer of the y-coordinate.*

save x - *Saves the x-coordinate of the selected item*

save y - *Saves the y-coordinate of the selected item*

set x - *the selected item gets the saved value as x-coordinate*

set y - *the selected item gets the saved value as y-coordinate*

Color State - *the selected state gets another color. If you push the button again, another color appears. Four different colors are available. You can switch on/out color for states on main-form 1.*
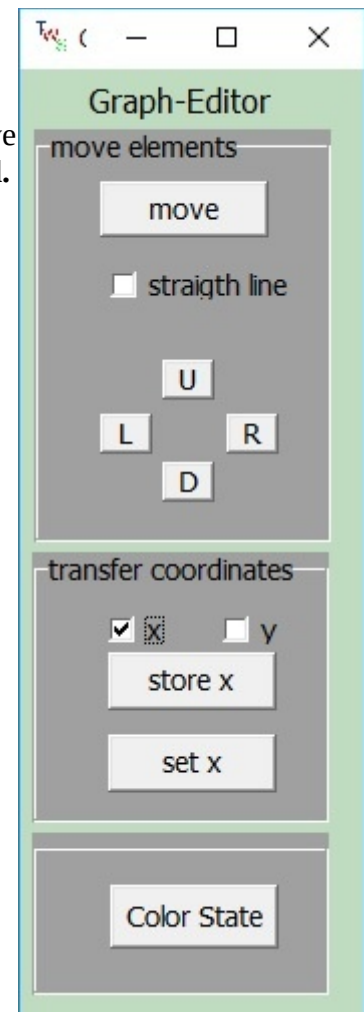
Some useful remarks

1) How is an instruction built ?

Example : S0 ab : cd RL S2 +
if the machine is in state S0 and the R/W-head is over an 'a' at tape1 and over an 'b'on tape 2 then
the machine writes 'c','d' on tape1, tape2, step to the right on tape1 and to the left on tape2.
The new state is S2. The mark '+' means,that if '+' is active, the machine will stop in running
mode before executing this instruction.

2) Can I write any character on the tapes ?

There are only five exceptions :

a) '_' stands for a space. Therefore it can not be used as a character on his own.

b) '?', '!', '§', '#' are **joker-characters** and must not be used on a tape.

A joker-character is standing for any character.

Example :
S1 ?! : !? RR S2   changes the characters from tape1 and tape2 no matter what is really written on
both tapes.
Imagine   S1 ?! : !? RR S2   and   S1 ab : cd RL S2   are both in the table of a machine with two
tapes and ab is written on the tapes and S1 is the current state
then   S1 ab : cd RL S2   will be executed because this instruction has no joker-character.
Instructions without joker-characters comes first.

3) Which machine will be loaded if TWS.exe starts ?

TWS.exe stores the path to the last handled machine in Workfile.txt.
On the next start TWS.exe tries to load this machine.
If it fails, TWS.exe is searching for a machine intro.tm.
If TWS.exe can't find intro.tm, it starts with an empty turing-machine with four tapes.

4) Data Types of Turing-machines

Since TWS 2.0 we have a new data type *.gtm for turing-machines. A gtm-file contains all the
information as a tm-file and additionly information to build the graph. You can still use the old tm-
file. For dfa-files exists a gfa-file accordingly.

5) Set TWS.exe as program for files of type *.gtm, *.tm, *.dfa, *gfa

If you click twice a file of such a data type, Windows will ask you for a suited program. Choose
TWS. Windows saves this information. If you now doubleclick such a file, TWS starts with the
associated machine.

6) Change the speed

While the machine is running you can change the speed by typing a numbe $0 - 9$.

7) The move 'S' = Stopp

To avoid the move 'S', you better let the machine run into a halting state. No instruction will
continue from a halting state.

8) Extensive Graphs

With little effort you can build graphs with up to 20 states. If a graph is bigger, the canvas is not
big enough. With the two scrollbars you can move the canvas vertically and horizontally. A part of
the graph disappears and you have free space to draw more pieces from the graph. Unfortunally
the whole graph can not be seen. If the machine is running the current state can disappear . If you

choose the option 'center', the graph will always be moved such that the current state will be placed into the center of the canvas. In this way i have build a graph with 50 States without greater gifficulties.