Fachhochschule Kiel
Hochschule für Angewandte Wissenschaften

Simulating Digital Systems – a reflected view onto the simulation tool landscape

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Overview

- Introduction
- Digital Simulator v5.57
- Digital by Helmut Neemann
- Circuitverse
- Conclusion

Introduction

- Development of digital systems: **multistep process**
  - Specifying requirements
  - Specifying functions
  - Designing the logic of the system
  - Generating a schematic
  - **Simulating the system**
  - Generating a layout / producing a PCB
  - Verifying the design

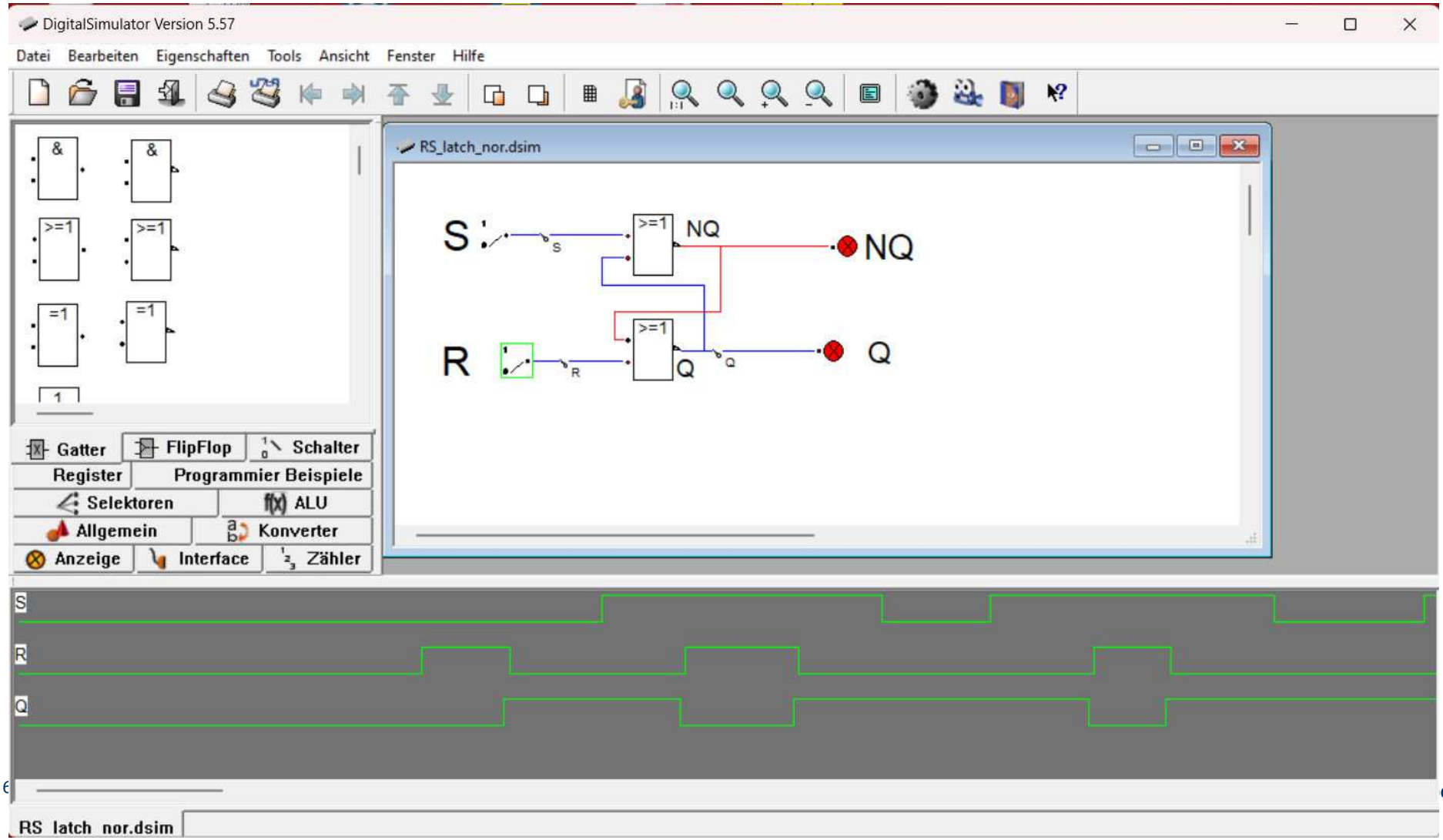
General Remarks on Digital Simulators

- Provide necessary elements: IO-elements, gates, datapath components (e.g. multiplexers), flipflops, etc.
- Provide the possibility to monitor certain input and output signals
- At the 1st glance: Simulators seem very similar, however:
- When working with a specific simulator there are quite some differences regarding
  - Capabilities
  - Handling
  - Intended use
- Example: simple RS-Latch based on NOR-Gates

Digital Simulator v5.57

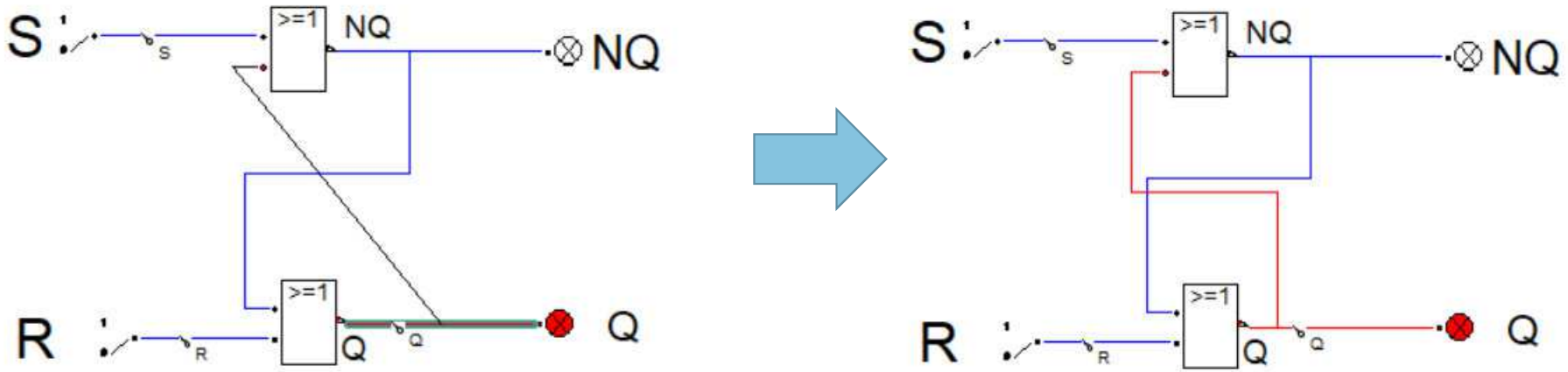
- Simulator created by Andreas Hertz group
- Simulator available at: https://sourceforge.net/projects/digisimulator/files/install%20EXE/5.57/DigitalSimulatorV5.57.exe/download

Digital Simulator v5.57

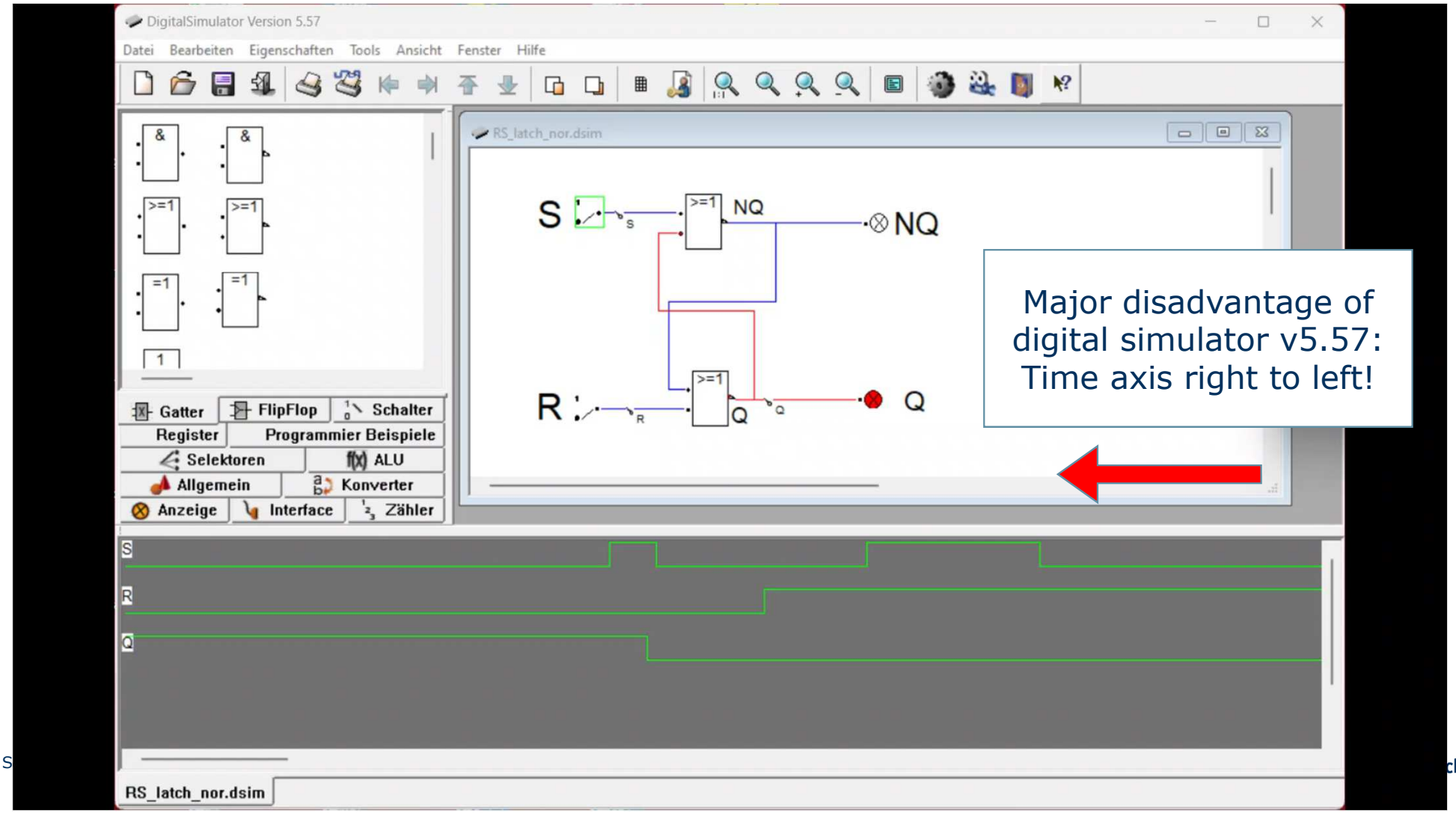


Digital Simulator v5.57

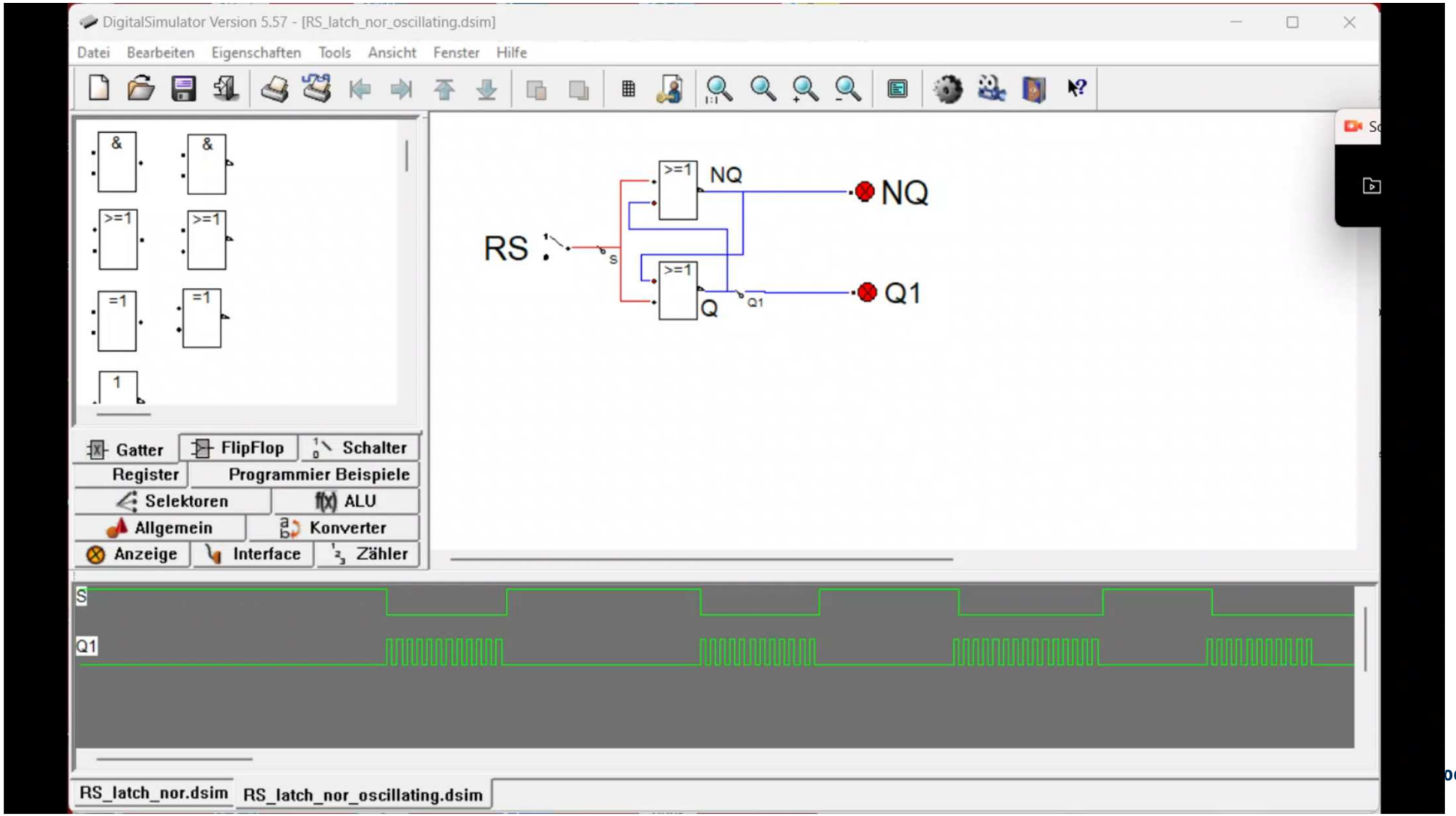
- Wiring extremely intuitive and quick!
- Rectangular wiring maintained, when repositioning elements!



Digital Simulator v5.57 – regular operation of RS latch



Digital Simulator v5.57 – oscillating RS latch (race condition)

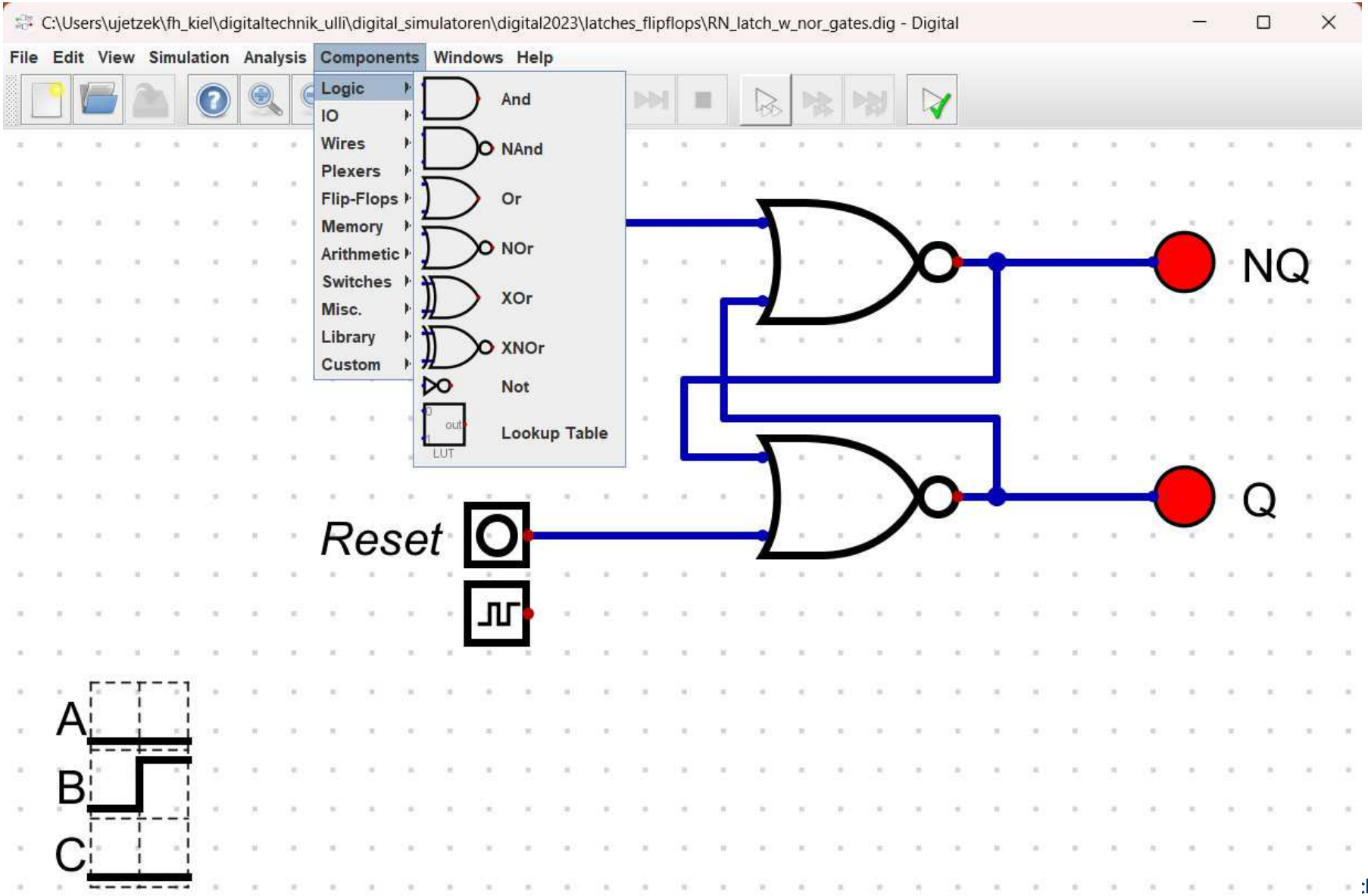


Digital Simulator v5.57

+ very intuitive and easy to use!
+ wiring extremely quick and easy!
+ supports continuous time input signals
+ allows to simulate oscillating systems
+ well suited for education, in particular to explain / learn digital logic!
- time direction from right to left (contrary to ‚normal' usage)
- simulator does not contain any standard IC elements → not suited to bring any simulation into a ‚real' design
- simulator not supported any more

„Digital“

- Created by Helmut Neemann
- Available on Github: https://github.com/hneemann/Digital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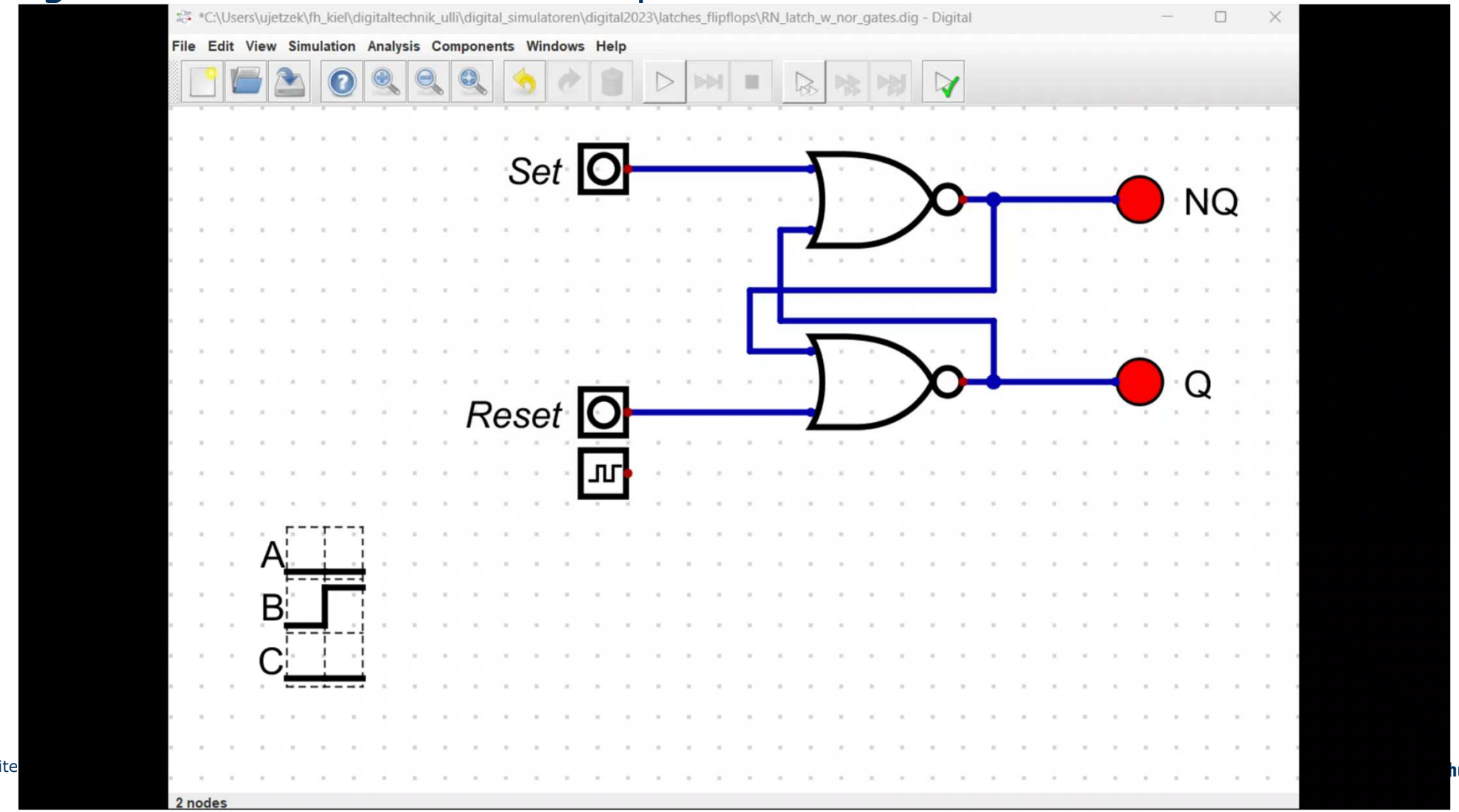
File Edit View Simulation Analysis Components Windows Help
Logic
IO
Wires
Plexers
Flip-Flops
Memory
Arithmetic
Switches
Misc.
Library
Custom
And
NAnd
Or
NOr
XOr
XNOr
Not
Lookup Table
LUT
NQ
Q
Reset
A
B
C

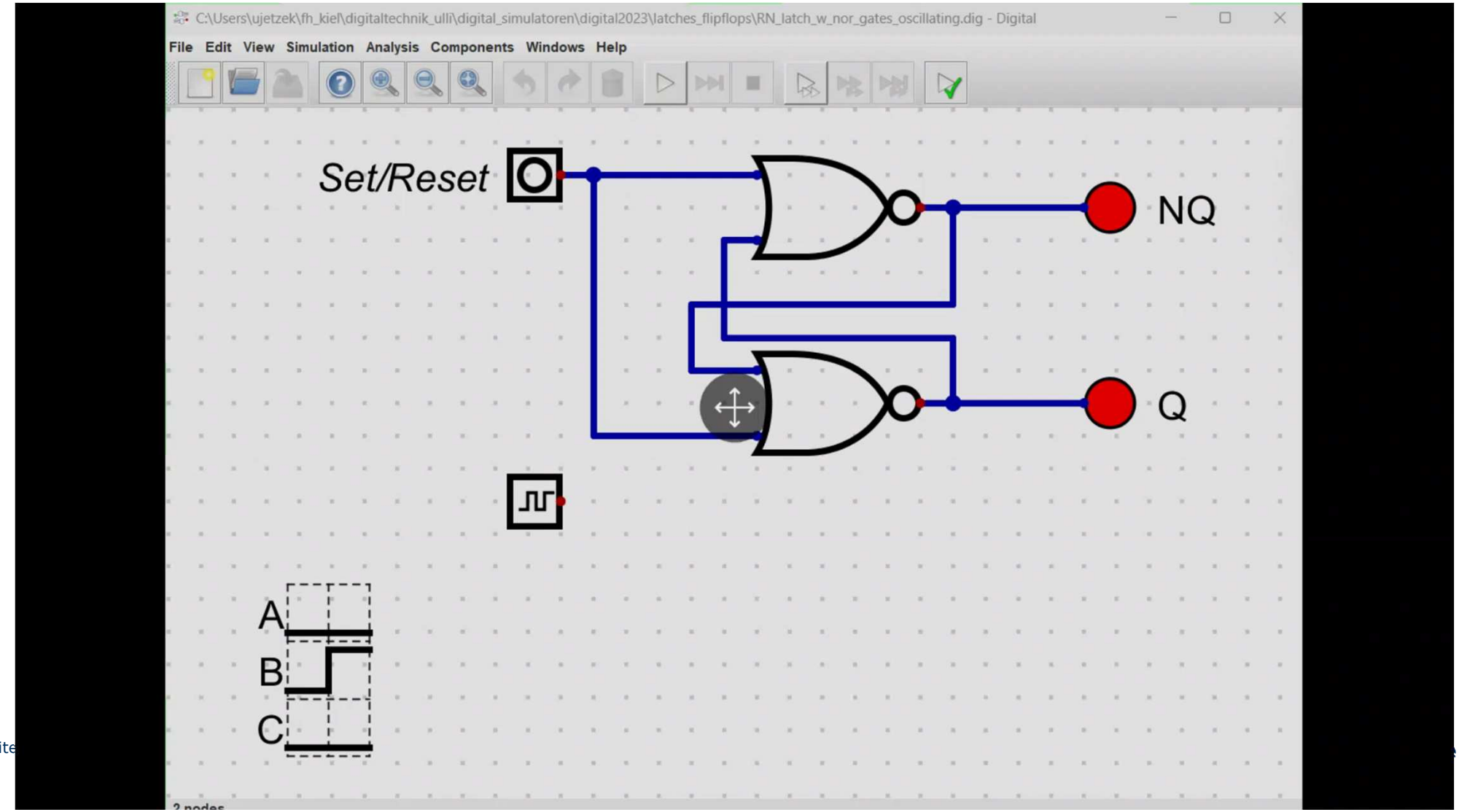
„Digital“

- works with **drop-down** menues
- Wiring not so intuitive – takes more time to get into it …
- Does not allow continuous input signals, rather works with ‚implicit‘ clocked time base.
- Is multi-lingual (German, English, Spanish, French, Italian, …)
- English or Germal logic element notation possible

„Digital“ – RS Latch – normal operation



„Digital“ – oscillating RS Latch (race condition)



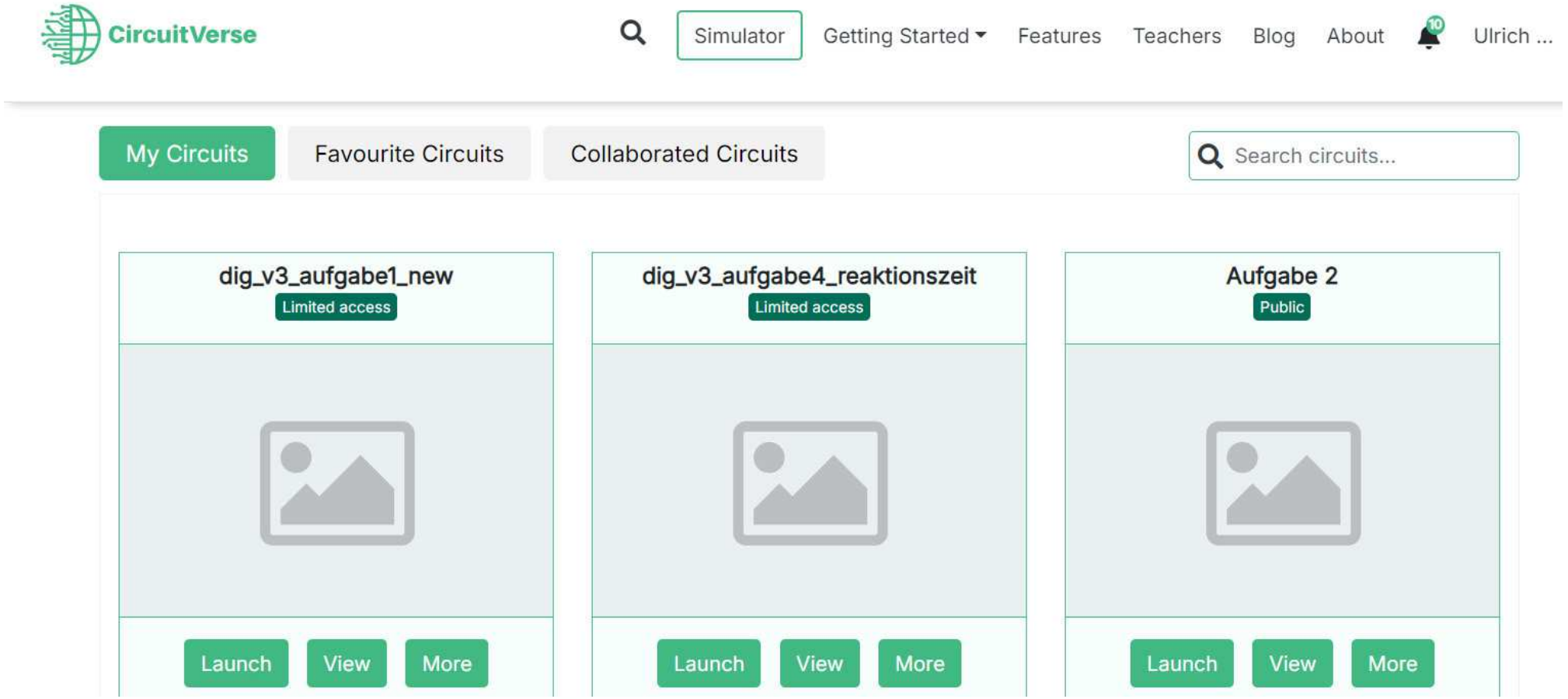
„Digital“

+ Supports logic analysis of combinatorial logic, may
  - Generate Boolean function of existing circuit
  - Truth table and K-map
+ Also supports standard IC, like 74xx series
+ Supports export of standard-IC-based circuits to VHDL and Verilog!
+ more useful to bring designs forward to real implementation
- Not so intuitive – needs to more time to get into it
- Does not support continuous input signals (implicit clock base)
- Does not allow simulation of oscillating circuits (however: Warning occurs!)

„Circuitverse“

- Is a digital simulation internet platform
- Available under: https://circuitverse.org/
- created and maintained by an Indian student-driven organisation,
- Is an open source project available on github: https://github.com/CircuitVerse
- Intended as platform for teachers and students to dive into the world of digital circuits

„Circuitverse“ - dashboard



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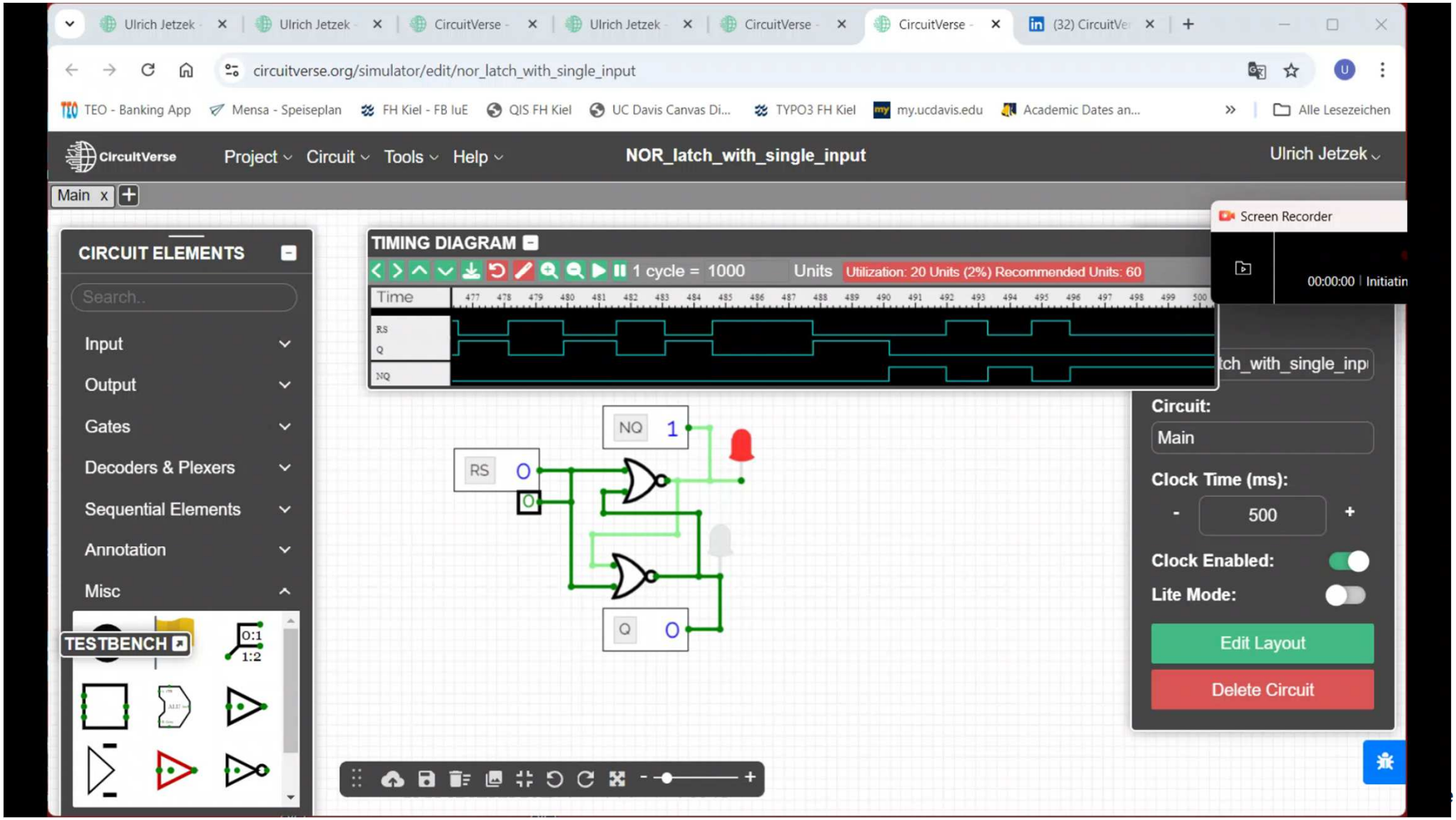
„Circuitverse“

- Offers the possibility to create **student groups**, e.g. different lab groups
- **„Mentor“ and „Member“ roles** available
- Possibility to **post specific assignments** with deadlines.
- **Grading possibility** exists
- Mentor may online observe simulation design progress for a specific class (only requirement: students need to frequently save their projects).
- Collaboration on same project possible by different persons


Ulrich Jetzek
CircuitVerse
(32) CircuitVe
circuitverse.org/simulator/edit/nor_latch_with_single_input
TEO - Banking App
Mensa - Speiseplan
FH Kiel - FB IuE
QIS FH Kiel
UC Davis Canvas Di...
TYPO3 FH Kiel
my.ucdavis.edu
Academic Dates an...
Alle Lesezeichen
CircuitVerse
Project
Circuit
Tools
Help
NOR_latch_with_single_input
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Main
Screen Recorder
00:00:00 | Initiatin
CIRCUIT ELEMENTS
Search..
Input
Output
Gates
Decoders & Plexers
Sequential Elements
Annotation
Misc
TESTBENCH
TIMING DIAGRAM
1 cycle = 1000
Units
Utilization: 20 Units (2%) Recommended Units: 60
Time
RS
Q
NQ
NQ 1
RS 0
Q 0
Circuit:
Main
Clock Time (ms):
500
Clock Enabled:
Lite Mode:
Edit Layout
Delete Circuit

„Circuitverse“ – summary

+ Digital simulation platform intended for online education
+ Provides very good feature set for online classes:
    - student groups
    - mentor- and member role
    - Collaboration possibilities
    - monitoring design progress of students
    - posting assignments
    - Grading possibilities
+ Was of great help during Covid-times!

- Race condition/oscillating circuit not visible in simulation nor blocked by simulator.
- Does not provide standard elements (e.g. 74xx ICs), very limited support for implementation of circuits / student projects.

Conclusion

- Presented digital simulators provide good features for digital circuit simulation!
- All of them are valuable tools for students to learn the fundamentals of digital system design
- „Digital simulator v5.57“ – most intuitive and easiest to handle.
- „Digital“ provides most support for implementation of digital circuits and additional analysing features (Boolean function generation, K-maps, …).
- „Circuitverse“ great internet platform – good for online education formats.

Thank you !

Any questions?