Carolin Zöbelein

Josephsplatz 8, 90403 Nürnberg, Germany
contact@carolin-zoebelein.de
PGP: D4A7 35E8 D47F 801F 2CF6 2BA7 927A FD3C DE47 E13B

Research & Work

Independent mathematical scientist Since 2016/11

Primary: Researcher, Secondary: Adviser and freelance contractor *Remote, Germany*

Ronin Institute 2021/03 - 2024/06

Research Scholar, https://ronininstitute.org *Remote, USA*

- Focus on Mathematical and Theoretical Computer Science of Distributed Network Algorithms & Protocols
- International clients from Germany, Israel, UK, USA
- `https://research.carolin-zoebelein.de`

Areas of work:

Mathematics: Mathematical & Theoretical Computer Science, Algorithms, Graph Theory, Geometry, Algebra, Combinatorics, Number Theory
Computer Science: Theoretical Computer Science, Distributed Network Algorithms & Protocols, Online privacy & anonymity, Online traffic obfuscation and ways for circumventing blocking and censorship, Reverse engineering, Computer forensics, Social engineering

Highlights:

Grant: NGI Zero Discovery, 19 100 EUR, European Commission's Next Generation Internet programme

Related background:

Tor Project, Supporter and volunteer, Privacy-Preserving Statistics with Privcount in Tor
Infineon Technologies AG, Cyber Defence Center, Research Student Project
Neuropil, IoT open source secure data exchange layer, Bloom filter design
Member of the PoPETs artifact review committee
Strong Technical Skills

Research work: $\approx$ 9 years | Student research work: 3.25 years | Projects: $>$ 9 | Student Projects: 4 | Grants & Fellowships: 2, Total: 19 100 EUR | Awards: 1 | Reviewer jobs: 3 | Exhibitions: 2 | Organized events: $>$ 1 | Teaching experience: $\approx$ 21 years | Coding experience: $\approx$ 24 years | Spoken languages: 7

More Information

`https://github.com/Samdney`
`https://arxiv.org/a/zobelein_c_1.html`
`https://twitter.com/SamdneyTweet`
`https://research.carolin-zoebelein.de`
`https://art.carolin-zoebelein.de`
`https://blog.carolin-zoebelein.de`

References: On demand.

Secondary work

Artist Since 2015/05

Freelancer *Remote, Germany*

- Connection and integration of scientific phenomena into artwork, as well as artwork about mathematics, online privacy and anonymity, digital security and human rights
- `https://art.carolin-zoebelein.de`

Privacy & Anonymity Since 2016/05
Volunteering *Remote*

- Since 2019, Research and development of algorithms for online anonymity and censorship circumvention, in distributed networks
- Since 2018, Giving offline and remote workshops & coachings about online privacy and anonymity tools
- Since 2016/05, Helping people online in forums, chats and by email, regarding using online privacy, anonymity, censorship circumvention and encryption tools (VPNs, Tor, PGP, Messaging Apps, ...)
- Tor Project, Since 2016/05, Started as regular volunteer, At the moment only spontaneously helping people with Tor related topics online (`https://www.torproject.org/`)

Former Experiences

Infineon Technologies AG Neubiberg (near München) 2018/11 - 2019/05
Student research project, Information Security - Cyber Defence Center *Germany*

- Topic: *Evading detection and treatment*, Machine learning based malware detection
- Analysing of characteristics usable for detection improvements in existing company protection system of different kinds of malware, Investigation in different possible strategies, Elaboration of a machine learning based solution
- Coding language: Python TensorFlow and Keras

Friedrich-Alexander-University Erlangen-Nürnberg, Department for Mathematics 2016/04 - 2016/09
Student assistant, IT-Support *Germany*

Siemens AG Forchheim 2015/03 - 2015/09
Working student, Computer Tomography development *Germany*

- Data analysis programming for research: Revision of existing numerical analysing scripts for accuracy improvements of CT X-ray tubes
- Coding language: Matlab

Friedrich-Alexander-University Erlangen-Nürnberg 2012/10 - 2016/09
Teaching assistant *Germany*

- Tutor for exercise lessons and practical courses in physics and mathematics for undergraduate and graduate level, Involvement in revision of exercise, homework and exam problems as well as in marking of homework and exams

High-Octane Motorsports e.V., University Erlangen-Nürnberg 2012/10 - 2013/07
Student member, Society in terms of the competition Formula Student *Germany*

- Implementation of mathematical tire design models according to Pacejka, Hans B.. Comparison of models with collected data of current racing car and deriving information for vehicle dynamics improvements
- Coding language: Matlab

University medical centre Erlangen, ENT-hospital, Phoniatry and pedaudiology 2011/01 - 2012/03
Research assistant, Group: Fluid physical principles of the human vocalisation *Germany*

- Development and revision of simulation and data analysis programs for research: Simulation of human vocal folds oscillations, Revision and implementation of camera calibration software for recording of vocal folds oscillations of animals, DFG Research Group FOR 894
- Coding languages: C/C++, C#, Python

Independent 2004/03 - 2016/03
Volunteering *Germany*

- Unpaid private lessons for socially disadvantaged pupils

Studies

Friedrich-Alexander-University Erlangen-Nürnberg 2017/10 - 2019/03
Bachelor of Science Computer Science, Paused *Germany*

- Major interests: Cryptography, IT-Security, Theoretical Computer Science

Friedrich-Alexander-University Erlangen-Nürnberg 2013/04 - 2016/09
Master of Science Physics, Aborted *Germany*

Friedrich-Alexander-University Erlangen-Nürnberg 2008/10 - 2013/09
Bachelor of Science Physics, 2013/09 *Germany*

- Bachelor thesis: *Dirac-Observablen in der Kosmologie* (Dirac observables in cosmology)
  Chair for Theoretical Physics III: Institute for Quantum Gravity, Supervisor: Prof. Dr. Kristina Giesel
- Major interests: Quantum Gravity, Mathematical Physics, Influence of Number Theory on Physics

School education

Peter-Vischer-School Nürnberg 2004/09 - 2008/06
Department Gymnasium, Mathematic, natural scientific focus *Germany*
- Abitur 2008/06 (University entrance qualification)

Peter-Vischer-School Nürnberg 2000/09 - 2004/07
Department Realschule, Mathematic, natural scientific, technical focus *Germany*
- School leaving certificate 2004/07

Ludwig-Uhland-School Nürnberg 1998/09 - 2000/07
Department Hauptschule *Germany*

Training courses

Friedrich-Alexander-University Erlangen-Nürnberg 2017/11
Training center for academic teaching (FBZHL) *Germany*
- Didactics for tutors of the Faculty of Engineering - Basic course II

Friedrich-Alexander-University Erlangen-Nürnberg 2017/10
Training center for academic teaching (FBZHL) *Germany*
- Cross-cultural sensitization for tutors

Bibliography

Current highlight:

⇒ Carolin Zöbelein. Collatz ghost cycles and multi-level sequences. 2024. Preprint.

For a list of my work, go to ...
(Currently, under construction. Adding former NDA work. 2025/02)

`https://research.carolin-zoebelein.de/public.html#Bibliography`
`https://research.carolin-zoebelein.de/files/bibliography.pdf`

Projects

Highlights:

Research work (Excerpt):

- **Graph data compression (GDC)**
  An high ratio compression algorithm for data transmission in distributed networks. It's based on new approaches for representing binary data by (hyper)graph concepts.
- **Graph geometrical object algebra (GGOA)**
  An algebra and programm paradigm based on the concept of representing binary strings as d-dimensional objects in an object space. This introduces a Turing complete programming language, capable of simultaneously in-built 'calculations' solely done by the data saving process itself without the necessity of separate calculation steps. In this way, we receive highly computation efficient algorithms.
- **Multi-problem graph synapses (MPGS)**
  A multi-problem solving framework based on the remapping of the edge interpretation in mathematical graphs, in analogy to brain neural networks
- **Ant, swarm and self-reconfiguring modular robotics**
  Algorithm and hardware designs for ant, swarm and self-reconfiguring modular robots
- **Adaptive live video frame generation (ALVFG)**
  Algorithm development for interactive live ML video frame generation by online learning.
- **Elements of number theory and combinatorics**
  A collection of smaller works around number theory and combinatorics.
- **Algorithms in arts (AIA)**
  Algorithms for image and art work generation based on interactive online learning.

Former work:

- **Combsee**
  Theoretical research and implementation of a decentralized, privacy preserving, search engine. Former: 'Decentralized privacy preserving search by mathematical design'. Related Funding: NGI Zero Discovery.
- **#Hashtag**
  A digital art short film series, making fully computer generated short films related to hashtags.

Software (Excerpt):

- **Distributed network simulation framework** (`dnsimme`)
  Simulation framework for distributed networks, overlay topologies and networks, packet, and protocol experiments, Offers easy experiment setup and analyzing tools, Language: Python
- **Object algebra and programming library** (`libggoa`)
  Experimental implementation of object algebra and programming, Language: Python
- **Self-reconfiguring modular robot simulation framework** (`swarmibots`)
  Simulation framework for experimental self-reconfiguring modular robot algorithms, Language: Python
- **Interactive live ML video generation** (`quickvfgmm`)
  Backend development for interactive live ML video frame generation, implementing own online learning algorithms which generate the next few video, live, during watching the current video frames, based on user interaction, Server and video frame management between user view and frame generation, Language (core code): Python

Grants & Fellowships

NGI Zero Discovery | *Grant, 19 100 EUR, NLnet Foundation, Netherlands, EU* 2019/12

- NLnet manages the NGI0 Discovery Fund, a fund dedicated to search technologies which creates an open, trustworthy and reliable internet for all. The fund was established with financial support from the European Commission's Next Generation Internet programme, under the aegis of DG Communications Networks, Content and Technology.
- `https://nlnet.nl/discovery/`
  `https://www.ngi.eu/`
  `https://cordis.europa.eu/project/id/825322/`
  `https://research.carolin-zoebelein.de/Funding/2019/NGI-Zero-Search-and-Discovery-Fund.html`

Private Donors | *Worldwide* Since 2018

- Financial support from private donors

YOLANTE | *Siemens AG, Germany* 2013

- Mentorship program for female students, Mentee

Awards

Mädchen für Technik Preis (Girls for Technology award) | *Siemens AG, Germany* 2005/07

- Pupil award for extraordinary achievements in mathematical, natural scientifical and technical subjects

Reviewer

- Member of the PoPETs artifact review committee 2020, 2021, and 2022 (`https://petsymposium.org`)

Contributions

Neuropil | *IoT open source secure data exchange layer* 2019/12 - 2020/02

- Neuropil is a dynamic, decentralized and fully automated open source solution for the secure exchange of data between IoT devices and applications, by pi-lar GmbH.
- Kind of contribution: Bloom filter improvements for data distribution within the network
- `https://www.neuropil.org/`

Privacy-Preserving Statistics with Privcount in Tor | *Tor protocol specification proposal* 2017/12
(Shamir version)

- PrivCount is a differential privacy privacy-preserving way to collect aggregate statistics about the Tor network without exposing the statistics from any single Tor relay, by Nick Mathewson, Tim Wilson-Brown and Aaron Johnson.
- Kind of contribution: Analysis of design questions for implementation
- `https://gitweb.torproject.org/torspec.git/tree/proposals/288-privcount-with-shamir.txt`

Tor Project support material | *Tor user support and Tor Browser Manual* 2016

- Tor Project offers support material for users and node operators on their websites. The Tor Browser Manual gives a step-by-step introduction into the correct usage of Tor Browser. The support page offers general information about a wide range of most demand topics.
- Kind of contribution: Review of Tor Browser Manual and writing of content parts of the support page
- `https://tb-manual.torproject.org/`
  `https://support.torproject.org/`

Software

Cool Down | *Health & Fitness* | *Android app, Java* v01: 2018/09/09

- Includes advertising
- App for your mental health which wants to help you to conquer bad emotional times.

Catchy Balls | *Casual Game* | *Android app, Java* v01: 2018/06/04

- Includes In-App purchases
- Catch all the balls which have the shown color and get points.

Exhibitions

'Concept' - International Exhibition on Conceptual Art 2016/05/06 - 2016/05/29
Group exhibition *Korea*

- CICA Museum, 196-30, Samdo-ro, Yangchon-eup, Gimpo-si, Gyeonggi-do, Korea 415-843
- Artworks: Photo with title *I was here*, Photo with title *Signing*
- `https://cicamuseum.com/concept-2016-5-6-29`
  `https://cicamuseum.com/wp-content/uploads/2016/05/Concept_catalog.pdf`

#TwitterArtExhibit: NYC - 2016 2016/03/31 - 2016/04/21
Group exhibition *USA*

- Trygve Lie Gallery, 317 E 52nd St., New York, NY 10022
- Artwork: Postcard (Acrylic paint) with title *All is public - No secrets*
- `http://twitterartexhibit.org`

Organized Meetups & Workshops

Online privacy & anonymity Since 2018
Offline and online, EU countries, On demand

- Workshops & Coachings about online privacy and anonymity tools

Why you should study Number Theory! 2018/10
Friedrich-Alexander-University Erlangen-Nürnberg, Department for Mathematics *Germany*

- Meetup, A friendly together for talking about Number Theory studies with coffee and tea

Teaching

- **Non academic:**
  - Offline and remote teaching about online anonymity, privacy and encryption tools
  - Private lessons for pupils of fifth year and above, from all kinds of Bavarian school types.
    Subjects: Mathematics, Physics, Chemistry, Technology, Computer Science, French, Spanish
- **Bachelor courses (Tutor):**
  - Mathematics for engineers 1 & 2
  - Experimental physics for natural scientists 1 & 2
  - Experimental physics for engineers 1 & 2
  - Experimental physics 5: Nuclear and particle physics
  - Theoretical physics 4: Statistical physics
  - Practical basis courses 1 in physics for physicists part 1 & 2
  - Practical courses in physics for engineers
- **Master courses (Tutor):**
  - Advanced experimental physics: Particle and astroparticle physics
  - Advanced theoretical physics: Advanced quantum mechanics

Soft Skills

Grant Writing | Pitching | Funding Acquisition | Crowdfunding | Academic Writing | Project Management | Speaker | Teaching | Cross-Cultural Experienced | Strong Interdisciplinary | Abstract Thinking | High Creativity | Thinking Out of the Box | Helpful | Friendly | Passion Driven

Technical Skills

Coding: C, C++, C#, Java, LabView, NASM, Perl, Python, Rust, Shell Scripting
ML: TensorFlow, Keras
Web: CSS, Django, Flask, HTML, Jinja2
Mobile Dev.: Android apps (Java)
Continuous integration: Travis CI
Debugging: gdb, pdb, Valgrind
Testing: Python unittest, Python pytest
Database: MySQL, PostgreSQL, SQLite
Documentation: ReadTheDocs, Sphinx
Math: GNU PSPP, GNU Octave, Maple, Matlab, R, SageMath, Scilab
Virtualization: Docker, KVM, QEMU, VirtualBox
Cloud Comp.: AWS, Docker Cloud, Microsoft Azure
Networking: Ettercap, netcat, netstat, nmap, scapy, tcpdump, traceroute, Wireshark, ...
WebServer: Apache HTTP Server, nginx
Monitoring: Munin, Nagios, Zabbix
SCM: Puppet
VC: Git, SVN
Writing & Office: LaTeX, LibreOffice
OS: Linux, BSD, Windows
CAD - Basics: Solid Edge, Pro/ENGINEER Wildfire

Languages

First: German
Good: English
Basics: Modern Standard Arabic, Standard Chinese, French, Spanish, Swahili
A few words: German Sign Language, Hausa, Modern Hebrew, Italian, Japanese, Kinyarwanda, Russian, Standard Tibetan

Free time activities

The normal stuff...
Bushcraft, Krav Maga, A bit archery

The nerd stuff...
Reading, Every kind of language (spoken, coding, math, ...), Hanging around on irc

February 13, 2025