Bas Nijholt, PhD

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Introduction

I specialize in developer productivity infrastructure that accelerates research and engineering workflows. As the author of adaptive (parallel adaptive sampling), pipefunc (DAG-based workflow framework running from laptops to HPC), unidep (monorepo package manager: 2h ⟶ 12s installs), and mindroom.chat (federated AI agent platform), I build tooling that removes friction from development cycles at scale. I maintain 30+ Python packages spanning parallel workflows, numerical algorithms, and infrastructure automation. My Ph.D. in quantum mechanics grounds me in algorithmic thinking; my engineering focus is making complex systems fast and accessible.

Education

Delft University of Technology Delft, the Netherlands
Ph.D. candidate in computational quantum mechanics Jan 2016 – Dec 2019, 40 h/w

- Thesis title: "Towards Realistic Numerical Simulations of Majorana Devices".
- Conducted theoretical research on Majorana devices for qubits in topological quantum computing, resulting in 10 peer-reviewed papers and 621 citations, with an h-index of 10.
- Contributed to various open-source projects within the Python ecosystem, including 17 conda-forge packages, HoloViews, Kwant, pandas, Jupyter, SLURM, dask, and ipyparallel.
- Managed system administration tasks, including group's JupyterHub, Ansible, Docker, Git, and continuous integration (CI).
- Authored 3 Python packages for facilitating adaptive computing in research (HPC), used by Microsoft, Rolls-Royce, University of Maryland, TU Delft, TU Eindhoven, University of Illinois, and more.

Delft University of Technology Delft, The Netherlands
Master of Science in Applied Physics Sep 2013 – Sep 2015

- Specialization in Applied Physics, with a focus on quantum mechanics and computational physics.
- Recipient of the prestigious Justus & Louise van Effen Research Grant, awarded to the top 5% of students for research at one of the world's top-20 universities (Harvard).
- Founded a student organization that organized educational activities, including visits to CERN and networking events with alumni.
- Thesis titled *"Orbital effect of magnetic field on the Majorana phase diagram"* under the supervision of Dr. Anton Akhmerov.
- Achieved a GPA of 8/10.

Delft University of Technology Delft, The Netherlands
Bachelor of Science in Applied Physics Sep 2009 – Jul 2013

- Bachelor thesis conducted at the Kavli Institute of Nanoscience Delft, Bionanoscience Department, under Cees Dekker's group: *"Single-Molecule Studies of the Annealing Helicase HARP using Magnetic Tweezers."* Received a grade of 9/10.
- Completed additional courses (31 ECTS) in Biochemistry, Molecular Genetics, Chemistry, Cell Biology, and related subjects. GPA of 8/10.

- Completed a Minor in Computer Science Education, obtaining a second-degree teaching qualification. GPA of 9/10.
- Actively involved in several committees at the Student Association of Applied Physics.

Experience

IonQ Redmond, United States
Staff Engineer Nov 2023 – Present, 40 h/w

- Work across developer productivity, compiler optimizations, and large-scale quantum simulations.
- Built a framework to represent simulations as directed acyclic graphs (DAGs) that runs identically from laptops to supercomputers (open-source: pipefunc).
- Developed simulation software combining Python with lower-level languages (C++ via pybind11) for performance-critical HPC workloads.
- Developed software to manage simulation workloads across our HPC infrastructure.
- Created a package manager that reduced monorepo install time from 2 hours to 12 seconds (open-source: unidep).
- Advocate for and prototype agentic AI coding workflows to accelerate development.

Microsoft Research — Station Q Redmond, USA (NL until Jan 2021)
Senior Quantum Software Engineer Aug 2021 – Nov 2023, 40 h/w

- Work on making the first topological quantum computer a reality, specifically on inventing, developing, and applying machine learning and data analysis tools in a variety of experimental contexts.
- Led the development of a tool for efficient data management, enabling the upload/download of validated, N-dimensional arrays to a cloud-based data lake, and facilitated SQL querying for selective data retrieval.
- Designed and developed advanced tools for the design and modeling of next-generation topological qubits and their control hardware.
- Principal developer of proprietary chip design software, enabling comprehensive 3D simulations of quantum devices and automated preparation of fabrication-ready layouts, thereby accelerating the design-to-production process.
- Developing and testing bleeding edge physics simulation capabilities for quantum information applications.
- Inventing, developing, and applying machine learning and data analysis tools in a variety of experimental contexts.
- Creating and maintaining HPC cloud cluster infrastructure of >100.000 CPU cores on Microsoft Azure on which quantum simulations are performed.

Microsoft Research — Station Q Delft, the Netherlands
Quantum Simulation Engineer Jan 2020 – Aug 2021, 40 h/w

- Contributed to the development of the first topological quantum computer by designing and applying Bayesian machine learning techniques for quantum computer calibration protocols.
- Developed automated data processing pipelines for extracting relevant physical parameters from large datasets for topological quantum computer design.
- Formulated theories and simulation workflows to derive physical parameters from experimental data.
- Created research software for running massively parallel adaptive parameter sweeps.

Microsoft Research — Station Q Santa Barbara, United States
Research Intern (2nd time) Apr 2019 – Jul 2019, 40 h/w

- Developed a general-purpose Python program called Adaptive-scheduler for interactively managing adaptive parallel simulations on over 100k cores, using cloud HPC infrastructure.
- Continued work on the previous year's project.

Microsoft Research — Station Q Santa Barbara, United States
Research Intern (1st time) May 2018 – Aug 2018, 40 h/w

- Created a simulation code to extract spin-orbit coupling constants in semiconducting nanowires from weak-anti-localization data.
- Contributed to Microsoft's in-house simulation software packages.

Harvard University — Wyss Institute Boston, United States
Research Intern Sep 2015 – Dec 2015, 40 h/w

- Developed an innovative algorithm for designing large DNA origami structures during an internship at William Shih's lab.
- Received a 9/10 grade for the project.

TU Delft — Bètasteunpunt Delft, the Netherlands
Student assistant Nov 2013 – March 2014, 4 h/w

- Designed an engaging educational program on quantum mechanics for high school teachers, complemented by lectures on Majorana particles by Leo Kouwenhoven.
- Created a concise educational program on image processing applications.

Antoniuscollege Gouda Gouda, the Netherlands
(Licensed) Computer Science Teacher and Math Teacher Sep 2012 – Aug 2013, 16 p/w

- Taught mathematics to first graders of havo and vwo (pre-university) where I implemented the flipped classroom concept.
- Taught computer science to fifth and sixth graders in their final year (pre-university) and introduced students to programming (i.e. Java), project management, game development, data.

Lyceo Delft, the Netherlands
Planner and software engineer Mar 2012 – May 2012, 40 h/w

- Streamlined the process of automating and coordinating the scheduling of over a thousand teachers for exam training.
- Developed a web-tool to efficiently schedule tutors for exam training sessions, managing up to 200 teachers and 1000 students per day.

TU Delft Delft, the Netherlands
Mathematics and mechanics help desk 2011 – 2012, 4 h/w

- Assisted and addressed questions from TU Delft bachelor students on calculus and mechanics at the help desk.

Nijholt.biz Rotterdam, the Netherlands
Web designer 2002 – 2010 (8 years)

- Designed and hosted websites for various clients, including dentists, hotels, restaurants, car dealerships, filmmakers, and personal webpages since the age of 12.

Highlighted Projects

Adaptive source
main author

- Developed a Python package that accelerates simulation code by intelligently sampling points in parameter space, boosting performance by 10-100 times. Widely used by researchers in computational sciences and has received >1000★ on GitHub.

Topological Gap Protocol source
main code author

- Open-sourced code that performs the analysis as reported in "InAs-Al Hybrid Devices Passing the Topological Gap Protocol" by Microsoft Azure Quantum.

Adaptive-scheduler source
main author

- Designed a tool for scheduling and managing adaptive interactive parallel jobs on massive scale (tested on >100,000 cores on Azure), extensively used by the Microsoft Station Q team.

pipefunc source
author & maintainer

- Lightweight DAG framework for scientific workflows; runs identically from laptops to supercomputers.

unidep source
author & maintainer

- Unified package manager that cut large monorepo install time from 2 hours to 12 seconds.

mindroom.chat source
author & maintainer

- Federated AI agent platform built on Matrix protocol; agents with persistent memory that work across Slack, Discord, Telegram, and WhatsApp via bridges.
- Leverages Docker and Kubernetes for deployment; supports self-hosted and cloud instances with end-to-end encryption.
- Multi-agent collaboration with 80+ tool integrations and automated scheduling workflows.

topocondmat.org source
online course

- Developed a website for an online course on topology in condensed matter, which is automatically compiled from Jupyter notebooks using CI. Also responsible for coding the interactive plots featured on the site.

Home Assistant
top 1% contributor

- Contributed to the largest open-source home automation project (>100k users), built on Python and fully asynchronous.
- Main developer of Adaptive Lighting (with 1000s of users) and Home Assistant Streamdeck YAML, which programs a Streamdeck in YAML.

Certifications

TU Delft
Second-degree High School Teaching Qualification in Computer Science Jan 2013

Skills, Languages & Interests

- **Skills**: Python, Git, Docker, CI, Go, Bash, Linux, Ansible, High-performance computing, Machine learning, Fortran, Java, Matlab, PHP, HTML, CSS, LaTeX, LabView, and basic office programs.
- **Languages**: Dutch (native) and English (professional)
- **Interests**: world-literature (Dostoevsky), landscape photography, hiking, open-source software, home automation, AI, finance, music (Nicolas Jaar), science, biotechnology, nanoscience, art (Van Gogh, Courbet), philosophy, physics.