Karl Welzel

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Education

01/2022–06/2026 **DPhil in Mathematics**, *Numerical Analysis Group, University of Oxford*.
Thesis: Tensor Methods for Continuous Optimization
Supervisor: Raphael A. Hauser

10/2020–07/2021 **M.Sc. in Mathematical Sciences**, *University of Oxford*, Classification: Distinction, Ranking: 2/52.
Thesis: Sketching for Infeasible Interior-Point Methods
Supervisor: Coralia Cartis
Relevant Courses: Continuous Optimisation; Numerical Linear Algebra; Theories of Deep Learning; Approximation of Functions

10/2017–09/2020 **B.Sc. in Mathematics**, *Rheinische Friedrich-Wilhelms-Universität Bonn*, Overall grade: 1.3.
Thesis: LogSumExp Objectives for VLSI Placement
Supervisor: Stephan Held
Relevant Courses: Introduction to Discrete Mathematics; Linear and Integer Programming; Combinatorics, Graphs and Matroids

08/2009–07/2017 **Abitur**, *CJD Christophorusschule Königswinter*, Overall grade: 1.0.
Honours Courses: Mathematics; English; Chemistry

Work Experience

01/2022–03/2026 **Mathematics Tutor and Teaching Assistant**, *University of Oxford*.
I taught B6.3 Integer Programming to third-year undergraduates and C6.2 Continuous Optimization to masters students in the years 2022 to 2026.
I was responsible both for marking the problem sheets and presenting the solutions on the whiteboard.

08/2025–10/2025 **Software Engineering Internship**, *TNG Technology Consulting*, Munich, Germany.
I helped develop an internal web application based on a modern stack of software tools while learning about many different aspects of managing large-scale software projects in a professional environment.

03/2020–06/2020 **Undergraduate Research Assistant**, *Rheinische Friedrich-Wilhelms-Universität Bonn*.
As part of my Bachelor's thesis, I contributed to a large and mature C++ codebase developed at the Institute for Discrete Mathematics and used by IBM to optimize their chip designs.

Scholarships

08/2017–09/2021 Scholarship by the **Professor-Rhein-Stiftung Königswinter**, a foundation that supports the best students of the natural sciences and related fields from Königswinter

01/2022–12/2025 Studentship by **INNOHK and the Hong Kong Centre for Intelligent Multidimensional Data Analysis** funding the PhD in Oxford

Volunteering

10/2021–03/2023 **Subject Editor for Mathematics & Production Lead**, *St Catherine's Academic Review*.
I participated in a student-run journal project, both as subject editor for Mathematics and typesetting the journal in LaTeX.

02/2021–06/2021 **MCR IT Officer**, *St Catherine's College, University of Oxford*.
I was part of the committee representing the community of graduate students (MCR) of St Catherine's College and helped modernise its website.

Publications

08/2025 Coralia Cartis, Raphael A. Hauser, Yang Liu and Karl Welzel. *Local Convergence of Adaptively Regularized Tensor Mathods*. in preparation. Aug. 2025

02/2025 Coralia Cartis, Raphael Hauser, Yang Liu, Karl Welzel and Wenqi Zhu. *Efficient Implementation of Third-order Tensor Methods with Adaptive Regularization for Unconstrained Optimization*. preprint on arXiv. Feb. 2025. DOI: 10.48550/arXiv.2501.00404

03/2024 Karl Welzel and Raphael A. Hauser. 'Approximating Higher-Order Derivative Tensors Using Secant Updates'. In: *SIAM Journal on Optimization* 34.1 (Mar. 2024), pp. 893–917. ISSN: 1052-6234, 1095-7189. DOI: 10.1137/23M1549687

Conference Presentations

22/07/2025 **International Conference on Continuous Optimization**, *Los Angeles, CA, USA*.
"Convergence of adaptively regularized tensor methods"

01/07/2025	**EUROPT 2025 Conference**, *Southampton, UK*. "Convergence of adaptively regularized tensor methods"
11/09/2024	**Annual Conference OR66**, *Bangor, UK*. "Quasi-Tensor Methods"
25/07/2024	**International Symposium on Mathematical Programming**, *Montreal, Canada*. "Approximate Derivatives for Tensor Methods"
24/08/2023	**International Congress on Industrial and Applied Mathematics**, *Tokyo, Japan*. "Approximating Higher-Order Derivative Tensors Using Secant Updates"
28/06/2023	**Biennial Numerical Analysis Conference**, *Glasgow, UK*. "Generalizing Quasi-Newton Updates to Higher-Order Derivatives"
03/06/2023	**SIAM Conference on Optimization**, *Seattle, WA, USA*. "Generalizing Quasi-Newton Updates to Higher-Order Derivatives"

Languages

German	**Mother tongue**.
English	**Fluent**, C2.

Programming languages

Python	**Advanced**	*since 2012*
C++	**Advanced**	*since 2017*
LaTeX	**Advanced**	*since 2017*
Matlab	**Intermediate**	*since 2022*