

# Thomas Georg Grill

## Curriculum Vitae

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Sweden

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### Education

- September 2025– present **PhD Mathematics**, Royal Institute of Technology (KTH), Stockholm, Sweden  
PhD studies in pure mathematics with graduate school and teaching assignments. Research in algebraic neural network theory.
- September 2022– August 2025 **M.Sc. in Mathematics**, Ludwig-Maximilians-Universität München (LMU Munich), Munich, Germany, Grade: 1.0  
Main focus on algebraic geometry and algebraic topology with category theory behind it. Engaged with content and assignments of a lecture on cohomology of sheaves.  
Master's Thesis: *The Local and Global  $\mathbb{A}^1$ -Brouwer Degree of Endomorphisms of Projective  $n$ -Spaces*, supervisor: Prof. F. Morel
- Fall term 2024 **Exchange Student**, Carleton University, Ottawa, Canada  
Spread coursework over mathematics and computer science. Notable courses include an introduction to machine learning and a graduate lecture on graph theory.
- October 2019– August 2022 **B.Sc. in Mathematics with minor in computer science**, LMU Munich, Grade: 1.01  
After completing core coursework, kept a broad foundation by attending advanced lectures on complex analysis, functional analysis, and commutative algebra. Coursework in CS includes lectures on logic and theoretical computer science as well as coding-heavy lectures.  
Bachelor's Thesis: *The Auslander-Buchsbaum Theorem*, supervisor: Prof. A. Rosenschon

### Research Interests

- Algebraic and Differential Geometry with its applications, such as neuroalgebraic geometry, metric algebraic geometry and  $\mathbb{A}^1$ -homotopy theory.
- Group actions on spaces and induced symmetries.
- Neural Networks and their neuromanifolds.

### Research Experience

- Summer 2025 **Master's thesis**, LMU Munich, Supervisor: Prof. F. Morel, August 2025  
*The Local and Global  $\mathbb{A}^1$ -Brouwer Degree of Endomorphisms of Projective  $n$ -Spaces*  
○ Investigating construction of a local degree for morphisms  $\mathbb{P}_k^n \rightarrow \mathbb{P}_k^n$ , inspired by analogues from algebraic topology/differential geometry.  
○ Applying cellular homology as introduced by Morel and Sawant (2023) to define a global degree.  
○ Generalizing constructions found in literature to a wider class of morphisms and exploring the relationship between local and global degrees.

### Conference Attendance

- September 2025 **WASP-NEST Neural3D Workshop**, at Chalmers University
- March 2025 **Conference on Motivic Homotopy Theory**, Universität Regensburg
  - Closely linked to Master's thesis
  - Gave overview and insights into current research topics and subareas like tropical geometry, infinity categories and log structures

## Talks and Presentation

- September 2025 **When Training a Network Becomes Easy Or Hard – The Boundary of Neuro-manifolds (in English)**, KTH, Introductory presentation about my research  
Motivation and definition of boundary together with presentation of simple connections between the boundary and training behaviour.
- Fall term 2024 **Algebraic Geometric Codes (in English)**, Carleton University, Project Presentation in an Advanced Lecture on Coding Theory  
Introduction of basic projective algebraic geometry to an audience without prior background in algebraic geometry and explanation of its application to coding theory.
- Fall term 2024 **Computation of Curvature Values and Directions on Meshes (in English)**, Carleton University, Project Presentation in Lecture on Geometry Processing  
Results gained through implementing a discrete version of the curvature tensor computation for triangle meshes.
- Winter term 2023/2024 **The Mod 2 Cohomology Ring of Some Eilenberg–MacLane Spaces (in English)**, LMU Munich, Master Seminar on Spectral Sequences (2 times 90 minutes)  
Motivation and presentation of the computation of mod 2 cohomology rings of the Eilenberg–MacLane spaces  $K(\mathbb{Z}, n)$  and  $K(\mathbb{Z}/2, n)$ . It also touched on Steenrod squares, transgression, and Zeeman's comparison theorem.
- Summer Term 2022 **Support Vector Machines (in English)**, LMU Munich, Bachelor Seminar on Applications of Convex Optimization  
Conveyed intuition for support vector machines (SVMs) and presentation of mathematical background by deriving the optimization problem in both primal and dual form. It also covered how to use kernel methods to classify non-linearly separable classes.

## Tutoring Experiences

- Summer term 2023 **Teaching Assistant, Geometry and Topology of Surfaces (undergraduate, in German)**, LMU Munich  
Presentation of exercises and their solutions in interactive problem sessions. Explanation of topics such as point-set topology, fundamental forms, geodesics, and curvature. Grading submissions and giving constructive and individual feedback.
- Summer term 2022 **Teaching Assistant, Formal Languages and Complexity (undergraduate, in German)**, LMU Munich  
Leading interactive problem sessions and tailoring explanation of topics such as finite automata, formal grammar, computability, and complexity to the level of the audience. Weekly grading of 40 submissions.
- Winter term 2020/2021 **Teaching Assistant, Linear Algebra for Computer Scientists and Statisticians (1st year course, in German)**, LMU Munich  
Presentation of solutions in interactive problem sessions and support in topics such as basic group theory, matrices (including rank and determinant), vector spaces, and formal mathematical writing. Weekly grading of 30 submissions including constructive and individual feedback on computations, proofs, and mathematical writing.

## Technical Skills

- Mathematical Software Python (NumPy, PyTorch), Macaulay2, SageMath (basic familiarity)
- Tools LaTeX, Git

## Languages

- German Native

English Fluent (C1/C2); TOFEL iBT: 110 (2024)

French Basic (B1)