

# Luciano Melodia

📍 Erlangen

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## Education

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### Friedrich-Alexander Universität Erlangen-Nürnberg

Oct 2024 – March 2026

*M.Sc. Mathematics, Digital Humanities*

- **Thesis:** Universal Coefficients for Homology of Ample Groupoids
- **Topics:** Algebraic Topology, Tensor Categories, Homological Algebra

### Friedrich-Alexander Universität Erlangen-Nürnberg

Oct 2021 – Sept 2024

*B.Sc. Mathematics, Computer Science*

- **Thesis:** Algebraic and Topological Persistence
- **Topics:** Applied Topology, Persistent Homology

### Universität Regensburg

April 2015 – March 2018

*M.A. Information Science*

- **Thesis:** Deep Learning Estimation of Absorbed Radiation Dose for Nuclear Medicine Diagnostics
- **Topics:** Machine Learning, Deep Learning, Matrix Factorization

### Universität Regensburg

Oct 2012 – March 2015

*B.A. German Philology, Italian Philology, Media Informatics, Information Science*

- **Thesis:** Development of a Punctuation Platform with Linguistic Modules for Information Retrieval
- **Topics:** Natural Language Processing, Information Retrieval, Electronic Corpora

### Universität Regensburg

Oct 2012 – April 2013

*Studienbegleitende IT-Ausbildung*

### Albertus-Magnus-Gymnasium Regensburg

Sept 2004 – May 2012

*Abitur*

## Experience

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### Student Assistant

Erlangen

*Algebra and Geometry*

April 2023 – March 2026

*Applied Analysis*

*Applied Mathematics*

*Representation Theory and Operator Algebras*

*Representation Theory and Mathematical Physics*

- 2026, 2023 Tutor in Topology
- 2026, 2024 Tutor in Analysis 3
- 2025 Tutor in Mathematics for Engineers A4 (stochastic)
- 2025 Tutor in Analysis 2
- 2024 Tutor in Topology and Applications
- 2024 Tutor in Linear Algebra 1
- Lecture on the Tietze Extension Theorem
- Lecturer for mathematical proof sessions
- Lecturer for exercise sessions
- Supervision and correction of written exams

### Tutor

Erlangen

*Private*

Jan 2024 – Dez 2025

Preparation for

- mathematics, 2 students, undergraduate studies
- computer science, 1 student, undergraduate studies

- chemical and biological engineering, 1 student, undergraduate studies
- physics, 1 student, undergraduate studies
- Abitur, 13 students, bavarian Gymnasium
- secondary school, 2 students, bavarian Mittelschule
- secondary school, 3 students, bavarian Realschule
- elementary school, 1 student, bavarian Grundschule

## **Werkstudent**

*Corscience GmbH & Co. KG*

*Erlangen*

*Aug 2021 – Aug 2022*

- Deep convolutional networks trained on multiple GPUs for automatic detection of calibration spikes in ECG data; achieved an accuracy of over ninety-nine percent on ten-fold cross validation with a data set of about one million real world samples tested with sigma five significance, which is state of the art
- Residual networks for detection of ECG curves in documents; achieved an IOU of approximately ninety-eight percent on ten-fold cross validation with a data set of about ten million artificially enlarged samples using generative neural networks tested with sigma three significance, which is state of the art
- Image segmentation using matrix factorisation techniques to isolate ECG curves. Achieved an IOU of approximately ninety-nine percent tested with sigma six significance, which is state of the art

## **Staff Applied Research Scientist**

*Siemens Energy AG*

*Erlangen*

*Sept 2018 – Dez 2021*

*Chair for Evolutionary Data Management*

- Development of a novel interpolation technique based on the topology of power plant signals to augment reliably data for large scale machine learning training. Validation was performed using theoretical guarantees and practical tests involving handwriting and signals from four different power plants. This novel method has been published at the International Workshop on Combinatorial Image Analysis. The code is open source: Package SIML [🔗](#) [📄](#).
- A novel technique has been developed to estimate roughly the number of parameters in hidden-layer neural networks for signal data. The results were presented at the International Conference on Pattern Recognition. These results have been validated using tailored toy datasets and real power plant signals from a total of four different power plants. Therefore, the technique can be scaled up for big data. Cost savings from reducing training time and current have been estimated to 25.000€ per year. The neural networks achieved close-to-perfect accuracy in classifying the signal data. The code is open source: Package NTOPL [🔗](#) [📄](#).
- These results were then used to train a classifier for the KKS (Kraftwerkskennzeichensystem). The aim was to classify each stage of the power plant's hierarchical labelling system down to the level of a sensor. First, the data was enriched using reliable Voronoi interpolation. We then used this estimate to create a trainable, tractable neural network. Finally, we designed a neural network that takes preprocessed signals and their Betti zero and Betti one curves as input. We achieved an accuracy of over 93% for the coarsest KKS stage and up to 54% for the physical entity using data from four power plants over multiple years. These results have been published in the proceedings of the European Conference on Principles and Practice of Knowledge Discovery in Databases. The code is open source: Package Twirlflake [🔗](#) [📄](#).
- Correction of written exams
- Assistance in oral exams
- Preparation and execution of electronic exams
- Participation in the data science program
- Supervision and execution of
  1. 2021 lecture on Knowledge Discovery in Databases (evaluation Ø1.56)
  2. 2020 seminar on Persistent Homology in Data Analytics
  3. 2020 seminar on Topological Data Analysis (evaluation Ø1.14)
  4. 2019, 2020, 2021 exercises in Process Oriented Information Systems (evaluation Ø1.18)
  5. 2018, 2019, 2020, 2021 seminar on New Technologies in Data Management
  6. 2018, 2019, 2020, 2021 exercises in Computer Science for Engineers
  7. 2018 exercises in Conceptual Modeling
- Supervision of theses:

1. M.Sc. Sauerhammer (2021): A Classification Dashboard for Sensor Signals from Power Plants
  2. M.Sc. Seidel (2020): Classification of Microbes using Time Series Gas Sensor Array Data
  3. M.Sc. Siddiqui (2020): Extraction of Fetal and Maternal Heart-beats from ECG Signals
  4. B.Sc. Hahn (2021): Classification of Sensor Signals from Power Plants
  5. B.Sc. Schäfer (2021): Learning Validation Models from Sensors of a Power Plant
- Programming with CUDA v.11.0, Tensorflow 2.4, CuDNN v.8.0.4. in Python v.3.8 and v.3.9
  - Operating systems: Ubuntu 20.04, Solus 4, Archlinux 5.11, Windows 11

## Data Scientist

*mb Support GmbH*

*Regensburg*

*June 2015 – March 2018*

- Industrial document-digitization pipeline for mass paper-pile scanning; scanning-street engineering; one-percent character-error-rate OCR via Google Cloud Vision and custom recurrent neural networks; ergonomic user-interface integration for Openviva C2; Industrial scanning throughput benchmark: capacity for approximately sixty million documents in continuous operation
- Asterisk telecommunication-API integration into Openviva C2 with ergonomic design, roughly five thousand lines of PL/SQL and Python
- Statistical data and market analysis with deep neural and convolutional networks and regression methods

## Research Assistant

*Chair for German Linguistics*

*Universität Regensburg*

*Oct 2013 – Sept 2015*

- Proofreading of books and papers
- Correction of exams
- Organisation of conferences
- Maintenance of the university website
- Implementation of a scientific social network featuring a custom JavaScript-written search engine for real-time online usage, comprising approximately a thousand lines of code

## Chef

*Apostelkeller*

*Regensburg*

*Sept 2012 – Dez 2015*

- Cooking with menu for up to 140 guests
- Waitressing
- Stock management

## Service Staff

*Trademarketing Service GmbH*

*Regensburg*

*Nov 2012 – Mai 2015*

- Goods management, receipt and ordering.

## Translator

*Anatol GmbH & Co. KG*

*Regensburg*

*Oct 2012 – Aug 2014*

- Translation between Italian – German – Polish – English

## Volunteer




*Alten- und Pflegeheim St. Josef*

*Regensburg*












*Aug 2010*

## Publications





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<b>Homological Time Series Analysis of Sensor Signals from Power Plants.</b>	2021
<i>Luciano Melodia</i> , Richard Lenz	
10.1007/978-3-030-93736-2_22 	
<b>Estimate of the Neural Network Dimension Using Algebraic Topology and Lie Theory.</b>	2021
<i>Luciano Melodia</i> , Richard Lenz	
10.1007/978-3-030-68821-9_2 	
<b>Persistent Homology as a Stopping Criterion for Voronoi Interpolation.</b>	2020
<i>Luciano Melodia</i> , Richard Lenz	
10.1007/978-3-030-51002-2_3 	

## Conferences

Learning on Graphs, LOG 	2022-24
◦ Reviewer, Program Committee	
Advances in Databases, Knowledge, and Data Applications 	2020-24
◦ Reviewer, Program Committee	
Geometrical and Topological Representation Learning, Workshop at ICLR 	2022
◦ Reviewer, Program Committee	
International Conference on Pattern Recognition 	2021
◦ Author, full paper	
International Workshop on Combinatorial Image Analysis 	2020
◦ Author, full paper	
International Conference on Practical Mathematical Discourse 	2020
◦ Guest talk, Introduction to Persistent Homology	
Topological Data Analysis and Beyond, Workshop at NeuRIPS 	2020
◦ Reviewer, Program Committee	
Symposium on Principles of Database Systems, SIGMOD/PODS 	2020
European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases, ECML/PKDD 	2019-2020
◦ Author, full paper	
Sprachmanagement & Orthografie 	2015
Destandardisierung und Standardvarietät 	2013
◦ Author, full paper	

## Awards, Grants and Service

Top Reviewer Award from Learning on Graphs 	2024
Oskar-Karl-Forster Scholarship Fellow 	2024
Student Representative for the Department of Mathematics at Friedrich-Alexander Universität Erlangen-Nürnberg	2024
Member of the Gesellschaft für Informatik e.V. 	2019-20
Member of the Computational Intelligence and Machine Learning Group 	2017-18
Student Representative for the Department of Language, Literature and Cultural Sciences at Universität Regensburg	2016

## Addendum

**Programming:** Python, Rust, C++

**Web Technologies:** HTML5, CSS3, Javascript, PHP

**Typesetting:** L<sup>A</sup>T<sub>E</sub>X

**Operating Systems:** Arch Linux, Ubuntu, Mac OS, Windows

**Languages:** German native, English C2, Italian C2, Polish B2, Spanish A2

**Sports:** Boxing, Muay Thai, Weng Chun, Table Tennis

**Hobbies:** Cooking, Novels

## References

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- Prof. Dr. Karl-Herrmann Neeb  *2025-26*  
◦ Department of Mathematics  
◦ Friedrich-Alexander Universität Erlangen-Nürnberg  
◦ Professor for Lie Groups and Representation Theory  
✉ neeb@math.fau.de  
📞 +49 9131 85-67037
- Prof. Dr. Catherine Meusburger  *2024-26*  
◦ Department of Mathematics  
◦ Friedrich-Alexander Universität Erlangen-Nürnberg  
◦ Professor for Representation Theory and Mathematical Physics  
✉ catherine.meusburger@fau.de  
📞 +49 9131 85-67034
- Prof. Dr. Kang Li  *2022-26*  
◦ Department of Mathematics  
◦ Friedrich-Alexander Universität Erlangen-Nürnberg  
◦ Professor for Representation Theory and Operator Algebras  
✉ kang.li@fau.de  
📞 +49 9131 85-67060
- Prof. Dr. Richard Lenz  *2018-21*  
◦ Department of Computer Science  
◦ Friedrich-Alexander Universität Erlangen-Nürnberg  
◦ Professor for Evolutionary Data Management  
✉ richard.lenz@fau.de  
📞 +49 9131 85-27899
- Prof. Dr. em. Elmar Lang  *2018-21*  
◦ Department of Biophysics  
◦ Universität Regensburg  
◦ Professor for Computational Intelligence  
✉ elmar.w.lang@ur.de
- Prof. Dr. Paul Rössler  *2013-16*  
◦ Department of German Philology  
◦ Universität Regensburg  
◦ Professor for German Linguistics  
✉ paul.roessler@ur.de  
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