

# Dr. rer. nat. Sebastian Lapuschkin

\* December 16, 1986 in Würzburg

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[scholar.google.com/citations?user=wpLQuroAAAAJ](https://scholar.google.com/citations?user=wpLQuroAAAAJ)



## Short Bio

Sebastian Lapuschkin is the Head of the Explainable Artificial Intelligence research group at Fraunhofer Heinrich Hertz Institute (HHI) in Berlin.

He received his Ph.D. degree with distinction from the Technische Universität Berlin in 2018 for his pioneering contributions to the field of Explainable Artificial Intelligence (XAI) and interpretable machine learning. From 2007 to 2013 he studied computer science (B. Sc. and M. Sc.) at the Technische Universität Berlin, with a focus on software engineering and machine learning.

Sebastian is the recipient of multiple awards, including the Hugo-Geiger-Prize for outstanding doctoral achievement and the 2020 Pattern Recognition Best Paper Award.

His research has shaped the field of XAI from the very beginning, with contributions to the first wave of XAI such as the popular and widely-used Layer-wise

Relevance Propagation method, as well as timely works influencing the second wave of XAI with additions to the sub-fields of Mechanistic Interpretability, Data Attribution and XAI-based model- and data improvement.

Sebastian is an avid advocate for Open Science, demonstrated by numerous Free Open Source Software toolboxes published with the intent to warrant and facilitate reproducibility in AI research.

Since 2024 he is co-organizing The World Conference on eXplainable Artificial Intelligence and serves as a Topic Editor on “Opportunities and Challenges in Explainable Artificial Intelligence” for the MDPI Open Access Journals.

Further research interests include efficient machine learning and data analysis, as well as data and algorithm visualization.

## Professional Experience

Technological University Dublin

DUBLIN, IRELAND

### External Scholar

2025 -

at the Centre of eXplainable Artificial Intelligence. The Centre is the first of its kind in the Republic of Ireland and it aims to increase further and synergise cross-centres, college and external research collaboration.

Multidisciplinary Digital Publishing Institute (MDPI)

### Topic Editor

2024 - 2026

for “Opportunities and Challenges in Explainable Artificial Intelligence”.

Submission pre-screening, review management and decision handling.

XAI4Science

### Organizer

2024 -

of the 1st workshop “XAI4Science: From Understanding Model Behavior to Discovering New Scientific Knowledge (2025)”, co-located with ICLR 2025 at Singapore EXPO, Singapore.

TBA: 2nd of the workshop at AAAI 2026, Singapore.

World Conference on eXplainable Artificial Intelligence

### Steering Committee Member

2024 -

for the 3rd XAI World Conference (2025) in Istanbul, Turkey, as well as future undisclosed instances of the conference.

Panelist, Conference and Special Track co-organization.

### Programme Committee Chair

2023 - 2024

for the 2nd XAI World Conference (2024) in Valetta, Malta.

Conference and Special Track co-organization.

Fraunhofer Heinrich-Hertz-Institute

BERLIN, GERMANY

### Contact Person

2025 -

for the Erasmus Mundus Joint Master in Intelligent Field Robotic Systems (IFRoS) associate partnership of Fraunhofer HHI.

**Ethics Committee Member**

2023 -

Founding member of the first ethics committee at Fraunhofer HHI.

*Responsibilities:* Fulfilling the task and demand of assessing ethical aspects of research on and with humans, as well as general ethical issues.

**Head of Explainable Artificial Intelligence**

2021 -

Research Group Leadership and direction of XAI research & applications.

(current number of staff: 1 PostDocs, 20 PhD researchers, 30+ student research assistants & 3 Technical Staff).

*Research:* Work towards the next generation of local-global Explainable AI approaches and XAI-based model improvement by, e.g., increasing efficiency (see also) and debugging model training, reasoning and datasets (see also). Provision of powerful modified backprop XAI for Pytorch models, and tools for reproducible XAI evaluations to the community, e.g., via Zennit, LXT and Quantus.

*Further responsibilities:* Project management and (funding) acquisition. Recruitment and guidance of research personnel. Founding member of the Ethics Committee at Fraunhofer HHI.

**Tenured Researcher**

2019 - 2020

PostDoc research position in the Machine Learning Group at Fraunhofer HHI.

*Research:* Development of Spectral Relevance Analysis, automating the detection of “Clever Hans” moments in machine learning. Measurably increasing the explanation quality of local XAI. Provision of modified backprop XAI in Keras/Tensorflow via iNNvestigate.

*Further responsibilities:* Project (funding) acquisition. Recruitment and guidance of PhD students and student research assistants.

**Research Associate**

2014 - 2018

Founding member of the Machine Learning Group at Fraunhofer HHI.

*Research:* Furthering XAI research with the development and evaluation of corresponding methods, as well as applications in various expert domains, resulting in several highly cited publications, open source software tools and repositories, and the first recorded encounter of the “Clever Hans” effect in machine learning via XAI.

*Other contributions:* Contributions to the h.266 (VVC) video codec via learnable intra-frame prediction filters. Planning and conceptualization of an HPC cluster with modern GPU hardware implemented at Fraunhofer HHI. Development and showcasing multiple XAI demos at international events.

Technische Universität Berlin

BERLIN, GERMANY

**Research Associate**

2013 - 2014

*Research:* Formalization and development of the “Layer-wise Relevance Propagation” (LRP) method of Explainable AI for explaining individual predictions of nonlinear machine learning models.

Supervision by Prof. Dr. Klaus-Robert Müller.

**Student Research- & Teaching Assistant**

2011 - 2013

*Research:* Structure and cell type detection in large histopathology images using Bag of Words features and SVM classifiers. Development of XAI for the pipeline.

*Teaching:* Preparation and lecturing (of exercise sessions) in the courses “Machine Learning 1” and “Machine Learning 2 – Theory and Application” and associated academic courses. Visualization and animation of data and learning algorithms discussed throughout the course work.

Research & Teaching assistant to Prof. Dr. Klaus-Robert Müller.

**Student Teaching Assistant**

2009 - 2011

Course instruction for algorithmic and practical foundations of computer science (B.Sc.): Basic and advanced Java development, software engineering and OOP concepts, algorithms on image and graph data, among others.

Teaching assistant to Prof. Dr. Marc Alexa, Prof. Dr. Odej Kao and Prof. Dr. Oliver Brock.

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**Education**

Technische Universität Berlin

BERLIN, GERMANY

**PhD in Machine Learning (*summa cum laude*)**

2018

*Date of oral defense:* December 19<sup>th</sup>, 2018.

*Dean's signature on Doctorate Certificate dated* January 23<sup>rd</sup>, 2019.

Research and application of methods of *Explainable AI (XAI)*: Layer-wise Relevance Propagation, Deep Taylor Decomposition and Spectral Relevance Analysis.

Thesis: “Opening the machine learning black box with Layer-wise Relevance Propagation”

Supervision headed by Prof. Dr. Klaus-Robert Müller.

## Master of Science in Computer Science

2013

Focus on machine learning, computer vision and large scale data analysis.

Thesis: "On Pixel-wise Predictions from Image-wise Bag of Words Classification"

Thesis supervision headed by Prof. Dr. Alexander Binder.

## Bachelor of Science in Computer Science

2010

Focus on algorithms and software development

Thesis: "Keyword-Based Image Browsing of Large Image Databases"

Thesis supervision headed by Prof. Dr. Kristian Hildebrand.

Deutschhaus-Gymnasium

Abitur (pre-university secondary education)

WÜRZBURG, GERMANY

2007

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## Teaching

*See section "Talks & Lectures / Invited Lectures" below for a list of additional invited and individual lectures held.*

**WS 24/25** Machine Learning Seminar.

[**Universitat de Girona / IFRoS**. Guest Lecturer. Interactive Block Seminar "An Introduction to Explainable AI", 1 full week.]

**WS 23/24** Machine Learning Seminar.

[**Universitat de Girona / IFRoS**. Guest Lecturer. Interactive Block Seminar "Explainable AI", 1 full week.]

**WS 23/24** Responsible Artificial Intelligence 1.

[**Technische Universität Berlin**. Co-Teaching, Lecture Design, Interactive Coding Sessions.]

**WS 21/22** Machine Learning Seminar.

[**Universitat de Girona**. Guest Lecturer. Interactive Block Seminar "Explainable AI", 1 full week.]

**SS 17** Seminar Cognitive Algorithms (block seminar).

[**Technische Universität Berlin**. 1:1 Student Guidance and Co-Supervision, Grading.]

**WS 13/14** Python Programming for Machine Learning (block seminar).

[**Technische Universität Berlin**. Co-Teaching, Grading, Exercise Design.]

Matlab Programming for Machine Learning and Data Analysis (block seminar).

[**Technische Universität Berlin**. Co-Teaching, Grading, Exercise Design.]

**SS13** Integrated Lecture Machine Learning II.

[**Technische Universität Berlin**. Teaching (Exercise sessions), Grading, Exercise Design.]

Python Programming for Machine Learning (block seminar).

[**Technische Universität Berlin**. Co-Teaching, Grading, Exercise Design.]

**WS 12/13** Integrated Lecture Machine Learning I.

[**Technische Universität Berlin**. Teaching (Exercise sessions), Grading, Exercise Design.]

Matlab Programming for Machine Learning and Data Analysis (block seminar).

[**Technische Universität Berlin**. Co-Teaching, Grading, Exercise Design.]

**SS12** Machine Learning II – Theory and Application.

[**Technische Universität Berlin**. Teaching (Exercise sessions), Grading, Exercise Design.]

Matlab Programming for Machine Learning and Data Analysis (block seminar).

[**Technische Universität Berlin**. Co-Teaching, Grading, Exercise Design.]

**WS 11/12** Machine Learning I.

[**Technische Universität Berlin**. Teaching (Exercise sessions), Grading, Exercise Design.]

Matlab Programming for Machine Learning and Data Analysis (block seminar).

[**Technische Universität Berlin**. Co-Teaching, Grading, Exercise Design.]

**SS 11** Methodisch-praktische Grundlagen der Informatik 2 ("Algorithms and Data Structures").

[**Technische Universität Berlin**. Teaching (Exercise sessions), Grading, Exercise Design.]

**WS 10/11** Methodisch-praktische Grundlagen der Informatik 4 ("Advanced Algorithms").

[**Technische Universität Berlin**. Teaching (Exercise sessions), Grading, Exercise Design.]

**SS 10** Methodisch-praktische Grundlagen der Informatik 2 ("Algorithms and Data Structures").

[**Technische Universität Berlin**. Teaching (Exercise sessions), Grading, Exercise Design.]

## Talks & Lectures

### Talks

*excludes internal/confidential events*

1. "Explainability in the Era of LLMs: New Challenges and Pathways to Actionable Insights" (2025-08-14).  
*2025 Workshop on Self-Supervised Learning for Signal Decoding, Aalborg, Denmark, (invited talk)*
2. "Decoding AI: How Explainability Unlocks Actionable Insights" (2025-05-23).  
*dida conference 2025, Berlin, Germany, (invited talk)*
3. "Artificial Intelligence We Can Trust – From Explainable to Actionable and Regenerative AI" (2024-02-02).  
*MPNE Consensus 2024 Workshop, Berlin, Germany, (invited talk)*
4. "From Concepts to Prototypes – Towards Minimal Effort Post-Hoc Interpretability" (2024-01-12).  
*2<sup>nd</sup> Machine Teaching for XAI Workshop (MT4XAI), Valencia, Spain, (invited talk)*
5. "Explaining AI with Concept Relevance Propagation" (2023-10-06).  
*4<sup>th</sup> Japanese-American-German Frontiers of Science (JAGFOS) Symposium, Dresden, Germany, (flash talk & poster, invited)*
6. "Model-Assisted Data Analysis via XAI" (2023-07-05).  
*19<sup>th</sup> Machine Learning in Healthcare Meetup Berlin, Berlin Institute of Health, (invited talk)*
7. "Accessing the Hidden Space with Explainable Artificial Intelligence" (2023-06-27).  
*Informatik-Kolloquium, Universität Bremen, (invited talk)*
8. "Explainable AI and Beyond with Concept Relevance Propagation" (2023-05-24).  
*Data Professional Days / Data4Business Days Köln, (keynote)*
9. "Beyond Heatmaps – Explaining with Concepts" (2022-10-21).  
*BIFOLD Graduate School Welcome Days, (invited talk)*
10. "Explain to Not Forget: Defending Against Catastrophic Forgetting with XAI " (2022-08-24).  
*CD-MAKE 2022, (paper presentation)*
11. "Zukünftige Trends in der KI und Einsatzmöglichkeiten im Bauwesen" (2022-06-24).  
*BIMKIT Jahresveranstaltung 2022, (keynote)*
12. "Beyond Explaining" (2021-06-03).  
*Melanoma Patient Network Europe Meet-up – MPNE meets AI , (invited talk)*
13. "Beyond Explaining: Explainable AI for Model Improvement" (2021-05-05).  
*Sensor and Measurement Science International 2021, (invited talk)*
14. "Efficient and Effective Neural Network Pruning with Layer-wise Relevance Propagation" (2020-11-12).  
*Machine Learning Seminar at Fraunhofer HHI / Technische Universität Berlin*
15. "Towards Best Practice in Explaining Neural Network Decisions with LRP" (2020-07-21).  
*IEEE World Congress on Computational Intelligence 2020 / IJCNN 2020*
16. "XAI for Analyzing and Unlearning Spurious Correlations in ImageNet" (2020-07-18).  
*XXAI: Extending Explainable AI Beyond Deep Models and Classifiers, (ICML 2020 Workshop)*
17. "XAI via LRP and SpRAy" (2020-07-02).  
*Ada Day at Ada Lovelace Center / Fraunhofer IIS, (invited talk)*
18. "Interpretable Machine Learning through Layer-wise Relevance Propagation" (2020-02-18).  
*Fraunhofer Symposium Netzwert 2020*
19. "Interpretable Machine Learning through Layer-wise Relevance Propagation" (2019-12-12).  
*Gesellschaft von Freunden des HHI e.V.*
20. "Explainable Artificial Intelligence — Opening the Machine Learning Black Box with Layer-wise Relevance Propagation" (2019-09-26).  
*AMA Wissenschaftsrat 2019, (invited talk)*
21. "Finding Clever Hans" (2019-07-16).  
*Universität Bamberg, (invited talk & press interview)*
22. "AI – Opening the Black Box" (2019-02-25).  
*Robert Koch Institut, (invited talk)*
23. "AI – Opening the Black Box" (2019-02-22).  
*Technology Innovation Day – 91 Years HHI*

24. "Understanding and Comparing Deep Neural Networks for Age and Gender Classification" (2017-10-27).  
*ICCV'17 Workshop on Analysis and Modeling of Faces and Gestures*
25. "Layer-wise Relevance Propagation" (2014-09-10).  
*IDA Retreat'14*

#### Invited Lectures

*Individual Lectures as Parts of Seminars and Workshops*

1. "XAI as a Tool Beyond Model Understanding – From Heatmaps to Concepts and XAI Automation" (2024-11-27).  
*CBS CoCoNUT | Max Planck Institute for Human Cognitive and Brain Sciences | Leipzig*
2. "Human-Understandable Explanations through Concept Relevance Propagation" (2023-01-12).  
*Machine Teaching for Humans Workshop, Madeira | University of Bergen, (invited, keynote)*
3. "Towards Human-understandable Explanations with XAI 2.0" (2022-10-24).  
*AI4Good webinar series of the International Telecommunication Union (ITU), (streaming link)*
4. "Towards Actionable XAI" (2022-09-27).  
*International Artificial Intelligence Doctoral Academy, (link to slides and video)*
5. "Recent Advances in Explainable AI" (2022-09-08).  
*BB-KI-Chips Summer School Potsdam | Universität Potsdam*
6. "XAI BEYOND EXPLAINING: Using Explainability for Improving Deep Machine Learning Models" (2021-08-27).  
*2nd Summer School on Machine Learning in Bioinformatics | Higher School of Economics Moscow, (link to video)*
7. "Neuronale Netze mit LRP (richtig) erklären" (2020-08).  
*KI-Campus | Die Lernplattform für Künstliche Intelligenz*
8. "Explainable Artificial Intelligence — Opening the Machine Learning Black Box with Layer-wise Relevance Propagation" (2019-08-16).  
*SIMULA Summer School on Smart cities for a Sustainable Energy Future - From Design to Practice*

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#### Supervision & Guidance

Collaboration with and (co-)supervision of 3 (Senior) Technical Staff, 2 PostDocs, 32 PhD Students, 40+ Master's Students, 3 Bachelor's Students and 9 Guest Researchers since 2017

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#### Third-Party Funded Research Projects

|   |                   |
|---|-------------------|
| <b>xJuRAG</b><br>Explainable AI für juristische RAG-Anwendungen. leading role.                                      | 2025/10 - 2028/09 |
| <b>EPIBMI</b><br>Explainable & Physics-Informed-based Model Improvements. leading role.                             | 2025/08 - 2026/10 |
| <b>ACHILLES</b><br>Human-Centred Machine Learning: Lighter, Clearer, Safer. leading role.                           | 2024/12 - 2028/11 |
| <b>TEMA</b><br>Trusted Extremely Precise Mapping and Prediction for Emergency Management. leading role.             | 2022/12 - 2026/11 |
| <b>DAKI-FWS</b><br>Data- and AI-supported Early Warning System  | 2021/12 - 2024/22 |
| <b>iToBoS</b><br>Intelligent Total Body Scanner. leading role.  | 2021/04 - 2025/03 |
| <b>BerDiBa</b><br>Berlin Digital Rail Operations  | 2021/01 - 2024/07 |
| <b>Patho234</b><br>Machine Learning-driven Multidimensional Imaging Analysis of Reactive and Neoplastic Lymph Nodes | 2020/01 - 2022/12 |
| <b>TraMeExCo</b><br>Transparent Medical Expert Companion  | 2018/09 - 2021/08 |

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## Honors & Awards

|   |             |
|---|-------------|
| <b>Machine Learning and the Physical Sciences Reproducibility Badge</b>   | 2024        |
| For the paper "PINNfluence: Influence Functions for Physics-Informed Neural Networks"   |             |
| <b>Stanford Top 2% Scientist Worldwide*</b>   | 2022 - 2024 |
| Among the 2% most impactful researchers of 2024 <sup>(rank(ns)=114,641)</sup> , 2023 <sup>(rank(ns)=136,075)</sup> , 2022 <sup>(rank(ns)=195,784)</sup> |             |
| *) which is to be taken with a grain of salt.   |             |
| <b>Best Short Paper Award @ ETRA</b>  | 2023        |
| The ACM Symposium for Eye Tracking Research and Applications  |             |
| <b>Pattern Recognition Best Paper Award and Pattern Recognition Medal</b>   | 2020        |
| For the paper "Explaining NonLinear Classification Decisions with Deep Taylor Decomposition"  |             |
| <b>Hugo-Geiger-Prize (1st place)</b>  | 2019        |
| Förderpreis für herausragende Promotionsleistungen  |             |
| <b>Freunde des HHI Nachwuchspreis</b>   | 2019        |
| Förderpreis für exzellente wissenschaftliche Arbeiten am HHI  |             |
| <b>ERCIM Cor van Baayen Award (finalist)</b>  | 2019        |
| Cor Baayen Young Researcher Award   |             |
| <b>Best Paper Award @ ICMLW</b>   | 2016        |
| ICML'16 Workshop on Visualization for Deep Learning   |             |

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## Patents

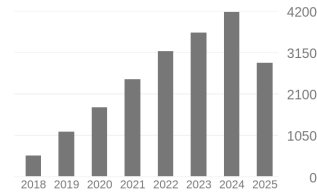
|  |                      |
|--|----------------------|
| <b>Attention Head Functionalities in Machine Learning Models</b>   | 2025                 |
| TBA "Attention Head Functionalities in Machine Learning Models"  | published 2025-05-15 |
| <b>Relevance Score Assignment dealing with an Attention Module and Applications thereof</b>              | 2024                 |
| WO 2025163210 A1 "Relevance Score Assignment dealing with an Attention Module and Applications thereof"  | published 2025-02-03 |
| <b>A Concept Representation of a Machine Learning Model</b>  | 2024                 |
| TBA "A concept representation of a machine learning model"   | published 2024-12-11 |
| <b>Analyzing an Inference of a Machine Learning Predictor</b>  | 2023                 |
| WO 2023237560 A1 "Analyzing an Inference of a Machine Learning Predictor"                                | published 2023-12-14 |
| <b>Method and System for Simulating an Optical Image of a Photonic and/or Electronic Device</b>          | 2022                 |
| EP 4001902 A1 "Method and System for Simulating an Optical Image of a Photonic and/or Electronic Device" | published 2022-05-25 |
| <b>Pruning and/or Quantizing Machine Learning Predictors</b>   | 2020                 |
| EP 3991102 A1 "Pruning and/or Quantizing Machine Learning Predictors"                                    | published 2022-05-04 |
| US 2022/0114455 A1 "Pruning and/or Quantizing Machine Learning Predictors"                               | published 2022-04-14 |
| WO 2020/260656 A1 "Pruning and/or Quantizing Machine Learning Predictors"                                | published 2020-12-30 |
| <b>Relevance Score Assignment for Artificial Neural Networks</b>   | 2016                 |
| US 20180018553 "Relevance Score Assignment for Artificial Neural Networks "                              | granted 2024-10-04   |
| CN 107636693 "Relevance Score Assignment for Artificial Neural Networks"                                 | granted 2022-01-11   |
| EP 3271863 "Relevance Score Assignment for Artificial Neural Network"                                    | granted 2021-07-28   |
| JP 6725547 "Relevance Score Assignment for Artificial Neural Networks"                                   | granted 2020-07-22   |
| KR 102130162 "Assignment of Relevance Scores for Artificial Neural Networks"                             | granted 2020-07-06   |
| CA 2979579 "Relevance Score Assignment for Artificial Neural Networks"                                   | granted 2020-02-18   |
| RU 2703343 "Relevancy Assessment for Artificial Neural Networks"   | granted 2019-10-16   |
| BR 112017019821 "Relevance Score Assignment for Artificial Neural Networks "                             | published 2018-05-15 |
| WO 2016150472 A1 "Relevance score assignment for artificial neural network"                              | published 2016-09-29 |

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## Publications

### Summary of Scientific Impact

|                | All   | Since 2020 |
|----------------|-------|------------|
| # Publications | 96    | 76         |
| # Citations    | 20446 | 18256      |
| h-index        | 37    | 36         |
| i10-index      | 62    | 61         |



per Google Scholar, retrieved on September 24<sup>th</sup>, 2025.

### List of Publications

#### Journal Articles

1. Dreyer M, Berend J, Labarta T, Vielhaben J, Wiegand T, **Lapuschkin S** and Samek W (2025).  
“Mechanistic Understanding and Validation of Large AI Models with SemanticLens”.  
In: *Nature Machine Intelligence* 1–14.  
<https://github.com/jim-berend/semanticlens> | Demo: <https://semanticlens.hhi-research-insights.eu>
2. Pahde F, Wiegand T, **Lapuschkin S** and Samek W (2025).  
“Ensuring Medical AI Safety: Explainable AI-Driven Detection and Mitigation of Spurious Model Behavior and Associated Data”.  
In: *Machine Learning* 114(9):206.  
<https://github.com/frederikpahde/medical-ai-safety>
3. Ma J, Weicken E, Pahde F, Weitz K, **Lapuschkin S**, Samek W and Wiegand T (2025).  
“Künstliche Intelligenz auf dem Prüfstand: Anforderungen, Qualitätskriterien und Prüfwerkzeuge für medizinische Anwendungen [Artificial intelligence under scrutiny: requirements, quality criteria, and testing tools for medical applications]”.  
In: *Bundesgesundheitsblatt – Gesundheitsforschung – Gesundheitsschutz* 68:915-923
4. Storås A M, Dreyer M, Pahde F, **Lapuschkin S**, Samek W, Halvorsen P, de Lange T, Mori Y, Hann A, Berzin T M, Parasa S and Riegler M A (2025).  
“Exploring the Clinical Value of Concept-based AI Explanations in Gastrointestinal Disease Detection”.  
In: *Scientific Reports* 15(1):28860.  
<https://github.com/AndreaStoraas/conceptXAI-GItract>
5. Weber L, Berend J, Weckbecker M, Binder A, Wiegand T, Samek W and **Lapuschkin S** (2025).  
“Efficient and Flexible Neural Network Training through Layer-wise Feedback Propagation”.  
In: *Transactions on Machine Learning Research* 9oToxYVOSW.  
<https://github.com/leanderweber/layerwise-feedback-propagation>
6. Hedström A, Bommer P L, Burns T F, **Lapuschkin S**, Samek W and Höhne M-C M (2025).  
“Evaluating Interpretable Methods via Geometric Alignment of Functional Distortions”.  
In: *Transactions on Machine Learning Research* ukLxqA8zXj.  
<https://github.com/annahedstroem/GEF> | TMLR Survey Certification
7. Bley F, **Lapuschkin S**, Samek W and Montavon G (2025).  
“Explaining Predictive Uncertainty by Exposing Second-Order Effects”.  
In: *Pattern Recognition* 160:111171.  
<https://github.com/florianbley/XAI-2ndOrderUncertainty>
8. Vielhaben J, **Lapuschkin S**, Montavon G and Samek W (2024).  
“Explainable AI for Time Series via Virtual Inspection Layers”.  
In: *Pattern Recognition* 150:110309.  
<https://github.com/jvielhaben/DFT-LRP>
9. Becker S, Vielhaben J, Ackermann M, Müller K-R, **Lapuschkin S** and Samek W (2024).  
“AudioMNIST: Exploring Explainable Artificial Intelligence for Audio Analysis on a Simple Benchmark”.  
In: *Journal of the Franklin Institute* 361(1):418–428.  
<https://github.com/soerenab/AudioMNIST>
10. Achibat R, Dreyer M, Eisenbraun I, Bosse S, Wiegand T, Samek W and **Lapuschkin S** (2023).  
“From attribution maps to human-understandable explanations through Concept Relevance Propagation”.  
In: *Nature Machine Intelligence* 5(9):1006–1019.  
<https://github.com/rachtibat/zennit-crp> | <https://github.com/maxdreyer/crp-human-study>
11. Hedström A, Bommer P, Wickstrøm K K, Samek W, **Lapuschkin S** and Höhne M-C M (2023).  
“The Meta-Evaluation Problem in Explainable AI: Identifying Reliable Estimators with MetaQuantus”.

- In: *Transactions on Machine Learning Research* j3FK00HyfU.  
<https://github.com/annahedstroem/MetaQuantus>
12. Weber L, **Lapuschkin S**, Binder A and Samek W (2023).  
 “Beyond Explaining: Opportunities and Challenges of XAI-Based Model Improvement”.  
 In: *Information Fusion* 92:154–176
  13. Hedström A, Weber L, Krakowczyk D G, Bareeva D, Motzkus F, Samek W, **Lapuschkin S** and Höhne M-C M (2023).  
 “Quantus: An Explainable AI Toolkit for Responsible Evaluation of Neural Network Explanations and Beyond”.  
 In: *Journal of Machine Learning Research* 24(34):1–11.  
<https://github.com/understandable-machine-intelligence-lab/quantus>
  14. Hofmann S M, Beyer F, **Lapuschkin S**, Golterman O, Loeffler M, Müller K-R, Villringer A, Samek W and Witte A V (2022).  
 “Towards the Interpretability of Deep Learning Models for Multi-modal Neuroimaging: Finding Structural Changes of the Ageing Brain”.  
 In: *NeuroImage* 261:119504
  15. Ma J, Schneider L, **Lapuschkin S**, Achtibat R, Duchrau M, Krois J, Schwendicke F and Samek W (2022).  
 “Towards Trustworthy AI in Dentistry”.  
 In: *Journal of Dental Research* 00220345221106086
  16. Rieckmann A, Dworzynski P, Arras L, **Lapuschkin S**, Samek W, Onyebuchi A A, Rod N H, Ekstrøm C T (2022).  
 “Causes of Outcome Learning: A Causal Inference-inspired Machine Learning Approach to Disentangling Common Combinations of Potential Causes of a Health Outcome”.  
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