

curriculum vitae of
Christian Bock

ML FOR HEALTHCARE · TIME SERIES ANALYSIS · DEEP LEARNING
TOPOLOGICAL DATA ANALYSIS · GRAPH-STRUCTURED DATA

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EDUCATION

- Oct. 2017 – present **Ph.D.** in Machine Learning and Healthcare ETH ZURICH, SWITZERLAND
I develop and apply methods from **topological data analysis** for machine learning tasks such as graph classification or to improve our understanding of deep learning and neuroscience. Further, I utilize and develop methods for the classification of real-world **biomedical time-series**. These methods extend to **statistical work** on pioneering significant pattern mining for time-series data.
- Apr. 2015 – Mar. 2017 **M.Sc.** in Biomedical Informatics (valedictorian, final grade 1.1/A) HEIDELBERG UNIVERSITY, GERMANY
Thesis title: “Analysis and Classification of Pathogenic Amino Acid Substitutions in Predicted Protein Structures and Special Classes of Proteins”. Authored at the University of Washington, Seattle.
- Oct. 2011 – Mar. 2015 **B.Sc.** in Biomedical Informatics (top of class, final grade 1.4/A) HEIDELBERG UNIVERSITY, GERMANY
Thesis title: “A Feasibility Study of a Home-Based Sensor System for Older Adults, using the Microsoft HomeOS Platform”. Authored at University of Washington, Seattle.

PUBLICATIONS

Authors who equally contributed to a publication are marked with a †.

CONFERENCE AND JOURNAL PUBLICATIONS

1. Bastian Rieck[†], **Christian Bock**[†], and Karsten Borgwardt. A Persistent Weisfeiler-Lehman Procedure for Graph Classification. In *Proceedings of the 36th International Conference on Machine Learning (ICML)*, 2019.
2. Bastian Rieck[†], Matteo Togninalli[†], **Christian Bock**[†], Michael Moor, Max Horn, Thomas Gumbsch, and Karsten Borgwardt. Neural persistence: A complexity measure for deep neural networks using algebraic topology. In *Proceedings of the 7th International Conference on Learning Representations (ICLR)*, 2019.
3. **Christian Bock**[†], Matteo Togninalli[†], Elisabetta Ghisu, Thomas Gumbsch, Bastian Rieck, and Karsten Borgwardt. A Wasserstein Subsequence Kernel for Time Series. In *Proceedings of the 19th IEEE International Conference on Data Mining (ICDM)*, 2019.
4. **Christian Bock**, Thomas Gumbsch, Michael Moor, Bastian Rieck, Damian Roqueiro, and Karsten Borgwardt. Association Mapping in Biomedical Time Series via Statistically Significant Shapelet Mining. In *Bioinformatics, Volume 34*, 2018.
5. Stephanie L Hyland[†], Martin Faltys[†], Matthias Hüser[†], Xinrui Lyu[†], Thomas Gumbsch[†], Cristóbal Esteban, **Christian Bock**, Max Horn, Michael Moor, Bastian Rieck, Marc Zimmermann, Dean Bodenham, Karsten Borgwardt, Gunnar Rätsch, and Tobias M Merz. Machine Learning for Early Prediction of Circulatory Failure in the Intensive Care Unit. *Nature Medicine* 26, 2020.
6. Bastian Rieck[†], Tristan Yates[†], **Christian Bock**, Karsten Borgwardt, Guy Wolf, Nicholas Turk-Browne, and Smita Krishnaswamy. Uncovering the Topology of Time-Varying fMRI Data using Cubical Persistence. Accepted as spotlight presentation at the 34th Conference on Neural Information Processing Systems (NeurIPS), 2020.
7. Max Horn, Michael Moor, **Christian Bock**, Bastian Rieck, and Karsten Borgwardt. Set Functions for Time Series. In *Proceedings of the 37th International Conference on Machine Learning (ICML)*, 2020.

8. Thomas Gumbsch, **Christian Bock**, Michael Moor, Bastian Rieck, and Karsten Borgwardt. Enhancing statistical power in temporal biomarker discovery through representative shapelet mining, Accepted for presentation at *the 19th European Conference on Computational Biology (ECCB)*, 2020.
9. Tianyun Liu, Shirbi Ish-Shalom, Wen Torng, Aleix Lafita, **Christian Bock**, Matthew Mort, David N Cooper, Spencer Bliven, Guido Capitani, Sean D Mooney, and Russ B Altman. Biological and Functional Relevance of CASP Predictions. In *Proteins: Structure, Function, and Bioinformatics, Volume 86*, 2018.
10. Gustavo Glusman, Peter W Rose, Andreas Prlić, Jennifer Dougherty, José M Duarte, Andrew S Hoffman, Geoffrey J Barton, Emøke Bendixen, Timothy Bergquist, **Christian Bock**, Elizabeth Brunk, Marija Buljan, Stephen K Burley, et al. . Mapping Genetic Variations to Three-Dimensional Protein Structures to Enhance Variant Interpretation: A Proposed Framework. In *Genome Medicine, Volume 9*, 2017.
11. Anne M Turner, Julio C Facelli, Monique Jaspers, Thomas Wetter, Daniel Pfeifer, Laël Cranmer Gatewood, Terry Adam, YuChuan Li, Ming-Chin Lin, R Scott Evans, Anna Beukenhorst, Hugo JT van Mens, Esmée Tensen, **Christian Bock**, et al. . Solving Interoperability in Translational Health. In *Applied Clinical Informatics, Volume 8*, 2017.
12. **Christian Bock**, George Demiris, Yong Choi, Thai Le, Hilaire J Thompson, Arjmand Samuel, and Danny Huang. Engaging Older Adults in the Visualization of Sensor Data Facilitated by an Open Platform for Connected Devices. In *Technology and Health Care, Volume 24*, 2016.
13. George Demiris, Thai Le, **Christian Bock**, Hilaire J Thompson, Arjmand Samuel, Danny Huang, and Amar Phanishayee. Privacy Considerations for the Visualization of Longitudinal Activity and Environmental Data Generated by Smart Home Applications for Older Adults. In *The Gerontologist, Volume 55*, 2015.
14. **Christian Bock**, Thai Le, Arjmand Samuel, Danny Huang, Hilaire J Thompson, and George Demiris. Visualizing Sensor Data through an Open Platform for Connected Devices. In *Studies in Health Technology and Informatics, Volume 216*, 2015.

WORKSHOP PUBLICATIONS

15. **Christian Bock**[†], Matteo Togninalli[†], Elisabetta Ghisu, Thomas Gumbsch, Bastian Rieck, and Karsten Borgwardt. A Wasserstein Subsequence Kernel for Time Series. At the *Optimal Transport & Machine Learning Workshop at NeurIPS*, 2019.[†]
16. Michael Moor, Max Horn, **Christian Bock**, Karsten Borgwardt, and Bastian Rieck. Path Imputation Strategies for Signature Models. At the *Workshop on the Art of Learning with Missing Values (Artemiss) at ICML*, 2020.

BOOK CHAPTERS

17. **Christian Bock**[†], Michael Moor[†], Catherine R Jutzeler, and Karsten Borgwardt. Machine Learning for Biomedical Time Series Classification: From Shapelets to Deep Learning. In *Artificial Neural Networks, pp. 33-71*. Springer US, 2020.

PRESENTATIONS AND TALKS

Jun. /Jul. 2020	The Machine Learning Summer School (MLSS) [Video] “Predicting stress-induced myocardial ischemia from multi-lead ECG using multi-task learning”.	VIRTUAL
Nov. 2019	19 th IEEE International Conference on Data Mining (ICDM) [Oral] “A Wasserstein Subsequence Kernel for Time Series”.	BEIJING, CHINA
Jul. 2018	26 th Conference on Intelligent Systems for Molecular Biology (ISMB) [Oral] “Association Mapping in Biomedical Time Series via Statistically Significant Shapelet Mining”.	CHICAGO, IL, USA

[†]An extension of the ICDM paper with more experiments, comparisons, and discussions.

Jun. 2018 Personalized Health Technologies and Translational Research Conference ZURICH, SWITZERLAND
[Oral] “Association Mapping in Biomedical Time Series via Statistically Significant Shapelet Mining”.

HONORS AND SCHOLARSHIPS

2011 – 2017	Full undergraduate and graduate scholarship	FRIEDRICH-EBERT FOUNDATION, GERMANY
2017	DREAM Challenges Student Travel Scholarship	INT. SOCIETY FOR COMP. BIOLOGY, USA
2017	Finalist for the “Wings of Excellence” Award	ST. GALLEN SYMPOSIUM, SWITZERLAND
2017	Award for graduating top of class	CHILLI GMBH, GERMANY
2016	Full travel scholarship to participate in the IPHIE Master Class	HEIDELBERG UNIVERSITY, GERMANY
2015	Award for graduating top of class	ERNST-FRANZ VOGELMANN FOUNDATION, GERMANY
2014	1 st Prize at the Startp Weekend	UNIVERSITY OF WASHINGTON, USA

SERVICE TO THE SCIENTIFIC COMMUNITY

Reviewing	Conferences NeurIPS (2020), ML4H Workshop at NeurIPS (2020), AAAI (2021), ICLR (2021), MLHC (2020), ECML-PKDD (2019)
	Journals OUP Bioinformatics (2020), IEEE Transactions on Neural Networks and Learning Systems (TNNLS) (2019), Springer Machine Learning (2019)
Supervision	Master’s Theses Levente Lippenszky. “Generalizing the Wasserstein Time Series Kernel Using Locality Sensitive Hashing”. Co-Supervision with the Seminar of Statistics (ETH Zurich)
Teaching	Teaching Assistant for Data Mining I (2019) ETH ZURICH, SWITZERLAND Contents of the Lecture: Similarity measures and metrics, Classification algorithms (k NN, Naive Bayes, Linear Discriminant Analysis, Logistic Regression, Decision Trees, Support Vector Machines), Kernel methods, Clustering ((Kernel) k -means), DBScan, Spectral Clustering, EM Clustering, Hierarchical Clustering)
	Teaching Assistant for Data Mining II (2021) ETH ZURICH, SWITZERLAND Contents of Lecture: (Kernel) Principal Component Analysis, Singular Value Decomposition, Multidimensional Scaling, Self-Organizing Maps, Transductive Learning, Correlation, Association Rule and Graph Mining, Topic Modeling
Others	Program Committee Memberships ‘Topological Data Analysis and Beyond’ workshop at NeurIPS 2020. ‘Machine Learning for Pharma and Healthcare Applications’ (PharML) workshop at ECML-PKDD 2020.

SKILLS

Strong knowledge of **python**¹ with a focus on data science libraries such as **numpy**, **pytorch**, **pandas**, **scikit-learn**, **TensorFlow/Keras**.
Strong knowledge in **LaTeX** (including creating visualizations with **TikZ**), the **git** version control system, and the **bash** shell.
Working knowledge in **Java**, **JavaScript** (e.g. **node.js** and **d3.js**), **C++**, **SQL**, and **ABAP**.
Working knowledge in the **SNOMEDCT** medical ontology, the **HL7 FHIR** communication standard, and programming for the **SAP HANA** database.
German is my mother tongue, I speak and write proficient in English, and have elementary proficiency in French.

¹Example repositories: WTK, P-WL, or ml-on-fhir

EXTRACURRICULAR ACTIVITIES

- Jul. 2020 Machine Learning Summer School (2020) VIRTUAL
Participated in the two-weeks long summer school, which included lectures from Yoshua Bengio, Bernhard Schölkopf, Francis Bach, and others (acceptance rate: 13%). I presented our work on “Predicting stress-induced myocardial ischemia from multi-lead ECG using multi-task learning”.
- 2017 & 2018 St. Gallen Symposium ST. GALLEN, SWITZERLAND
Selected member of the academic jury for the global “Wings of Excellence” essay competition 2018. My 2017 essay titled “Towards a Global Electronic Health Record – Solving the Intrinsic Problem of a Data-Driven Healthcare System” was selected as an outstanding contribution. This included an invitation to the symposium as a “Leader of Tomorrow”.