Christian Bock

3RD YEAR PHD CANDIDATE · MACHINE LEARNING FOR HEALTHCARE

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Education

ETH Zürich (Swiss Federal Institute of Technology Zürich) *Basel, Switzerland*

PHD IN MACHINE LEARNING IN HEALTHCARE *Oct. 2017 - Present*

At the forefront of developing methods from Topological Data Analysis for classification purposes and to improve our understanding of deep learning.

Development and application of state-of-the-art attention and convolutional neural network models for biomedical time series data.

Developed the first method to find statistically significant subsequences in time series that efficiently reduces the search space using contingency table based pruning criteria.

Heidelberg University *Heidelberg, Germany*

M.SC. IN MEDICAL COMPUTER SCIENCE (VALEDICTORIAN, FINAL GRADE 1.1/A) *Apr. 2015 - Mar. 2017*

Thesis title: "Analysis and Classification of Pathogenic Amino Acid Substitutions in Predicted Protein Structures and Special Classes of Proteins". Written at University of Washington, Seattle.

Heidelberg University *Heidelberg, Germany*

B.SC. IN MEDICAL COMPUTER SCIENCE (TOP OF CLASS, FINAL GRADE 1.4/A) *Oct. 2011 - Mar. 2015*

Thesis title: "A Feasibility Study of a Home-Based Sensor System for Older Adults, using the Microsoft HomeOS Platform". Written at University of Washington, Seattle.

Publications

AUTHORS WHO EQUALLY CONTRIBUTED TO A PUBLICATION ARE MARKED WITH †.

Conference & Journal Publications

2019

- 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.
- 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.
- **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.
- 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. To appear in *Nature Medicine*.

2018

- **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.
- 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.

2017

- 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.
- 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.

2016

- **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.

2015

- 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.
- **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

2019

- **Christian Bock**†, Matteo Togninalli†, Elisabetta Ghisu, Thomas Gumbsch, Bastian Rieck, and Karsten Borgwardt. A Wasserstein Subsequence Kernel for Time Series. In *Optimal Transport & Machine Learning Workshop at NeurIPS*, 2019.[1]

Book Chapters

2020

- **Christian Bock**†, Michael Moor†, Catherine R Jutzeler, and Karsten Borgwardt. Machine Learning for Biomedical Time Series Classification: From Shapelets to Deep Learning. To be published in *Artificial Neural Networks* of the Springer Book Series *Methods in Molecular Biology* 2020.

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

Preprints

2019

- Max Horn, Michael Moor, **Christian Bock**, Bastian Rieck, and Karsten Borgwardt. Set Functions for Time Series. arXiv preprint arXiv:1909.12064. Also submitted to the 8th International Conference on Learning Representations (ICLR).

Honors & Scholarships

2011-2017	**Full Scholarship**: Full undergraduate and graduate scholarship	*Friedrich-Ebert Foundation, Germany*
2017	**Travel Scholarship**: DREAM Challenges Student Travel Scholarship	*International Society for Computational Biology, USA*
2017	**Finalist**: "Wings of Excellence" Award	*St. Gallen Symposium, Switzerland*
2017	**Award**: Award for graduating top of class	*Chili GmbH, Germany*
2016	**Travel Scholarship**: Full travel scholarship to participate in IPHIE Master Class in Salt Lake City, Utah, USA	*Heidelberg University, Germany*
2015	**Award**: Award for graduating top of class	*Ernst-Franz Vogelmann Foundation, Germany*
2014	**1st Prize**: Startup Weekend	*University of Washington, USA*

Skills

IT	git, bash, HL7 V2, HL7 FHIR, SAP HANA
Programming	Python[2] (numpy, pandas, scikit-learn, PyTorch, TensorFlow, Keras), JavaScript (d3.js, node.js), ABAP, LaTeX, SQL, C++
Languages	German (native speaker), English (professional proficiency), French (elementary proficiency)

Presentations

19th IEEE International Conference on Data Mining (ICDM) *Beijing, China*
Oral Presentation *Nov. 2019*

- A Wasserstein Subsequence Kernel for Time Series

26th Conference on Intelligent Systems for Molecular Biology (ISMB) *Chicago, IL, USA*
Oral Presentation *Jul. 2018*

- Association Mapping in Biomedical Time Series via Statistically Significant Shapelet Mining

Personalized Health Technologies and Translational Research Conference 2018 *Zürich, Switzerland*
Contributed Talk *Jun. 2018*

- Association Mapping in Biomedical Time Series via Statistically Significant Shapelet Mining

[2] Example repositories: WTK or P-WL, or ml-on-fhir

Reviewing

2019 **Journals**: IEEE Transaction on Neural Networks and Learning Systems (TNNLS), Springer Machine Learning

2019 **Conferences**: European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases (ECMLPKDD)

Work Experience

SAP SE (SAP Innovation Center) *Walldorf, Germany*
Working Student *Oct. 2014 - Sep. 2016*

- Worked for the SAP Foundation for Health team and contributed to frontend and backend development utilizing technologies like `jQuery`, `d3.js`, `SAPUI5`, `SQL`, and `JavaScript`.
- Implemented the full stack of an modularized interactive genome-browser and complex visualizations collaborating with academic partners.

SAP SE *Walldorf, Germany*
Working Student *Apr. 2013 - Mar. 2014*

- Developed a checking report for customers of SAP's solution for hospitals to reduce maintenance effort.
- Developed a quick-start program which enables customers to start implementing a Service Oriented Architecture (SOA).

Startup-Netzwerk SUN e.V. (www.startupnetzwerk.org) *Berlin, Germany*
Co-Initiator and Head of Development *Nov. 2012 - Sep. 2013*

- Initially deployed and further developed a startup network for companies, startups, and high-performing students (around 1000 active members).
- Led a team of web developers in the creation of a web community that brings together young entrepreneurs, investors, and highly-skilled students.