Machine Learning in Biomedicine (PI: Christoph Bock)

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The Principal Investigator (https://www.bocklab.org/people)
Christoph Bock is a Principal Investigator at CeMM and Professor of [Bio]Medical Informatics at the Medical University of Vienna. His research combines biology (single-cell sequencing, epigenetics, CRISPR screening, synthetic biology) with computation (bioinformatics, machine learning, artificial intelligence) – for cancer, immunology, and precision medicine. Christoph Bock is also scientific coordinator of the Biomedical Sequencing Facility at CeMM, member of the Human Cell Atlas (HCA) Organizing Committee, fellow of the European Lab for Learning and Intelligent Systems (ELLIS), and elected board member of the Young Academy in the Austrian Academy of Sciences. He has received important research awards, including an ERC Starting Grant (2016-2021), an ERC Consolidator Grant (2021-2026), the Otto Hahn Medal of the Max Planck Society (2009), the Overton Prize of the International Society for Computational Biology (2017), and the Erwin Schrödinger Prize of the Austrian Academy of Sciences (2022). He has been listed among the world's "Highly Cited Researchers" (ISI) since 2019. He co-founded two startup companies in Vienna: Myllia Biotechnology and Neurolentech.

The Research Group (http://bocklab.org)
We pursue highly collaborative research at the interface of biology and medicine. Our goal is to advance the understanding and treatment of human diseases through innovative technologies combined with bioinformatics / machine learning / artificial intelligence, in areas such as cancer and immunology. We work along five main directions:

1. *Machine learning.* Huge datasets pose new analytical challenges. As members of the European Laboratory for Learning and Intelligent Systems, we develop methods for interpretable deep learning and artificial intelligence in biology / biomedicine.

2. *High-throughput technology.* Many groundbreaking discoveries are driven by new technologies. We invest heavily into technology development, in areas such as single-cell sequencing, CRISPR screens, epigenome editing, and synthetic biology.

3. *Computational biology.* Bioinformatic methods are essential for advancing biomedical research. We develop algorithms and software for large-scale data analysis, and we pursue clinical collaborations to demonstrate personalized health impact.

4. *Single-cell biology.* Many diseases show deregulated epigenetic cell states. As members of the Human Cell Atlas, we use single-cell and spatial profiling, human organoids, and mouse models to dissect the regulatory foundations of cancer & immunity.

5. *Immune cell engineering.* CAR T cells have shown dramatic efficacy for blood cancers and may spearhead a broad shift toward personalized, cell-based therapies. We use high-throughput technology to design synthetic immune cells as therapies.
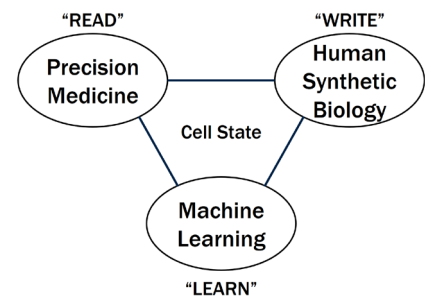
PhD students & postdocs in our group have consistently published in excellent journals, including Nature, Science, Nature Medicine (2x), Nature Methods (5x), Nature Biotechnology, Nature Immunology, Nature Chemical Biology, Nature Communications (4x), Immunity (2x), Cell Stem Cell (2x), Bioinformatics, Genome Biology (2x), plus many papers from collaborations: https://goo.gl/k6yCFa. They have won prestigious fellowships, e.g. from the European Molecular Biology Organization (5x), Human Frontier Science Program, Humboldt Foundation, German Research Foundation, Austrian Science Fund (2x), European Union (2x), and German National Academic Foundation.

Based at the AI Institute of MedUni Vienna

Goal: Learn to program cell states for therapy

Committed to advancing personalized medicine

Participating in major global research consortia

Collaborative research: ML/AI & biomedicine

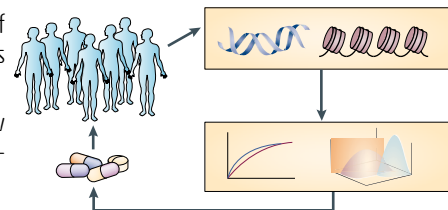**Five Selected Publications** (see https://bocklab.org/publications for the full list)

Schaefer, Peneder et al. (2024) Joint embedding of transcriptomes and text enables interactive single-cell RNA-seq data exploration via natural language. *ICLR 2024 Workshop on Machine Learning for Genomics Explorations.* [Spotlight paper]

Fortelny, Farlik et al. (2024). JAK-STAT signaling maintains homeostasis in T cells and macrophages. *Nature Immunology* 25, 847-859.

Krausgruber, Fortelny et al. (2020). Structural cells are key regulators of organ-specific immune response. *Nature* 583, 296-302.

Klughammer et al. (2018). The DNA methylation landscape of glioblastoma disease progression in time and space. *Nature Medicine* 24, 1611-1624.

Datlinger et al. (2017). Pooled CRISPR screening with single-cell transcriptome readout. *Nature Methods,* 14, 297-301.