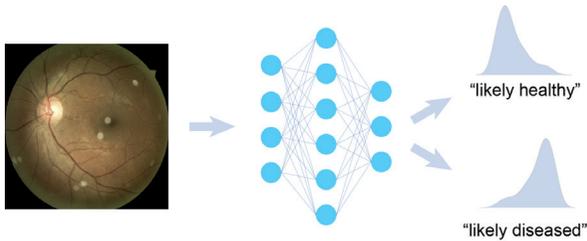


## ... performing in Excellence

### Methodology

Our expertise is in data science and applied machine learning. This means we use mathematical models and algorithms to analyze and understand complex data.

Typically, we work in close collaboration with experimental or clinical partners in an iterative process to define the research question and the optimal experimental and analytic methods. We are devoted to the principles of open science and reproducibility.



Deep neural networks are the state of the art in detecting eye diseases.

### Research questions

- What are the defining features of neural cell types in the retina?
- How do neural computations arise from the properties of individual cells and the circuits they form and how are they affected in disease?
- How can one use advances in machine learning to model neural activity at different levels of description from detailed biophysical to statistical models?
- How can one improve clinical diagnostics leveraging recent progress in machine learning?

## Contact

### Institute for Ophthalmic Research Neural Data Science for Vision Research

Head: PD Dr. Philipp Berens

University of Tübingen  
Werner Reichardt Centre for  
Integrative Neuroscience

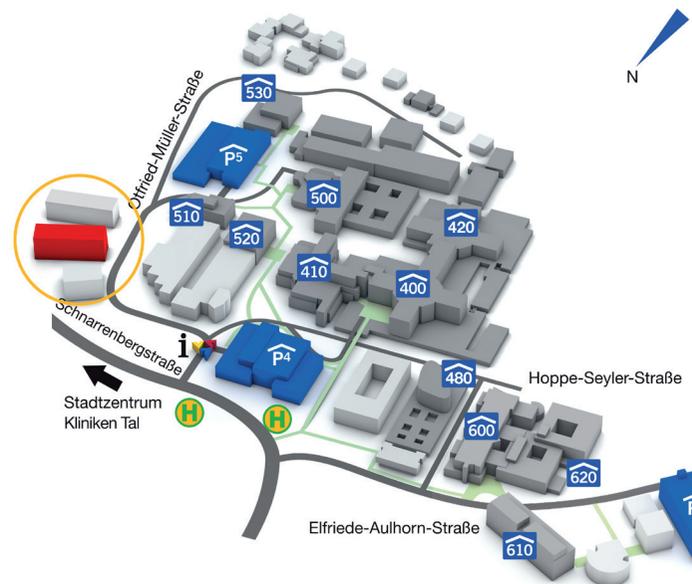
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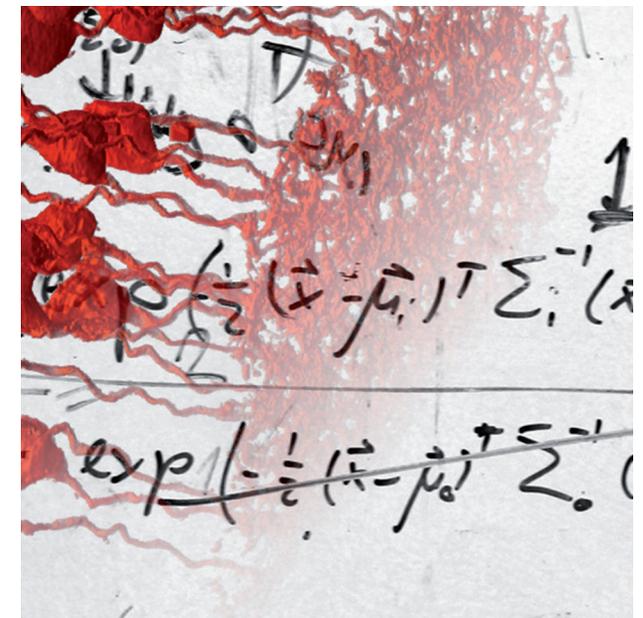
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### How to find us:



## Berens Lab Neural Data Science for Vision Research





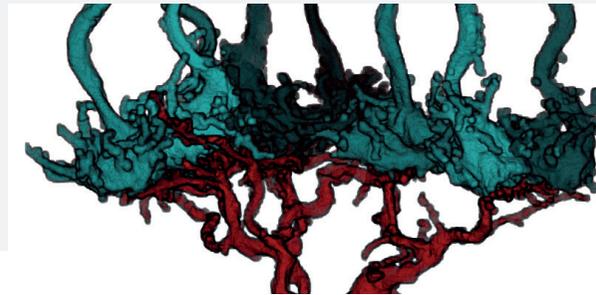
## Data science – turning data into knowledge

We use techniques from machine learning, high-dimensional statistics, neural coding, visualization and data management to make use of large and complex datasets in visual neuroscience and clinical diagnostics, with a particular focus on the retina and its diseases.

## Cell-type identification based on functional, morphological or transcriptomic data

We are working on methods to identify the building blocks of the visual system, the cell types of the retina and visual cortex, based on large scale functional two-photon imaging experiments, high-resolution morphological reconstructions and single-cell transcriptomes.

Many of our projects we do in collaboration with the group of Thomas Euler at the institute. The complexity and variety of data sources requires specialized statistical models for reliable cell type inference. In particular, we are interested in how one can efficiently combine (partially incomplete) data from different sources.



Cone photoreceptors contacting a bipolar cell in mouse retina reconstructed from electronmicroscopy data.

## Effects of degenerative diseases and clinical diagnostics

We are interested in whether certain cell types throughout the retina are particularly susceptible to degenerative diseases such as retinitis pigmentosa and develop statistical techniques to reliably identify the effect of these diseases at the network level.

In addition, we explore how this work may have consequences for treatment of such diseases and the design of neuroprosthetic devices and how we can use our techniques to more effectively diagnose degenerative eye diseases in humans.

# Research toSee

## The Institute for Ophthalmic Research

Seeing is an essential part of human life. As a leading centre for vision research we conduct rigorous research in order to break new ground in understanding the principles of vision and the mechanisms of blinding diseases. We are confident that this research will enable us to rationally develop effective treatments that ultimately retain or restore vision.

Within the Center for Ophthalmology at the University of Tübingen Medical Centre, we and our colleagues at the University Eye Hospital jointly strive for scientific excellence, for speed in translating the advancements into patient's benefit, and for training and mentoring the next generation of leaders in our field.

As leaders and partners in multi-national collaborations, we work for continuous strengthening our ties to fellow international scientists in the public and private sector and to foundations, industry and patient organizations.

As an integral part of Tübingen's biomedical and neuroscience campus, we offer a scientific environment that favors creativity for generating groundbreaking ideas, their transfer into reality and their translation into diagnostics and therapy to help those that suffer from vision loss.



### Philipp Berens

- PD Dr. rer. nat.
- Head of the Neural Data Science for Vision Research Lab



Bernstein Award in  
Computational Neuroscience  
Philipp Berens