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DISSERTATION TITLE:	*Computational Tools for Modeling, Data Storage, and Education in Neuroscience*

Neuroscience has experienced an explosion in technologies available for monitoring the brain. As a consequence of this technological progression, experimental data is generated at an ever increasing rate. This has created a need for computational tools and models to manage, analyze, interpret, and link the massive amounts of data. In his doctoral thesis, Milad H. Mobarhan addresses current challenges in managing experimental data, and provides new tools for computational modeling, in addition to an educational tool for training of future neuroscientists.

In the first part of his thesis, Mobarhan uses computational models to investigate visual processing in the lateral geniculate nucleus (LGN). Placed en route from the retina to the primary visual cortex, the LGN is the first place in the visual system where what we see is influenced by how we feel. A striking feature of the early visual system is the massive feedback from cortex to the LGN and a major question in visual neuroscience is the functional role of this feedback. In his work, Mobarhan identifies a particular feedback configuration that both explains current experimental data best, and is also well-suited to remove redundancy in the visual information conveyed to the cortex. This result indicates that cortical feedback may play a central role for efficient processing of visual information.

In the second part of his thesis, Mobarhan and his colleagues have developed a novel standard, the Experimental Directory Structure (Exdir), for organizing experimental data in file system directories. Exdir has several advantages compared to existing standards, including reduced risk of data corruption, human-readable meta-data, and provides a more convenient way to store raw data from external applications. By standardizing data storage using file system directories, Exdir provides an opportunity for increased data sharing, which is important for reproducible research.

To make computational modeling accessible to students without programming experience, Mobarhan and his colleagues have in addition developed an educational neural network app, called Neuronify. With Neuronify, the user can explore neural networks in an interactive way, and get a hands-on experience with simulation-based neuroscience. Neuronify is freely available on smart phones and tablet computers as well as personal computers. It has currently been downloaded more than 57,000 times and is already actively used in several neuroscience courses across the world.

Overall this thesis contributes to the understanding of the visual processing in the LGN and provides new computational tools to the community.