

Blue Brain

# BluePyOpt

An extensible framework for data-driven  
model parameter optimization

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## The Blue Brain Python Optimization Library (BluePyOpt) is an extensible framework for data-driven model parameter optimization that wraps and standardizes several existing open-source tools.

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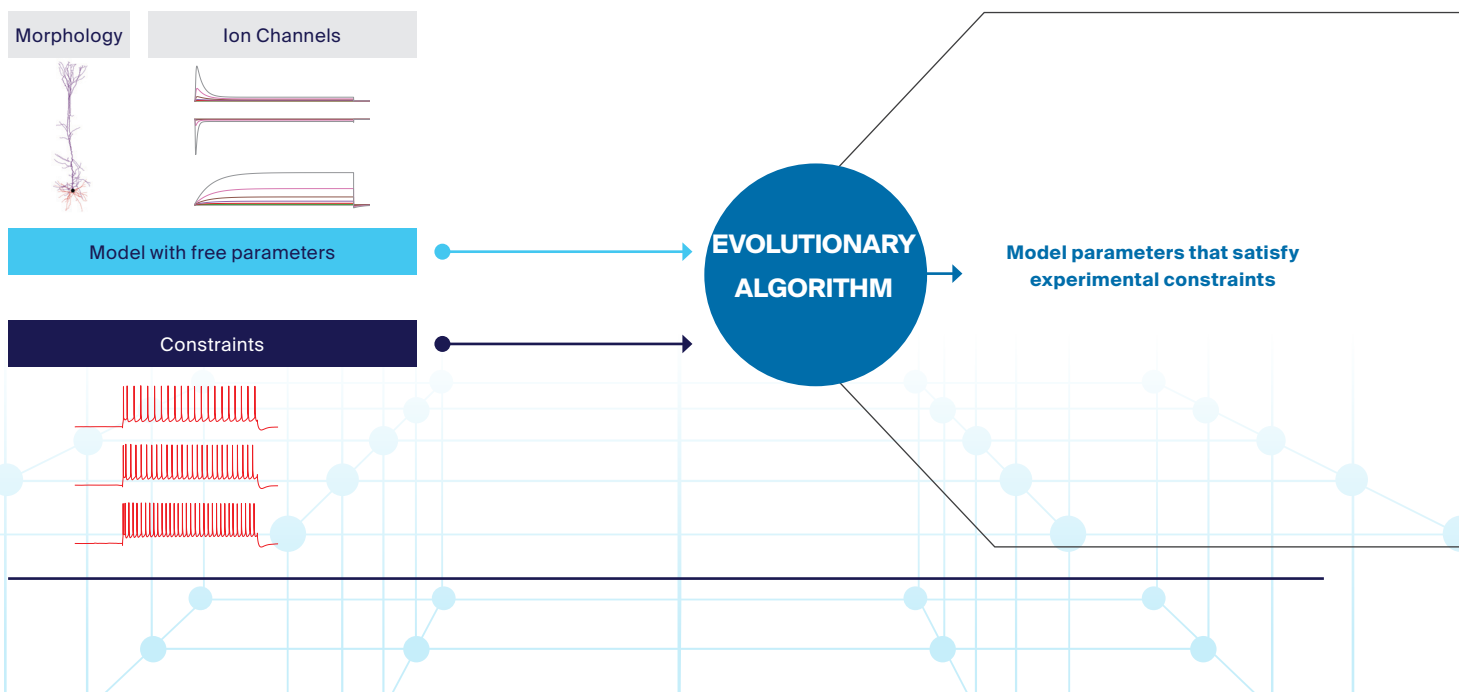
BluePyOpt simplifies the task of creating and sharing model parameter optimizations, and the associated techniques and knowledge. This is achieved by abstracting the optimization and evaluation tasks into various reusable and flexible discrete elements according to established best-practices.

Furthermore, BluePyOpt provides methods for setting up both small- and large-scale optimizations on a variety of platforms, ranging from laptops to Linux clusters and cloud-based compute infrastructures.

At its core, BluePyOpt is a framework providing a conceptual scaffolding in the form of an object-oriented application programming interface (API) for constructing optimization problems according to established best-practices, while leveraging existing search algorithms and modeling simulators transparently “under the hood.” For common optimization tasks, the user configures the optimization by writing a short Python script using the BluePyOpt API. For more advanced use cases, the user is free to extend the API in accordance with their own needs, potentially contributing these extensions back to the core library. The latter is important for BluePyOpt APIs to remain broadly applicable and state-of-the-art, as best-practices develop for specific problem domains, mirroring the evolution that has occurred for neuron model optimization strategies.

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Depending on the complexity of the model to be optimized, BluePyOpt optimizations can require significant computing resources. The systems available to neuroscientists in the community can be very heterogeneous, and it is often difficult for users to set up the required software. BluePyOpt therefore, also provides a novel cloud configuration mechanism to automate setting up the required environment on a local machine, cluster system, or cloud services.



## BluePyOpt Adopters

BluePyOpt is extensively used within the **Blue Brain Project**, **Human Brain Project** and in other institutes around the world including the **Allen Institute for Brain Science**.

With BluePyOpt, the Blue Brain Project builds models for neocortical and thalamic cell models and uses it to fit parameters of synaptic models.

For parameter optimization of biophysically detailed cell models it is used for example, by the groups of **Prof. Michele Migliore** (hippocampus), **Prof. Egidio d'Angelo** (cerebellum), **Prof. Idan Segev** (human cells) and the **Science for Life Laboratory, KTH** (basal ganglia).

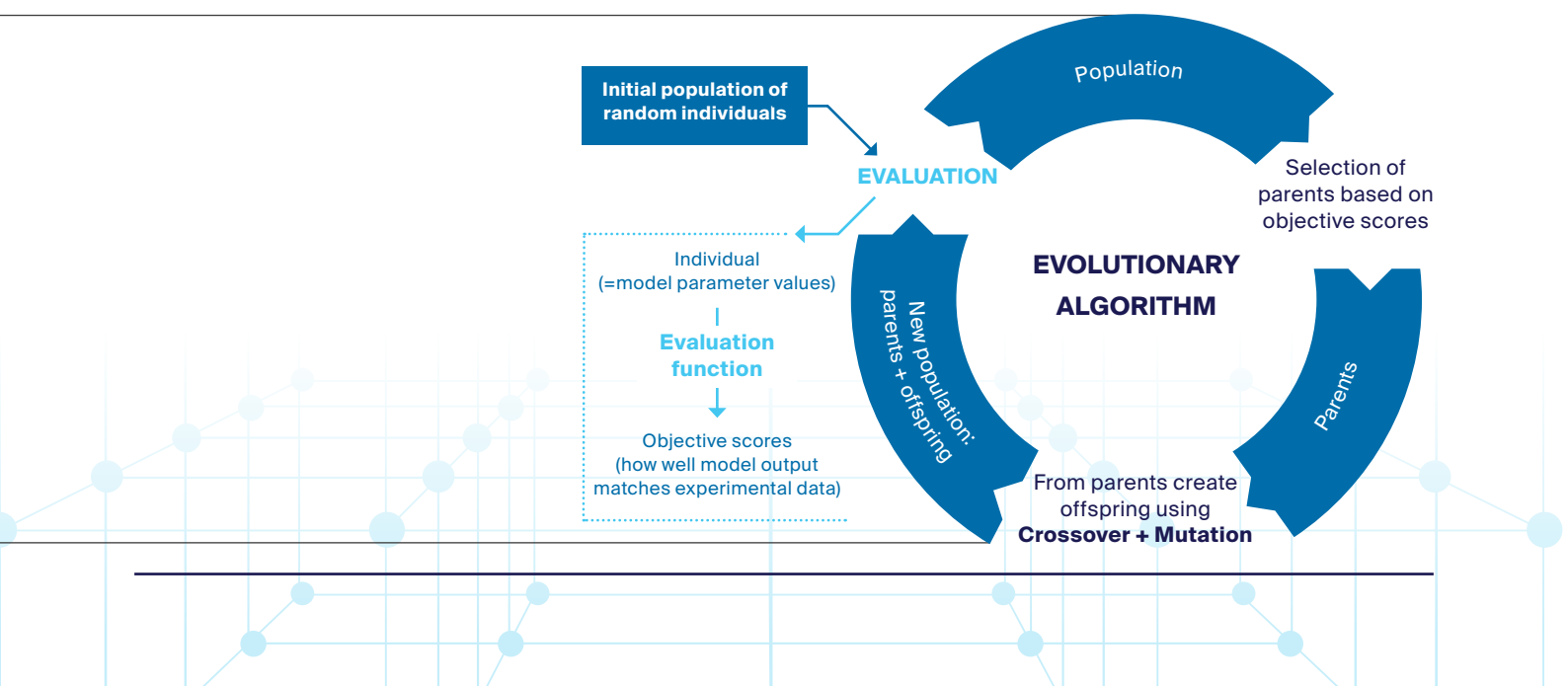
*“BluePyOpt is an invaluable tool in my everyday work, and it represents a new big step forward in the field of computational neuroscience. Its wide deployment on many HPC systems makes it a wonderful and efficient way to generate a large variety of computational model using the NEURON simulation environment”*

Prof. Michele Migliore, CNR-IBF

**The Allen Institute for Brain Science** uses BluePyOpt for creating both single cell models of mouse visual cortex and human cells.

*“One of the great challenges in cellular and systems neuroscience is reducing experimental data from various techniques into computational models that help establish theories of the brain and computation. In this effort, a key contribution has been the development and deployment of the eFEL and BluePyOpt tools - these tools play a central role in the Allen Institute model generation workflow and the computational models we publish through our web products”*

Costas Anastassiou, PhD, Assistant Investigator,  
Allen Institute for Brain Science



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## About EPFL's Blue Brain Project

The aim of the EPFL Blue Brain Project, a Swiss brain research initiative founded and directed by Professor Henry Markram, is to establish simulation neuroscience as a complementary approach alongside experimental, theoretical and clinical neuroscience to understanding the brain, by building the world's first biologically detailed digital reconstructions and simulations of the mouse brain.

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## BluePyOpt is available under Lesser GNU Public License, at: [github.com/BlueBrain/BluePyOpt](https://github.com/BlueBrain/BluePyOpt)

It can be used on all systems that can run Python  
and the NEURON simulator.

Support is also available using a chat channel:

**[gitter.im/BlueBrain/BluePyOpt](https://gitter.im/BlueBrain/BluePyOpt)**

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## Accompanying paper to be cited when using BluePyOpt

Van Geit W, Gevaert M, Chindemi G, Rössert C, Courcol J-D, Muller EB, Schürmann F, Segev I and Markram H (2016). BluePyOpt: Leveraging open source software and cloud infrastructure to optimise model parameters in neuroscience. *Front. Neuroinform.* 10:17. doi:10.3389/fninf.2016.00017

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## For technical information on BluePyOpt or to request a demonstration, please contact:

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