BluePyOpt: Leveraging open source software and cloud infrastructure to optimise model parameters in neuroscience

By segev
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By segev November 9, 2016

Abstract:

At many scales in neuroscience, appropriate mathematical models take the form of complex dynamical systems. Parametrising such models to conform to the multitude of available experimental constraints is a global nonlinear optimisation problem with a complex fitness landscape, requiring numerical techniques to find suitable approximate solutions. Stochastic optimisation approaches, such as evolutionary algorithms, have been shown to be effective, but often the setting up of such optimisations and the choice of a specific search algorithm and its parameters is non-trivial, requiring domain-specific expertise. Here we describe BluePyOpt, a Python package targeted at the broad neuroscience community to simplify this task. BluePyOpt is an extensible framework for data-driven model parameter optimisation that wraps and standardises several existing open-source tools. It simplifies the task of creating and sharing these optimisations, and the associated techniques and knowledge. This is achieved by abstracting the optimisation and evaluation tasks into various reusable and flexible discrete elements according to established best-practices. Further, BluePyOpt provides methods for setting up both small- and large-scale optimisations on a variety of platforms, ranging from laptops to Linux clusters and cloud-based compute infrastructures. The versatility of the BluePyOpt framework is demonstrated by working through three representative neuroscience specific use cases.

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