The Modeler's Workspace: A Tool for Computational Neuroscientists

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Introduction

A realistic neuronal model represents a modeler's understanding of the structure and function of a part of the nervous system. As the number of neurobiologists constructing realistic models continues to grow, and the models become ever more sophisticated, they collectively represent a significant accumulation of knowledge about the structural and functional organization of nervous systems. But at the same time, locating appropriate models and interpreting them becomes increasingly difficult. The central motivation for the Modeler's Workspace project is to address these problems of locating and interpreting models by creating software for assisting computational neuroscientists.

Goals of the Modeler's Workspace

- Interact with databases of models and other objects
- Create, edit and visualize models
- Interact with simulation systems such as GENESIS and NEURON
- Manage a personal database of models & other objects
- Collaborate with others using shared editing and viewing of database contents

Main Components in the System

(1) *User Interface*:
- A portable Java program
  - Runs as separate app or in a web browser
- Communicates with Workspace Database over net
 - Roaming user can access personal database from anywhere

(2) *Workspace Database*:
- Stand-alone server program, runs on user's office computer and waits for network connections
- Private repository for user's models & documents
- Rendezvous point for collaborative activities

(3) *Modeler's Workspace Directory*:
- Global registry of databases and users

### Example of the User Interface: Search
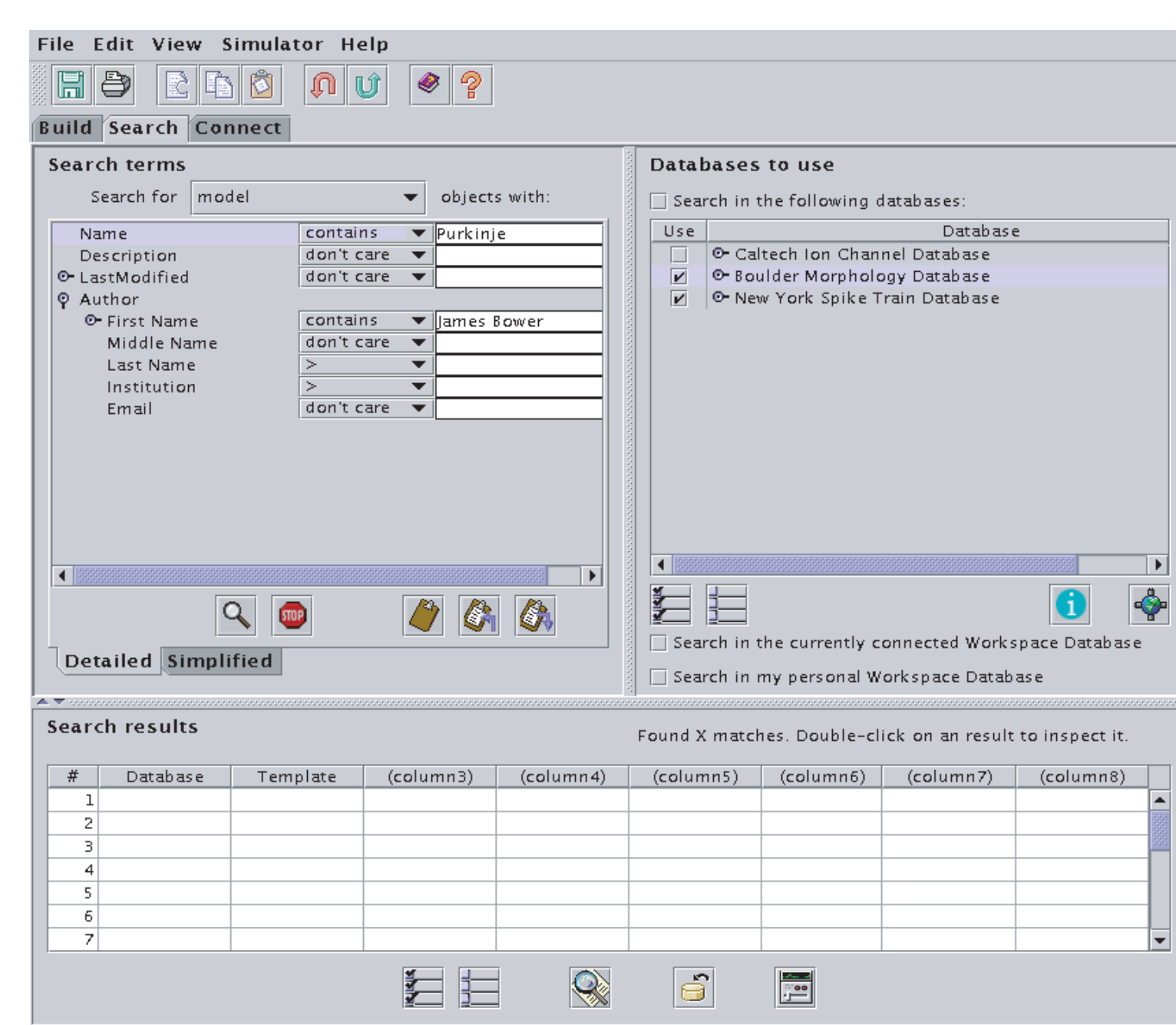
The Search pane will allow the user to select the type of object they want to search for, and the available databases they want to use. Results will be shown in a summary table. Double-clicking on a row will provide a detailed view of the object in a separate window.
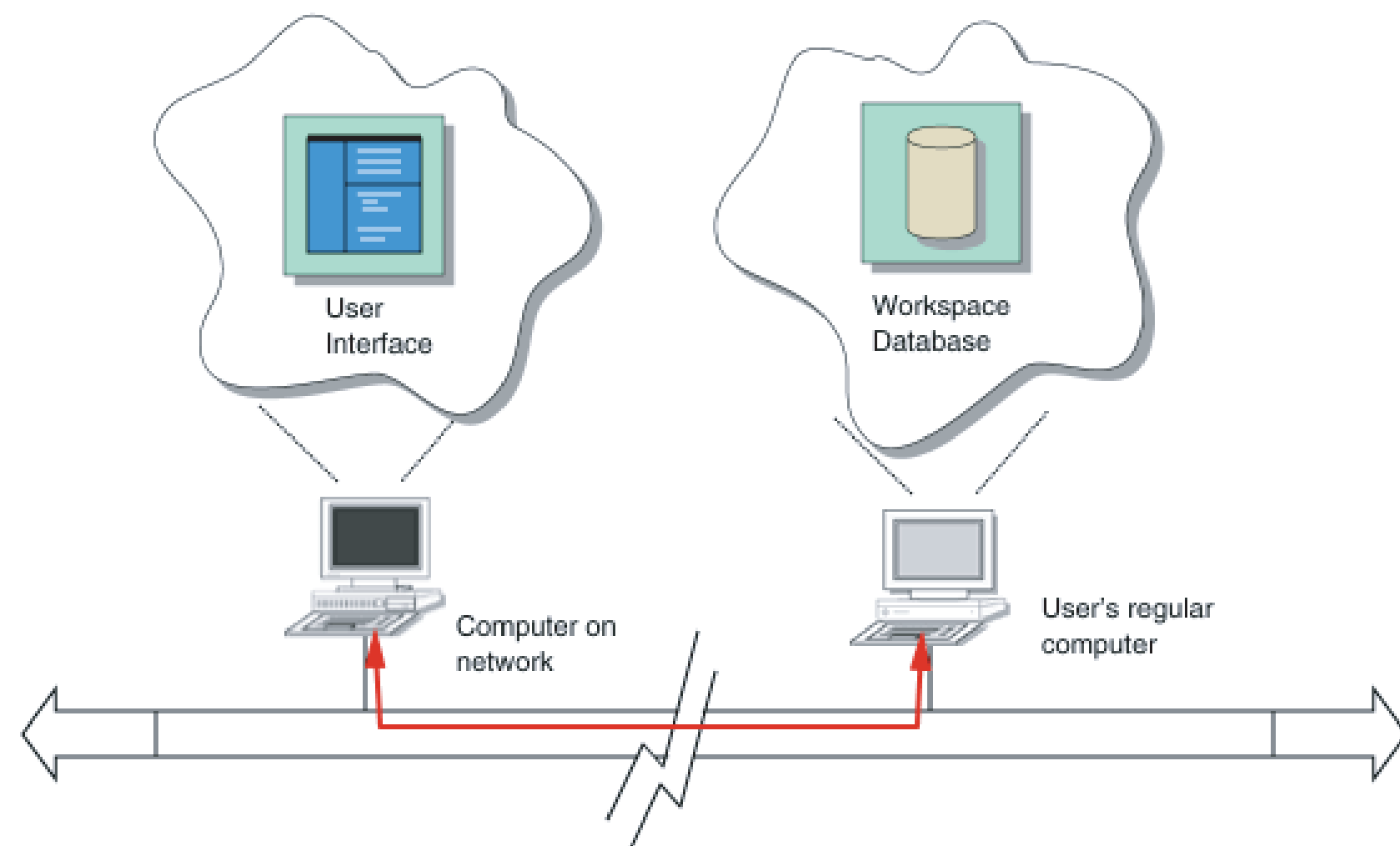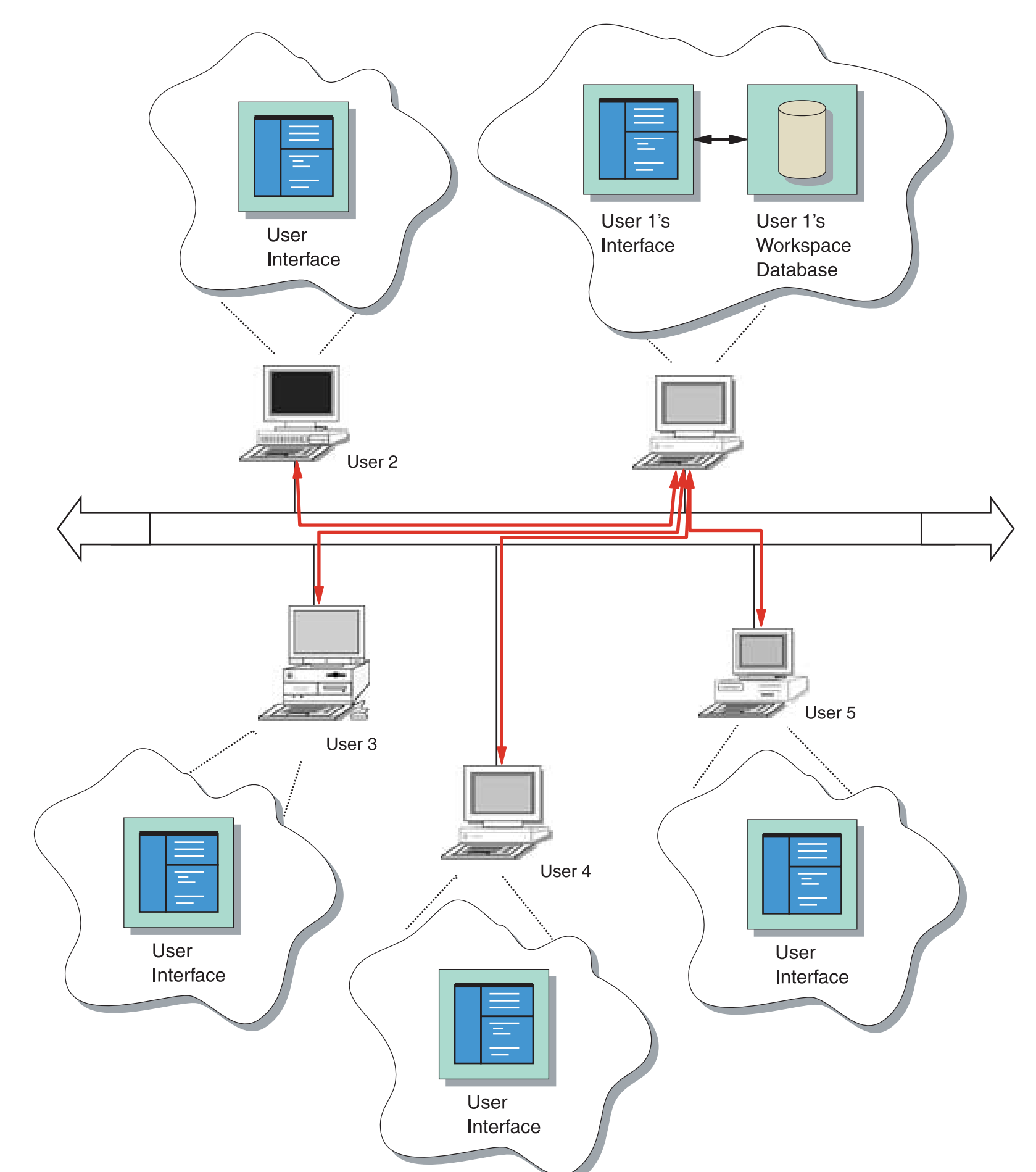
Modular, Network-Based System

Workspace Database

Directory
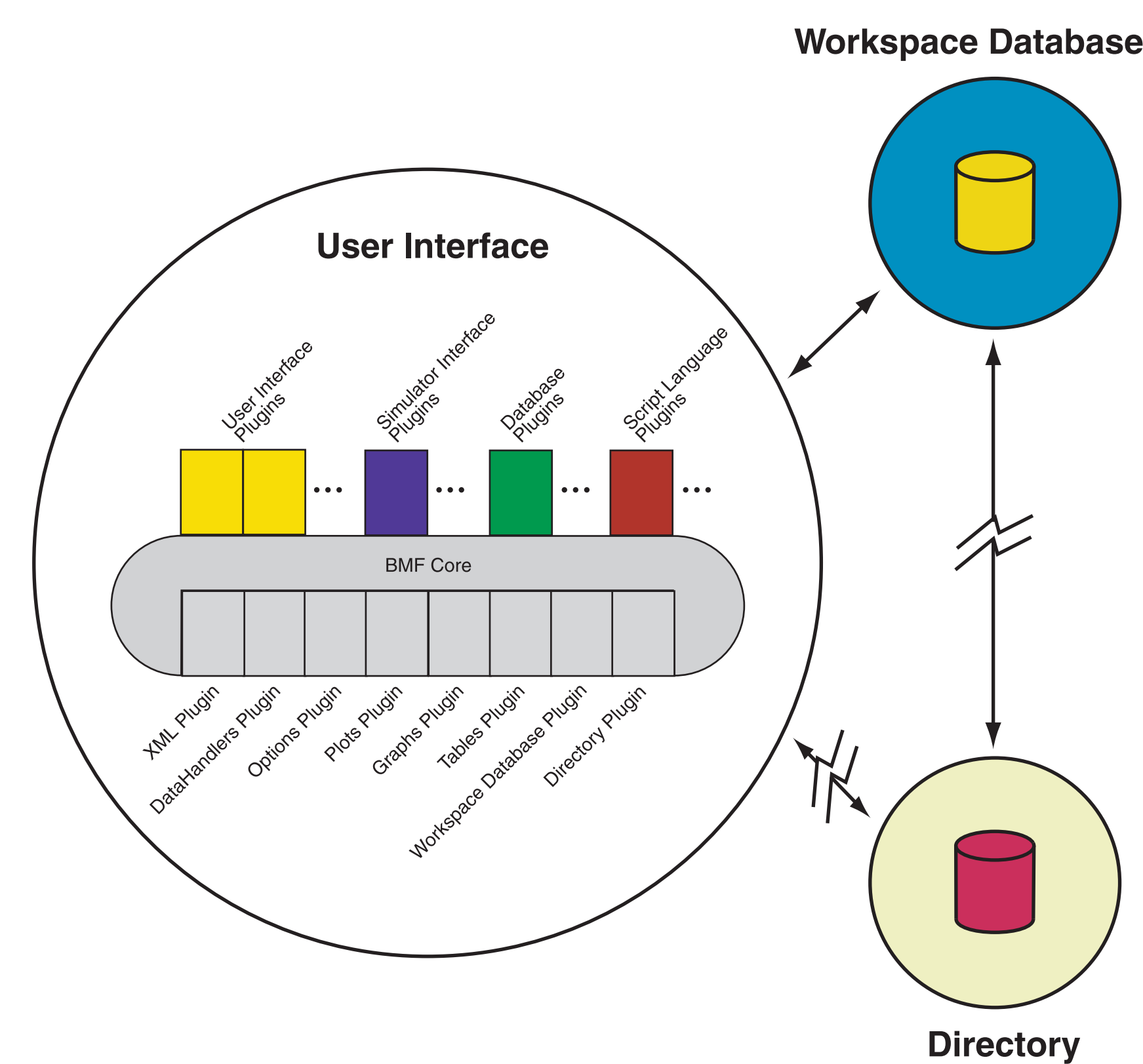
Usage Case 1: Single User in Normal Case
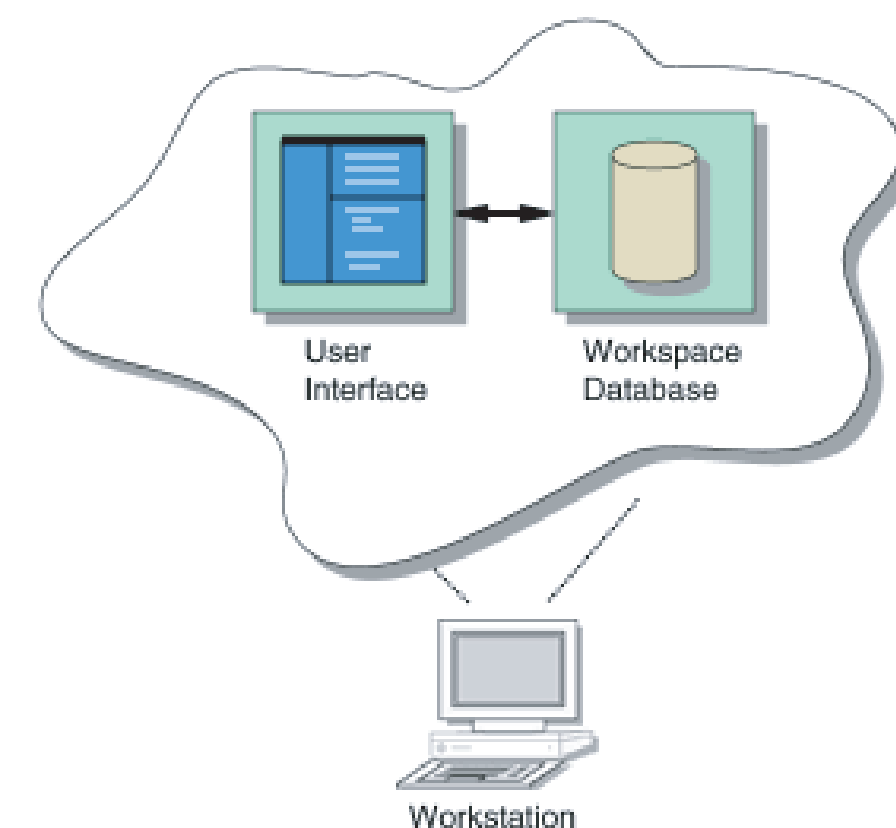
Usage Case 2: Roaming User

### Usage Case 3: Multiple Users Collaborating

## Underlying Software Framework

- The Modeler's Workspace is being built on top of a new, general, open, modular framework, the *Biology Modeling Framework* (BMF).
- The Modeler's Workspace is a particular collection of components packaged together with the BMF.
- Another application based on the BMF is the *Systems Biology Workbench*, another project underway at Caltech (**www.cds.caltech.edu/erato**).

Framework Architecture

- The BMF Core software consists of a plugin manager and a collection of core "plugin" modules:
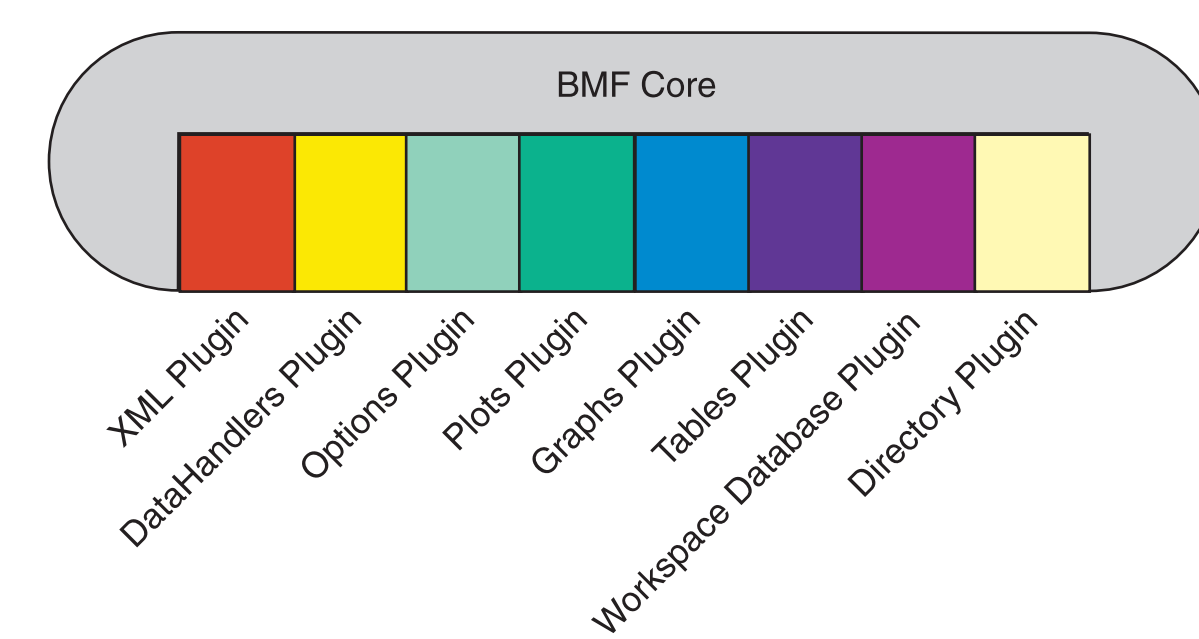
- Task-specific functionality is implemented using additional application-specific plugins:
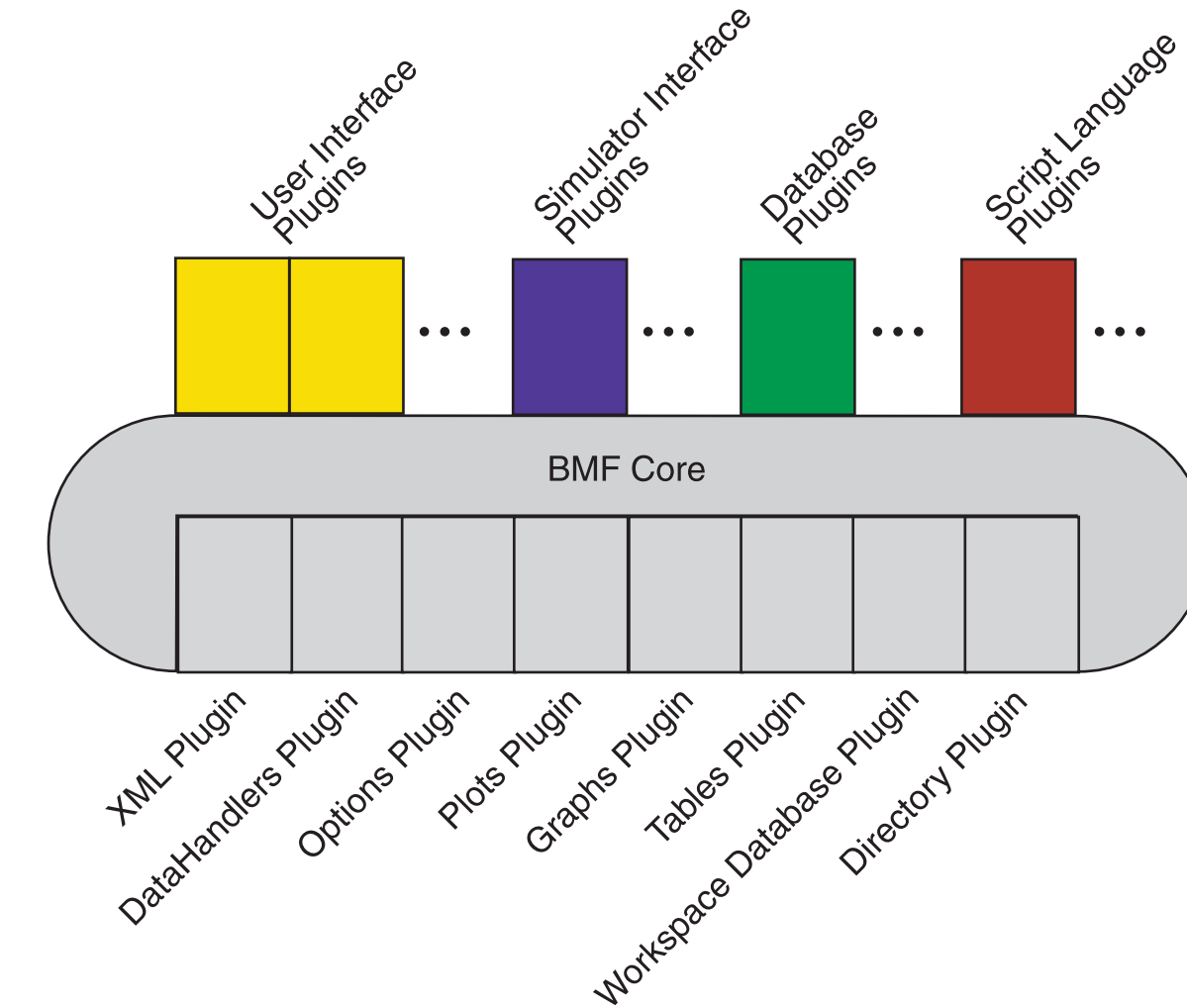
- Categories of application-specific plugins:

  User Interface plugins: main window, neuron model inspector, ion channel model inspector, reference inspector, template editor

 *Database plugins*: interfaces to third-party databases

  Simulator plugins: interfaces to GENESIS, NEURON

  Scripting plugins: any language supported by the Bean Scripting Framework from IBM (e.g., Python)

Inspectors

We are developing specialized viewer/editor plugins called *inspectors* for different types of data objects, such as neuron models, ion channel models, references, etc.

Objects without a specialized inspector are edited with a Generic Inspector.
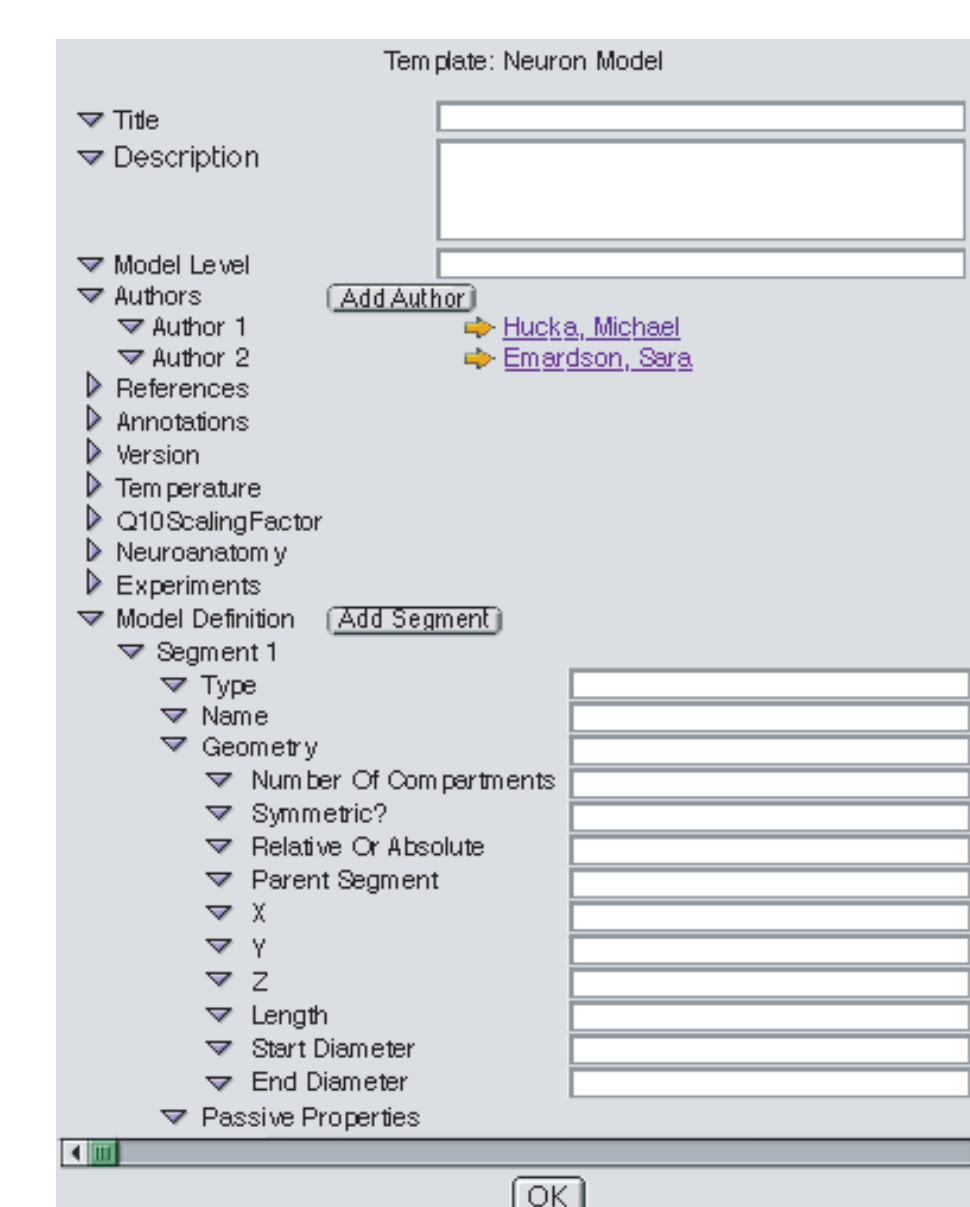
Generic Inspector

Objects in the Database

- A Workspace Database contains objects representing different types of entities: models, bib references, etc.
- Each object is structured according to a template:
  - A *template* (= schema) defines an object's format
  - Different templates used for different kinds of objects
    - E.g.: "Neuron Model", "Ion Channel Model"
- Objects are encoded internally in XML. The Workspace Database stores XML objects.
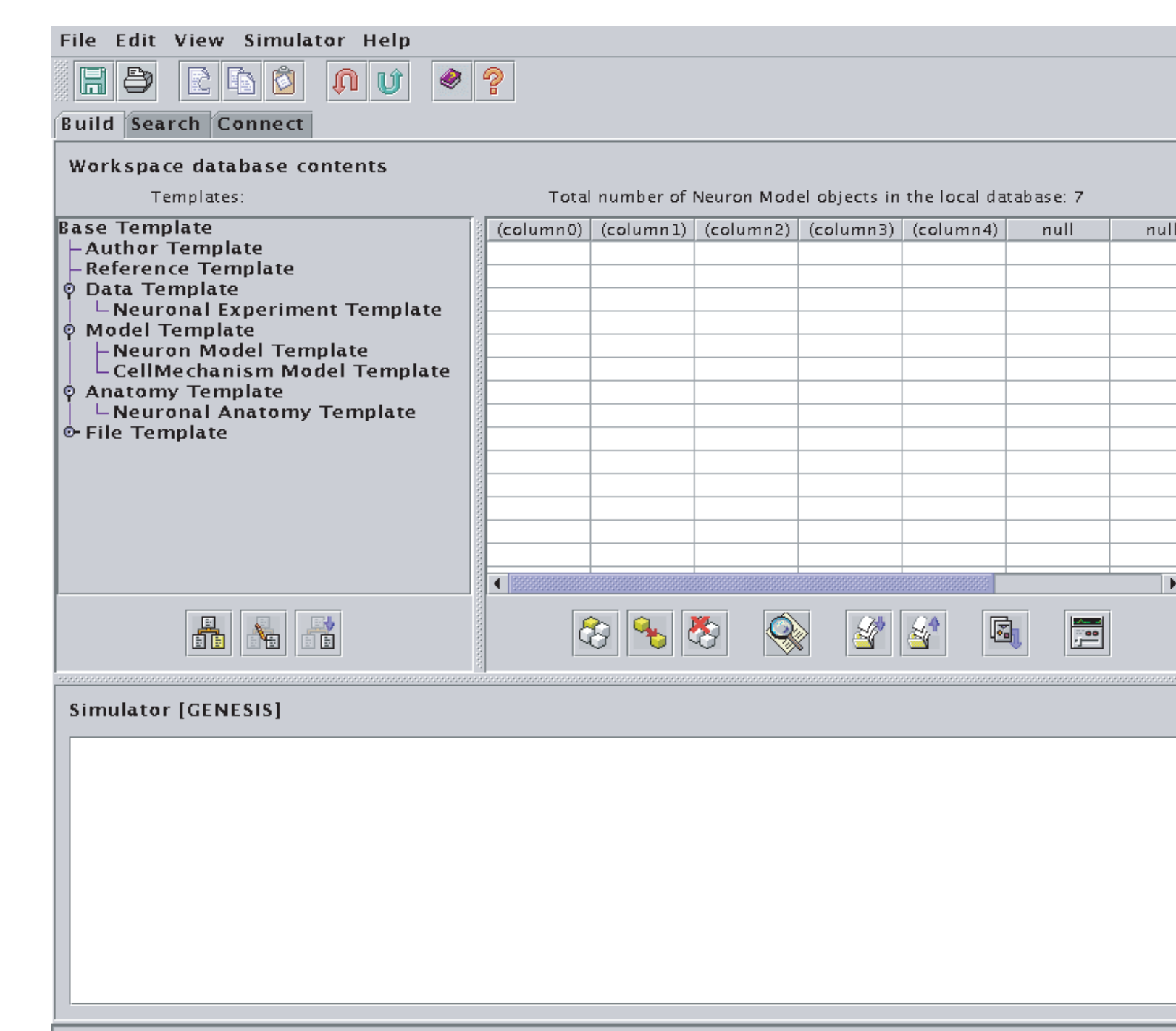
Template Hierarchy

Templates in the system form a simple inheritance hierarchy. Templates are stored as XML Schemas.
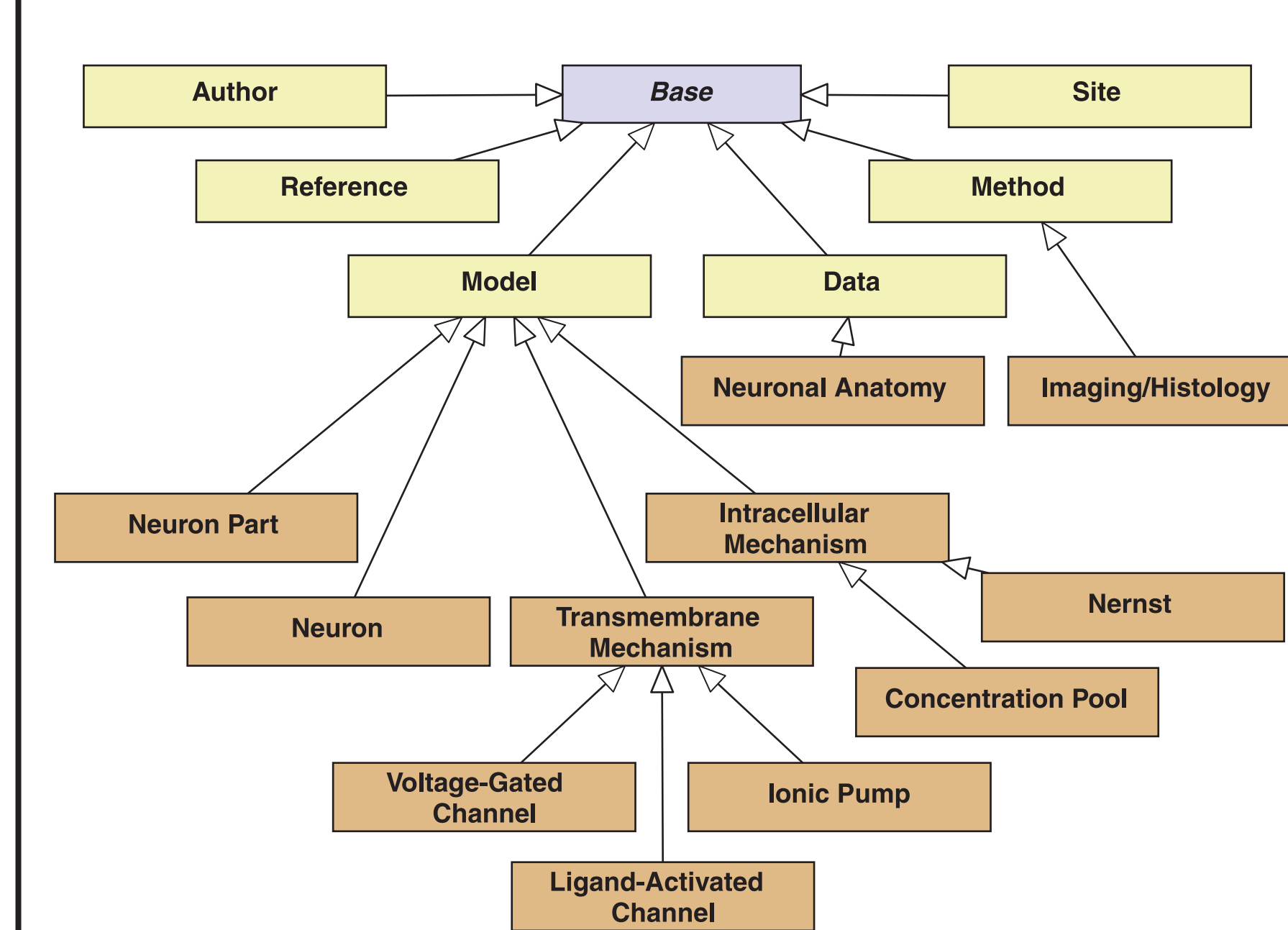
The first-level elements (in pale yellow above) are consistent with the Common Data Model of Gardner et al. (**cdm.med.cornell.edu**).

Managing Objects in the Personal Database

The Build pane will display a list of the known templates, a summary list of the objects in the user's Workspace Database, and a window to the command line of a simulation program such as GENESIS.

The user will be able to double-click on a item in the database list and edit the object in an appropriate inspector.

Eventually, the interface to GENESIS will be replaced by a collection of plugins in the Modeler's Workspace.
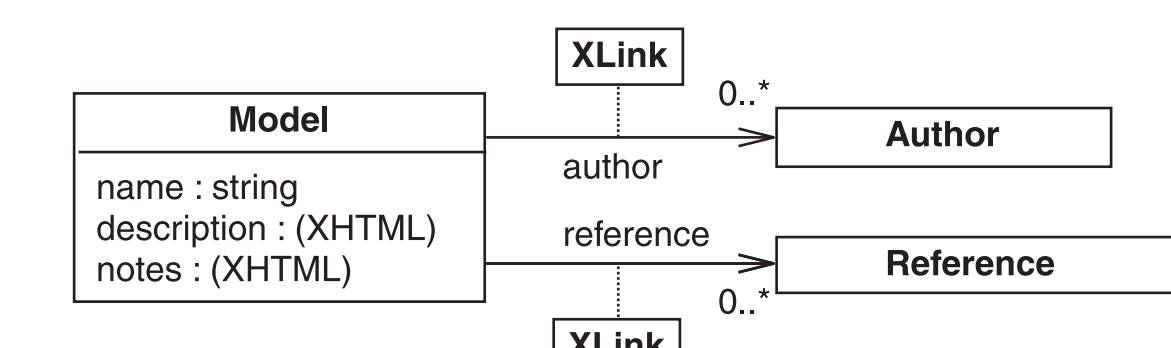
Example Templates

We describe templates using UML, a standard notation.

The **Base** template is simple and generic, with only an ID and version attribute.
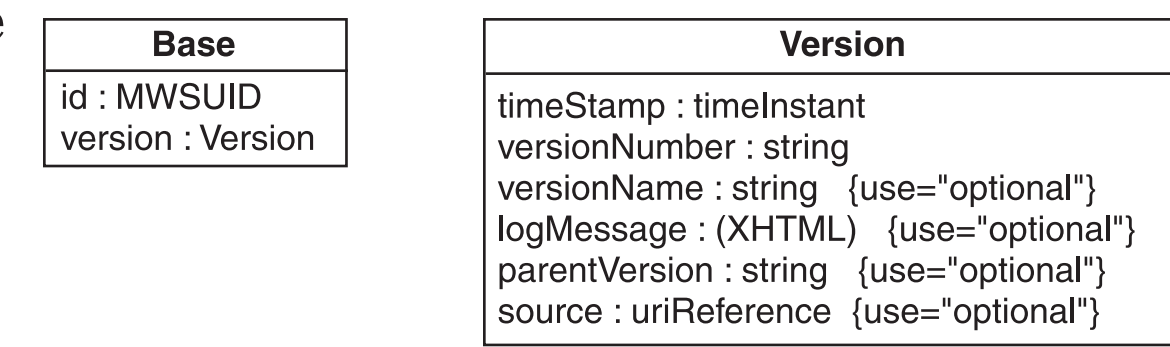
All model representations are derived from the **Model** template, which inherits from the Base template and adds new attributes for name, description, notes, and links to authors and references.

The **Neuron** template combines features of the representations used in both GENESIS and NEURON.
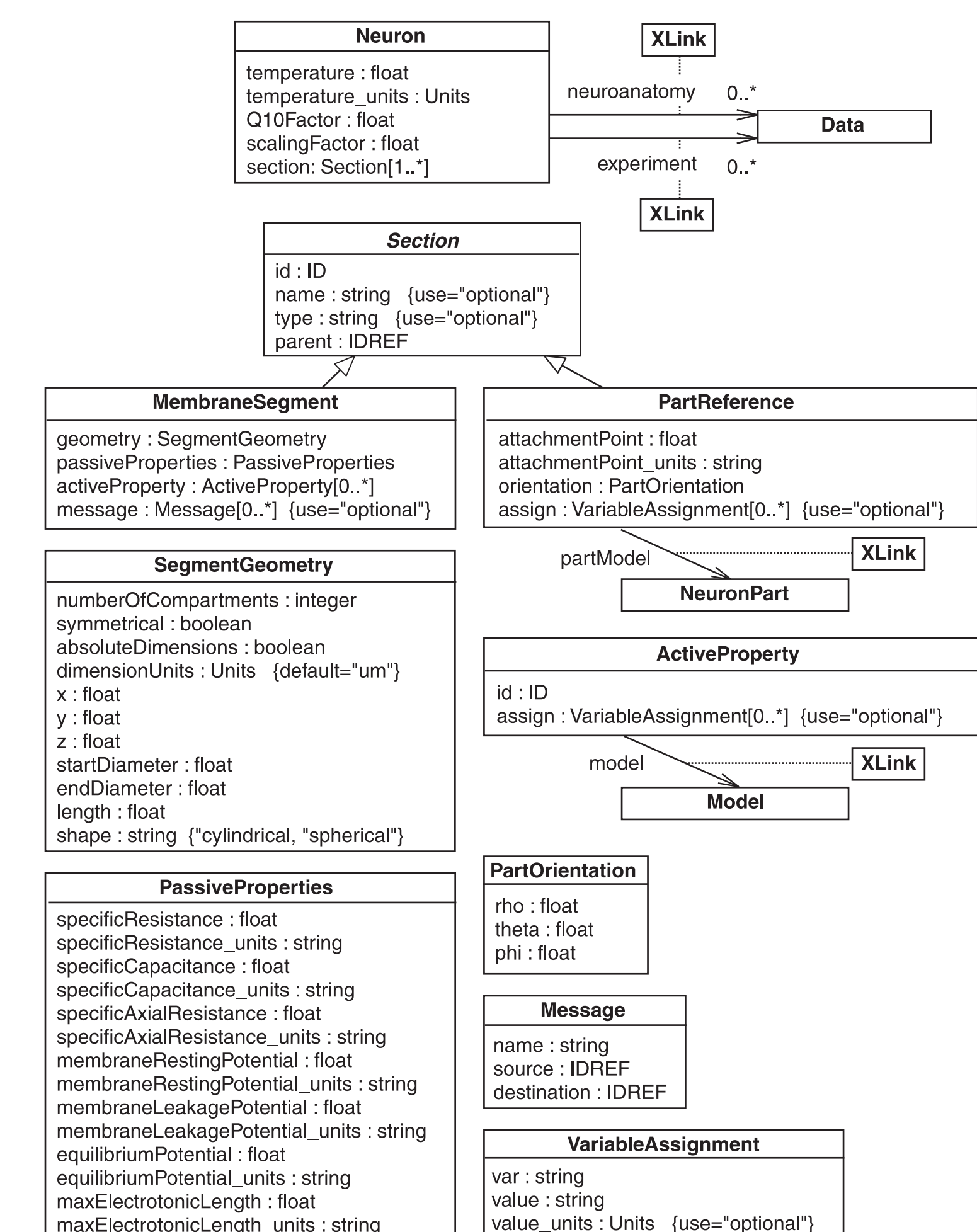
Development Status

The Modeler's Workspace is under active development. We have so far implemented the Search/Build/Connect panes, a preliminary version of the BMF core framework, and the main templates necessary to define models of neurons.

URLs

Modeler's Workspace: **www.modelersworkspace.org**
Systems Biology Workbench: **www.cds.caltech.edu/erato**
GENESIS: **www.bbb.caltech.edu/GENESIS**