**CNO Documentation**

This document is the support used to create the documentation wiki.

**Introduction**

Why do we need an ontology for?

Rationale for the development of CNO

What is CNO?

CNO is a domain specific terminology that can be used for annotating resources in Computational Neurosciences.

It has been developed using the cutting-edge technology to allow the construction of a logical model that would enable inferences.

How has it been developed?

Using Protégé to create an owl structure. Up to 0.5 used Protégé 3.4.4. For 0.5 used protégé 4.1

Terms are coming from books and scholarpedia

The difficulty of designing such ontology: a rationale for the contribution of the community.

Problems with the terminology. Need to clearly define concepts.

CNO internal model

CNO has been build around a model-centric model. A simple schema describing this model is provided below.

A model can be defined by:

1- the model description that exist such as a publication, a particular implementation, a XML representation, ...

2- model quality/property that inheres from the structure of the model

3- model component that represent the constituent part of the model

CNO has been build upon the assumption that any model can be described by its constituent parts that we named “model component”.

These model components can have different complexity and relates to differents aspects of the model i.e. network spatial layout that describes how cellular models are arranged in the network abstract space, an ionic current used to build a “realistic” biophysical model of a cortical pyramidal cell, the kinetic rate of calcium binding in a biophysical synaptic plasticity model, and so on and so forth.

COULD CORRESPOND TO PART OF SOURCE CODE

Looking at these different components, some are simply parameters or variables and some are complex mathematical description based on a particular formalism (e.g. the ionic current that could be described using the Hodgkin and Huxley formalism). In order to represent this different levels of complexity we created two subclasses: the elementary model components that represent simple entities like membrane voltage, kinetic constant, indices and would be either a parameter or a variable of the model; and the aggregated component that would represent complex mathematical elements constructed using both elementary component and mathematical operators and functions.

As the scope of this ontology is not to provide an ontology of mathematics, we are not considering the mathematical operators in our model. However, in latter version, we could consider linking CNO with such mathematical ontologies if they exist.

Another important concept attached to a model in general is that it is described somewhere, either by a publication or a modelDB accession number where you can access the source code. Therefore, we created a class named “model description” that encompasses the different types of description (XML, publication, source code).

As models are often build upon the work of other or well agreed published models that can have a specific name such as the Leaky-integrate-and-fire model or adaptative exponential integrate-and-fire for instance or can be named using the author’s name such as markram and tsodyks model, Fitzhugh-Nagumo or even the famous Hodgkin and Huxley models. These different models have well known characteristics that used as a base for build up different models.

To represent these “standard” models, we created a class named “defined models”. These different models can be described by 1- the first publication that present them and 2- their specific composition in model element.

To give an example, the Leaky Integrate-and-Fire is composed of a fixed spiking threshold, a stimulation current or a synaptic current, a point morphology, a refractory period and a leak current.

This particular structure could be represented through restrictions on the type of components that compose them. This class leaves open the possibility classifying any annotated model that present these features as a Leaky Integrate-and-Fire model even if this information hasn’t been provided in the annotations.

We are planning to create these restrictions once the ontology is more mature.

As for defined model, we can define specific types of models such biophysical cellular model or threshold-based model to continue on the example of the LIF.

We are proposing a first classification of model with the “defined model type”.

As these two particular classes can be considered as redundant, we might merge them in latter version to simplify the structure.

Finally, models have particular properties/qualities that relates to their intrinsic behavior like oscillators, memory storage. To represent these properties of models, we created the class “model quality”.

Work done on CNO version 0.5:

Objective is to go one step further toward the integration of CNO into NIFSTD and interoperability with other Biomedical Ontologies such OBI, IAO that would allow to link model to their biological counter-part.

Update or add definitions

Integration into BFO framework

Mapping with other ontologies: SBO

Creating a structure that could receive instances to test the logical model.

Integration into the Basic Formal Ontology

The Basic Formal Ontology is a high-level ontology that describes material entities bounded in space. Although a model can be considered as a material entity through it implementation or the publication that describes it, models cannot really be bounded in space.

However, models aim to describe material entities (real neurons, synapses, or part of the brain). Based on the work of OBI and IAO, we chose to first consider model