NeuroNames

in

JSON and XML-2020

BrainInfo

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NeuroNames in JSON and XML-2020
Nomenclature (names) and Ontology (definitions)

http://braininfo.org/api/swagger

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NeuroNames is a digital codification of neuroanatomical nomenclature (names) and ontology (definitions and relations) designed for use by neuroinformaticists. The nomenclature enables those engaged in database management and website development to resolve ambiguity of nomenclature that handicaps use of databases by scientists with limited knowledge of neuroanatomy and that prevent interoperability between databases indexed in different terminologies. New users are advised to use the JSON version. XML-2020 has obsolete features for compatibility with older XML versions.

The JSON and XML-2020 versions of NeuroNames provide a unique standard name, synonyms in several languages, definitions and URLs to that and other information for the most comprehensive set of neuroanatomical structures currently available to the information technology community. The NeuroNames nomenclature and ontology continue to evolve toward the ideal of codifying all names and all definitions of neuroanatomical structures found in neuroscientific publications. It includes a standard vocabulary of structure names, which are selected to maximize practical use in verbal communication as well as computerized knowledge management. The JSON version differs from the XML-2020 version in that it omits obsolete keys that are retained in the XML-version for compatibility with earlier XML versions. The XML-2020 version differs from previous XML versions in that it corrects defects that prevented accurate construction of hierarchical models of brain structure. Both versions are updated as new information is added to the BrainInfo/NeuroNames database.

Now more than twenty-five years in development, NeuroNames relates more than 16,000 names in eight languages to some 3.000 neuroanatomical concepts. Designed originally to allow the BrainInfo/ NeuroMaps website to interpret users' queries and to clarify the terminology of remote web pages (Bowden et al., 2011), it has become a resource vocabulary of the National Library of Medicine's Unified Medical Language System and the basis for the brain regions component of NIFSTD. Earlier versions of NeuroNames have been downloaded to hundreds of laboratories for indexing data and for linking to BrainInfo. This version has been modified to correct a problem with designation of 'parents' of a structure so that the same structure can appear in multiple hierarchical models.

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For instructions on the use of NeuroNames as a mediator of neuroanatomical data transfer between websites that use different nomenclatures, see:

> Bowden DM, Dubach MF, Dong E. Informatics for Interoperability of Molecular-Genetic and Neurobehavioral Databases. In: Gerlai RT, ed. Molecular- Genetic and Statistical Techniques for Behavioral and Neural Research. Academic Press: Elsevier; 2018:31–50.

When we last analyzed BrainInfo statistics in 2017, the website was attracting an average of 600 visitors/day, who downloaded, on average, 2,000 pages/day. The number of structure names and concepts in NeuroNames continues to grow.

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NeuroNames Ontology and Standard Nomenclature
in JSON and XML-2020

JSON/XML-2020 Old XML	Definition
NeuroNamesId Old XML concept brainInfoID	A unique and permanent **numeric identifier** is assigned to each neuro-anatomical structure. The structural concept it names is the text definition of the structure in the NeuroNames ontology (**CDefinition** below). NeuroNames includes concepts of central nervous system structures from the level of cerebrospinal trunk (brain and spinal cord) down to the lowest level of primary structures, i.e., cortical areas, nuclei, tracts and fasciculi. It does not include comprehensive listings of layers of cortex in individual architectonic areas or subnuclei of all nuclei.
Obsolete Excel and Old XML CNIDType CNID CTypeID CType BrainStructureType	**These keys** are only of potential use to users of NeuroNames versions earlier than 2009. In the first digital version of NeuroNames issued in 1999, each structure was classified as 'h' or 'a' depending on whether it was an item in the classical hierarchy of brain structures ('h' for hierarchy) or not ('a' for ancillary). In addition, it was assigned a random numeric ID. The combination was used by many individuals to bookmark pages in BrainInfo and by many websites for interoperability with BrainInfo. New users can consider them obsolete. Reorganization of BrainInfo in 2009 involved replacement of the dual alphanumeric system with a single numeric ID for each structure, i.e., the concept brainInfoID, now NeuroNamesID, described above. One can still interact with BrainInfo using the old XML keys, but the old XML has not been updated since 2018. Some 500 concepts and several thousand structure names have been added to NeuroNames since the conversion. So new users are advised to use the current NeuroNamesID for indexing, bookmarking and interoperability.
StandardName Old XML standardName	A single, unique **standard name** for every structure allows NeuroNames to be used as a controlled vocabulary for indexing and interoperability of databases. The standard names are used in BrainInfo to assure consistent, unambiguous definition of neuroanatomical structures and their relations to one another. Two absolute criteria for selecting a standard name are that it be English and that it be unique, i.e., apply to one and only one structure. Other considerations in selecting a standard name from among synonyms are mnemonic value, use frequency, brevity, ease of spelling, ease of pronunciation, and consistency of format with the names of other structures in the same category. Very occasionally the standard name of a structure is changed if we come across a synonym that better fits the criteria. Thus, the standard name, while unique, is not a reliable substitute for the numeric NeuroNamesID for indexing a database.

StandardAcronym Old XML standardAcronym	A **standard acronym** for each structure allows NeuroNames to provide a controlled label set for illustrations, graphs and tables. Many but not all structures have a standard acronym, which is used to maintain consistency for those purposes in BrainInfo. The only absolute criterion in selecting a standard acronym is that it be unique. Other important considerations are brevity, mnemonic value, and usage in the most widely used brain atlases. As with the standard name, a standard acronym is very occasionally changed. Thus, the standard acronym is not a reliable substitute for the numeric NeuroNamesID for indexing a neuroanatomical database.
BrainInfoURL	The **BrainInfoURL** enables a developer to send users to the page in the BrainInfo website that contains the Central Directory for a structure. It is intended for use by developers who want to give their users access to BrainInfo's information, about a structure, including links to multiple illustrations, without having to copy the information into their website.
CDefinition Old XML cDefinition	Definitions are called **concept definitions** rather than structure definitions, because many of the terms in NeuroNames refer to other kinds of concept, e.g., 'dorsal' and 'ventral', rather than to a neural structure. The inclusion of definitions of structures is the feature of NeuroNames that makes it a neuroanatomical *ontology* rather than merely a *nomenclature*, i.e., a name list or lexicon. The definitions in NeuroNames are the 'operational definitions' required in scientific discourse. Thus, all definitions in NeuroNames include the species and methods used to demonstrate them as well as features by which they are recognized.
Synonyms Old XML Synonym	The best-known neuroanatomical structures have an average of six English and Latin **synonyms** in common use. All the names and acronyms for a given structure are its synonyms. The standard name is selected from among English or anglicized Latin synonyms.The inclusion of all names for a structure in NeuroNames allows the manager of a database or knowledge resource to have it respond to queries that use *any* of the structure's synonyms. Key features of a synonym are its language (SynonymLanguage) and its use frequency in the published literature (pubMedHits)
SynonymLanguage Old XML synonymLanguage	NeuroNames includes the names of neuroanatomical structures in several languages. Currently it includes **synonyms in eight languages**: English, Latin, French, German, Indonesian, Italian, Russian and Spanish. Acronyms are treated as a 'ninth language'. Names are case sensitive and represented in Unicode for the alphabet of the language.

Organism	The **organism** specified under Synonyms merely refers to the species studied in the source where the synonym was found. For a complete list of species in which the structure is found, the user should consult the definition…or Species Having or Lacking this Structure in the BrainInfo website.
SynonymName	**Synonym names** are case-sensitive and spelled exactly as they appear and in the same alphabet (Unicode) as in the source document where they are first encountered.
SynonymSource	The **source of a synonym** is represented by a tag in the form: [first author's last name]-[year of publication][optional a,b,c etc. to distinguish sources by the same first author in the same year].
SynonymSourceTitle	The title of the source of a synonym is presented. Other details of the citation are not included in the JSON file.
PubMedHits Old XML pubMedHits	A major criterion in the selection of a standard name from among synonyms is its **use frequency**. The metric for use frequency in NeuroNames is the number of PubMed abstracts in which the name has appeared.
BrainInfoURL Old XML brainInfoURL	The **URL of the Central Directory page in BrainInfo** is used for interoperability between a neuroscientific database or website and BrainInfo. It enables developers to link users of other websites to the webpage in BrainInfo that provides, or provides links to, such information. The Central Directory provides the text definition of the structure, illustrations, connections, kinds of cells found there, and species that have or do not have the structure.
Parents	The **parent** of a structure is useful for constructing a hierarchical model that illustrates the location of a structure in relation to other structures in the hierarchy. A structure can have only one parent in a given model, but the structure can appear in more than one model. The model where it has a given parent is specified by the tag 'ModelName' (see below).
JSON **ModelName**	The **name of a model** indicates the hierarchy in which a particular structure-parent relation pertains. The name of the model is always different from the name of the top parent structure in a hierarchy. It often designates the species to which it applies and whether it is a structural hierarchy, in which structures are grouped by proximity, or a functional hierarchy, in which structures are grouped by multiple criteria including, particularly, connections.