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# **fairgraph Documentation**

***Release 0.8.0***

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**fairgraph** is an experimental Python library for working with metadata in the EBRAINS Knowledge Graph, with a particular focus on data reuse, although it is also useful in metadata registration/curation. The API is not stable, and is subject to change.



# CHAPTER 1

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## Installation

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To get the latest release:

```
pip install git+https://github.com/HumanBrainProject/kg-core-python.git#egg=kg-core
pip install fairgraph
```

To get the development version:

```
git clone https://github.com/HumanBrainProject/fairgraph.git
pip install -r ./fairgraph/requirements.txt
pip install -U ./fairgraph
```





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## About the Knowledge Graph

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The EBRAINS Knowledge Graph is a metadata store for neuroscience.

When sharing neuroscience data, it is essential to also share all of the context and background information needed to interpret and understand the data: the age of the subject, the sampling rate of the recording system, etc. For the EBRAINS data sharing platform, the actual data files are stored at the Swiss National Supercomputing Center, CSCS. All of the metadata associated with these files (including the precise file locations) is stored in the Knowledge Graph.

There are many ways to access the contents of the Knowledge Graph: through a [graphical search interface](#), with an anatomical search through the EBRAINS brain [atlases](#), through web services, and through Python clients.

**fairgraph** is an experimental, high-level Python client for the Knowledge Graph, which aims to be convenient, powerful and easy-to-use. Alternative ways to access the Knowledge Graph programmatically are summarized in the section “Alternatives” below.

### 2.1 Structure

The EBRAINS Knowledge Graph is a semantic graph database (in the sense of [graph theory](#)). It consists of “nodes”, each of which contains metadata about a specific aspect of a neuroscience experiment. These nodes are connected to each other, and the connections represent the relationships between the different pieces of metadata (for example, a node representing a slice of rat hippocampus will be connected to other nodes representing each of the neurons in that slice that was recorded from with an electrode, or reconstructed from microscopy images. The connections between nodes are of many different types, so that we can represent precisely the meaning of the connection, the type of the relationship (this is why we call it a `_semantic_graph`). This graph structure gives great flexibility and ease of evolution compared to a traditional database.

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**Todo:** insert a figure here showing a part of the graph

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**fairgraph** maps the Knowledge Graph onto connected Python objects. For example, a node in the graph containing metadata about a neuron whose activity was recorded using patch-clamp electrophysiology is represented by a Python object `PatchedCell` whose attributes correspond to the metadata stored in that node `_and_` to the semantic connections to other nodes.

### 2.1.1 Alternatives

For more information about developer access to the KG, see <https://kg.ebrains.eu/develop.html>.

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## Querying the Knowledge Graph

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### 3.1 Setting up a connection

Communication between fairgraph metadata objects and the Knowledge Graph web service is through a client object, for which an access token associated with an EBRAINS account is needed. To obtain an EBRAINS account, please see <https://ebrains.eu/register>.

If you are working in a Collaboratory Jupyter notebook, the client will find your token automatically.

If working outside the Collaboratory, we recommend you obtain a token from whichever authentication endpoint is available to you, and save it as an environment variable so the client can find it, e.g. at a shell prompt:

```
export KG_AUTH_TOKEN=eyJhbGciOi...
```

You can then create the client object:

```
>>> from fairgraph import KGClient
>>> client = KGClient()
```

You can also pass the token explicitly to the client:

```
>>> client = KGClient(token)
```

### 3.2 Listing the available metadata types

Each type of metadata node in the Knowledge Graph is represented by a Python class. These classes are organized into modules according to the openMINDS schemas. For a full list of modules, see *Metadata domains*.

To get a list of classes in a given module, import the module and then run `list_kg_classes()`, e.g.:

```
>>> import fairgraph.openminds.core as omcore

>>> omcore.list_kg_classes()
[fairgraph.openminds.core.research.behavioral_protocol.BehavioralProtocol,
fairgraph.openminds.core.actors.contact_information.ContactInformation,
fairgraph.openminds.core.data.content_type.ContentType,
fairgraph.openminds.core.miscellaneous.doi.DOI,
fairgraph.openminds.core.products.dataset.Dataset,
fairgraph.openminds.core.products.dataset_version.DatasetVersion,
fairgraph.openminds.core.data.file.File,
fairgraph.openminds.core.data.file_bundle.FileBundle,
fairgraph.openminds.core.data.file_repository.FileRepository,
fairgraph.openminds.core.data.file_repository_structure.FileRepositoryStructure,
fairgraph.openminds.core.miscellaneous.funding.Funding,
fairgraph.openminds.core.miscellaneous.gridid.GRIDID,
fairgraph.openminds.core.miscellaneous.isbn.ISBN,
fairgraph.openminds.core.data.license.License,
fairgraph.openminds.core.products.meta_data_model.MetaDataModel,
fairgraph.openminds.core.products.meta_data_model_version.MetaDataModelVersion,
fairgraph.openminds.core.products.model.Model,
fairgraph.openminds.core.products.model_version.ModelVersion,
fairgraph.openminds.core.miscellaneous.orcid.ORCID,
fairgraph.openminds.core.actors.organization.Organization,
fairgraph.openminds.core.actors.person.Person,
fairgraph.openminds.core.products.project.Project,
fairgraph.openminds.core.research.protocol.Protocol,
fairgraph.openminds.core.research.protocol_execution.ProtocolExecution,
fairgraph.openminds.core.miscellaneous.rorid.RORID,
fairgraph.openminds.core.miscellaneous.swhid.SWHID,
fairgraph.openminds.core.data.service_link.ServiceLink,
fairgraph.openminds.core.products.software.Software,
fairgraph.openminds.core.products.software_version.SoftwareVersion,
fairgraph.openminds.core.research.stimulation.Stimulation,
fairgraph.openminds.core.research.subject.Subject,
fairgraph.openminds.core.research.subject_group.SubjectGroup,
fairgraph.openminds.core.research.subject_group_state.SubjectGroupState,
fairgraph.openminds.core.research.subject_state.SubjectState,
fairgraph.openminds.core.research.tissue_sample.TissueSample,
fairgraph.openminds.core.research.tissue_sample_collection.TissueSampleCollection,
fairgraph.openminds.core.research.tissue_sample_collection_state.
↳TissueSampleCollectionState,
fairgraph.openminds.core.research.tissue_sample_state.TissueSampleState,
fairgraph.openminds.core.miscellaneous.url.URL]
```

### 3.3 Listing all metadata nodes of a given type

To obtain a list of all the metadata nodes of a given type, import the associated class and use the `list()` method, passing the *client* object you created previously, e.g. to get a list of patched cells:

```
from fairgraph.openminds.core import License

licenses = License.list(client)
```

By default, this gives you the first 100 results. You can change the number of results retrieved and the starting point, e.g.

```
licenses = License.list(client, from_index=15, size=10)
```

This returns 10 nodes starting with the 15th. To see how many nodes there are in total:

```
License.count(client)
```

**Note:** if you consistently retrieve an empty list, it is probably because you do not yet have the necessary permissions. See [Access permissions](#) for more information.

## 3.4 Filtering/searching

To obtain only metadata nodes that have certain properties, you can filter the list of nodes. For example, to see only datasets whose name contain the phrase ‘patch-clamp’:

```
from fairgraph.openminds.core import DatasetVersion

datasets = DatasetVersion.list(client, name="patch-clamp")
```

**Warning:** the filtering system is currently primitive, and unaware of hierarchies, e.g. filtering by “hippocampus” will not return cells with the brain region set to “hippocampus CA1”. This is on our list of things to fix soon! To see a list of possible search terms, use the `fields()` attribute, e.g. `DatasetVersion.fields`.

## 3.5 Retrieving a specific node based on its name or id

If you know the name or unique id of a node in the KnowledgeGraph, you can retrieve it directly:

```
dataset_of_interest = DatasetVersion.by_name('Whole cell patch-clamp recordings of_
↳cerebellar Golgi cells', client)
dataset_of_interest = DatasetVersion.from_id('17196b79-04db-4ea4-bb69-d20aab6f1d62',
↳client)
```

## 3.6 Viewing metadata and connections

Once you have retrieved a node of interest, the associated metadata are available as attributes of the Python object, e.g.:

```
>>> dataset_of_interest.id
'https://kg.ebrains.eu/api/instances/17196b79-04db-4ea4-bb69-d20aab6f1d62'

>>> dataset_of_interest.uuid
'17196b79-04db-4ea4-bb69-d20aab6f1d62'

>>> dataset_of_interest.description[:100] + "..."
'The Golgi cells, together with granule cells and mossy fibers, form a neuronal_
↳microcircuit regulati...'
```

Connections between graph nodes are also available as attributes:

```
>>> dataset_of_interest.license
KGProxyV3([<class 'fairgraph.openminds.core.data.license.License'>], 'https://kg.
↳ebrains.eu/api/instances/6ebce971-7f99-4fbc-9621-eeae47a70d85')
```

By default, for performance reasons, connections are not followed, and instead you will see either a `KGQuery` or `KGProxy` object. In both these cases, follow the connection using the `resolve()` method, e.g.:

```
>>> license = dataset_of_interest.license.resolve(client)

>>> license.name
'Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International'
```

---

**Note:** It is rather cumbersome to have to follow all these connections manually. In the near future, you will be able to ask fairgraph to resolve the connections for you, although with the risk of poor performance if your node of interest is indirectly connected to many other nodes in the graph.

---

## 3.7 Strict mode

If you don't provide all of the metadata attributes and data types expected, fairgraph will warn you.

If you wish to be certain that all required attributes have been provided, you can turn on strict checking for a given node type as follows:

```
DatasetVersion.set_strict_mode(True)
```

This will then raise an `Exception` if an attribute is missing or of the wrong data type.

---

## Creating and updating metadata nodes

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To create a new metadata node, create an instance of the appropriate Python class, then use the `save()` method, e.g.:

```
from fairgraph.openminds.core import SoftwareVersion, URL

sv = SoftwareVersion(
    name="numpy",
    alias="numpy",
    version_identifier="1.14.9"
)
sv.save(client, space="myspace")
```

To update a node, edit the attributes of the corresponding Python object, then `save()` again:

```
from fairgraph.base_v3 import IRI

sv.homepage = URL(url=IRI("https://numpy.org"))
sv.save(client)
```

(Note that for updating existing objects you don't need to specify the space.)

### 4.1 How does fairgraph distinguish between creating a new node and modifying an existing one?

If a previously-created node has been retrieved from the Knowledge Graph, it will have a unique ID, and therefore calling `save()` will update the node with this ID.

If a new Python object is created with the same or similar metadata, **fairgraph** queries for a node with matching metadata for a *subset* of the fields. If you want to know which fields are included in the match, examine the `existence_query_fields` attribute, e.g.:

```
>>> SoftwareVersion.existence_query_fields
('alias', 'version_identifier')
```

## 4.2 Permissions

If you get an error message when trying to create or update a node, it may be because you do not have the necessary permissions. See [Access permissions](#) for more information.



## 5.1 KG version 3

### 5.1.1 openminds.core

#### Actors

```
class fairgraph.openminds.core.actors.person.Person (id=None, data=None,  
                                                    space=None, scope=None,  
                                                    **properties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on a person.

#### Parameters

- **affiliations** (*Affiliation*) – Declaration of a person being closely associated to an organization.
- **contact\_information** (*ContactInformation*) – Any available way used to contact a person or business (e.g., address, phone number, email address, etc.).
- **digital\_identifiers** (*ORCID*) – Digital handle to identify objects or legal persons.
- **family\_name** (*str*) – Name borne in common by members of a family.
- **given\_name** (*str*) – Name given to a person, including all potential middle names, but excluding the family name.

```
class fairgraph.openminds.core.actors.contact_information.ContactInformation (id=None,  
                                                                           data=None,  
                                                                           space=None,  
                                                                           scope=None,  
                                                                           **prop-  
                                                                           er-  
                                                                           ties)
```

Bases: fairgraph.base\_v3.KGObject

**Parameters** **email** (*str*) – Address to which or from which an electronic mail can be sent.

```
class fairgraph.openminds.core.actors.organization.Organization (id=None,
                                                                data=None,
                                                                space=None,
                                                                scope=None,
                                                                **properties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on an organization.

#### Parameters

- **name** (*str*) – Whole, non-abbreviated name of the organization.
- **alias** (*str*) – Shortened or fully abbreviated name of the organization.
- **digital\_identifiers** (*GRIDID*, *RORID*, *RRID*) – Digital handle to identify objects or legal persons.
- **has\_parent** (*Organization*) – Reference to a parent object or legal person.
- **homepage** (*URL*) – Main website of the organization.

```
class fairgraph.openminds.core.actors.affiliation.Affiliation (data=None,
                                                             **properties)
```

Bases: fairgraph.base\_v3.EmbeddedMetadata

#### Parameters

- **end\_date** (*date*) – Date in the Gregorian calendar at which something terminates in time.
- **organization** (*Organization*) – Legally accountable, administrative and functional structure.
- **start\_date** (*date*) – Date in the Gregorian calendar at which something begins in time

```
class fairgraph.openminds.core.actors.contribution.Contribution (data=None,
                                                                **properties)
```

Bases: fairgraph.base\_v3.EmbeddedMetadata

Structured information on the contribution made to a research product.

#### Parameters

- **contribution\_types** (*ContributionType*) – Distinct class of what was given or supplied as a part or share.
- **contributor** (*Organization*, *Person*) – Legal person that gave or supplied something as a part or share.

## Data

```
class fairgraph.openminds.core.data.content_type.ContentType (id=None,
                                                             data=None,
                                                             space=None,
                                                             scope=None,
                                                             **properties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on the content type of a file instance, bundle or repository.

**Parameters**

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the content type.
- **data\_types** (*DataType*) – no description available
- **description** (*str*) – Longer statement or account giving the characteristics of the content type.
- **display\_label** (*str*) – no description available
- **file\_extensions** (*str*) – String of characters attached as suffix to the names of files of a particular format.
- **related\_media\_type** (*IRI*) – Reference to an official two-part identifier for file formats and format contents.
- **specification** (*IRI*) – Detailed and precise presentation of, or proposal for something.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.core.data.file.File (id=None, data=None, space=None,  
                                              scope=None, **properties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on a file instances.

**Parameters**

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the file.
- **iri** (*IRI*) – Stands for Internationalized Resource Identifier which is an internet protocol standard that builds on the URI protocol, extending the set of permitted characters to include Unicode/ISO 10646.
- **content\_description** (*str*) – no description available
- **data\_types** (*DataType*) – no description available
- **file\_repository** (*FileRepository*) – no description available
- **format** (*ContentType*) – Method of digitally organizing and structuring data or information.
- **hash** (*Hash*) – Term used for the process of converting any data into a single value. Often also directly refers to the resulting single value.
- **is\_part\_of** (*FileBundle*) – Reference to the ensemble of multiple things or beings.
- **special\_usage\_role** (*FileUsageRole*) – Particular function of something when it is used.
- **storage\_size** (*QuantitativeValue*) – Quantitative value defining how much disk space is used by an object on a computer system.

```
class fairgraph.openminds.core.data.file_bundle.FileBundle (id=None, data=None,  
                                                         space=None,  
                                                         scope=None, **prop-  
                                                         erties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on a bundle of file instances.

**Parameters**

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the file bundle.
- **content\_description** (*str*) – no description available
- **descended\_from** (*LocalFile, Technique, BehavioralProtocol, File, FileBundle, Subject, SubjectGroup, SubjectGroupState, SubjectState, TissueSample, TissueSampleCollection, TissueSampleCollectionState, TissueSampleState*) – no description available
- **format** (*ContentType*) – Method of digitally organizing and structuring data or information.
- **grouping\_type** (*FileBundleGrouping*) – no description available
- **hash** (*Hash*) – Term used for the process of converting any data into a single value. Often also directly refers to the resulting single value.
- **is\_part\_of** (*FileBundle, FileRepository*) – Reference to the ensemble of multiple things or beings.
- **storage\_size** (*QuantitativeValue*) – Quantitative value defining how much disk space is used by an object on a computer system.

```
class fairgraph.openminds.core.data.file_repository.FileRepository (id=None,  
                                                                    data=None,  
                                                                    space=None,  
                                                                    scope=None,  
                                                                    **properties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on a file repository.

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the file repository.
- **iri** (*IRI*) – Stands for Internationalized Resource Identifier which is an internet protocol standard that builds on the URI protocol, extending the set of permitted characters to include Unicode/ISO 10646.
- **content\_type\_patterns** (*ContentTypePattern*) – no description available
- **format** (*ContentType*) – Method of digitally organizing and structuring data or information.
- **hash** (*Hash*) – Term used for the process of converting any data into a single value. Often also directly refers to the resulting single value.
- **hosted\_by** (*Organization*) – Reference to an organization that provides facilities and services for something.
- **repository\_type** (*FileRepositoryType*) – no description available
- **storage\_size** (*QuantitativeValue*) – Quantitative value defining how much disk space is used by an object on a computer system.
- **structure\_pattern** (*FileRepositoryStructure*) – no description available

```
class fairgraph.openminds.core.data.file_repository_structure.FileRepositoryStructure (id=None, data=None,
                                                                                       space=None,
                                                                                       scope=None,
                                                                                       **properties)
    Bases: fairgraph.base_v3.KGObject
```

#### Parameters

- **lookup\_label** (*str*) – no description available
- **file\_path\_patterns** (*FilePathPattern*) – no description available

```
class fairgraph.openminds.core.data.license.License (id=None, data=None,
                                                                 space=None, scope=None,
                                                                 **properties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on a used license.

#### Parameters

- **name** (*str*) – Whole, non-abbreviated name of the license.
- **alias** (*str*) – Shortened or fully abbreviated name of the license.
- **legal\_code** (*IRI*) – Type of legislation that claims to cover the law system (complete or parts) as it existed at the time the code was enacted.
- **webpages** (*str*) – Hypertext document (block of information) found on the World Wide Web.

```
class fairgraph.openminds.core.data.service_link.ServiceLink (id=None,
                                                                 data=None,
                                                                 space=None,
                                                                 scope=None,
                                                                 **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the service link.
- **data\_location** (*File, FileArchive, FileBundle, ParcellationEntityVersion*) – no description available
- **open\_data\_in** (*URL*) – no description available
- **preview\_image** (*File*) – no description available
- **service** (*Service*) – no description available

## Miscellaneous

```
class fairgraph.openminds.core.miscellaneous.doi.DOI (id=None, data=None,
                                                                 space=None, scope=None,
                                                                 **properties)
```

Bases: fairgraph.base\_v3.KGObject

**Parameters** **identifier** (*str*) – Term or code used to identify the DOI.

```
class fairgraph.openminds.core.miscellaneous.funding.Funding (id=None,  
                                                         data=None,  
                                                         space=None,  
                                                         scope=None,  
                                                         **properties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on used funding.

#### Parameters

- **acknowledgement** (*str*) – Official declaration or avowal of appreciation of an act or achievement.
- **award\_number** (*str*) – Machine-readable identifier for a benefit that is conferred or bestowed on the basis of merit or need.
- **award\_title** (*str*) – Human-readable identifier for a benefit that is conferred or bestowed on the basis of merit or need.
- **funder** (*Organization*, *Person*) – Legal person that provides money for a particular purpose.

```
class fairgraph.openminds.core.miscellaneous.gridid.GRIDID (id=None, data=None,  
                                                         space=None,  
                                                         scope=None, **prop-  
                                                         erties)
```

Bases: fairgraph.base\_v3.KGObject

**Parameters identifier** (*str*) – Term or code used to identify the GRIDID.

```
class fairgraph.openminds.core.miscellaneous.isbn.ISBN (id=None,      data=None,  
                                                         space=None, scope=None,  
                                                         **properties)
```

Bases: fairgraph.base\_v3.KGObject

**Parameters identifier** (*str*) – Term or code used to identify the ISBN.

```
class fairgraph.openminds.core.miscellaneous.orcid.ORCID (id=None,      data=None,  
                                                         space=None,  
                                                         scope=None, **proper-  
                                                         ties)
```

Bases: fairgraph.base\_v3.KGObject

**Parameters identifier** (*str*) – Term or code used to identify the ORCID.

```
class fairgraph.openminds.core.miscellaneous.rorid.RORID (id=None,      data=None,  
                                                         space=None,  
                                                         scope=None, **proper-  
                                                         ties)
```

Bases: fairgraph.base\_v3.KGObject

**Parameters identifier** (*str*) – Term or code used to identify the RORID.

```
class fairgraph.openminds.core.miscellaneous.swhid.SWHID (id=None,      data=None,  
                                                         space=None,  
                                                         scope=None, **proper-  
                                                         ties)
```

Bases: fairgraph.base\_v3.KGObject

**Parameters identifier** (*str*) – Term or code used to identify the SWHID.

```
class fairgraph.openminds.core.miscellaneous.url.URL (id=None, data=None,  
                                                    space=None, scope=None,  
                                                    **properties)
```

Bases: fairgraph.base\_v3.KGObject

**Parameters** **url** (*IRI*) – no description available

## Products

```
class fairgraph.openminds.core.products.dataset.Dataset (id=None, data=None,  
                                                    space=None, scope=None,  
                                                    **properties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on data originating from human/animal studies or simulations (concept level).

### Parameters

- **name** (*str*) – Whole, non-abbreviated name of the dataset.
- **alias** (*str*) – Shortened or fully abbreviated name of the dataset.
- **authors** (*Organization, Person*) – Creator of a literary or creative work, as well as a dataset publication.
- **custodians** (*Organization, Person*) – The ‘custodian’ is a legal person who is responsible for the content and quality of the data, metadata, and/or code of a research product.
- **description** (*str*) – Longer statement or account giving the characteristics of the dataset.
- **digital\_identifier** (*DOI*) – Digital handle to identify objects or legal persons.
- **versions** (*DatasetVersion*) – Reference to variants of an original.
- **homepage** (*URL*) – Main website of the dataset.
- **how\_to\_cite** (*str*) – Preferred format for citing a particular object or legal person.

```
class fairgraph.openminds.core.products.dataset_version.DatasetVersion (id=None,  
                                                                    data=None,  
                                                                    space=None,  
                                                                    scope=None,  
                                                                    **prop-  
                                                                    er-  
                                                                    ties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on data originating from human/animal studies or simulations (version level).

### Parameters

- **name** (*str*) – Whole, non-abbreviated name of the dataset version.
- **alias** (*str*) – Shortened or fully abbreviated name of the dataset version.
- **accessibility** (*ProductAccessibility*) – Level to which something is accessible to the dataset version.
- **authors** (*Organization, Person*) – Creator of a literary or creative work, as well as a dataset publication.
- **behavioral\_protocols** (*BehavioralProtocol*) – no description available

- **copyright** (*Copyright*) – Exclusive and assignable legal right of an originator to re-produce, publish, sell, or distribute the matter and form of a creative work for a defined time period.
- **custodians** (*Organization, Person*) – The ‘custodian’ is a legal person who is responsible for the content and quality of the data, metadata, and/or code of a research product.
- **data\_types** (*SemanticDataType*) – no description available
- **description** (*str*) – Longer statement or account giving the characteristics of the dataset version.
- **digital\_identifier** (*DOI*) – Digital handle to identify objects or legal persons.
- **ethics\_assessment** (*EthicsAssessment*) – Judgment about the applied principles of conduct governing an individual or a group.
- **experimental\_approaches** (*ExperimentalApproach*) – no description available
- **full\_documentation** (*DOI, File, URL*) – Non-abridged instructions, comments, and information for using a particular product.
- **funding** (*Funding*) – Money provided by a legal person for a particular purpose.
- **homepage** (*URL*) – Main website of the dataset version.
- **how\_to\_cite** (*str*) – Preferred format for citing a particular object or legal person.
- **input\_data** (*DOI, File, FileBundle, URL*) – Data that is put into a process or machine.
- **is\_alternative\_version\_of** (*DatasetVersion*) – Reference to an original form where the essence was preserved, but presented in an alternative form.
- **is\_new\_version\_of** (*DatasetVersion*) – Reference to a previous (potentially outdated) particular form of something.
- **keywords** (*ActionStatusType, AgeCategory, AnatomicalAxesOrientation, AnatomicalPlane, AnnotationType, AtlasType, BiologicalOrder, BiologicalSex, BreedingType, CellCultureType, CellType, ContributionType, CranialWindowType, CriteriaQualityType, DataType, DeviceType, Disease, DiseaseModel, EthicsAssessment, ExperimentalApproach, FileBundleGrouping, FileRepositoryType, FileUsageRole, GeneticStrainType, Handedness, Language, Laterality, MeasuredQuantity, MetaDataModelType, ModelAbstractionLevel, ModelScope, MolecularEntity, OperatingDevice, OperatingSystem, Organ, PatchClampVariation, PreparationType, ProductAccessibility, ProgrammingLanguage, QualitativeOverlap, SemanticDataType, Service, SoftwareApplicationCategory, SoftwareFeature, Species, StimulationApproach, StimulusType, SubcellularEntity, SubjectAttribute, Technique, TermSuggestion, Terminology, TissueSampleAttribute, TissueSampleType, TypeOfUncertainty, UBERONParcellation, UnitOfMeasurement*) – Significant word or concept that are representative of the dataset version.



- **license** (`License`) – Grant by a party to another party as an element of an agreement between those parties that permits to do, use, or own something.
- **other\_contributions** (`Contribution`) – Giving or supplying of something (such as money or time) as a part or share other than what is covered elsewhere.
- **preparation\_designs** (`PreparationType`) – no description available
- **related\_publications** (`DOI`, `HANDLE`, `ISBN`) – Reference to something that was made available for the general public to see or buy.
- **release\_date** (`date`) – Fixed date on which a product is due to become or was made available for the general public to see or buy
- **repository** (`FileRepository`) – Place, room, or container where something is deposited or stored.
- **studied\_specimens** (`Subject`, `SubjectGroup`, `TissueSample`, `TissueSampleCollection`) – no description available
- **study\_targets** (`BiologicalOrder`, `BiologicalSex`, `BreedingType`, `CellCultureType`, `CellType`, `Disease`, `DiseaseModel`, `GeneticStrainType`, `Handedness`, `MolecularEntity`, `Organ`, `Species`, `SubcellularEntity`, `TermSuggestion`, `UBERONParcellation`, `CustomAnatomicalEntity`, `ParcellationEntity`, `ParcellationEntityVersion`) – Structure or function that was targeted within a study.
- **support\_channels** (`str`) – Way of communication used to interact with users or customers.
- **techniques** (`Technique`) – Method of accomplishing a desired aim.
- **version\_identifier** (`str`) – Term or code used to identify the version of something.
- **version\_innovation** (`str`) – Documentation on what changed in comparison to a previously published form of something.

```
class fairgraph.openminds.core.products.model.Model(id=None, data=None,
                                                    space=None, scope=None,
                                                    **properties)
```

Bases: `fairgraph.base_v3.KGObject`

Structured information on a computational model (concept level).

#### Parameters

- **name** (`str`) – Whole, non-abbreviated name of the model.
- **alias** (`str`) – Shortened or fully abbreviated name of the model.
- **abstraction\_level** (`ModelAbstractionLevel`) – Extent of simplification of physical, spatial, or temporal details or attributes in the study of objects or systems.
- **custodians** (`Organization`, `Person`) – The ‘custodian’ is a legal person who is responsible for the content and quality of the data, metadata, and/or code of a research product.
- **description** (`str`) – Longer statement or account giving the characteristics of the model.
- **developers** (`Organization`, `Person`) – Legal person that creates or improves products or services (e.g., software, applications, etc.).

- **digital\_identifier** (*DOI*, *SWHID*) – Digital handle to identify objects or legal persons.
- **versions** (*ModelVersion*) – Reference to variants of an original.
- **homepage** (*URL*) – Main website of the model.
- **how\_to\_cite** (*str*) – Preferred format for citing a particular object or legal person.
- **model\_scope** (*ModelScope*) – Extent of something.
- **study\_targets** (*BiologicalOrder*, *BiologicalSex*, *BreedingType*, *CellCultureType*, *CellType*, *Disease*, *DiseaseModel*, *GeneticStrainType*, *Handedness*, *MolecularEntity*, *Organ*, *Species*, *SubcellularEntity*, *TermSuggestion*, *UBERONParcellation*, *CustomAnatomicalEntity*, *ParcellationEntity*, *ParcellationEntityVersion*) – Structure or function that was targeted within a study.

```
class fairgraph.openminds.core.products.model_version.ModelVersion (id=None,
                                                                    data=None,
                                                                    space=None,
                                                                    scope=None,
                                                                    **properties)
```

Bases: `fairgraph.base_v3.KGObject`

Structured information on a computational model (version level).

#### Parameters

- **name** (*str*) – Whole, non-abbreviated name of the model version.
- **alias** (*str*) – Shortened or fully abbreviated name of the model version.
- **accessibility** (*ProductAccessibility*) – Level to which something is accessible to the model version.
- **copyright** (*Copyright*) – Exclusive and assignable legal right of an originator to reproduce, publish, sell, or distribute the matter and form of a creative work for a defined time period.
- **custodians** (*Organization*, *Person*) – The ‘custodian’ is a legal person who is responsible for the content and quality of the data, metadata, and/or code of a research product.
- **description** (*str*) – Longer statement or account giving the characteristics of the model version.
- **developers** (*Organization*, *Person*) – Legal person that creates or improves products or services (e.g., software, applications, etc.).
- **digital\_identifier** (*DOI*, *SWHID*) – Digital handle to identify objects or legal persons.
- **format** (*ContentType*) – Method of digitally organizing and structuring data or information.
- **full\_documentation** (*DOI*, *File*, *URL*) – Non-abridged instructions, comments, and information for using a particular product.
- **funding** (*Funding*) – Money provided by a legal person for a particular purpose.
- **homepage** (*URL*) – Main website of the model version.

- **how\_to\_cite** (*str*) – Preferred format for citing a particular object or legal person.
- **input\_data** (*DOI*, *File*, *FileBundle*, *URL*) – Data that is put into a process or machine.
- **is\_alternative\_version\_of** (*ModelVersion*) – Reference to an original form where the essence was preserved, but presented in an alternative form.
- **is\_new\_version\_of** (*ModelVersion*) – Reference to a previous (potentially out-dated) particular form of something.
- **keywords** (*ActionStatusType*, *AgeCategory*, *AnatomicalAxesOrientation*, *AnatomicalPlane*, *AnnotationType*, *AtlasType*, *BiologicalOrder*, *BiologicalSex*, *BreedingType*, *CellCultureType*, *CellType*, *ContributionType*, *CranialWindowType*, *CriteriaQualityType*, *DataType*, *DeviceType*, *Disease*, *DiseaseModel*, *EthicsAssessment*, *ExperimentalApproach*, *FileBundleGrouping*, *FileRepositoryType*, *FileUsageRole*, *GeneticStrainType*, *Handedness*, *Language*, *Laterality*, *MeasuredQuantity*, *MetaDataModelType*, *ModelAbstractionLevel*, *ModelScope*, *MolecularEntity*, *OperatingDevice*, *OperatingSystem*, *Organ*, *PatchClampVariation*, *PreparationType*, *ProductAccessibility*, *ProgrammingLanguage*, *QualitativeOverlap*, *SemanticDataType*, *Service*, *SoftwareApplicationCategory*, *SoftwareFeature*, *Species*, *StimulationApproach*, *StimulusType*, *SubcellularEntity*, *SubjectAttribute*, *Technique*, *TermSuggestion*, *Terminology*, *TissueSampleAttribute*, *TissueSampleType*, *TypeOfUncertainty*, *UBERONParcellation*, *UnitOfMeasurement*) – Significant word or concept that are representative of the model version.
- **licenses** (*License*) – Grant by a party to another party as an element of an agreement between those parties that permits to do, use, or own something.
- **other\_contributions** (*Contribution*) – Giving or supplying of something (such as money or time) as a part or share other than what is covered elsewhere.
- **output\_data** (*DOI*, *File*, *FileBundle*, *URL*) – Data that comes out of, is delivered or produced by a process or machine.
- **related\_publications** (*DOI*, *HANDLE*, *ISBN*) – Reference to something that was made available for the general public to see or buy.
- **release\_date** (*date*) – Fixed date on which a product is due to become or was made available for the general public to see or buy
- **repository** (*FileRepository*) – Place, room, or container where something is deposited or stored.
- **support\_channels** (*str*) – Way of communication used to interact with users or customers.
- **version\_identifier** (*str*) – Term or code used to identify the version of something.
- **version\_innovation** (*str*) – Documentation on what changed in comparison to a previously published form of something.

```
class fairgraph.openminds.core.products.project.Project (id=None,      data=None,
                                                         space=None, scope=None,
                                                         **properties)
```

Bases: `fairgraph.base_v3.KGObject`

Structured information on a research project.

#### Parameters

- **name** (*str*) – Whole, non-abbreviated name of the project.
- **alias** (*str*) – Shortened or fully abbreviated name of the project.
- **coordinators** (*Organization*, *Person*) – Legal person who organizes the collaborative work of people or groups.
- **description** (*str*) – Longer statement or account giving the characteristics of the project.
- **has\_research\_products** (*WorkflowRecipe*, *WorkflowRecipeVersion*, *Dataset*, *DatasetVersion*, *MetaDataModel*, *MetaDataModelVersion*, *Model*, *ModelVersion*, *Software*, *SoftwareVersion*, *LivePaper*, *LivePaperVersion*, *BrainAtlas*, *BrainAtlasVersion*) – Reference to subsidiary research products.
- **homepage** (*URL*) – Main website of the project.

```
class fairgraph.openminds.core.products.software.Software (id=None, data=None,
                                                         space=None,
                                                         scope=None, **proper-
                                                         ties)
```

Bases: `fairgraph.base_v3.KGObject`

Structured information on a software tool (concept level).

#### Parameters

- **name** (*str*) – Whole, non-abbreviated name of the software.
- **alias** (*str*) – Shortened or fully abbreviated name of the software.
- **custodians** (*Organization*, *Person*) – The ‘custodian’ is a legal person who is responsible for the content and quality of the data, metadata, and/or code of a research product.
- **description** (*str*) – Longer statement or account giving the characteristics of the software.
- **developers** (*Organization*, *Person*) – Legal person that creates or improves products or services (e.g., software, applications, etc.).
- **digital\_identifier** (*DOI*, *SWHID*) – Digital handle to identify objects or legal persons.
- **versions** (*SoftwareVersion*) – Reference to variants of an original.
- **homepage** (*URL*) – Main website of the software.
- **how\_to\_cite** (*str*) – Preferred format for citing a particular object or legal person.

```
class fairgraph.openminds.core.products.software_version.SoftwareVersion (id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **prop-
                                                                              er-
                                                                              ties)
```

Bases: `fairgraph.base_v3.KGObject`

## Parameters

- **name** (*str*) – Whole, non-abbreviated name of the software version.
- **alias** (*str*) – Shortened or fully abbreviated name of the software version.
- **accessibility** (*ProductAccessibility*) – Level to which something is accessible to the software version.
- **application\_categories** (*SoftwareApplicationCategory*) – Distinct class that groups software programs which perform a similar task or set of tasks.
- **copyright** (*Copyright*) – Exclusive and assignable legal right of an originator to reproduce, publish, sell, or distribute the matter and form of a creative work for a defined time period.
- **custodians** (*Organization*, *Person*) – The ‘custodian’ is a legal person who is responsible for the content and quality of the data, metadata, and/or code of a research product.
- **description** (*str*) – Longer statement or account giving the characteristics of the software version.
- **developers** (*Organization*, *Person*) – Legal person that creates or improves products or services (e.g., software, applications, etc.).
- **devices** (*OperatingDevice*) – Piece of equipment or mechanism (hardware) designed to serve a special purpose or perform a special function.
- **digital\_identifier** (*DOI*, *SWHID*) – Digital handle to identify objects or legal persons.
- **features** (*SoftwareFeature*) – Structure, form, or appearance that characterizes the software version.
- **full\_documentation** (*DOI*, *File*, *URL*) – Non-abridged instructions, comments, and information for using a particular product.
- **funding** (*Funding*) – Money provided by a legal person for a particular purpose.
- **homepage** (*URL*) – Main website of the software version.
- **how\_to\_cite** (*str*) – Preferred format for citing a particular object or legal person.
- **input\_formats** (*ContentType*) – Format of data that is put into a process or machine.
- **is\_alternative\_version\_of** (*SoftwareVersion*) – Reference to an original form where the essence was preserved, but presented in an alternative form.
- **is\_new\_version\_of** (*SoftwareVersion*) – Reference to a previous (potentially outdated) particular form of something.
- **keywords** (*ActionStatusType*, *AgeCategory*, *AnatomicalAxesOrientation*, *AnatomicalPlane*, *AnnotationType*, *AtlasType*, *BiologicalOrder*, *BiologicalSex*, *BreedingType*, *CellCultureType*, *CellType*, *ContributionType*, *CranialWindowType*, *CriteriaQualityType*, *DataType*, *DeviceType*, *Disease*, *DiseaseModel*, *EthicsAssessment*, *ExperimentalApproach*, *FileBundleGrouping*, *FileRepositoryType*, *FileUsageRole*, *GeneticStrainType*, *Handedness*, *Language*, *Laterality*, *MeasuredQuantity*, *MetaDataModelType*, *ModelAbstractionLevel*, *ModelScope*, *MolecularEntity*, *OperatingDevice*, *OperatingSystem*, *Organ*,

*PatchClampVariation, PreparationType, ProductAccessibility, ProgrammingLanguage, QualitativeOverlap, SemanticDataType, Service, SoftwareApplicationCategory, SoftwareFeature, Species, StimulationApproach, StimulusType, SubcellularEntity, SubjectAttribute, Technique, TermSuggestion, Terminology, TissueSampleAttribute, TissueSampleType, TypeOfUncertainty, UBERONParcellation, UnitOfMeasurement*) – Significant word or concept that are representative of the software version.

- **languages** (*Language*) – System of communication (words, their pronunciation, and the methods of combining them) used and understood by a particular community.
- **licenses** (*License*) – Grant by a party to another party as an element of an agreement between those parties that permits to do, use, or own something.
- **operating\_systems** (*OperatingSystem*) – Software that controls the operation of a computer and directs the processing of programs.
- **other\_contributions** (*Contribution*) – Giving or supplying of something (such as money or time) as a part or share other than what is covered elsewhere.
- **output\_formats** (*ContentType*) – Format of data that comes out of, is delivered or produced by a process or machine.
- **programming\_languages** (*ProgrammingLanguage*) – Distinct set of instructions for computer programs in order to produce various kinds of output.
- **related\_publications** (*DOI, HANDLE, ISBN*) – Reference to something that was made available for the general public to see or buy.
- **release\_date** (*date*) – Fixed date on which a product is due to become or was made available for the general public to see or buy
- **repository** (*FileRepository*) – Place, room, or container where something is deposited or stored.
- **requirements** (*str*) – Something essential to the existence, occurrence or function of something else.
- **support\_channels** (*str*) – Way of communication used to interact with users or customers.
- **version\_identifier** (*str*) – Term or code used to identify the version of something.
- **version\_innovation** (*str*) – Documentation on what changed in comparison to a previously published form of something.

## Research

```
class fairgraph.openminds.core.research.behavioral_protocol.BehavioralProtocol (id=None,  
                                                                              data=None,  
                                                                              space=None,  
                                                                              scope=None,  
                                                                              **properties)
```

Bases: fairgraph.base\_v3.KGObject

### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the behavioral protocol.
- **described\_in** (*DOI*, *File*, *URL*) – no description available
- **description** (*str*) – Longer statement or account giving the characteristics of the behavioral protocol.
- **internal\_identifier** (*str*) – Term or code that identifies the behavioral protocol within a particular product.
- **stimulations** (*Stimulation*) – no description available

```
class fairgraph.openminds.core.research.protocol.Protocol (id=None, data=None,
                                                         space=None,
                                                         scope=None, **properties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on a research project.

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the protocol.
- **description** (*str*) – Longer statement or account giving the characteristics of the protocol.
- **stimulations** (*Stimulation*) – no description available
- **techniques** (*Technique*) – Method of accomplishing a desired aim.

```
class fairgraph.openminds.core.research.protocol_execution.ProtocolExecution (id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **properties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on a protocol execution.

#### Parameters

- **lookup\_label** (*str*) – no description available
- **behavioral\_protocols** (*BehavioralProtocol*) – no description available
- **custom\_property\_sets** (*CustomPropertySet*) – no description available
- **description** (*str*) – Longer statement or account giving the characteristics of the protocol execution.
- **ended\_at\_time** (*datetime*) – no description available
- **inputs** (*File*, *FileBundle*, *SubjectGroupState*, *SubjectState*, *TissueSampleCollectionState*, *TissueSampleState*) – Something or someone that is put into or participates in a process or machine.
- **is\_part\_of** (*DatasetVersion*) – Reference to the ensemble of multiple things or beings.

- **outputs** (`File`, `FileBundle`, `SubjectGroupState`, `SubjectState`, `TissueSampleCollectionState`, `TissueSampleState`) – Something or someone that comes out of, is delivered or produced by a process or machine.
- **preparation\_design** (`PreparationType`) – no description available
- **protocols** (`Protocol`) – Plan that describes the process of a scientific or medical experiment, treatment, or procedure.
- **started\_at\_time** (`datetime`) – no description available
- **study\_targets** (`BiologicalOrder`, `BiologicalSex`, `BreedingType`, `CellCultureType`, `CellType`, `Disease`, `DiseaseModel`, `GeneticStrainType`, `Handedness`, `MolecularEntity`, `Organ`, `Species`, `SubcellularEntity`, `TermSuggestion`, `UBERONParcellation`, `CustomAnatomicalEntity`, `ParcellationEntity`, `ParcellationEntityVersion`) – Structure or function that was targeted within a study.

```
class fairgraph.openminds.core.research.stimulation.Stimulation (id=None,
                                                                data=None,
                                                                space=None,
                                                                scope=None,
                                                                **properties)
```

Bases: `fairgraph.base_v3.KGObject`

#### Parameters

- **lookup\_label** (`str`) – no description available
- **custom\_property\_sets** (`CustomPropertySet`) – no description available
- **data\_locations** (`File`, `FileBundle`) – no description available
- **description** (`str`) – Longer statement or account giving the characteristics of the stimulation.
- **stimulation\_approach** (`StimulationApproach`) – no description available
- **stimulus\_type** (`StimulusType`) – no description available

```
class fairgraph.openminds.core.research.subject.Subject (id=None, data=None,
                                                         space=None, scope=None,
                                                         **properties)
```

Bases: `fairgraph.base_v3.KGObject`

Structured information on a subject.

#### Parameters

- **lookup\_label** (`str`) – no description available
- **biological\_sex** (`BiologicalSex`) – Differentiation of individuals of most species (animals and plants) based on the type of gametes they produce.
- **internal\_identifier** (`str`) – Term or code that identifies the subject within a particular product.
- **is\_part\_of** (`SubjectGroup`) – Reference to the ensemble of multiple things or beings.
- **species** (`Species`, `Strain`) – Category of biological classification comprising related organisms or populations potentially capable of interbreeding, and being designated



by a binomial that consists of the name of a genus followed by a Latin or latinized uncapitalized noun or adjective.

- **studied\_states** ([SubjectState](#)) – Reference to a point in time at which the subject was studied in a particular mode or condition.

```
class fairgraph.openminds.core.research.subject_group.SubjectGroup (id=None,
                                                                    data=None,
                                                                    space=None,
                                                                    scope=None,
                                                                    **properties)
```

Bases: `fairgraph.base_v3.KGObject`

#### Parameters

- **lookup\_label** (*str*) – no description available
- **additional\_remarks** (*str*) – Mention of what deserves additional attention or notice.
- **biological\_sex** ([BiologicalSex](#)) – Differentiation of individuals of most species (animals and plants) based on the type of gametes they produce.
- **internal\_identifier** (*str*) – Term or code that identifies the subject group within a particular product.
- **quantity** (*int*) – Total amount or number of things or beings.
- **species** ([Species](#), *Strain*) – Category of biological classification comprising related organisms or populations potentially capable of interbreeding, and being designated by a binomial that consists of the name of a genus followed by a Latin or latinized uncapitalized noun or adjective.
- **studied\_states** ([SubjectGroupState](#)) – Reference to a point in time at which the subject group was studied in a particular mode or condition.

```
class fairgraph.openminds.core.research.subject_group_state.SubjectGroupState (id=None,
                                                                                data=None,
                                                                                space=None,
                                                                                scope=None,
                                                                                **properties)
```

Bases: `fairgraph.base_v3.KGObject`

#### Parameters

- **lookup\_label** (*str*) – no description available
- **additional\_remarks** (*str*) – Mention of what deserves additional attention or notice.
- **age** ([QuantitativeValue](#), [QuantitativeValueRange](#)) – Time of life or existence at which some particular qualification, capacity or event arises.
- **age\_categories** ([AgeCategory](#)) – Distinct life cycle class that is defined by a similar age or age range (developmental stage) within a group of individual beings.
- **attributes** ([SubjectAttribute](#)) – no description available
- **descended\_from** ([SubjectGroupState](#)) – no description available
- **handedness** ([Handedness](#)) – Degree to which an organism prefers one hand or foot over the other hand or foot during the performance of a task.

- **pathologies** (*Disease*, *DiseaseModel*) – Structural and functional deviation from the normal that constitutes a disease or characterizes a particular disease.
- **relative\_time\_indication** (*QuantitativeValue*, *QuantitativeValueRange*) – no description available
- **weight** (*QuantitativeValue*, *QuantitativeValueRange*) – Amount that a thing or being weighs.

```
class fairgraph.openminds.core.research.subject_state.SubjectState (id=None,
                                                                    data=None,
                                                                    space=None,
                                                                    scope=None,
                                                                    **properties)
```

Bases: *fairgraph.base\_v3.KGObject*

Structured information on a temporary state of a subject.

#### Parameters

- **lookup\_label** (*str*) – no description available
- **additional\_remarks** (*str*) – Mention of what deserves additional attention or notice.
- **age** (*QuantitativeValue*, *QuantitativeValueRange*) – Time of life or existence at which some particular qualification, capacity or event arises.
- **age\_category** (*AgeCategory*) – Distinct life cycle class that is defined by a similar age or age range (developmental stage) within a group of individual beings.
- **attributes** (*SubjectAttribute*) – no description available
- **descended\_from** (*SubjectState*) – no description available
- **handedness** (*Handedness*) – Degree to which an organism prefers one hand or foot over the other hand or foot during the performance of a task.
- **pathologies** (*Disease*, *DiseaseModel*) – Structural and functional deviation from the normal that constitutes a disease or characterizes a particular disease.
- **relative\_time\_indication** (*QuantitativeValue*, *QuantitativeValueRange*) – no description available
- **weight** (*QuantitativeValue*, *QuantitativeValueRange*) – Amount that a thing or being weighs.

```
class fairgraph.openminds.core.research.tissue_sample.TissueSample (id=None,
                                                                    data=None,
                                                                    space=None,
                                                                    scope=None,
                                                                    **properties)
```

Bases: *fairgraph.base\_v3.KGObject*

Structured information on a tissue sample.

#### Parameters

- **lookup\_label** (*str*) – no description available
- **anatomical\_locations** (*UBERONParcellation*, *CustomAnatomicalEntity*, *ParcellationEntity*, *ParcellationEntityVersion*) – no description available

- **biological\_sex** (`BiologicalSex`) – Differentiation of individuals of most species (animals and plants) based on the type of gametes they produce.
- **internal\_identifier** (`str`) – Term or code that identifies the tissue sample within a particular product.
- **is\_part\_of** (`TissueSampleCollection`) – Reference to the ensemble of multiple things or beings.
- **laterality** (`Laterality`) – Differentiation between a pair of lateral homologous parts of the body.
- **origin** (`CellType`, `Organ`) – Source at which something begins or rises, or from which something derives.
- **species** (`Species`, `Strain`) – Category of biological classification comprising related organisms or populations potentially capable of interbreeding, and being designated by a binomial that consists of the name of a genus followed by a Latin or latinized uncapitalized noun or adjective.
- **studied\_states** (`TissueSampleState`) – Reference to a point in time at which the tissue sample was studied in a particular mode or condition.
- **type** (`TissueSampleType`) – Distinct class to which a group of entities or concepts with similar characteristics or attributes belong to.

```
class fairgraph.openminds.core.research.tissue_sample_collection.TissueSampleCollection (id=
```

```
date
spa
sco
**p
er-
ties
```

Bases: `fairgraph.base_v3.KGObject`

#### Parameters

- **lookup\_label** (`str`) – no description available
- **additional\_remarks** (`str`) – Mention of what deserves additional attention or notice.
- **anatomical\_locations** (`UBERONParcellation`, `CustomAnatomicalEntity`, `ParcellationEntity`, `ParcellationEntityVersion`) – no description available
- **biological\_sex** (`BiologicalSex`) – Differentiation of individuals of most species (animals and plants) based on the type of gametes they produce.
- **internal\_identifier** (`str`) – Term or code that identifies the tissue sample collection within a particular product.
- **laterality** (`Laterality`) – Differentiation between a pair of lateral homologous parts of the body.
- **origins** (`CellType`, `Organ`) – Source at which something begins or rises, or from which something derives.
- **quantity** (`int`) – Total amount or number of things or beings.
- **species** (`Species`, `Strain`) – Category of biological classification comprising related organisms or populations potentially capable of interbreeding, and being designated by a binomial that consists of the name of a genus followed by a Latin or latinized uncapitalized noun or adjective.

- **studied\_states** (*TissueSampleCollectionState*) – Reference to a point in time at which the tissue sample collection was studied in a particular mode or condition.
- **types** (*TissueSampleType*) – Distinct class to which a group of entities or concepts with similar characteristics or attributes belong to.

```
class fairgraph.openminds.core.research.tissue_sample_collection_state.TissueSampleCollect:
```

Bases: `fairgraph.base_v3.KGObject`

#### Parameters

- **lookup\_label** (*str*) – no description available
- **additional\_remarks** (*str*) – Mention of what deserves additional attention or notice.
- **age** (*QuantitativeValue*, *QuantitativeValueRange*) – Time of life or existence at which some particular qualification, capacity or event arises.
- **attributes** (*TissueSampleAttribute*) – no description available
- **descended\_from** (*SubjectGroupState*, *SubjectState*, *TissueSampleCollectionState*, *TissueSampleState*) – no description available
- **pathologies** (*Disease*, *DiseaseModel*) – Structural and functional deviation from the normal that constitutes a disease or characterizes a particular disease.
- **relative\_time\_indication** (*QuantitativeValue*, *QuantitativeValueRange*) – no description available
- **weight** (*QuantitativeValue*, *QuantitativeValueRange*) – Amount that a thing or being weighs.

```
class fairgraph.openminds.core.research.tissue_sample_state.TissueSampleState (id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **properties)
```

Bases: `fairgraph.base_v3.KGObject`

Structured information on a temporary state of a tissue sample.

#### Parameters

- **lookup\_label** (*str*) – no description available
- **additional\_remarks** (*str*) – Mention of what deserves additional attention or notice.
- **age** (*QuantitativeValue*, *QuantitativeValueRange*) – Time of life or existence at which some particular qualification, capacity or event arises.
- **attributes** (*TissueSampleAttribute*) – no description available
- **descended\_from** (*SubjectGroupState*, *SubjectState*, *TissueSampleCollectionState*, *TissueSampleState*) – no description available

- **pathologies** (*Disease, DiseaseModel*) – Structural and functional deviation from the normal that constitutes a disease or characterizes a particular disease.
- **relative\_time\_indication** (*QuantitativeValue, QuantitativeValueRange*) – no description available
- **weight** (*QuantitativeValue, QuantitativeValueRange*) – Amount that a thing or being weighs.

### 5.1.2 openminds.controlledterms

```
class fairgraph.openminds.controlledterms.action_status_type.ActionStatusType (id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the action status type.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the action status type.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the InterLex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.age_category.AgeCategory (id=None,
                                                                    data=None,
                                                                    space=None,
                                                                    scope=None,
                                                                    **properties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on the life cycle (semantic term) of a specific age group.

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the age category.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the age category.

- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.anatomical_axes_orientation.AnatomicalAxesOrienta
```

Bases: `fairgraph.base_v3.KGObject`

Structured information on the anatomical directions of the X, Y, and Z axis.

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the anatomical axes orientation.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the anatomical axes orientation.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.biological_order.BiologicalOrder (id=None,  
                                                                           data=None,  
                                                                           space=None,  
                                                                           scope=None,  
                                                                           **prop-  
                                                                           er-  
                                                                           ties)
```

Bases: `fairgraph.base_v3.KGObject`

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the biological order.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.

- **description** (*str*) – Longer statement or account giving the characteristics of the biological order.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.biological_sex.BiologicalSex (id=None,
                                                                    data=None,
                                                                    space=None,
                                                                    scope=None,
                                                                    **properties)
    """
```

Bases: fairgraph.base\_v3.KGObject

Structured information on the biological sex of a subject.

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the biological sex.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the biological sex.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.cell_type.CellType (id=None,
                                                             data=None,
                                                             space=None,
                                                             scope=None,
                                                             **properties)
    """
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the cell type.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.

- **description** (*str*) – Longer statement or account giving the characteristics of the cell type.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.contribution_type.ContributionType (id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **properties)
```

Bases: `fairgraph.base_v3.KGObject`

Structured information on the type of contribution a person or organization performed.

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the contribution type.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the contribution type.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.criteria_quality_type.CriteriaQualityType (id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **properties)
```

Bases: `fairgraph.base_v3.KGObject`

Structured information on the quality type of the defined criteria for a measurement.

#### Parameters



- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the criteria quality type.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the criteria quality type.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.data_type.DataType (id=None,
                                                             data=None,
                                                             space=None,
                                                             scope=None,
                                                             **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the data type.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the data type.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.device_type.DeviceType (id=None,
                                                                    data=None,
                                                                    space=None,
                                                                    scope=None,
                                                                    **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the device type.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.

- **description** (*str*) – Longer statement or account giving the characteristics of the device type.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the InterLex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.disease.Disease(id=None, data=None,
                                                         space=None,
                                                         scope=None, **properties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on a disease.

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the disease.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the disease.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the InterLex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.disease_model.DiseaseModel(id=None,
                                                                      data=None,
                                                                      space=None,
                                                                      scope=None,
                                                                      **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the disease model.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the disease model.

- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.ethics_assessment.EthicsAssessment (id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **prop-
                                                                              er-
                                                                              ties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on the ethics assessment of a dataset.

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the ethics assessment.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the ethics assessment.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.experimental_approach.ExperimentalApproach (id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **prop-
                                                                              er-
                                                                              ties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the experimental approach.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.

- **description** (*str*) – Longer statement or account giving the characteristics of the experimental approach.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the InterLex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.file_bundle_grouping.FileBundleGrouping (id=None,
                                                                                     data=None,
                                                                                     space=None,
                                                                                     scope=None,
                                                                                     **properties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on the grouping mechanism of a file bundle.

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the file bundle grouping.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the file bundle grouping.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the InterLex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.file_repository_type.FileRepositoryType (id=None,
                                                                                     data=None,
                                                                                     space=None,
                                                                                     scope=None,
                                                                                     **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the file repository type.

- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the file repository type.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.file_usage_role.FileUsageRole (id=None,
                                                                    data=None,
                                                                    space=None,
                                                                    scope=None,
                                                                    **prop-
                                                                    er-
                                                                    ties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on the usage role of a file instance or bundle.

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the file usage role.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the file usage role.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.handedness.Handedness (id=None,
                                                                    data=None,
                                                                    space=None,
                                                                    scope=None,
                                                                    **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the handedness.

- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the handedness.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.language.Language (id=None,
                                                             data=None,
                                                             space=None,
                                                             scope=None,
                                                             **properties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on the available language setting.

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the language.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the language.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.laterality.Laterality (id=None,
                                                                    data=None,
                                                                    space=None,
                                                                    scope=None,
                                                                    **properties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on the lateral direction.

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the laterality.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.

- **description** (*str*) – Longer statement or account giving the characteristics of the laterality.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.meta_data_model_type.MetaDataType (id=None,  

data=None,  
space=None,  
scope=None,  
**properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the meta data model type.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the meta data model type.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.model_abstraction_level.ModelAbstractionLevel (id=  

data=  
space=  
scope=  
**properties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on abstraction level of the computational model.

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the model abstraction level.

- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the model abstraction level.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.model_scope.ModelScope (id=None,  
                                                                    data=None,  
                                                                    space=None,  
                                                                    scope=None,  
                                                                    **proper-  
                                                                    ties)
```

Bases: `fairgraph.base_v3.KGObject`

Structured information on the scope of the computational model.

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the model scope.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the model scope.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.operating_device.OperatingDevice (id=None,  
                                                                                data=None,  
                                                                                space=None,  
                                                                                scope=None,  
                                                                                **prop-  
                                                                                er-  
                                                                                ties)
```

Bases: `fairgraph.base_v3.KGObject`

Structured information on the operating device.

#### Parameters



- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the operating device.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the operating device.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.operating_system.OperatingSystem(id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **properties)

Bases: fairgraph.base_v3.KGObject
```

Structured information on the operating system.

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the operating system.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the operating system.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.organ.Organ(id=None,
                                                         data=None,
                                                         space=None,
                                                         scope=None,
                                                         **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the organ.

- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the organ.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.preparation_type.PreparationType (id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the preparation type.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the preparation type.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.product_accessibility.ProductAccessibility (id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the product accessibility.

- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the product accessibility.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.programming_language.ProgrammingLanguage (id=None,
data=None,
space=None,
scope=None,
**properties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on the programming language.

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the programming language.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the programming language.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.qualitative_overlap.QualitativeOverlap (id=None,
data=None,
space=None,
scope=None,
**properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the qualitative overlap.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the qualitative overlap.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.semantic_data_type.SemanticDataType (id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the semantic data type.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the semantic data type.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.service.Service (id=None, data=None,
                                                            space=None,
                                                            scope=None, **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the service.

- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the service.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the InterLex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.software_application_category.SoftwareApplication
```

Bases: `fairgraph.base_v3.KGObject`

Structured information on the category of the software application.

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the software application category.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the software application category.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the InterLex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.software_feature.SoftwareFeature (id=None,  
                                                                    data=None,  
                                                                    space=None,  
                                                                    scope=None,  
                                                                    **properties)
```

Bases: `fairgraph.base_v3.KGObject`

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the software feature.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the software feature.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the InterLex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.species.Species(id=None, data=None,
                                                         space=None,
                                                         scope=None, **properties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on the species.

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the species.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the species.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the InterLex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.stimulation_approach.StimulationApproach(id=None,
                                                                                     data=None,
                                                                                     space=None,
                                                                                     scope=None,
                                                                                     **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the stimulation approach.

- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the stimulation approach.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the InterLex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.stimulus_type.StimulusType (id=None,
                                                                    data=None,
                                                                    space=None,
                                                                    scope=None,
                                                                    **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the stimulus type.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the stimulus type.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the InterLex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.technique.Technique (id=None,
                                                                data=None,
                                                                space=None,
                                                                scope=None,
                                                                **properties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on the technique.

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the technique.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.

- **description** (*str*) – Longer statement or account giving the characteristics of the technique.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the InterLex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.term_suggestion.TermSuggestion (id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the term suggestion.
- **add\_existing\_terminology** (*Terminology*) – Reference to an existing terminology (distinct class to group related terms).
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the term suggestion.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the InterLex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **suggest\_new\_terminology** (*str*) – Proposal of a new distinct class to group related terms.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.terminology.Terminology (id=None,
                                                                      data=None,
                                                                      space=None,
                                                                      scope=None,
                                                                      **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters



- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the terminology.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the terminology.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.tissue_sample_type.TissueSampleType (id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **prop-
                                                                              er-
                                                                              ties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on the general type of the tissue sample.

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the tissue sample type.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the tissue sample type.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.type_of_uncertainty.TypeOfUncertainty (id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **prop-
                                                                              er-
                                                                              ties)
```

Bases: fairgraph.base\_v3.KGObject

**Parameters**

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the type of uncertainty.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the type of uncertainty.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.uberon_parcellation.UBERONParcellation (id=None,
                                                                                   data=None,
                                                                                   space=None,
                                                                                   scope=None,
                                                                                   **prop-
                                                                                   er-
                                                                                   ties)
```

Bases: fairgraph.base\_v3.KGObject

**Parameters**

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the u b e r o n parcellation.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the u b e r o n parcellation.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

```
class fairgraph.openminds.controlledterms.unit_of_measurement.UnitOfMeasurement (id=None,
                                                                                   data=None,
                                                                                   space=None,
                                                                                   scope=None,
                                                                                   **prop-
                                                                                   er-
                                                                                   ties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on the unit of measurement.

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the unit of measurement.
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **description** (*str*) – Longer statement or account giving the characteristics of the unit of measurement.
- **interlex\_identifier** (*IRI*) – Persistent identifier for a term registered in the Inter-Lex project.
- **knowledge\_space\_link** (*IRI*) – Persistent link to an encyclopedia entry in the Knowledge Space project.
- **preferred\_ontology\_identifier** (*IRI*) – Persistent identifier of a preferred ontological term.
- **synonyms** (*str*) – Words or expressions used in the same language that have the same or nearly the same meaning in some or all senses.

### 5.1.3 openminds.sands

```
class fairgraph.openminds.sands.atlas.brain_atlas.BrainAtlas (id=None,
                                                             data=None,
                                                             space=None,
                                                             scope=None,
                                                             **properties)
```

Bases: fairgraph.base\_v3.KGObject

Structured information on a brain atlas (concept level).

#### Parameters

- **name** (*str*) – Whole, non-abbreviated name of the brain atlas.
- **alias** (*str*) – Shortened or fully abbreviated name of the brain atlas.
- **abbreviation** (*str*) – no description available
- **authors** (*Organization*, *Person*) – Creator of a literary or creative work, as well as a dataset publication.
- **custodians** (*Organization*, *Person*) – The ‘custodian’ is a legal person who is responsible for the content and quality of the data, metadata, and/or code of a research product.
- **description** (*str*) – Longer statement or account giving the characteristics of the brain atlas.
- **digital\_identifier** (*DOI*, *ISBN*, *RRID*) – Digital handle to identify objects or legal persons.
- **has\_terminology** (*ParcellationTerminology*) – no description available
- **versions** (*BrainAtlasVersion*) – Reference to variants of an original.
- **homepage** (*URL*) – Main website of the brain atlas.
- **how\_to\_cite** (*str*) – Preferred format for citing a particular object or legal person.

```
class fairgraph.openminds.sands.atlas.brain_atlas_version.BrainAtlasVersion (id=None,  
data=None,  
space=None,  
scope=None,  
**properties)
```

Bases: `fairgraph.base_v3.KGObject`

Structured information on a brain atlas (version level).

### Parameters

- **name** (*str*) – Whole, non-abbreviated name of the brain atlas version.
- **alias** (*str*) – Shortened or fully abbreviated name of the brain atlas version.
- **abbreviation** (*str*) – no description available
- **accessibility** (`ProductAccessibility`) – Level to which something is accessible to the brain atlas version.
- **atlas\_type** (`AtlasType`) – no description available
- **authors** (`Organization`, `Person`) – Creator of a literary or creative work, as well as a dataset publication.
- **coordinate\_space** (`CommonCoordinateSpace`) – Two or three dimensional geometric setting.
- **copyright** (`Copyright`) – Exclusive and assignable legal right of an originator to reproduce, publish, sell, or distribute the matter and form of a creative work for a defined time period.
- **custodians** (`Organization`, `Person`) – The ‘custodian’ is a legal person who is responsible for the content and quality of the data, metadata, and/or code of a research product.
- **description** (*str*) – Longer statement or account giving the characteristics of the brain atlas version.
- **digital\_identifier** (`DOI`, `ISBN`, `RRID`) – Digital handle to identify objects or legal persons.
- **full\_documentation** (`DOI`, `File`, `URL`) – Non-abridged instructions, comments, and information for using a particular product.
- **funding** (`Funding`) – Money provided by a legal person for a particular purpose.
- **has\_terminology\_version** (`ParcellationTerminologyVersion`) – no description available
- **homepage** (`URL`) – Main website of the brain atlas version.
- **how\_to\_cite** (*str*) – Preferred format for citing a particular object or legal person.
- **is\_alternative\_version\_of** (`BrainAtlasVersion`) – Reference to an original form where the essence was preserved, but presented in an alternative form.
- **is\_new\_version\_of** (`BrainAtlasVersion`) – Reference to a previous (potentially outdated) particular form of something.
- **keywords** (`ActionStatusType`, `AgeCategory`, `AnatomicalAxesOrientation`, `AnatomicalPlane`, `AnnotationType`, `AtlasType`, `BiologicalOrder`, `BiologicalSex`, `BreedingType`,

*CellCultureType, CellType, ContributionType, CranialWindowType, CriteriaQualityType, DataType, DeviceType, Disease, DiseaseModel, EthicsAssessment, ExperimentalApproach, FileBundleGrouping, FileRepositoryType, FileUsageRole, GeneticStrainType, Handedness, Language, Laterality, MeasuredQuantity, MetaDataModelType, ModelAbstractionLevel, ModelScope, MolecularEntity, OperatingDevice, OperatingSystem, Organ, PatchClampVariation, PreparationType, ProductAccessibility, ProgrammingLanguage, QualitativeOverlap, SemanticDataType, Service, SoftwareApplicationCategory, SoftwareFeature, Species, StimulationApproach, StimulusType, SubcellularEntity, SubjectAttribute, Technique, TermSuggestion, Terminology, TissueSampleAttribute, TissueSampleType, TypeOfUncertainty, UBERONParcellation, UnitOfMeasurement*) – Significant word or concept that are representative of the brain atlas version.

- **license** (*License*) – Grant by a party to another party as an element of an agreement between those parties that permits to do, use, or own something.
- **ontology\_identifiers** (*str*) – Term or code used to identify the brain atlas version registered within a particular ontology.
- **other\_contributions** (*Contribution*) – Giving or supplying of something (such as money or time) as a part or share other than what is covered elsewhere.
- **related\_publications** (*DOI, HANDLE, ISBN*) – Reference to something that was made available for the general public to see or buy.
- **release\_date** (*date*) – Fixed date on which a product is due to become or was made available for the general public to see or buy
- **repository** (*FileRepository*) – Place, room, or container where something is deposited or stored.
- **support\_channels** (*str*) – Way of communication used to interact with users or customers.
- **version\_identifier** (*str*) – Term or code used to identify the version of something.
- **version\_innovation** (*str*) – Documentation on what changed in comparison to a previously published form of something.

```
class fairgraph.openminds.sands.atlas.common_coordinate_space.CommonCoordinateSpace (id=None,
data=None,
space=None,
scope=None,
**properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Whole, non-abbreviated name of the common coordinate space.
- **alias** (*str*) – Shortened or fully abbreviated name of the common coordinate space.
- **anatomical\_axes\_orientation** (*AnatomicalAxesOrientation*) – Relation between reference planes used in anatomy and mathematics.

- **axes\_origins** (*QuantitativeValue*) – Special point in a coordinate system used as a fixed point of reference for the geometry of the surrounding space.
- **default\_images** (*File*) – Two or three dimensional image that particularly represents a specific coordinate space.
- **description** (*str*) – Longer statement or account giving the characteristics of the common coordinate space.
- **digital\_identifier** (*DOI*, *ISBN*, *RRID*) – Digital handle to identify objects or legal persons.
- **homepage** (*URL*) – Main website of the common coordinate space.
- **how\_to\_cite** (*str*) – Preferred format for citing a particular object or legal person.
- **native\_unit** (*UnitOfMeasurement*) – Determinate quantity used in the original measurement.
- **ontology\_identifiers** (*str*) – Term or code used to identify the common coordinate space registered within a particular ontology.
- **release\_date** (*date*) – Fixed date on which a product is due to become or was made available for the general public to see or buy
- **version\_identifier** (*str*) – Term or code used to identify the version of something.

```
class fairgraph.openminds.sands.non_atlas.custom_anatomical_entity.CustomAnatomicalEntity (id=
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the custom anatomical entity.
- **has\_annotations** (*CustomAnnotation*) – no description available
- **related\_uberon\_term** (*UBERONParcellation*) – no description available
- **relation\_assessments** (*QualitativeRelationAssessment*, *QuantitativeRelationAssessment*) – no description available

```
class fairgraph.openminds.sands.non_atlas.custom_coordinate_space.CustomCoordinateSpace (id=
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the custom coordinate space.
- **anatomical\_axes\_orientation** (*AnatomicalAxesOrientation*) – Relation between reference planes used in anatomy and mathematics.

- **axes\_origins** (*QuantitativeValue*) – Special point in a coordinate system used as a fixed point of reference for the geometry of the surrounding space.
- **default\_images** (*File*) – Two or three dimensional image that particularly represents a specific coordinate space.
- **native\_unit** (*UnitOfMeasurement*) – Determinate quantity used in the original measurement.

```
class fairgraph.openminds.sands.atlas.parcellation_entity.ParcellationEntity (id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the parcellation entity.
- **lookup\_label** (*str*) – no description available
- **alternative\_names** (*str*) – no description available
- **definition** (*str*) – Short, but precise statement of the meaning of a word, word group, sign or a symbol.
- **has\_parents** (*ParcellationEntity*) – Reference to a parent object or legal person.
- **versions** (*ParcellationEntityVersion*) – Reference to variants of an original.
- **ontology\_identifiers** (*str*) – Term or code used to identify the parcellation entity registered within a particular ontology.
- **related\_uberon\_term** (*UBERONParcellation*) – no description available

```
class fairgraph.openminds.sands.atlas.parcellation_entity_version.ParcellationEntityVersion
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the parcellation entity version.
- **lookup\_label** (*str*) – no description available
- **additional\_remarks** (*str*) – Mention of what deserves additional attention or notice.
- **alternative\_names** (*str*) – no description available
- **corrected\_name** (*str*) – no description available
- **has\_annotations** (*AtlasAnnotation*) – no description available
- **has\_parents** (*ParcellationEntity*, *ParcellationEntityVersion*) – Reference to a parent object or legal person.

- **ontology\_identifiers** (*str*) – Term or code used to identify the parcellation entity version registered within a particular ontology.
- **relation\_assessments** (*QualitativeRelationAssessment*, *QuantitativeRelationAssessment*) – no description available
- **version\_identifier** (*str*) – Term or code used to identify the version of something.
- **version\_innovation** (*str*) – Documentation on what changed in comparison to a previously published form of something.

**class** fairgraph.openminds.sands.atlas.parcellation\_terminology\_version.**ParcellationTermino**

Bases: fairgraph.base\_v3.EmbeddedMetadata

#### Parameters

- **defined\_ins** (*File*) – Reference to a file instance in which something is stored.
- **has\_entity\_versions** (*ParcellationEntityVersion*) – no description available
- **ontology\_identifiers** (*str*) – Term or code used to identify the parcellation terminology version registered within a particular ontology.

### 5.1.4 openminds.computation

**class** fairgraph.openminds.computation.environment.**Environment** (*id=None*,  
*data=None*,  
*space=None*,  
*scope=None*,  
*\*\*properties*)

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the environment.
- **configuration** (*Configuration*) – no description available
- **description** (*str*) – Longer statement or account giving the characteristics of the environment.
- **hardware** (*HardwareSystem*) – no description available
- **software** (*SoftwareVersion*) – no description available

**class** fairgraph.openminds.computation.hardware\_system.**HardwareSystem** (*id=None*,  
*data=None*,  
*space=None*,  
*scope=None*,  
*\*\*properties*)

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the hardware system.



- **description** (*str*) – Longer statement or account giving the characteristics of the hardware system.
- **version** (*str*) – no description available

```
class fairgraph.openminds.computation.launch_configuration.LaunchConfiguration (id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the launch configuration.
- **arguments** (*str*) – no description available
- **description** (*str*) – Longer statement or account giving the characteristics of the launch configuration.
- **environment\_variables** (*PropertyValueList*) – no description available
- **executable** (*str*) – no description available

```
class fairgraph.openminds.computation.data_analysis.DataAnalysis (id=None,
                                                                    data=None,
                                                                    space=None,
                                                                    scope=None,
                                                                    **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **lookup\_label** (*str*) – no description available
- **custom\_property\_sets** (*CustomPropertySet*) – no description available
- **description** (*str*) – Longer statement or account giving the characteristics of the data analysis.
- **ended\_at\_time** (*datetime*) – no description available
- **environment** (*Environment*) – no description available
- **inputs** (*LocalFile*, *File*, *FileBundle*, *SoftwareVersion*) – Something or someone that is put into or participates in a process or machine.
- **launch\_configuration** (*LaunchConfiguration*) – no description available
- **outputs** (*LocalFile*, *File*, *FileBundle*) – Something or someone that comes out of, is delivered or produced by a process or machine.
- **recipe** (*WorkflowRecipeVersion*) – no description available
- **resource\_usages** (*QuantitativeValue*, *QuantitativeValueRange*) – no description available
- **started\_at\_time** (*datetime*) – no description available
- **started\_by** (*SoftwareAgent*, *Person*) – no description available

- **status** (*ActionStatusType*) – no description available
- **study\_targets** (*BiologicalOrder, BiologicalSex, BreedingType, CellCultureType, CellType, Disease, DiseaseModel, GeneticStrainType, Handedness, MolecularEntity, Organ, Species, SubcellularEntity, TermSuggestion, UBERONParcellation, CustomAnatomicalEntity, ParcellationEntity, ParcellationEntityVersion*) – Structure or function that was targeted within a study.
- **tags** (*str*) – no description available
- **was\_informed\_by** (*DataAnalysis, Optimization, Simulation, Visualization*) – no description available

```
class fairgraph.openminds.computation.simulation.Simulation (id=None,
                                                             data=None,
                                                             space=None,
                                                             scope=None,
                                                             **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **lookup\_label** (*str*) – no description available
- **custom\_property\_sets** (*CustomPropertySet*) – no description available
- **description** (*str*) – Longer statement or account giving the characteristics of the simulation.
- **ended\_at\_time** (*datetime*) – no description available
- **environment** (*Environment*) – no description available
- **inputs** (*LocalFile, File, FileBundle, ModelVersion, SoftwareVersion*) – Something or someone that is put into or participates in a process or machine.
- **launch\_configuration** (*LaunchConfiguration*) – no description available
- **outputs** (*LocalFile, File, FileBundle*) – Something or someone that comes out of, is delivered or produced by a process or machine.
- **recipe** (*WorkflowRecipeVersion*) – no description available
- **resource\_usages** (*QuantitativeValue, QuantitativeValueRange*) – no description available
- **started\_at\_time** (*datetime*) – no description available
- **started\_by** (*SoftwareAgent, Person*) – no description available
- **status** (*ActionStatusType*) – no description available
- **study\_targets** (*BiologicalOrder, BiologicalSex, BreedingType, CellCultureType, CellType, Disease, DiseaseModel, GeneticStrainType, Handedness, MolecularEntity, Organ, Species, SubcellularEntity, TermSuggestion, UBERONParcellation, CustomAnatomicalEntity, ParcellationEntity, ParcellationEntityVersion*) – Structure or function that was targeted within a study.
- **tags** (*str*) – no description available

- **was\_informed\_by** (*DataAnalysis*, *Optimization*, *Simulation*, *Visualization*) – no description available

```
class fairgraph.openminds.computation.visualization.Visualization (id=None,
                                                                    data=None,
                                                                    space=None,
                                                                    scope=None,
                                                                    **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **lookup\_label** (*str*) – no description available
- **custom\_property\_sets** (*CustomPropertySet*) – no description available
- **description** (*str*) – Longer statement or account giving the characteristics of the visualization.
- **ended\_at\_time** (*datetime*) – no description available
- **environment** (*Environment*) – no description available
- **inputs** (*LocalFile*, *File*, *FileBundle*, *SoftwareVersion*) – Something or someone that is put into or participates in a process or machine.
- **launch\_configuration** (*LaunchConfiguration*) – no description available
- **outputs** (*LocalFile*, *File*, *FileBundle*) – Something or someone that comes out of, is delivered or produced by a process or machine.
- **recipe** (*WorkflowRecipeVersion*) – no description available
- **resource\_usages** (*QuantitativeValue*, *QuantitativeValueRange*) – no description available
- **started\_at\_time** (*datetime*) – no description available
- **started\_by** (*SoftwareAgent*, *Person*) – no description available
- **status** (*ActionStatusType*) – no description available
- **study\_targets** (*BiologicalOrder*, *BiologicalSex*, *BreedingType*, *CellCultureType*, *CellType*, *Disease*, *DiseaseModel*, *GeneticStrainType*, *Handedness*, *MolecularEntity*, *Organ*, *Species*, *SubcellularEntity*, *TermSuggestion*, *UBERONParcellation*, *CustomAnatomicalEntity*, *ParcellationEntity*, *ParcellationEntityVersion*) – Structure or function that was targeted within a study.
- **tags** (*str*) – no description available
- **was\_informed\_by** (*DataAnalysis*, *Optimization*, *Simulation*, *Visualization*) – no description available

```
class fairgraph.openminds.computation.optimization.Optimization (id=None,
                                                                    data=None,
                                                                    space=None,
                                                                    scope=None,
                                                                    **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **lookup\_label** (*str*) – no description available
- **custom\_property\_sets** (*CustomPropertySet*) – no description available
- **description** (*str*) – Longer statement or account giving the characteristics of the optimization.
- **ended\_at\_time** (*datetime*) – no description available
- **environment** (*Environment*) – no description available
- **inputs** (*LocalFile, File, FileBundle, ModelVersion, SoftwareVersion*) – Something or someone that is put into or participates in a process or machine.
- **launch\_configuration** (*LaunchConfiguration*) – no description available
- **outputs** (*LocalFile, File, FileBundle, ModelVersion*) – Something or someone that comes out of, is delivered or produced by a process or machine.
- **recipe** (*WorkflowRecipeVersion*) – no description available
- **resource\_usages** (*QuantitativeValue, QuantitativeValueRange*) – no description available
- **started\_at\_time** (*datetime*) – no description available
- **started\_by** (*SoftwareAgent, Person*) – no description available
- **status** (*ActionStatusType*) – no description available
- **study\_targets** (*BiologicalOrder, BiologicalSex, BreedingType, CellCultureType, CellType, Disease, DiseaseModel, GeneticStrainType, Handedness, MolecularEntity, Organ, Species, SubcellularEntity, TermSuggestion, UBERONParcellation, CustomAnatomicalEntity, ParcellationEntity, ParcellationEntityVersion*) – Structure or function that was targeted within a study.
- **tags** (*str*) – no description available
- **was\_informed\_by** (*DataAnalysis, Optimization, Simulation, Visualization*) – no description available

```
class fairgraph.openminds.computation.software_agent.SoftwareAgent (id=None,  
                                                                    data=None,  
                                                                    space=None,  
                                                                    scope=None,  
                                                                    **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the software agent.
- **environment** (*Environment*) – no description available
- **software** (*SoftwareVersion*) – no description available

```
class fairgraph.openminds.computation.workflow_execution.WorkflowExecution (id=None,
                                                                           data=None,
                                                                           space=None,
                                                                           scope=None,
                                                                           **properties)

Bases: fairgraph.base_v3.KGObject
```

#### Parameters

- **recipe** (*WorkflowRecipeVersion*) – no description available
- **stages** (*DataAnalysis*, *Optimization*, *Simulation*, *Visualization*) – no description available
- **started\_by** (*SoftwareAgent*, *Person*) – no description available

### 5.1.5 openminds.ephys

```
class fairgraph.openminds.ephys.entity.device.Device (id=None, data=None,
                                                       space=None, scope=None,
                                                       **properties)

Bases: fairgraph.base_v3.KGObject
```

```
class fairgraph.openminds.ephys.entity.electrode_array.ElectrodeArray (id=None,
                                                                           data=None,
                                                                           space=None,
                                                                           scope=None,
                                                                           **properties)

Bases: fairgraph.base_v3.KGObject
```

#### Parameters

- **amplifiers** (*Device*) – no description available
- **electrodes** (*Electrode*) – Elements in a semiconductor device that emits or collects electrons or holes or controls their movements.
- **internal\_identifier** (*str*) – Term or code that identifies the electrode array within a particular product.

```
class fairgraph.openminds.ephys.entity.patched_cell.PatchedCell (id=None,
                                                                    data=None,
                                                                    space=None,
                                                                    scope=None,
                                                                    **properties)

Bases: fairgraph.base_v3.KGObject
```

#### Parameters

- **lookup\_label** (*str*) – no description available
- **additional\_remarks** (*str*) – Mention of what deserves additional attention or notice.
- **age** (*QuantitativeValue*, *QuantitativeValueRange*) – Time of life or existence at which some particular qualification, capacity or event arises.
- **attributes** (*TissueSampleAttribute*) – no description available

- **chloride\_reversal\_potentials** (*Measurement*) – no description available
- **descended\_from** (*SubjectGroupState, SubjectState, TissueSampleCollectionState, TissueSampleState*) – no description available
- **end\_membrane\_potential** (*Measurement*) – no description available
- **labeling\_compound** (*str*) – no description available
- **liquid\_junction\_potentials** (*Measurement*) – no description available
- **pathologies** (*Disease, DiseaseModel*) – Structural and functional deviation from the normal that constitutes a disease or characterizes a particular disease.
- **pipettes** (*Pipette*) – no description available
- **seal\_resistances** (*Measurement*) – no description available
- **start\_membrane\_potential** (*Measurement*) – no description available
- **weight** (*QuantitativeValue, QuantitativeValueRange*) – Amount that a thing or being weighs.

```
class fairgraph.openminds.ephys.entity.pipette.Pipette (id=None, data=None,
                                                         space=None, scope=None,
                                                         **properties)
```

Bases: fairgraph.base\_v3.KGObject

```
class fairgraph.openminds.ephys.entity.channel.Channel (data=None, **properties)
Bases: fairgraph.base_v3.EmbeddedMetadata
```

#### Parameters

- **internal\_identifier** (*str*) – Term or code that identifies the channel within a particular product.
- **unit\_of\_measurement** (*UnitOfMeasurement*) – no description available

```
class fairgraph.openminds.ephys.entity.electrode_contact.ElectrodeContact (id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **prop-
                                                                              er-
                                                                              ties)

Bases: fairgraph.base_v3.KGObject
```

```
class fairgraph.openminds.ephys.entity.electrode.Electrode (id=None, data=None,
                                                             space=None,
                                                             scope=None, **prop-
                                                             erties)

Bases: fairgraph.base_v3.KGObject
```

```
class fairgraph.openminds.ephys.entity.cell.Cell (id=None, data=None, space=None,
                                                    scope=None, **properties)

Bases: fairgraph.base_v3.KGObject
```

```
class fairgraph.openminds.ephys.entity.measurement.Measurement (data=None,
                                                                    **properties)

Bases: fairgraph.base_v3.EmbeddedMetadata
```

#### Parameters

- **description** (*str*) – Longer statement or account giving the characteristics of the measurement.
- **devices** (*Device*, *Electrode*, *ElectrodeArray*, *Pipette*) – Piece of equipment or mechanism (hardware) designed to serve a special purpose or perform a special function.
- **measured\_quantity** (*MeasuredQuantity*) – no description available
- **timestamp** (*datetime*) – no description available
- **values** (*QuantitativeValue*, *QuantitativeValueRange*) – Entry for a property.

```
class fairgraph.openminds.ephys.entity.recording.Recording (id=None, data=None,
                                                            space=None,
                                                            scope=None, **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **channels** (*Channel*) – no description available
- **data\_locations** (*File*, *FileBundle*) – no description available
- **description** (*str*) – Longer statement or account giving the characteristics of the recording.
- **devices** (*Device*, *Electrode*, *ElectrodeArray*, *Pipette*) – no description available
- **internal\_identifier** (*str*) – Term or code that identifies the recording within a particular product.
- **orders** (*int*) – no description available
- **time\_step** (*QuantitativeValue*) – no description available
- **unit\_of\_measurement** (*UnitOfMeasurement*) – no description available

```
class fairgraph.openminds.ephys.activity.brain_slicing_activity.BrainSlicingActivity (id=None,
                                                                                      data=None,
                                                                                      space=None,
                                                                                      scope=None,
                                                                                      **properties)
```

Bases: fairgraph.base\_v3.KGObject

```
class fairgraph.openminds.ephys.activity.patch_clamp_activity.PatchClampActivity (id=None,
                                                                                   data=None,
                                                                                   space=None,
                                                                                   scope=None,
                                                                                   **properties)
```

Bases: fairgraph.base\_v3.KGObject

```
class fairgraph.openminds.ephys.activity.craniotomy.Craniotomy (id=None,
                                                                data=None,
                                                                space=None,
                                                                scope=None,
                                                                **properties)
```

Bases: fairgraph.base\_v3.KGObject

```
class fairgraph.openminds.ephys.activity.electrode_placement_activity.ElectrodePlacementAct
```

Bases: fairgraph.base\_v3.KGObject

```
class fairgraph.openminds.ephys.activity.stimulation_experiment.StimulationExperiment (id=None,
                                                                                       data=None,
                                                                                       space=None,
                                                                                       scope=None,
                                                                                       **properties)
```

Bases: fairgraph.base\_v3.KGObject

```
class fairgraph.openminds.ephys.activity.culturing_activity.CulturingActivity (id=None,
                                                                                  data=None,
                                                                                  space=None,
                                                                                  scope=None,
                                                                                  **properties)
```

Bases: fairgraph.base\_v3.KGObject

### 5.1.6 openminds.publications

```
class fairgraph.openminds.publications.book.Book (id=None, data=None, space=None,
                                                    scope=None, **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the book.
- **iri** (*IRI*) – Stands for Internationalized Resource Identifier which is an internet protocol standard that builds on the URI protocol, extending the set of permitted characters to include Unicode/ISO 10646.
- **abstract** (*str*) – no description available
- **authors** (*Organization*, *Person*) – Creator of a literary or creative work, as well as a dataset publication.
- **cited\_publications** (*DOI*, *ISBN*) – no description available
- **copyright** (*Copyright*) – Exclusive and assignable legal right of an originator to reproduce, publish, sell, or distribute the matter and form of a creative work for a defined time period.



- **custodians** (*Organization*, *Person*) – The ‘custodian’ is a legal person who is responsible for the content and quality of the data, metadata, and/or code of a research product.
- **date\_created** (*date*) – no description available
- **date\_modified** (*date*) – no description available
- **date\_published** (*date*) – no description available
- **digital\_identifier** (*DOI*, *ISBN*) – Digital handle to identify objects or legal persons.
- **editors** (*Person*) – no description available
- **funding** (*Funding*) – Money provided by a legal person for a particular purpose.
- **keywords** (*BiologicalOrder*, *BiologicalSex*, *BreedingType*, *CellCultureType*, *CellType*, *Disease*, *DiseaseModel*, *GeneticStrainType*, *Handedness*, *MolecularEntity*, *Organ*, *Species*, *SubcellularEntity*, *TermSuggestion*, *UBERONParcellation*, *CustomAnatomicalEntity*, *ParcellationEntity*, *ParcellationEntityVersion*) – Significant word or concept that are representative of the book.
- **license** (*License*) – Grant by a party to another party as an element of an agreement between those parties that permits to do, use, or own something.
- **publisher** (*Organization*, *Person*) – no description available
- **version\_identifier** (*str*) – Term or code used to identify the version of something.

```
class fairgraph.openminds.publications.chapter.Chapter (id=None,      data=None,
                                                         space=None, scope=None,
                                                         **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the chapter.
- **iri** (*IRI*) – Stands for Internationalized Resource Identifier which is an internet protocol standard that builds on the URI protocol, extending the set of permitted characters to include Unicode/ISO 10646.
- **abstract** (*str*) – no description available
- **authors** (*Organization*, *Person*) – Creator of a literary or creative work, as well as a dataset publication.
- **cited\_publications** (*DOI*, *ISBN*) – no description available
- **copyright** (*Copyright*) – Exclusive and assignable legal right of an originator to reproduce, publish, sell, or distribute the matter and form of a creative work for a defined time period.
- **custodians** (*Organization*, *Person*) – The ‘custodian’ is a legal person who is responsible for the content and quality of the data, metadata, and/or code of a research product.
- **date\_created** (*date*) – no description available
- **date\_modified** (*date*) – no description available
- **date\_published** (*date*) – no description available

- **digital\_identifier** (*DOI*) – Digital handle to identify objects or legal persons.
- **editors** (*Person*) – no description available
- **funding** (*Funding*) – Money provided by a legal person for a particular purpose.
- **is\_part\_of** (*Book*) – Reference to the ensemble of multiple things or beings.
- **keywords** (*BiologicalOrder, BiologicalSex, BreedingType, CellCultureType, CellType, Disease, DiseaseModel, GeneticStrainType, Handedness, MolecularEntity, Organ, Species, SubcellularEntity, TermSuggestion, UBERONParcellation, CustomAnatomicalEntity, ParcellationEntity, ParcellationEntityVersion*) – Significant word or concept that are representative of the chapter.
- **license** (*License*) – Grant by a party to another party as an element of an agreement between those parties that permits to do, use, or own something.
- **pagination** (*str*) – no description available
- **publisher** (*Organization, Person*) – no description available
- **version\_identifier** (*str*) – Term or code used to identify the version of something.

```
class fairgraph.openminds.publications.scholarly_article.ScholarlyArticle (id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **properties)
```

Bases: *fairgraph.base\_v3.KGObject*

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the scholarly article.
- **iri** (*IRI*) – Stands for Internationalized Resource Identifier which is an internet protocol standard that builds on the URI protocol, extending the set of permitted characters to include Unicode/ISO 10646.
- **abstract** (*str*) – no description available
- **authors** (*Organization, Person*) – Creator of a literary or creative work, as well as a dataset publication.
- **cited\_publications** (*DOI, ISBN*) – no description available
- **copyright** (*Copyright*) – Exclusive and assignable legal right of an originator to reproduce, publish, sell, or distribute the matter and form of a creative work for a defined time period.
- **custodians** (*Organization, Person*) – The ‘custodian’ is a legal person who is responsible for the content and quality of the data, metadata, and/or code of a research product.
- **date\_created** (*date*) – no description available
- **date\_modified** (*date*) – no description available
- **date\_published** (*date*) – no description available
- **digital\_identifier** (*DOI*) – Digital handle to identify objects or legal persons.

- **editors** (*Person*) – no description available
- **funding** (*Funding*) – Money provided by a legal person for a particular purpose.
- **is\_part\_of** (*PublicationIssue*, *PublicationVolume*) – Reference to the ensemble of multiple things or beings.
- **keywords** (*BiologicalOrder*, *BiologicalSex*, *BreedingType*, *CellCultureType*, *CellType*, *Disease*, *DiseaseModel*, *GeneticStrainType*, *Handedness*, *MolecularEntity*, *Organ*, *Species*, *SubcellularEntity*, *TermSuggestion*, *UBERONParcellation*, *CustomAnatomicalEntity*, *ParcellationEntity*, *ParcellationEntityVersion*) – Significant word or concept that are representative of the scholarly article.
- **license** (*License*) – Grant by a party to another party as an element of an agreement between those parties that permits to do, use, or own something.
- **pagination** (*str*) – no description available
- **publisher** (*Organization*, *Person*) – no description available
- **version\_identifier** (*str*) – Term or code used to identify the version of something.

```
class fairgraph.openminds.publications.periodical.Periodical (id=None,
                                                             data=None,
                                                             space=None,
                                                             scope=None,
                                                             **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Whole, non-abbreviated name of the periodical.
- **alias** (*str*) – Shortened or fully abbreviated name of the periodical.
- **digital\_identifier** (*ISSN*) – Digital handle to identify objects or legal persons.

```
class fairgraph.openminds.publications.publication_volume.PublicationVolume (id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **is\_part\_of** (*Periodical*) – Reference to the ensemble of multiple things or beings.
- **volume\_number** (*str*) – no description available

```
class fairgraph.openminds.publications.publication_issue.PublicationIssue (id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **is\_part\_of** (*PublicationVolume*) – Reference to the ensemble of multiple things or beings.
- **issue\_number** (*str*) – no description available

```
class fairgraph.openminds.publications.live_paper.LivePaper (id=None,  
                                                             data=None,  
                                                             space=None,  
                                                             scope=None,  
                                                             **properties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Whole, non-abbreviated name of the live paper.
- **alias** (*str*) – Shortened or fully abbreviated name of the live paper.
- **authors** (*Organization*, *Person*) – Creator of a literary or creative work, as well as a dataset publication.
- **custodians** (*Organization*, *Person*) – The ‘custodian’ is a legal person who is responsible for the content and quality of the data, metadata, and/or code of a research product.
- **description** (*str*) – Longer statement or account giving the characteristics of the live paper.
- **digital\_identifier** (*DOI*) – Digital handle to identify objects or legal persons.
- **versions** (*LivePaperVersion*) – Reference to variants of an original.
- **homepage** (*URL*) – Main website of the live paper.
- **how\_to\_cite** (*str*) – Preferred format for citing a particular object or legal person.

```
class fairgraph.openminds.publications.live_paper_version.LivePaperVersion (id=None,  
                                                                              data=None,  
                                                                              space=None,  
                                                                              scope=None,  
                                                                              **prop-  
er-  
ties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Whole, non-abbreviated name of the live paper version.
- **alias** (*str*) – Shortened or fully abbreviated name of the live paper version.
- **abouts** (*DatasetVersion*, *ModelVersion*, *SoftwareVersion*) – no description available
- **accessibility** (*ProductAccessibility*) – Level to which something is accessible to the live paper version.
- **authors** (*Organization*, *Person*) – Creator of a literary or creative work, as well as a dataset publication.
- **copyright** (*Copyright*) – Exclusive and assignable legal right of an originator to reproduce, publish, sell, or distribute the matter and form of a creative work for a defined time period.

- **custodians** (*Organization*, *Person*) – The ‘custodian’ is a legal person who is responsible for the content and quality of the data, metadata, and/or code of a research product.
- **description** (*str*) – Longer statement or account giving the characteristics of the live paper version.
- **digital\_identifier** (*DOI*) – Digital handle to identify objects or legal persons.
- **full\_documentation** (*DOI*, *File*, *URL*) – Non-abridged instructions, comments, and information for using a particular product.
- **funding** (*Funding*) – Money provided by a legal person for a particular purpose.
- **homepage** (*URL*) – Main website of the live paper version.
- **how\_to\_cite** (*str*) – Preferred format for citing a particular object or legal person.
- **is\_alternative\_version\_of** (*LivePaperVersion*) – Reference to an original form where the essence was preserved, but presented in an alternative form.
- **is\_new\_version\_of** (*LivePaperVersion*) – Reference to a previous (potentially outdated) particular form of something.
- **keywords** (*ActionStatusType*, *AgeCategory*, *AnatomicalAxesOrientation*, *AnatomicalPlane*, *AnnotationType*, *AtlasType*, *BiologicalOrder*, *BiologicalSex*, *BreedingType*, *CellCultureType*, *CellType*, *ContributionType*, *CranialWindowType*, *CriteriaQualityType*, *DataType*, *DeviceType*, *Disease*, *DiseaseModel*, *EthicsAssessment*, *ExperimentalApproach*, *FileBundleGrouping*, *FileRepositoryType*, *FileUsageRole*, *GeneticStrainType*, *Handedness*, *Language*, *Laterality*, *MeasuredQuantity*, *MetaDataModelType*, *ModelAbstractionLevel*, *ModelScope*, *MolecularEntity*, *OperatingDevice*, *OperatingSystem*, *Organ*, *PatchClampVariation*, *PreparationType*, *ProductAccessibility*, *ProgrammingLanguage*, *QualitativeOverlap*, *SemanticDataType*, *Service*, *SoftwareApplicationCategory*, *SoftwareFeature*, *Species*, *StimulationApproach*, *StimulusType*, *SubcellularEntity*, *SubjectAttribute*, *Technique*, *TermSuggestion*, *Terminology*, *TissueSampleAttribute*, *TissueSampleType*, *TypeOfUncertainty*, *UBERONParcellation*, *UnitOfMeasurement*) – Significant word or concept that are representative of the live paper version.
- **last\_modified** (*datetime*) – no description available
- **license** (*License*) – Grant by a party to another party as an element of an agreement between those parties that permits to do, use, or own something.
- **other\_contributions** (*Contribution*) – Giving or supplying of something (such as money or time) as a part or share other than what is covered elsewhere.
- **related\_publications** (*DOI*, *ISBN*, *ISSN*) – Reference to something that was made available for the general public to see or buy.
- **release\_date** (*date*) – Fixed date on which a product is due to become or was made available for the general public to see or buy
- **repository** (*FileRepository*) – Place, room, or container where something is deposited or stored.

- **support\_channels** (*str*) – Way of communication used to interact with users or customers.
- **version\_identifier** (*str*) – Term or code used to identify the version of something.
- **version\_innovation** (*str*) – Documentation on what changed in comparison to a previously published form of something.

```
class fairgraph.openminds.publications.live_paper_section.LivePaperSection (id=None,
                                                                              data=None,
                                                                              space=None,
                                                                              scope=None,
                                                                              **prop-
                                                                              er-
                                                                              ties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the live paper section.
- **description** (*str*) – Longer statement or account giving the characteristics of the live paper section.
- **is\_part\_of** (*LivePaperVersion*) – Reference to the ensemble of multiple things or beings.
- **order** (*int*) – no description available
- **section\_type** (*str*) – no description available

```
class fairgraph.openminds.publications.live_paper_resource_item.LivePaperResourceItem (id=None,
                                                                                          data=None,
                                                                                          space=None,
                                                                                          scope=None,
                                                                                          **prop-
                                                                                          er-
                                                                                          ties)
```

Bases: fairgraph.base\_v3.KGObject

#### Parameters

- **name** (*str*) – Word or phrase that constitutes the distinctive designation of the live paper resource item.
- **iri** (*IRI*) – Stands for Internationalized Resource Identifier which is an internet protocol standard that builds on the URI protocol, extending the set of permitted characters to include Unicode/ISO 10646.
- **hosted\_by** (*Organization*) – Reference to an organization that provides facilities and services for something.
- **is\_part\_of** (*LivePaperSection*) – Reference to the ensemble of multiple things or beings.

**fairgraph** currently provides the following modules for working with KG v3:

*openminds.core* covers general origin, location and content of research products.

*openminds.sands* covers brain atlases, as well as anatomical locations and relations of non-atlas data.

*openminds.controlledterms* covers consistent definition of neuroscience terms.

*openminds.computation* covers provenance of simulations, data analysis and visualizations in neuroscience.

*openminds.ephys* covers in-depth metadata for electrophysiology recordings, extending the basic information in openMINDS/core.

*openminds.publications* covers scientific publications, particularly interactive publications such as live papers.

## 5.2 KG version 2

### 5.2.1 minds

“Minimal Information for Neuroscience DataSets” - metadata common to all neuroscience datasets independent of the type of investigation

```
class fairgraph.minds.Person (id=None, instance=None, **properties)
```

Bases: fairgraph.minds.MINDSObject

A person associated with research data or models, for example as an experimentalist, or a data analyst.

#### Parameters

- **identifier** (*str*) –
- **name** (*str*) –
- **shortname** (*str*) –

```
class fairgraph.minds.Activity (id=None, instance=None, **properties)
```

Bases: fairgraph.minds.MINDSObject

A research activity.

#### Parameters

- **identifier** (*str*) –
- **name** (*str*) –
- **ethics\_approval** (*EthicsApproval*) –
- **ethics\_authority** (*EthicsAuthority*) –
- **methods** (*Method*) –
- **preparation** (*Preparation*) –
- **protocols** (*Protocol*) –

```
class fairgraph.minds.AgeCategory (id=None, instance=None, **properties)
```

Bases: fairgraph.minds.MINDSObject

An age category, e.g. “adult”, “juvenile”

#### Parameters

- **identifier** (*str*) –
- **name** (*str*) –

```
class fairgraph.minds.EthicsApproval (id=None, instance=None, **properties)
```

Bases: fairgraph.minds.MINDSObject

Record of an ethics approval.

**Parameters**

- **identifier** (*str*) –
- **name** (*str*) –
- **generated\_by** (*EthicsAuthority*) –

**class** fairgraph.minds.**EthicsAuthority** (*id=None, instance=None, \*\*properties*)  
Bases: fairgraph.minds.MINDSObject

A entity legally authorised to approve or deny permission to conduct an experiment on ethical grounds.

**Parameters**

- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.minds.**Dataset** (*id=None, instance=None, \*\*properties*)  
Bases: fairgraph.minds.MINDSObject

A collection of related data files.

**Parameters**

- **activity** (*Activity*) –
- **container\_url\_as\_ZIP** (*bool*) –
- **container\_url** (*str*) –
- **datalink** (*str*) –
- **dataset\_doi** (*str*) –
- **description** (*str*) –
- **external\_datalink** (*str*) –
- **identifier** (*str*) –
- **name** (*str*) –
- **release\_date** (*datetime*) –
- **component** (*PLAComponent*) –
- **contributors** (*Person*) –
- **doireference** (*str*) –
- **embargo\_status** (*EmbargoStatus*) –
- **formats** (*Format*) –
- **license** (*License*) –
- **modality** (*Modality*) –
- **owners** (*Person*) –
- **parcellation\_atlas** (*ParcellationAtlas*) –
- **parcellation\_region** (*ParcellationRegion*) –
- **part\_of** (*str*) –
- **publications** (*Publication*) –
- **reference\_space** (*ReferenceSpace*) –



- **specimen\_group** (*SpecimenGroup*) –

**methods** (*client*, *api*='query', *scope*='released')

Return a list of experimental methods associated with the dataset

**classmethod list** (*client*, *size*=100, *from\_index*=0, *api*='query', *scope*='released', *resolved*=False, *\*\*filters*)

List all objects of this type in the Knowledge Graph

**class** fairgraph.minds.**EmbargoStatus** (*id*=None, *instance*=None, *\*\*properties*)

Bases: fairgraph.minds.MINDSObject

Information about the embargo period during which a given dataset cannot be publicly shared.

#### Parameters

- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.minds.**File** (*id*=None, *instance*=None, *\*\*properties*)

Bases: fairgraph.minds.MINDSObject

Metadata about a single file.

#### Parameters

- **absolute\_path** (*str*) –
- **byte\_size** (*int*) –
- **content\_type** (*str*) –
- **hash** (*str*) –
- **identifier** (*str*) –
- **last\_modified** (*datetime*) –
- **name** (*str*) –
- **relative\_path** (*str*) –

**class** fairgraph.minds.**FileAssociation** (*id*=None, *instance*=None, *\*\*properties*)

Bases: fairgraph.minds.MINDSObject

A link between a file and a dataset.

#### Parameters

- **from** (*File*) –
- **identifier** (*str*) –
- **name** (*str*) –
- **to** (*Dataset*) –

**class** fairgraph.minds.**Format** (*id*=None, *instance*=None, *\*\*properties*)

Bases: fairgraph.minds.MINDSObject

A file/data format.

#### Parameters

- **identifier** (*str*) –
- **name** (*str*) –

```
class fairgraph.minds.License (id=None, instance=None, **properties)  
    Bases: fairgraph.minds.MINDSObject
```

A license governing sharing of a dataset.

**Parameters**

- **identifier** (*str*) –
- **name** (*str*) –

```
class fairgraph.minds.Method (id=None, instance=None, **properties)  
    Bases: fairgraph.minds.MINDSObject
```

An experimental method.

**Parameters**

- **identifier** (*str*) –
- **name** (*str*) –

```
class fairgraph.minds.Modality (id=None, instance=None, **properties)  
    Bases: fairgraph.minds.MINDSObject
```

A recording modality.

**Parameters**

- **identifier** (*str*) –
- **name** (*str*) –

```
class fairgraph.minds.ParcellationAtlas (id=None, instance=None, **properties)  
    Bases: fairgraph.minds.MINDSObject
```

A brain atlas in which the brain of a given species of animal is divided into regions.

**Parameters**

- **identifier** (*str*) –
- **name** (*str*) –

```
class fairgraph.minds.ParcellationRegion (id=None, instance=None, **properties)  
    Bases: fairgraph.minds.MINDSObject
```

A brain region as defined by a brain atlas.

**Parameters**

- **alias** (*str*) –
- **identifier** (*str*) –
- **name** (*str*) –
- **url** (*str*) –
- **species** (*Species*) –

```
class fairgraph.minds.PLAComponent (id=None, instance=None, **properties)  
    Bases: fairgraph.minds.MINDSObject
```

A data or software component, as defined in the HBP “project lifecycle” application.

**Parameters**

- **description** (*str*) –

- **identifier** (*str*) –
- **name** (*str*) –
- **component** (*str*) –

**class** fairgraph.minds.**Preparation** (*id=None, instance=None, \*\*properties*)

Bases: fairgraph.minds.MINDSObject

An experimental preparation.

#### Parameters

- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.minds.**Protocol** (*id=None, instance=None, \*\*properties*)

Bases: fairgraph.minds.MINDSObject

An experimental protocol.

#### Parameters

- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.minds.**Publication** (*id=None, instance=None, \*\*properties*)

Bases: fairgraph.minds.MINDSObject

A scientific publication.

#### Parameters

- **cite** (*str*) –
- **doi** (*str*) –
- **identifier** (*str*) –
- **name** (*str*) –
- **authors** (*Person*) –

**class** fairgraph.minds.**ReferenceSpace** (*id=None, instance=None, \*\*properties*)

Bases: fairgraph.minds.MINDSObject

A reference space for a brain atlas.

#### Parameters

- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.minds.**Role** (*id=None, instance=None, \*\*properties*)

Bases: fairgraph.minds.MINDSObject

The role of a person within an experiment.

#### Parameters

- **identifier** (*str*) –
- **name** (*str*) –

```
class fairgraph.minds.Sample (id=None, instance=None, **properties)  
    Bases: fairgraph.minds.MINDSObject
```

A sample of neural tissue.

**Parameters**

- **container\_url** (*str*) –
- **identifier** (*str*) –
- **name** (*str*) –
- **weight\_post\_fixation** (*str*) –
- **weight\_pre\_fixation** (*str*) –
- **methods** (*Method*) –
- **parcellation\_atlas** (*ParcellationAtlas*) –
- **parcellation\_region** (*ParcellationRegion*) –
- **reference** (*str*) –

```
class fairgraph.minds.Sex (id=None, instance=None, **properties)  
    Bases: fairgraph.minds.MINDSObject
```

The sex of an animal or person from whom/which data were obtained.

**Parameters**

- **identifier** (*str*) –
- **name** (*str*) –

```
class fairgraph.minds.SoftwareAgent (id=None, instance=None, **properties)  
    Bases: fairgraph.minds.MINDSObject
```

Software that performed a given activity.

**Parameters**

- **description** (*str*) –
- **identifier** (*str*) –
- **name** (*str*) –

```
class fairgraph.minds.Species (id=None, instance=None, **properties)  
    Bases: fairgraph.minds.MINDSObject
```

The species of an experimental subject, expressed with the binomial nomenclature.

**Parameters**

- **identifier** (*str*) –
- **name** (*str*) –

```
class fairgraph.minds.SpecimenGroup (id=None, instance=None, **properties)  
    Bases: fairgraph.minds.MINDSObject
```

A group of experimental subjects.

**Parameters**

- **identifier** (*str*) –
- **name** (*str*) –

- **subjects** ([Subject](#)) –

**class** fairgraph.minds.**Subject** (*id=None, instance=None, \*\*properties*)  
 Bases: fairgraph.minds.MINDSObject

The organism that is the subject of an experimental investigation.

#### Parameters

- **cause\_of\_death** (*str*) –
- **genotype** (*str*) –
- **identifier** (*str*) –
- **name** (*str*) –
- **strain** (*str*) –
- **strains** (*str*) –
- **weight** (*str*) –
- **age** (*str*) –
- **age\_category** ([AgeCategory](#)) –
- **samples** ([Sample](#)) –
- **sex** ([Sex](#)) –
- **species** ([Species](#)) –

fairgraph.minds.**list\_kg\_classes** ()  
 List all KG classes defined in this module

fairgraph.minds.**Project**  
 alias of [fairgraph.minds.PLAComponent](#)

## 5.2.2 uniminds

An updated version of MINDS

**class** fairgraph.uniminds.**UnimindsObject** (*id=None, instance=None, \*\*properties*)  
 Bases: fairgraph.minds.MINDSObject

**class** fairgraph.uniminds.**UnimindsOption** (*id=None, instance=None, \*\*properties*)  
 Bases: fairgraph.minds.MINDSObject

**class** fairgraph.uniminds.**Person** (*id=None, instance=None, \*\*properties*)  
 Bases: [fairgraph.uniminds.UnimindsObject](#)

A person associated with research data or models, for example as an experimentalist, or a data analyst.

#### Parameters

- **alternatives** ([KGObject](#)) –
- **email** (*str*) –
- **family\_name** (*str*) –
- **given\_name** (*str*) –
- **identifier** (*str*) –
- **name** (*str*) –

- **orcid**(*str*) –

**class** fairgraph.uniminds.**AbstractionLevel** (*id=None, instance=None, \*\*properties*)  
Bases: *fairgraph.uniminds.UnimindsOption*

Level of abstraction for a neuroscience model, e.g.rate neurons, spiking neurons

**Parameters**

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**AgeCategory** (*id=None, instance=None, \*\*properties*)  
Bases: *fairgraph.uniminds.UnimindsOption*

An age category, e.g. “adult”, “juvenile”

**Parameters**

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**BrainStructure** (*id=None, instance=None, \*\*properties*)  
Bases: *fairgraph.uniminds.UnimindsOption*

A sub-structure or region with the brain.

**Parameters**

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**CellularTarget** (*id=None, instance=None, \*\*properties*)  
Bases: *fairgraph.uniminds.UnimindsOption*

The type of neuron or glial cell that is the focus of the study.

**Parameters**

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**Country** (*id=None, instance=None, \*\*properties*)  
Bases: *fairgraph.uniminds.UnimindsOption*

A geographical country.

**Parameters**

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**Dataset** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsObject*

A collection of related data files.

#### Parameters

- **description** (*str*) –
- **identifier** (*str*) –
- **intended\_release\_date** (*datetime*) –
- **name** (*str*) –
- **brain\_structure** (*BrainStructure*) –
- **cellular\_target** (*CellularTarget*) –
- **contributor** (*Person*) –
- **custodian** (*Person*) –
- **doi** (*Doi*) –
- **embargo\_status** (*EmbargoStatus*) –
- **ethics\_approval** (*EthicsApproval*) –
- **funding\_information** (*FundingInformation*) –
- **hbp\_component** (*HBPComponent*) –
- **license** (*License*) –
- **main\_contact** (*Person*) –
- **main\_file\_bundle** (*FileBundle*) –
- **method** (*Method*) –
- **project** (*Project*) –
- **publication** (*Publication*) –
- **species** (*Species*) –
- **study\_target** (*StudyTarget*) –
- **subjectgroup** (*SubjectGroup*) –

**class** fairgraph.uniminds.**Disability** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsOption*

A disability or disease.

#### Parameters

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**Doi** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsOption*

Digital Object Identifier (<https://www.doi.org>)

#### Parameters

- **citation** (*str*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**EmbargoStatus** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsOption*

Information about the embargo period during which a given dataset cannot be publicly shared.

#### Parameters

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**EthicsApproval** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsObject*

Record of an ethics approval.

#### Parameters

- **alternatives** (*KGObject*) –
- **hbpethicsapproval** (*str*) –
- **identifier** (*str*) –
- **name** (*str*) –
- **country\_of\_origin** (*Country*) –
- **ethics\_authority** (*EthicsAuthority*) –

**class** fairgraph.uniminds.**EthicsAuthority** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsOption*

A entity legally authorised to approve or deny permission to conduct an experiment on ethical grounds.

#### Parameters

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**ExperimentalPreparation** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsOption*

An experimental preparation.

#### Parameters

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**File** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsObject*

Metadata about a single file.



**Parameters**

- **alternatives** (*KGObject*) –
- **description** (*str*) –
- **identifier** (*str*) –
- **name** (*str*) –
- **url** (*str*) –
- **mime\_type** (*MimeType*) –

**class** fairgraph.uniminds.**FileAssociation** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsObject*

A link between a file and a dataset.

**Parameters**

- **from** (*File*) –
- **identifier** (*str*) –
- **name** (*str*) –
- **to** (*Dataset*) –

**class** fairgraph.uniminds.**FileBundle** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsObject*

A collection of files (e.g. in a folder or directory structure)

**Parameters**

- **alternatives** (*KGObject*) –
- **description** (*str*) –
- **identifier** (*str*) –
- **name** (*str*) –
- **url** (*str*) –
- **usage\_notes** (*str*) –
- **file** (*File*) –
- **file\_bundle** (*FileBundle*) –
- **mime\_type** (*MimeType*) –
- **model\_instance** (*ModelInstance*) –

**class** fairgraph.uniminds.**FileBundleGroup** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsObject*

A collection of file bundles (see *FileBundle*)

**Parameters**

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**FundingInformation** (*id=None, instance=None, \*\*properties*)  
Bases: *fairgraph.uniminds.UnimindsObject*

Information about the source of funding of a study.

**Parameters**

- **alternatives** (*KGObject*) –
- **grant\_id** (*str*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**Genotype** (*id=None, instance=None, \*\*properties*)  
Bases: *fairgraph.uniminds.UnimindsOption*

Genetic makeup of a study subject, typically a reference to an inbred strain, with or without mutations.

**Parameters**

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**Handedness** (*id=None, instance=None, \*\*properties*)  
Bases: *fairgraph.uniminds.UnimindsOption*

Preferred hand (left, right, or ambidextrous)

**Parameters**

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**HBPCComponent** (*id=None, instance=None, \*\*properties*)  
Bases: *fairgraph.uniminds.UnimindsObject*

A data or software component, as defined in the HBP “project lifecycle” application.

**Parameters**

- **alternatives** (*KGObject*) –
- **associated\_task** (*str*) –
- **identifier** (*str*) –
- **name** (*str*) –
- **component\_owner** (*Person*) –

**class** fairgraph.uniminds.**License** (*id=None, instance=None, \*\*properties*)  
Bases: *fairgraph.uniminds.UnimindsOption*

A license governing sharing of a dataset.

**Parameters**

- **alternatives** (*KGObject*) –
- **fullname** (*str*) –

- **identifier** (*str*) –
- **name** (*str*) –
- **url** (*str*) –

**class** fairgraph.uniminds.**Method** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsObject*

An experimental method.

#### Parameters

- **alternatives** (*KGObject*) –
- **description** (*str*) –
- **fullname** (*str*) –
- **identifier** (*str*) –
- **name** (*str*) –
- **brain\_structure** (*BrainStructure*) –
- **ethics\_approval** (*EthicsApproval*) –
- **experimental\_preparation** (*ExperimentalPreparation*) –
- **method\_category** (*MethodCategory*) –
- **publication** (*Publication*) –
- **study\_target** (*StudyTarget*) –
- **submethod** (*Method*) –

**class** fairgraph.uniminds.**MethodCategory** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsOption*

A category used for classifying experimental methods (see *ExperimentalMethod*)

#### Parameters

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**MimeType** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsOption*

Media type of a document

#### Parameters

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**ModelFormat** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsOption*

Programming or markup language used to describe or create a model

#### Parameters

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**ModelInstance** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsObject*

A specific version/parameterization of a neuroscience model.

#### Parameters

- **alternatives** (*KGObject*) –
- **description** (*str*) –
- **identifier** (*str*) –
- **license** (*License*) –
- **name** (*str*) –
- **version** (*str*) –
- **abstraction\_level** (*AbstractionLevel*) –
- **brain\_structure** (*BrainStructure*) –
- **cellular\_target** (*CellularTarget*) –
- **contributor** (*Person*) –
- **custodian** (*Person*) –
- **main\_contact** (*Person*) –
- **used\_dataset** (*KGObject*) –
- **produced\_dataset** (*Dataset*) –
- **modelformat** (*ModelFormat*) –
- **modelscope** (*ModelScope*) –
- **publication** (*Publication*) –
- **study\_target** (*StudyTarget*) –
- **embargo\_status** (*EmbargoStatus*) –
- **alternate\_of** (*ModelInstance, MEModel*) –

**class** fairgraph.uniminds.**ModelScope** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsOption*

‘What is being modelled’: a protein, a single cell, the entire brain, etc.

#### Parameters

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**Organization** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsObject*

An organization associated with research data or models, e.g. a university, lab or department.

**Parameters**

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –
- **created\_as** (*str*) –

**class** fairgraph.uniminds.**Project** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsObject*

A research project, which may have generated one or more datasets (see *Dataset*)

**Parameters**

- **alternatives** (*KGObject*) –
- **description** (*str*) –
- **identifier** (*str*) –
- **name** (*str*) –
- **coordinator** (*Person*) –

**class** fairgraph.uniminds.**Publication** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsObject*

A scientific publication.

**Parameters**

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –
- **url** (*str*) –
- **brain\_structure** (*BrainStructure*) –
- **project** (*Project*) –
- **publication\_id** (*PublicationId*) –
- **study\_target** (*StudyTarget*) –
- **subjectgroup** (*SubjectGroup*) –

**class** fairgraph.uniminds.**PublicationId** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsOption*

Identifier for a publication (e.g. a DOI, a PubMed ID)

**Parameters**

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –
- **publication** (*Publication*) –
- **publication\_id\_type** (*PublicationIdType*) –

**class** fairgraph.uniminds.**PublicationIdType** (*id=None, instance=None, \*\*properties*)  
Bases: *fairgraph.uniminds.UnimindsOption*

A type of publication identifier (e.g. ISBN, DOI)

**Parameters**

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**Sex** (*id=None, instance=None, \*\*properties*)  
Bases: *fairgraph.uniminds.UnimindsOption*

The sex of an animal or person from whom/which data were obtained.

**Parameters**

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**Species** (*id=None, instance=None, \*\*properties*)  
Bases: *fairgraph.uniminds.UnimindsOption*

The species of an experimental subject, expressed with the binomial nomenclature.

**Parameters**

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**Strain** (*id=None, instance=None, \*\*properties*)  
Bases: *fairgraph.uniminds.UnimindsOption*

An inbred sub-population within a species.

**Parameters**

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**StudyTarget** (*id=None, instance=None, \*\*properties*)  
Bases: *fairgraph.uniminds.UnimindsObject*

The focus of an experimental or modelling study.

**Parameters**

- **alternatives** (*KGObject*) –
- **fullname** (*str*) –
- **identifier** (*str*) –
- **name** (*str*) –
- **study\_target\_source** (*StudyTargetSource*) –
- **study\_target\_type** (*StudyTargetType*) –

**class** fairgraph.uniminds.**StudyTargetSource** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsOption*

Context of a study target, e.g. if the target is a brain region, the source might be an atlas.

#### Parameters

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**StudyTargetType** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsOption*

Category of study target (see *StudyTarget*)

#### Parameters

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –

**class** fairgraph.uniminds.**Subject** (*id=None, instance=None, \*\*properties*)

Bases: *fairgraph.uniminds.UnimindsObject*

The organism that is the subject of an experimental investigation.

#### Parameters

- **age** (*str, float*) –
- **age\_range\_max** (*str, float*) –
- **age\_range\_min** (*str, float*) –
- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –
- **age\_category** (*AgeCategory*) –
- **brain\_structure** (*BrainStructure*) –
- **cellular\_target** (*CellularTarget*) –
- **disability** (*Disability*) –
- **genotype** (*Genotype*) –
- **handedness** (*Handedness*) –
- **publication** (*Publication*) –
- **sex** (*Sex*) –
- **species** (*Species*) –
- **strain** (*Strain*) –
- **study\_target** (*StudyTarget*) –

```
class fairgraph.uniminds.SubjectGroup (id=None, instance=None, **properties)  
    Bases: fairgraph.uniminds.UnimindsObject
```

A group of experimental subjects.

#### Parameters

- **age\_range\_max** (*str*, *float*) –
- **age\_range\_min** (*str*, *float*) –
- **alternatives** (*KGObject*) –
- **description** (*str*) –
- **identifier** (*str*) –
- **name** (*str*) –
- **num\_of\_subjects** (*int*) –
- **age\_category** (*AgeCategory*) –
- **cellular\_target** (*CellularTarget*) –
- **brain\_structure** (*BrainStructure*) –
- **disability** (*Disability*) –
- **genotype** (*Genotype*) –
- **handedness** (*Handedness*) –
- **publication** (*Publication*) –
- **sex** (*Sex*) –
- **species** (*Species*) –
- **strain** (*Strain*) –
- **study\_target** (*StudyTarget*) –
- **subjects** (*Subject*) –

```
class fairgraph.uniminds.TissueSample (id=None, instance=None, **properties)  
    Bases: fairgraph.uniminds.UnimindsObject
```

A sample of brain tissue.

#### Parameters

- **alternatives** (*KGObject*) –
- **identifier** (*str*) –
- **name** (*str*) –
- **subject** (*Subject*) –

```
fairgraph.uniminds.list_kg_classes ()  
    List all KG classes defined in this module
```

## 5.2.3 electrophysiology

Metadata for electrophysiology experiments.

The following methods are currently supported:



- patch clamp recording in brain slices
- sharp electrode intracellular recording in brain slices

#### Coming soon:

- patch clamp recordings in cultured neurons
- extracellular electrode recording, including tetrodes and multi-electrode arrays

```
class fairgraph.electrophysiology.Sensor(name, coordinate_system=None, coordinate_units=None, description=None, id=None, instance=None)
```

Bases: fairgraph.base\_v2.KGObject

Object specific to sensors used in electrode array experiments

#### Parameters

- **name** (*str*) –
- **coordinate\_system** (*Distribution*) –
- **coordinate\_units** (*str*) –
- **description** (*str*) –

```
class fairgraph.electrophysiology.Trace(name, data_location, generated_by, generation_metadata, channel, data_unit, time_step, part_of=None, retrieval_date=None, id=None, instance=None)
```

Bases: fairgraph.base\_v2.KGObject

Single time series recorded during an experiment or simulation.

*Trace* represents a single recording from a single channel. If you have a file containing recordings from multiple channels, or multiple recordings from a single channel, use *MultiChannelMultiTrialRecording*.

#### Parameters

- **name** (*str*) –
- **data\_location** (*Distribution*) –
- **generated\_by** (*PatchClampExperiment*) –
- **generation\_metadata** (*QualifiedTraceGeneration*) –
- **channel** (*int*) –
- **data\_unit** (*str*) –
- **time\_step** (*QuantitativeValue*) –
- **part\_of** (*Dataset*) –
- **retrieval\_date** (*datetime*) –

```
class fairgraph.electrophysiology.MultiChannelMultiTrialRecording(name,
                                                                    data_location,
                                                                    generated_by,
                                                                    generation_metadata,
                                                                    channel_names,
                                                                    data_unit,
                                                                    time_step,
                                                                    channel_type=None,
                                                                    part_of=None,
                                                                    id=None,
                                                                    instance=None)
```

Bases: *fairgraph.electrophysiology.Trace*

**Multiple time series recorded during an experiment or simulation.** Time series may be recorded from multiple channels. If you have a file containing only a single recording from a single channel, you may instead use *Trace*.

#### Parameters

- **name** (*str*) –
- **data\_location** (*Distribution*) –
- **generated\_by** (*PatchClampExperiment*, *ExtracellularElectrodeExperiment*, *ElectrodeArrayExperiment*, *EEGExperiment*, *ECOGExperiment*) –
- **generation\_metadata** (*QualifiedMultiTraceGeneration*) –
- **channel\_names** (*str*) –
- **data\_unit** (*str*) –
- **time\_step** (*QuantitativeValue*) –
- **channel\_type** (*ChannelType*) –
- **part\_of** (*Dataset*) –

```
class fairgraph.electrophysiology.PatchedCell(name, brain_location, collection=None, putative_cell_type=None, cell_type=None, morphology_type=None, experiments=None, pipette_id=None, seal_resistance=None, pipette_resistance=None, start_membrane_potential=None, end_membrane_potential=None, pipette_solution=None, liquid_junction_potential=None, labeling_compound=None, reversing_potential_cl=None, description=None, id=None, instance=None)
```

Bases: *fairgraph.base\_v2.KGObject*

A cell recorded in patch clamp.

**Parameters**

- **name** (*str*) –
- **brain\_location** (*BrainRegion*) –
- **collection** (*PatchedCellCollection*) –
- **cell\_type** (*CellType*) –
- **experiments** (*PatchClampExperiment*) –
- **pipette\_id** (*str*, *int*) –
- **seal\_resistance** (*QuantitativeValue*) –
- **pipette\_resistance** (*QuantitativeValue*) –
- **liquid\_junction\_potential** (*QuantitativeValue*) –
- **start\_membrane\_potential** (*QuantitativeValue*) –
- **end\_membrane\_potential** (*QuantitativeValue*) –
- **pipette\_solution** (*str*) –
- **labeling\_compound** (*str*) –
- **reversal\_potential\_cl** (*QuantitativeValue*) –
- **description** (*str*) –

**classmethod** **list** (*client*, *size=100*, *from\_index=0*, *api='query'*, *scope='released'*, *resolved=False*, *\*\*filters*)

List all objects of this type in the Knowledge Graph

```
class fairgraph.electrophysiology.PatchedSlice (name, slice, recorded_cells,
                                              recording_activity=None,
                                              brain_location=None,
                                              bath_solution=None, description=None,
                                              id=None, instance=None)
```

Bases: fairgraph.base\_v2.KGObject

A slice that has been recorded from using patch clamp.

**Parameters**

- **name** (*str*) –
- **slice** (*Slice*) –
- **recorded\_cells** (*PatchedCellCollection*) –
- **recording\_activity** (*PatchClampActivity*) –
- **brain\_location** (*BrainRegion*) –
- **bath\_solution** (*QuantitativeValue*) –
- **description** (*str*) –

```
class fairgraph.electrophysiology.PatchedCellCollection (name, cells, slice=None,
                                                         id=None, instance=None)
```

Bases: fairgraph.base\_v2.KGObject

A collection of patched cells.

**Parameters**

- **name** (*str*) –

- **cells** (*PatchedCell*) –
- **slice** (*PatchedSlice*) –

```
class fairgraph.electrophysiology.CellCulture (name, subject, cells, cultur-  
ing_activity=None, experiment=None,  
id=None, instance=None)
```

Bases: fairgraph.base\_v2.KGObject

A cell culture.

#### Parameters

- **name** (*str*) –
- **subject** (*Subject*) –
- **cells** (*PatchedCell*) –
- **culturing\_activity** (*CellCulturingActivity*) –
- **experiment** (*PatchClampActivity*) –

```
class fairgraph.electrophysiology.PatchClampActivity (name, recorded_tissue,  
recorded_slice=None,  
protocol=None, people=None, start_time=None,  
end_time=None, id=None,  
instance=None)
```

Bases: fairgraph.base\_v2.KGObject

A patch clamp recording session.

#### Parameters

- **name** (*str*) –
- **recorded\_tissue** (*CellCulture, Slice, CranialWindow*) –
- **recorded\_slice** (*PatchedSlice*) –
- **protocol** (*str*) –
- **people** (*Person*) –
- **start\_time** (*datetime*) –
- **end\_time** (*datetime*) –

```
class fairgraph.electrophysiology.PatchClampExperiment (name, recorded_cell, acqui-  
sition_device=None, stimu-  
lation=None, traces=None,  
start_time=None,  
end_time=None, people=None, protocol=None,  
id=None, instance=None)
```

Bases: fairgraph.base\_v2.KGObject

Stimulation of the neural tissue and recording of the responses during a patch clamp recording session.

#### Parameters

- **name** (*str*) –
- **recorded\_cell** (*PatchedCell*) –
- **acquisition\_device** (*Device*) –

- **stimulation** (*VisualStimulation, BehavioralStimulation, ElectrophysiologicalStimulation*) –
- **traces** (*Trace, MultiChannelMultiTrialRecording*) –
- **start\_time** (*datetime*) –
- **end\_time** (*datetime*) –
- **people** (*Person*) –
- **protocol** (*Protocol*) –

**classmethod from\_kg\_instance** (*instance, client, resolved=False*)  
docstring

**classmethod list** (*client, size=100, from\_index=0, api='query', scope='released', resolved=False, \*\*filters*)  
List all objects of this type in the Knowledge Graph

```
class fairgraph.electrophysiology.QualifiedTraceGeneration (name, stimulus_experiment, sweep, repetition=None, at_time=None, provider_experiment_id=None, provider_experiment_name=None, holding_potential=None, measured_holding_potential=None, input_resistance=None, series_resistance=None, compensation_current=None, id=None, instance=None)
```

Bases: `fairgraph.base_v2.KGObject`

Additional information about the generation of a single-channel electrophysiology trace.

#### Parameters

- **name** (*str*) –
- **stimulus\_experiment** (*PatchClampExperiment, IntraCellularSharpElectrodeExperiment*) –
- **sweep** (*int*) –
- **repetition** (*int*) –
- **at\_time** (*datetime*) –
- **provider\_experiment\_id** (*str*) –
- **provider\_experiment\_name** (*str*) –
- **holding\_potential** (*QuantitativeValue*) –
- **measured\_holding\_potential** (*QuantitativeValue*) –

- **input\_resistance** (*QuantitativeValue*) –
- **series\_resistance** (*QuantitativeValue*) –
- **compensation\_current** (*QuantitativeValue*) –

```
class fairgraph.electrophysiology.ImplantedBrainTissue(name, subject, implanta-  
tion_activity=None, experi-  
ment=None, id=None, in-  
stance=None)
```

Bases: *fairgraph.base\_v2.KGObject*

Brain tissue in which extracellular electrode was implanted.

#### Parameters

- **name** (*str*) –
- **subject** (*Subject*) –
- **implantation\_activity** (*ElectrodeImplantationActivity*) –
- **experiment** (*ExtracellularElectrodeExperiment*) –

```
class fairgraph.electrophysiology.ElectrodeArrayExperiment(name,           de-  
vice=None,           im-  
planted_brain_tissues=None,  
stimulation=None,  
sensors=None, digi-  
tized_head_points_coordinates=None,  
head_localization_coils_coordinates=None,  
digi-  
tized_head_points=False,  
digi-  
tized_landmarks=False,  
start_time=None,  
end_time=None,  
people=None, proto-  
col=None, id=None,  
instance=None)
```

Bases: *fairgraph.base\_v2.KGObject*

Electrode array experiment (EEG, ECoG, MEG, ERP).

#### Parameters

- **name** (*str*) –
- **device** (*Device*) –
- **implanted\_brain\_tissues** (*ImplantedBrainTissue*) –
- **stimulation** (*VisualStimulation, BehavioralStimulation, ElectrophysiologicalStimulation*) –
- **sensors** (*Sensor*) –
- **digitized\_head\_points\_coordinates** (*Sensor*) –
- **head\_localization\_coils\_coordinates** (*Sensor*) –
- **digitized\_head\_points** (*bool*) –
- **digitized\_landmarks** (*bool*) –

- **start\_time** (*datetime*) –
- **end\_time** (*datetime*) –
- **people** (*Person*) –
- **protocol** (*Protocol*) –

**classmethod list** (*client*, *size=100*, *from\_index=0*, *api='query'*, *scope='released'*, *resolved=False*, *\*\*filters*)

List all objects of this type in the Knowledge Graph

```
class fairgraph.electrophysiology.ECoGExperiment (name, device=None, im-
planted_brain_tissues=None, stim-
ulation=None, sensors=None, digi-
tized_head_points_coordinates=None,
head_localization_coils_coordinates=None,
digitized_head_points=False,
digitized_landmarks=False,
start_time=None, end_time=None,
people=None, protocol=None,
id=None, instance=None)
```

Bases: *fairgraph.electrophysiology.ElectrodeArrayExperiment*

Electrocorticography experiment.

#### Parameters

- **name** (*str*) –
- **device** (*Device*) –
- **implanted\_brain\_tissues** (*ImplantedBrainTissue*) –
- **stimulation** (*VisualStimulation*, *BehavioralStimulation*, *ElectrophysiologicalStimulation*) –
- **sensors** (*Sensor*) –
- **digitized\_head\_points\_coordinates** (*Sensor*) –
- **head\_localization\_coils\_coordinates** (*Sensor*) –
- **digitized\_head\_points** (*bool*) –
- **digitized\_landmarks** (*bool*) –
- **start\_time** (*datetime*) –
- **end\_time** (*datetime*) –
- **people** (*Person*) –
- **protocol** (*Protocol*) –

```
class fairgraph.electrophysiology.EEGExperiment (name, device=None, im-
planted_brain_tissues=None, stim-
ulation=None, sensors=None, digi-
tized_head_points_coordinates=None,
head_localization_coils_coordinates=None,
digitized_head_points=False,
digitized_landmarks=False,
start_time=None, end_time=None,
people=None, protocol=None,
id=None, instance=None)
```

Bases: `fairgraph.electrophysiology.ElectrodeArrayExperiment`

Electroencephalography experiment.

#### Parameters

- **name** (*str*) –
- **device** (*Device*) –
- **implanted\_brain\_tissues** (*ImplantedBrainTissue*) –
- **stimulation** (*VisualStimulation, BehavioralStimulation, ElectrophysiologicalStimulation*) –
- **sensors** (*Sensor*) –
- **digitized\_head\_points\_coordinates** (*Sensor*) –
- **head\_localization\_coils\_coordinates** (*Sensor*) –
- **digitized\_head\_points** (*bool*) –
- **digitized\_landmarks** (*bool*) –
- **start\_time** (*datetime*) –
- **end\_time** (*datetime*) –
- **people** (*Person*) –
- **protocol** (*Protocol*) –

```
class fairgraph.electrophysiology.ElectrodePlacementActivity (name, subject,  
                                                             brain_location,  
                                                             device=None,  
                                                             protocol=None,  
                                                             people=None,  
                                                             id=None, instance=None)
```

Bases: `fairgraph.base_v2.KGObject`

docstring

#### Parameters

- **name** (*str*) –
- **subject** (*Subject*) –
- **brain\_location** (*BrainRegion*) –
- **device** (*Device*) –
- **protocol** (*Protocol*) –
- **people** (*Person*) –



```
class fairgraph.electrophysiology.ElectrodeImplantationActivity(name, subject,
                                                                brain_location,
                                                                im-
                                                                planted_brain_tissues=None,
                                                                device=None,
                                                                cra-
                                                                nial_window=None,
                                                                proto-
                                                                col=None,
                                                                anesthe-
                                                                sia=None,
                                                                start_time=None,
                                                                end_time=None,
                                                                people=None,
                                                                id=None, in-
                                                                stance=None)
```

Bases: *fairgraph.electrophysiology.ElectrodePlacementActivity*

docstring

#### Parameters

- **name** (*str*) –
- **subject** (*Subject*) –
- **brain\_location** (*BrainRegion*) –
- **implanted\_brain\_tissues** (*ImplantedBrainTissue*) –
- **device** (*Device*) –
- **cranial\_window** (*CranialWindow*) –
- **protocol** (*Protocol*) –
- **anesthesia** (*str*) –
- **start\_time** (*datetime*) –
- **end\_time** (*datetime*) –
- **people** (*Person*) –

```
class fairgraph.electrophysiology.ExtracellularElectrodeExperiment(name,
                                                                    stimula-
                                                                    tion=None,
                                                                    recorded_cell=None,
                                                                    traces=None,
                                                                    id=None,
                                                                    in-
                                                                    stance=None)
```

Bases: *fairgraph.electrophysiology.PatchClampExperiment*

Stimulation of the neural tissue and recording of the responses with an extracellular electrode.

#### Parameters

- **name** (*str*) –
- **stimulation** (*VisualStimulation, BehavioralStimulation, ElectrophysiologicalStimulation*) –

- **recorded\_cell** (`ImplantedBrainTissue`) –
- **traces** (`Trace`) –

```
class fairgraph.electrophysiology.IntraCellularSharpElectrodeRecordedCell(name,  
                                                                           brain_location,  
                                                                           col-  
                                                                           lec-  
                                                                           tion=None,  
                                                                           pu-  
                                                                           ta-  
                                                                           tive_cell_type=None,  
                                                                           cell_type=None,  
                                                                           mor-  
                                                                           phol-  
                                                                           ogy_type=None,  
                                                                           ex-  
                                                                           per-  
                                                                           i-  
                                                                           ments=None,  
                                                                           pipette_id=None,  
                                                                           seal_resistance=None,  
                                                                           pipette_resistance=None,  
                                                                           start_membrane_potenti  
                                                                           end_membrane_potential  
                                                                           pipette_solution=None,  
                                                                           liq-  
                                                                           uid_junction_potential=  
                                                                           la-  
                                                                           bel-  
                                                                           ing_compound=None,  
                                                                           re-  
                                                                           ver-  
                                                                           sal_potential_cl=None,  
                                                                           de-  
                                                                           scrip-  
                                                                           tion=None,  
                                                                           id=None,  
                                                                           in-  
                                                                           stance=None)
```

Bases: `fairgraph.electrophysiology.PatchedCell`

A cell recorded intracellularly with a sharp electrode.

#### Parameters

- **name** (*str*) –
- **brain\_location** (`BrainRegion`) –
- **collection** (`IntraCellularSharpElectrodeRecordedCellCollection`) –
- **cell\_type** (`CellType`) –
- **experiments** (`IntraCellularSharpElectrodeExperiment`) –
- **pipette\_id** (*str*, *int*) –

- **seal\_resistance** (*QuantitativeValue*) –
- **pipette\_resistance** (*QuantitativeValue*) –
- **liquid\_junction\_potential** (*QuantitativeValue*) –
- **labeling\_compound** (*str*) –
- **reversal\_potential\_cl** (*QuantitativeValue*) –

```
class fairgraph.electrophysiology.IntraCellularSharpElectrodeRecording (name,
                                                                    recorded_tissue,
                                                                    recorded_slice=None,
                                                                    pro-
                                                                    to-
                                                                    col=None,
                                                                    peo-
                                                                    ple=None,
                                                                    start_time=None,
                                                                    end_time=None,
                                                                    id=None,
                                                                    in-
                                                                    stance=None)
```

Bases: *fairgraph.electrophysiology.PatchClampActivity*

A sharp-electrode recording session.

#### Parameters

- **name** (*str*) –
- **recorded\_tissue** (*CellCulture, Slice, CranialWindow*) –
- **recorded\_slice** (*IntraCellularSharpElectrodeRecordedSlice*) –
- **protocol** (*str*) –
- **people** (*Person*) –

```
class fairgraph.electrophysiology.IntraCellularSharpElectrodeRecordedCellCollection (name,
                                                                                      cells,
                                                                                      slice=None,
                                                                                      id=None,
                                                                                      in-
                                                                                      stance=None)
```

Bases: *fairgraph.electrophysiology.PatchedCellCollection*

A collection of cells recorded with a sharp electrode.

#### Parameters

- **name** (*str*) –
- **cells** (*IntraCellularSharpElectrodeRecordedCell*) –
- **slice** (*IntraCellularSharpElectrodeRecordedSlice*) –

```
class fairgraph.electrophysiology.IntraCellularSharpElectrodeRecordedSlice(name,  
                                                                           slice,  
                                                                           recorded_cells,  
                                                                           record-  
                                                                           ing_activity=None,  
                                                                           brain_location=None,  
                                                                           bath_solution=None,  
                                                                           de-  
                                                                           scrip-  
                                                                           tion=None,  
                                                                           id=None,  
                                                                           in-  
                                                                           stance=None)
```

Bases: *fairgraph.electrophysiology.PatchedSlice*

A slice that has been recorded from using a sharp electrode.

#### Parameters

- **name** (*str*) –
- **slice** (*Slice*) –
- **recorded\_cells** (*IntraCellularSharpElectrodeRecordedCellCollection*) –
- **recording\_activity** (*IntraCellularSharpElectrodeRecording*) –

```
class fairgraph.electrophysiology.IntraCellularSharpElectrodeExperiment(name,  
                                                                           recorded_cell,  
                                                                           ac-  
                                                                           qui-  
                                                                           si-  
                                                                           tion_device=None,  
                                                                           stim-  
                                                                           u-  
                                                                           la-  
                                                                           tion=None,  
                                                                           traces=None,  
                                                                           start_time=None,  
                                                                           end_time=None,  
                                                                           peo-  
                                                                           ple=None,  
                                                                           pro-  
                                                                           to-  
                                                                           col=None,  
                                                                           id=None,  
                                                                           in-  
                                                                           stance=None)
```

Bases: *fairgraph.electrophysiology.PatchClampExperiment*

Stimulation of the neural tissue and recording of the responses with a sharp intracellular electrode.

#### Parameters

- **name** (*str*) –
- **recorded\_cell** (*IntraCellularSharpElectrodeRecordedCell*) –

- **stimulation** (*VisualStimulation, BehavioralStimulation, ElectrophysiologicalStimulation*) –
- **traces** (*Trace*) –
- **people** (*Person*) –

**classmethod list** (*client, size=100, from\_index=0, api='query', scope='released', resolved=False, \*\*filters*)

List all objects of this type in the Knowledge Graph

```
class fairgraph.electrophysiology.QualifiedMultiTraceGeneration (name, stimulus_experiment, sweeps, channel_type=None, holding_potential=None, sampling_frequency=None, power_line_frequency=None, id=None, instance=None)
```

Bases: fairgraph.base\_v2.KGObject

#### Parameters

- **name** (*str*) –
- **stimulus\_experiment** (*ExtracellularElectrodeExperiment, IntraCellularSharpElectrodeExperiment, PatchClampExperiment, ElectrodeArrayExperiment*) –
- **sweeps** (*int*) –
- **channel\_type** (*str*) –
- **holding\_potential** (*QuantitativeValue*) –
- **sampling\_frequency** (*QuantitativeValue*) –
- **power\_line\_frequency** (*QuantitativeValue*) –

```
class fairgraph.electrophysiology.CellCulturingActivity (subject, cell_culture, brain_location=None, culture_type=None, culture_age=None, hemisphere=None, culture_solution=None, start_time=None, end_time=None, people=None, id=None, instance=None)
```

Bases: fairgraph.base\_v2.KGObject

The activity of preparing a cell culture from whole brain.

#### Parameters

- **subject** (*Subject*) –
- **cell\_culture** (*CellCulture*) –
- **brain\_location** (*BrainRegion*) –

- **culture\_type** ([CultureType](#)) –
- **culture\_age** ([QuantitativeValueRange](#)) –
- **hemisphere** (*str*) –
- **culture\_solution** (*str*) –
- **start\_time** (*datetime*) –
- **end\_time** (*datetime*) –
- **people** ([Person](#)) –

`fairgraph.electrophysiology.list_kg_classes()`

List all KG classes defined in this module

`fairgraph.electrophysiology.use_namespace(namespace)`

Set the namespace for all classes in this module.

## 5.2.4 brainsimulation

Metadata for model building, simulation and validation.

```
class fairgraph.brainsimulation.ModelProject (name, owners, authors, descrip-
tion, date_created, private, col-
lab_id=None, alias=None, organiza-
tion=None, pla_components=None,
brain_region=None, species=None, cell-
type=None, abstraction_level=None,
model_of=None, old_uuid=None,
parents=None, instances=None, im-
ages=None, id=None, instance=None)
```

Bases: `fairgraph.base_v2.KGObject`, `fairgraph.base_v2.HasAliasMixin`

Representation of a neuroscience model or modelling project.

We distinguish a model in an abstract sense (this class), which may have multiple parameterizations and multiple implementations, from a specific version and parameterization of a model - see [ModelInstance](#) and [ModelScript](#)

### Parameters

- **name** (*str*) –
- **owners** ([Person](#)) –
- **authors** ([Person](#)) –
- **description** (*str*) –
- **date\_created** (*datetime*) –
- **private** (*bool*) –
- **collab\_id** (*str*) –
- **alias** (*str*) –
- **organization** ([Organization](#)) –
- **pla\_components** (*str*) –
- **brain\_region** ([BrainRegion](#)) –

- **species** (*Species*) –
- **celltype** (*CellType*) –
- **abstraction\_level** (*AbstractionLevel*) –
- **model\_of** (*ModelScope*) –
- **old\_uuid** (*str*) –
- **parents** (*ModelProject*) –
- **instances** (*ModelInstance*, *MEModel*) –
- **images** (*dict*) –

```
class fairgraph.brainsimulation.ModelInstance(name, main_script, version, times-
                                             tamp=None,      brain_region=None,
                                             species=None,   model_of=None,   re-
                                             lease=None,    part_of=None,   de-
                                             scription=None, parameters=None,
                                             old_uuid=None,  alternate_of=None,
                                             id=None, instance=None)
```

Bases: *fairgraph.base\_v2.KGObject*

A specific implementation, code version and parameterization of a model.

See also: *ModelProject*, *MEModel*, *ModelScript*

#### Parameters

- **name** (*str*) –
- **brain\_region** (*BrainRegion*) –
- **species** (*Species*) –
- **model\_of** (*CellType*, *BrainRegion*) –
- **main\_script** (*ModelScript*) –
- **release** (*str*) –
- **version** (*str*) –
- **timestamp** (*datetime*) –
- **part\_of** (*KGObject*) –
- **description** (*str*) –
- **parameters** (*str*) –
- **old\_uuid** (*str*) –
- **alternate\_of** (*KGObject*) –

```
class fairgraph.brainsimulation.MEModel(name, e_model, morphology, main_script, ver-
                                          sion, timestamp=None, brain_region=None,
                                          species=None,   model_of=None,   release=None,
                                          part_of=None,   description=None, parame-
                                          ters=None, old_uuid=None, alternate_of=None,
                                          id=None, instance=None)
```

Bases: *fairgraph.brainsimulation.ModelInstance*

A specific implementation, code version and parameterization of a single neuron model with a defined morphology (M) and electrical (E) behaviour.

This is a specialized sub-class of *ModelInstance*.

See also: *ModelProject*, *ModelScript*, *Morphology*, *EModel*

#### Parameters

- **name** (*str*) –
- **brain\_region** (*BrainRegion*) –
- **species** (*Species*) –
- **model\_of** (*CellType*, *BrainRegion*) –
- **main\_script** (*ModelScript*) –
- **release** (*str*) –
- **version** (*str*) –
- **timestamp** (*datetime*) –
- **part\_of** (*KGObject*) –
- **description** (*str*) –
- **parameters** (*str*) –
- **old\_uuid** (*str*) –
- **alternate\_of** (*KGObject*) –
- **morphology** (*Morphology*) –
- **e\_model** (*EModel*) –

```
class fairgraph.brainsimulation.Morphology (name, cell_type=None, morphology_file=None, distribution=None, id=None, instance=None)
```

Bases: *fairgraph.base\_v2.KGObject*

The morphology of a single neuron model, typically defined as a set of cylinders or truncated cones connected in a tree structure.

#### Parameters

- **name** (*str*) –
- **cell\_type** (*CellType*) –
- **distribution** (*Distribution*) –

```
class fairgraph.brainsimulation.ModelScript (name, code_location=None, code_format=None, license=None, distribution=None, id=None, instance=None)
```

Bases: *fairgraph.base\_v2.KGObject*

Code or markup defining all or part of a model.

See also: *ModelInstance*, *MEModel*, *EModel*

#### Parameters



- **name** (*str*) –
- **code\_format** (*str*) –
- **license** (*str*) –
- **distribution** (*Distribution*) –

```
class fairgraph.brainsimulation.EModel (name, main_script=None, version=None, times-  

tamp=None, brain_region=None, species=None,  

model_of=None, release=None, part_of=None,  

description=None, parameters=None,  

old_uuid=None, id=None, instance=None)
```

Bases: *fairgraph.brainsimulation.ModelInstance*

The electrical component of an *MEModel*

#### Parameters

- **name** (*str*) –
- **brain\_region** (*BrainRegion*) –
- **species** (*Species*) –
- **model\_of** (*CellType, BrainRegion*) –
- **main\_script** (*ModelScript*) –
- **release** (*str*) –
- **version** (*str*) –
- **timestamp** (*datetime*) –
- **part\_of** (*KGObject*) –
- **description** (*str*) –
- **parameters** (*str*) –
- **old\_uuid** (*str*) –

```
class fairgraph.brainsimulation.ValidationTestDefinition (id=None, instance=None, **proper-  

ties)
```

Bases: *fairgraph.base\_v2.KGObject, fairgraph.base\_v2.HasAliasMixin*

Definition of a model validation test.

See also: *ValidationScript, ValidationActivity, ValidationResult*

#### Parameters

- **name** (*str*) –
- **authors** (*Person*) –
- **description** (*str*) –
- **date\_created** (*date, datetime*) –
- **alias** (*str*) –
- **brain\_region** (*BrainRegion*) –
- **species** (*Species*) –

- **celltype** (*CellType*) –
- **test\_type** (*str*) –
- **age** (*Age*) –
- **reference\_data** (*KGObject*) –
- **data\_type** (*str*) –
- **recording\_modality** (*str*) –
- **score\_type** (*str*) –
- **status** (*str*) –
- **old\_uuid** (*str*) –

**class** fairgraph.brainsimulation.**ValidationScript** (*id=None, instance=None, \*\*properties*)

Bases: fairgraph.base\_v2.KGObject

Code implementing a particular model validation test.

See also: [ValidationTestDefinition](#), [ValidationActivity](#),  
[ValidationResult](#)

#### Parameters

- **name** (*str*) –
- **date\_created** (*date, datetime*) –
- **repository** (*IRI*) –
- **version** (*str*) –
- **description** (*str*) –
- **parameters** (*str*) –
- **test\_class** (*str*) –
- **test\_definition** ([ValidationTestDefinition](#)) –
- **old\_uuid** (*str*) –

**class** fairgraph.brainsimulation.**ValidationResult** (*id=None, instance=None, \*\*properties*)

Bases: fairgraph.base\_v2.KGObject

The results of running a model validation test.

Including a numerical score, and optional additional data.

See also: [ValidationTestDefinition](#), [ValidationScript](#), [ValidationActivity](#).

#### Parameters

- **name** (*str*) –
- **generated\_by** ([ValidationActivity](#)) –
- **description** (*str*) –
- **score** (*float, int*) –
- **normalized\_score** (*float, int*) –

- **passed**(*bool*) –
- **timestamp**(*date, datetime*) –
- **additional\_data**(*KGObject*) –
- **old\_uuid**(*str*) –
- **collab\_id**(*str*) –
- **hash**(*str*) –

**class** fairgraph.brainsimulation.**ValidationActivity** (*id=None, instance=None, \*\*properties*)

Bases: fairgraph.base\_v2.KGObject

Record of the validation of a model against experimental data.

Links a *ModelInstance*, a *ValidationTestDefinition* and a reference data set to a *ValidationResult*.

#### Parameters

- **model\_instance**(*ModelInstance, MEModel*) –
- **test\_script**(*ValidationScript*) –
- **reference\_data**(*Collection*) –
- **timestamp**(*datetime*) –
- **result**(*ValidationResult*) –
- **started\_by**(*Person*) –
- **end\_timestamp**(*datetime*) –

**class** fairgraph.brainsimulation.**Simulation** (*id=None, instance=None, \*\*properties*)

Bases: fairgraph.base\_v2.KGObject

#### Parameters

- **name**(*str*) –
- **description**(*str*) –
- **identifier**(*str*) –
- **model\_instance**(*ModelInstance, MEModel*) –
- **config**(*SimulationConfiguration*) –
- **timestamp**(*datetime*) –
- **result**(*SimulationOutput*) –
- **started\_by**(*Person*) –
- **end\_timestamp**(*datetime*) –
- **computing\_environment**(*ComputingEnvironment*) –
- **status**(*str*) –
- **resource\_usage**(*float*) –
- **tags**(*str*) –
- **job\_id**(*str*) –

```
class fairgraph.brainsimulation.SimulationConfiguration (name, config_file=None,  
                                                    description=None, identifier=None,  
                                                    id=None,  
                                                    instance=None)
```

Bases: fairgraph.base\_v2.KGObject

**Parameters**

- **name** (*str*) –
- **identifier** (*str*) –
- **description** (*str*) –
- **config\_file** (*Distribution, str*) –

**save** (*client*)  
docstring

```
class fairgraph.brainsimulation.SimulationOutput (name, identifier=None, re-  
                                                    sult_file=None, generated_by=None,  
                                                    derived_from=None,  
                                                    data_type=None, variable=None,  
                                                    target=None, de-  
                                                    scription=None, timestamp=None,  
                                                    brain_region=None, species=None,  
                                                    celltype=None, id=None, in-  
                                                    stance=None)
```

Bases: fairgraph.base\_v2.KGObject

**Parameters**

- **name** (*str*) –
- **description** (*str*) –
- **identifier** (*str*) –
- **result\_file** (*Distribution, str*) –
- **generated\_by** (*Simulation*) –
- **derived\_from** (*KGObject*) –
- **target** (*str*) –
- **data\_type** (*str*) –
- **timestamp** (*datetime*) –
- **brain\_region** (*BrainRegion*) –
- **species** (*Species*) –
- **celltype** (*CellType*) –

**save** (*client*)  
docstring

fairgraph.brainsimulation.**list\_kg\_classes** ()  
List all KG classes defined in this module

fairgraph.brainsimulation.**use\_namespace** (*namespace*)  
Set the namespace for all classes in this module.

## 5.2.5 software

Metadata about, or related to, software

```
class fairgraph.software.SoftwareCategory (label, iri=None, strict=False)
    Bases: fairgraph.base_v2.OntologyTerm
```

```
class fairgraph.software.OperatingSystem (label, iri=None, strict=False)
    Bases: fairgraph.base_v2.OntologyTerm
```

```
class fairgraph.software.ProgrammingLanguage (label, iri=None, strict=False)
    Bases: fairgraph.base_v2.OntologyTerm
```

```
class fairgraph.software.SoftwareFeatureCategory (id=None, instance=None, **proper-
                                                    ties)
    Bases: fairgraph.base_v2.KGObject
```

### Parameters

- **identifier** (*str*) –
- **name** (*str*) –
- **description** (*str*) –
- **parent** (*SoftwareFeatureCategory*) –

```
class fairgraph.software.SoftwareFeature (id=None, instance=None, **properties)
    Bases: fairgraph.base_v2.KGObject
```

### Parameters

- **name** (*str*) –
- **description** (*str*) –
- **category** (*SoftwareFeatureCategory*) –
- **identifier** (*str*) –

```
class fairgraph.software.Keyword (id=None, instance=None, **properties)
    Bases: fairgraph.base_v2.KGObject
```

### Parameters

- **name** (*str*) –
- **identifier** (*str*) –

```
class fairgraph.software.Software (id=None, instance=None, **properties)
    Bases: fairgraph.base_v2.KGObject
```

### Parameters

- **name** (*str*) –
- **description** (*str*) –
- **citation** (*str*) –
- **release\_date** (*date*) –
- **categories** (*SoftwareCategory*) –
- **license** (*License*) –
- **operating\_system** (*OperatingSystem*) –
- **release\_notes** (*IRI*) –

- **requirements** (*str*) –
- **summary** (*str*) –
- **contributors** (*Person*) –
- **copyright** (*Person*, *Organization*) –
- **homepage** (*IRI*) –
- **documentation** (*IRI*) –
- **help** (*IRI*) –
- **source\_code** (*IRI*) –
- **programming\_languages** (*ProgrammingLanguage*) –
- **funding** (*Organization*) –
- **components** (*Software*) –
- **is\_free** (*bool*) –
- **keywords** (*Keyword*) –
- **version** (*str*) –
- **features** (*SoftwareFeature*) –

`fairgraph.software.list_kg_classes()`

List all KG classes defined in this module

`fairgraph.software.use_namespace(namespace)`

Set the namespace for all classes in this module.

## 5.2.6 core

Metadata for entities that are used in multiple contexts (e.g. in both electrophysiology and in simulation).

**class** `fairgraph.core.Subject` (*name*, *species*, *age=None*, *sex=None*, *handedness=None*, *strain=None*, *genotype=None*, *death\_date=None*, *group=None*, *id=None*, *instance=None*)

Bases: `fairgraph.base_v2.KGObject`

The individual organism that is the subject of an experimental study.

### Parameters

- **name** (*str*) –
- **species** (*Species*) –
- **strain** (*Strain*) –
- **genotype** (*Genotype*) –
- **sex** (*Sex*) –
- **handedness** (*Handedness*) –
- **age** (*Age*) –
- **death\_date** (*date*) –
- **group** (*Group*) –

```
class fairgraph.core.Organization (name, address=None, parent=None, id=None, in-  
                                stance=None)
```

Bases: fairgraph.base\_v2.KGObject

An organization associated with research data or models, e.g. a university, lab or department.

#### Parameters

- **name** (*str*) –
- **address** (*Address*) –
- **parent** (*Organization*) –

```
class fairgraph.core.Person (family_name, given_name, email=None, affiliation=None, id=None,  
                             instance=None)
```

Bases: fairgraph.base\_v2.KGObject

A person associated with research data or models, for example as an experimentalist, or a data analyst.

#### Parameters

- **family\_name** (*str*) – Family name / surname
- **given\_name** (*str*) – Given name
- **email** (*str*) – e-mail address
- **affiliation** (*Organization*) – Organization to which person belongs

```
classmethod list (client, size=100, api='query', scope='released', resolved=False, **filters)
```

List all objects of this type in the Knowledge Graph

```
classmethod me (client, api='query', allow_multiple=False)
```

Return the Person who is currently logged-in.

(the user associated with the token stored in the client).

If the Person node does not exist in the KG, it will be created.

```
class fairgraph.core.Identifier (id=None, instance=None, **properties)
```

Bases: fairgraph.base\_v2.KGObject

```
class fairgraph.core.Material (name, molar_weight=None, formula=None,  
                             stock_keeping_unit=None, reagent_distribution=None, ven-  
                             dor=None, id=None, instance=None)
```

Bases: fairgraph.base\_v2.KGObject

Metadata about a chemical product or other material used in an experimental protocol.

#### Parameters

- **name** (*str*) –
- **molar\_weight** (*QuantitativeValue*) –
- **formula** (*str*) –
- **stock\_keeping\_unit** (*str*) –
- **reagent\_distribution** (*Distribution*) –
- **vendor** (*Organization*) –

```
class fairgraph.core.Step(name, previous_step_name=None, sequence_number=None, identifier=None, version=None, distribution=None, description=None, materials=None, author=None, id=None, instance=None)
```

Bases: fairgraph.base\_v2.KGObject

A step in an experimental protocol.

#### Parameters

- **name** (*str*, *int*) –
- **previous\_step\_name** (*str*, *int*) –
- **sequence\_number** (*int*) –
- **identifier** (*str*) –
- **version** (*str*, *int*) –
- **distribution** (*Distribution*) –
- **description** (*str*) –
- **materials** (*Material*) –
- **author** (*Person*) –

```
class fairgraph.core.Protocol(name, version=None, identifier=None, doi=None, distribution=None, number_of_steps=None, steps=None, materials=None, author=None, date_published=None, id=None, instance=None)
```

Bases: fairgraph.base\_v2.KGObject

An experimental protocol.

#### Parameters

- **name** (*str*) –
- **version** (*str*, *int*) –
- **identifier** (*str*) –
- **distribution** (*Distribution*) –
- **number\_of\_steps** (*int*) –
- **steps** (*Step*) –
- **materials** (*Material*) –
- **author** (*Person*) –
- **date\_published** (*date*) –

```
class fairgraph.core.Collection(name, members, id=None, instance=None)
```

Bases: fairgraph.base\_v2.KGObject

A collection of other metadata objects

#### Parameters

- **name** (*str*) –
- **members** (*KGObject*) –

```
fairgraph.core.list_kg_classes()
```

List all KG classes defined in this module



`fairgraph.core.use_namespace(namespace)`  
Set the namespace for all classes in this module.

## 5.2.7 commons

**class** `fairgraph.commons.Address` (*locality, country*)  
Bases: `fairgraph.base_v2.StructuredMetadata`

**class** `fairgraph.commons.Group` (*label, iri=None, strict=False*)  
Bases: `fairgraph.base_v2.OntologyTerm`  
The subject group

**class** `fairgraph.commons.CultureType` (*label, iri=None, strict=False*)  
Bases: `fairgraph.base_v2.OntologyTerm`  
The type of cell culture used

**class** `fairgraph.commons.Species` (*label, iri=None, strict=False*)  
Bases: `fairgraph.base_v2.OntologyTerm`  
The species of an experimental subject, expressed with the binomial nomenclature.

**class** `fairgraph.commons.Shape` (*label, iri=None, strict=False*)  
Bases: `fairgraph.base_v2.OntologyTerm`  
Shape of a region of interest (ROI).

**class** `fairgraph.commons.MorphologyType` (*label, iri=None, strict=False*)  
Bases: `fairgraph.base_v2.OntologyTerm`  
The morphology of the cell used for recording.

**class** `fairgraph.commons.SomaType` (*label, iri=None, strict=False*)  
Bases: `fairgraph.base_v2.OntologyTerm`  
The type of soma of a reconstructed cell.

**class** `fairgraph.commons.ObjectiveType` (*label, iri=None, strict=False*)  
Bases: `fairgraph.base_v2.OntologyTerm`  
The type of objective used for microscopy.

**class** `fairgraph.commons.Strain` (*label, iri=None, strict=False*)  
Bases: `fairgraph.base_v2.OntologyTerm`  
An inbred sub-population within a species.

**class** `fairgraph.commons.Genotype` (*label, iri=None, strict=False*)  
Bases: `fairgraph.base_v2.OntologyTerm`  
Transgenic modification of the strain.

**class** `fairgraph.commons.Sex` (*label, iri=None, strict=False*)  
Bases: `fairgraph.base_v2.OntologyTerm`  
The sex of an animal or person from whom/which data were obtained.

**class** `fairgraph.commons.Handedness` (*label, iri=None, strict=False*)  
Bases: `fairgraph.base_v2.OntologyTerm`  
The handedness of an animal or person from whom/which data were obtained.

**class** fairgraph.common.ChannelType (label, iri=None, strict=False)  
Bases: fairgraph.base\_v2.OntologyTerm

The recording method used.

**class** fairgraph.common.BrainRegion (label, iri=None, strict=False)  
Bases: fairgraph.base\_v2.OntologyTerm

A sub-structure or region with the brain.

**class** fairgraph.common.CellType (label, iri=None, strict=False)  
Bases: fairgraph.base\_v2.OntologyTerm

A type of neuron or glial cell.

**class** fairgraph.common.AbstractionLevel (label, iri=None, strict=False)  
Bases: fairgraph.base\_v2.OntologyTerm

Level of abstraction for a neuroscience model, e.g.rate neurons, spiking neurons

**class** fairgraph.common.ModelScope (label, iri=None, strict=False)  
Bases: fairgraph.base\_v2.OntologyTerm  
docstring

**class** fairgraph.common.License (label, iri=None, strict=False)  
Bases: fairgraph.base\_v2.OntologyTerm

**class** fairgraph.common.StimulusType (label, iri=None, strict=False)  
Bases: fairgraph.base\_v2.OntologyTerm

**class** fairgraph.common.Origin (label, iri=None, strict=False)  
Bases: fairgraph.base\_v2.OntologyTerm

**class** fairgraph.common.QuantitativeValue (value, unit\_text, unit\_code=None)  
Bases: fairgraph.base\_v2.StructuredMetadata  
docstring

**class** fairgraph.common.QuantitativeValueRange (min, max, unit\_text, unit\_code=None)  
Bases: fairgraph.base\_v2.StructuredMetadata  
docstring

**class** fairgraph.common.Age (value, period)  
Bases: fairgraph.base\_v2.StructuredMetadata

#### Parameters

- **value** (*str*) –
- **period** (*str*) –

**fairgraph** currently provides the following modules for working with KG v2:

**minds** “Minimal Information for Neuroscience DataSets” - metadata common to all neuroscience datasets independent of the type of investigation

**uniminds** an updated version of MINDS

**electrophysiology** metadata relating to patch clamp and sharp electrode intracellular recordings *in vitro*. Support for extracellular recording, tetrodes, multi-electrode arrays and *in vivo* recordings coming soon.

**brainsimulation** metadata relating to modelling, simulation and validation

**software** metadata relating to software used in neuroscience (for simulation, data analysis, stimulus presentation, etc.)

*core* metadata for entities that are used in multiple contexts (e.g. in both electrophysiology and in simulation).

*commons* metadata that are not specific to EBRAINS, typically these refer to URIs in standard ontologies, outside the Knowledge Graph.

Additional modules are planned, e.g. for fMRI, functional optical imaging. In addition, the base, commons, and utility modules provide additional tools for structuring metadata and for working with fairgraph objects.



## CHAPTER 6

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### Access permissions

---

Before accessing the Human Brain Project/EBRAINS Knowledge Graph through fairgraph, you must read and accept the [Terms of Use](#), and then e-mail [support@ebrains.eu](mailto:support@ebrains.eu) to request access.



- *Contributions*
  - *Report bugs*
  - *Fix bugs or add new features*
  - *Improve documentation*
  - *Submit feedback*
- *Contributor guide*

## 7.1 Contributions

Contributions are welcome, and credit will always be given.

### 7.1.1 Report bugs

Report bugs through [GitHub](#).

Please report relevant information and preferably code that demonstrates the problem.

### 7.1.2 Fix bugs or add new features

Look through the GitHub issues for bugs. Anything is open to whoever wants to implement it. Changes should be proposed through pull requests.

### 7.1.3 Improve documentation

fairgraph could always use better documentation, whether as part of the official docs, in docstrings, or elsewhere (articles, tutorials, videos).

### 7.1.4 Submit feedback

The best way to send feedback is to [open an issue on GitHub](#).

## 7.2 Contributor guide

Coming soon.



## CHAPTER 8

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### Getting help

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In case of questions about **fairgraph**, please contact us via <https://ebrains.eu/support/>. If you find a bug or would like to suggest an enhancement or new feature, please open a ticket in the [issue tracker](#).



---

### Authors / contributors

---

The following people have contributed to fairgraph. Their affiliations at the time of the contributions are shown below.

- Andrew Davison [1]
- Onur Ates [1]
- Yann Zerlaut [1]
- Nico Feld [2]
- Glynis Mattheisen[1]

1. Department of Integrative and Computational Neuroscience, Paris-Saclay Institute of Neuroscience, CNRS/Université Paris Saclay
2. Human-Computer Interaction, Department IV, Computer Science, Universität Trier

### 9.1 Acknowledgements

```
<div></div>
```

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### 10.1 Installation

To get the latest release:

```
pip install git+https://github.com/HumanBrainProject/kg-core-python.git#egg=kg-core
pip install fairgraph
```

To get the development version:

```
git clone https://github.com/HumanBrainProject/fairgraph.git
pip install -r ./fairgraph/requirements.txt
pip install -U ./fairgraph
```

### 10.2 Basic setup

The basic idea of the library is to represent metadata nodes from the Knowledge Graph as Python objects. Communication with the Knowledge Graph service is through a client object, for which an access token associated with an EBRAINS account is needed.

If you are working in a Collaboratory Jupyter notebook, the client will take its access token from the notebook automatically:

```
>>> from fairgraph import KGClient
>>> client = KGClient()
```

If working outside the Collaboratory, you will need to obtain a token (for example from the KG Editor if you are a curator, or using `clb_oauth.get_token()` in a Collaboratory Jupyter notebook) and save it as an environment variable, e.g. at a shell prompt:

```
export KG_AUTH_TOKEN=eyJhbGciOiJIUzI1NiIsInR5cGE6ImV4dCI6ImNpZyJ9
```

and then in Python:

```
>>> token = os.environ['KG_AUTH_TOKEN']
```

Once you have a token:

```
>>> from fairgraph import KGClient

>>> client = KGClient(token)
```

## 10.3 Retrieving metadata from the Knowledge Graph

The different metadata/data types available in the Knowledge Graph are grouped into modules within the *openminds* module. For example:

```
>>> from fairgraph.openminds.core import DatasetVersion
```

Using these classes, it is possible to list all metadata matching a particular criterion, e.g.:

```
>>> datasets = DatasetVersion.list(client, from_index=10, size=10)
```

If you know the unique identifier of an object, you can retrieve it directly:

```
>>> dataset_of_interest = DatasetVersion.from_id("17196b79-04db-4ea4-bb69-d20aab6f1d62", client)
>>> dataset_of_interest.show()
id                                     https://kg.ebrains.eu/api/instances/17196b79-04db-4ea4-bb69-d20aab6f1d62
authors                               [KGProxy([<class 'fairgraph.openminds.core.actors.organization.Organization'>, <class 'fairgraph.openminds.core.actors.person.Person'>), 'https://kg.ebrains.eu/api/instances/56f86f58-add6-4684-aaf1-91083e1165e9'), KGProxy([<class 'fairgraph.openminds.core.actors.organization.Organization'>, <class 'fairgraph.openminds.core.actors.person.Person'>), 'https://kg.ebrains.eu/api/instances/3b0ceb13-5bcc-4f1d-8ddb-bd888a85b9c0'), KGProxy([<class 'fairgraph.openminds.core.actors.organization.Organization'>, <class 'fairgraph.openminds.core.actors.person.Person'>), 'https://kg.ebrains.eu/api/instances/6e3edece-60bc-4a4a-8399-45b1ee597d71'])]
behavioral_protocols                  None
digital_identifier                    KGProxy([<class 'fairgraph.openminds.core.miscellaneous.doi.DOI'>], 'https://kg.ebrains.eu/api/instances/c03106e1-1f30-446b-8439-ce77fc8358d6')
ethics_assessment                     KGProxy([<class 'fairgraph.openminds.controlledterms.ethics_assessment.EthicsAssessment'>], 'https://kg.ebrains.eu/api/instances/a217a2f8-dcb8-4ca9-9923-517af2aebc5b')
experimental_approachs                None
input_data                           None
is_alternative_version_of             None
is_new_version_of                     None
license                               KGProxy([<class 'fairgraph.openminds.core.data.license.License'>], 'https://kg.ebrains.eu/api/instances/6ebce971-7f99-4fbc-9621-eeae47a70d85')
preparation_designs                   None
```

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```

studied_specimens      [KGProxy((<class 'fairgraph.openminds.core.research.
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↳'>, <class 'fairgraph.openminds.core.research.tissue_sample_collection.
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↳<class 'fairgraph.openminds.core.research.tissue_sample.TissueSample'>, <class
↳'fairgraph.openminds.core.research.tissue_sample_collection.TissueSampleCollection'>
↳), 'https://kg.ebrains.eu/api/instances/3907e145-d2d1-42c7-8a05-a58e3dbf326f'),
↳KGProxy((<class 'fairgraph.openminds.core.research.subject.Subject'>, <class
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↳core.research.tissue_sample_collection.TissueSampleCollection'>), 'https://kg.
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↳SubjectGroup'>, <class 'fairgraph.openminds.core.research.tissue_sample.TissueSample
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↳<class 'fairgraph.openminds.core.research.tissue_sample.TissueSample'>, <class
↳'fairgraph.openminds.core.research.tissue_sample_collection.TissueSampleCollection'>
↳), 'https://kg.ebrains.eu/api/instances/94664b6e-8979-4cf6-b358-ff04056a4754')])
techniques              None
data_types              None
study_targets           None
accessibility           KGProxy([<class 'fairgraph.openminds.controlledterms.
↳product_accessibility.ProductAccessibility'>], 'https://kg.ebrains.eu/api/instances/
↳b2ff7a47-b349-48d7-8ce4-cf51868675f1')
copyright              None
custodians              KGProxy((<class 'fairgraph.openminds.core.actors.
↳organization.Organization'>, <class 'fairgraph.openminds.core.actors.person.Person'>
↳), 'https://kg.ebrains.eu/api/instances/762bd286-9d46-4ac5-889f-63b08d33c895')
description             The Golgi cells, together with granule cells and mossy_
↳fibers, form a neuronal microcircuit regulating information transfer at the_
↳cerebellum input stage. In order to further investigate the Golgi cells properties_
↳and their excitatory synapses, whole-cell patch-clamp recordings were performed on_
↳acute parasagittal cerebellar slices obtained from juvenile GlyT2-GFP mice (p16-
↳p21). Passive Golgi cells parameters were extracted in voltage-clamp mode by_
↳analyzing current relaxation induced by step voltage changes (IV protocol)._
↳Excitatory synaptic transmission properties were investigated by electrical_
↳stimulation of the mossy fibers bundle (5 pulses at 50 Hz, EPSC protocol, voltage-
↳clamp mode.
full_documentation      KGProxy((<class 'fairgraph.openminds.core.miscellaneous.
↳doi.DOI'>, <class 'fairgraph.openminds.core.data.file.File'>, <class 'fairgraph.
↳openminds.core.miscellaneous.url.URL'>), 'https://kg.ebrains.eu/api/instances/
↳d6cd3981-cdb1-460c-a4e4-29458fe0a47f')

```

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```

name                Whole cell patch-clamp recordings of cerebellar Golgi cells
funding              None
homepage             None
how_to_cite          None
keywords             None
other_contributions  None
related_publications [KGProxy((<class 'fairgraph.openminds.core.miscellaneous.
↳doi.DOI'>, <class 'fairgraph.openminds.core.miscellaneous.isbn.ISBN'>), 'https://kg.
↳ebrains.eu/api/instances/477b3e5d-5903-4a68-84b3-d29e38214ca8'), KGProxy((<class
↳'fairgraph.openminds.core.miscellaneous.doi.DOI'>, <class 'fairgraph.openminds.core.
↳miscellaneous.isbn.ISBN'>), 'https://kg.ebrains.eu/api/instances/9f1ec274-329a-4a9b-
↳802a-abd301614c2c'))]
release_date         None
repository           KGProxy((<class 'fairgraph.openminds.core.data.file_
↳repository.FileRepository'>], 'https://kg.ebrains.eu/api/instances/80e2ca84-b9fa-
↳43b7-b21a-b5f99d89f051'))
alias                Whole cell patch-clamp recordings of cerebellar Golgi cells
support_channels     None
version_identifier   None
version_innovation   None

```

Links between metadata in the Knowledge Graph are not followed automatically, to avoid unnecessary network traffic, but can be followed with the `resolve()` method:

```

>>> dataset_license = dataset_of_interest.license.resolve(client)
>>> dataset_license.show()
id                https://kg.ebrains.eu/api/instances/6ebce971-7f99-4fbc-9621-eeae47a70d85
name              Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International
legal_code        https://creativecommons.org/licenses/by-nc-sa/4.0/legalcode
alias             CC BY-NC-SA 4.0
webpages          ['https://creativecommons.org/licenses/by-nc-sa/4.0', 'https://spdx.org/
↳licenses/CC-BY-NC-SA-4.0.html']

```

The associated metadata are accessible as attributes of the Python objects, e.g.:

```

>>> print(dataset_of_interest.description)
The Golgi cells, together with granule cells and mossy fibers, form a neuronal_
↳microcircuit
regulating information transfer at the cerebellum input stage. In order to further_
↳investigate
the Golgi cells properties and their excitatory synapses, whole-cell patch-clamp_
↳recordings
were performed on acute parasagittal cerebellar slices obtained from juvenile GlyT2-
↳GFP mice
(p16-p21). Passive Golgi cells parameters were extracted in voltage-clamp mode by_
↳analyzing
current relaxation induced by step voltage changes (IV protocol). Excitatory synaptic
transmission properties were investigated by electrical stimulation of the mossy_
↳fibers bundle
(5 pulses at 50 Hz, EPSC protocol, voltage-clamp mode.

```

You can also download any associated data:

```

>>> dataset.download(client, "local_directory")

```



## 10.4 Filters

The `list()` method also allows you to filter the list of metadata objects based on their properties. For example, to filter by words in a dataset name:

```
>>> patch_clamp_datasets = DatasetVersion.list(client, name="patch")
>>> for ds in patch_clamp_datasets:
...     print(ds.name)
...
Patch-clamp electrophysiological characterization of neurons in human dentate gyrus
Whole cell patch-clamp recordings of cerebellar basket cells
Whole cell patch-clamp recordings of cerebellar Golgi cells
Whole cell patch-clamp recordings of cerebellar granule cells
Whole cell patch-clamp recordings of cerebellar stellate cells
```

To filter by species, we first need to retrieve the species metadata:

```
>>> from fairgraph.openminds.controlledterms import Species
>>> rat = Species.by_name("Rattus norvegicus", client)
```

We can then use this as a filter:

```
>>> rat_datasets = DatasetVersion.list(client, study_targets=rat)
```

To see a list of the fields that can be used for filtering:

```
>>> DatasetVersion.field_names
['authors', 'behavioral_protocols', 'digital_identifier', 'ethics_assessment',
 'experimental_approachs', 'input_data', 'is_alternative_version_of', 'is_new_version_
of',
 'license', 'preparation_designs', 'studied_specimens', 'techniques', 'data_types',
 'study_targets', 'accessibility', 'copyright', 'custodians', 'description',
 'full_documentation', 'name', 'funding', 'homepage', 'how_to_cite', 'keywords',
 'other_contributions', 'related_publications', 'release_date', 'repository', 'alias',
 'support_channels', 'version_identifier', 'version_innovation']
```

## 10.5 Storing and editing metadata

For those users who have the necessary permissions to store and edit metadata in the Knowledge Graph, **fairgraph** objects can be created or edited in Python, and then saved back to the Knowledge Graph, e.g.:

```
from fairgraph.openminds.core import Person, Organization, Affiliation

>>> mgm = Organization(name="Metro-Goldwyn-Mayer", alias="MGM")
>>> mgm.save(client, space="myspace")
>>> author = Person(family_name="Laurel", given_name="Stan",
...                 affiliations=Affiliation(organization=mgm))
>>> author.save(client, space="myspace")
```

## 10.6 Getting help

In case of questions about **fairgraph**, please e-mail [support@humanbrainproject.eu](mailto:support@humanbrainproject.eu). If you find a bug or would like to suggest an enhancement or new feature, please open a ticket in the [issue tracker](#).

## 10.7 Acknowledgements



This open source software code was developed in part or in whole in the Human Brain Project, funded from the European Union's Horizon 2020 Framework Programme for Research and Innovation under Specific Grant Agreements No. 720270, No. 785907 and No. 945539 (Human Brain Project SGA1, SGA2 and SGA3).

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