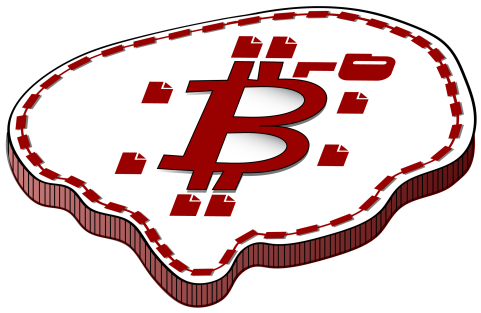
BIDScoin

Release 3.0

Feb 04, 2021

Contents



BIDScoin

BIDScoin is a user friendly open-source python toolkit that converts ("coins") source-level (raw) neuroimaging data-sets to nifti / json / tsv data-sets that are organized following the Brain Imaging Data Structure, a.k.a. BIDS standard. Rather then depending on complex or ambiguous programmatic logic for the identification of imaging modalities, BIDScoin uses a direct mapping approach to identify and convert the raw source data into BIDS data. Different runs of source data are identified by reading information from MRI header files (DICOM or PAR/REC or .7 format; e.g. SeriesDescription) and the mapping information about how these different runs should be named in BIDS can be specified a priori as well as by the researcher – bringing in the missing knowledge that often exists only in his or her head.

Because all the mapping information can be easily edited with a Graphical User Interface (GUI), BIDScoin requires no programming knowledge in order to use it.

CHAPTER 1

BIDScoin functionality

- [x] DICOM source data
- [x] PAR / REC source data
- [ ] P7 source data
- [ ] Nifti source data
- [x] Fieldmaps*
- [x] Multi-echo data*
- [x] Multi-coil data*
- [x] PET data*
- [ ] Stimulus / behavioural logfiles
- [x] Plug-ins

  * = Experimental support for PAR / REC source data

```
Are you a python programmer with an interest in BIDS who knows all about GE and / or␣
↪Philips data?
Are you experienced with parsing stimulus presentation log-files? Or do you have␣
↪ideas to improve
the this toolkit or its documentation? Have you come across bugs? Then you are highly␣
↪encouraged to
provide feedback or contribute to this project on https://github.com/Donders-
↪Institute/bidscoin.
```

CHAPTER 2

Note:

The full BIDScoin documentation is hosted at Read the Docs

Issues can be reported at Github

2.1 Installation

BIDScoin can be installed and should work on Linux, MS Windows and on OS-X computers (this latter option has not been tested) that satisfy the system requirements:

- dcm2niix
- python 3.6 or higher

2.1.1 Dcm2niix installation

BIDScoin relies on dcm2niix to convert the source imaging data to nifti. Please download and install dcm2niix yourself according to the instructions. When done, make sure that the path to the dcm2niix binary / executable is set correctly in the BIDScoin Options in the `[path_to_bidscoin]/heuristics/bidsmap_template.yaml` file or in the Site specific / customized template file.

2.1.2 Python 3 installation

BIDScoin is a python package and therefore a python interpreter needs to be present on the system. On Linux this is usually already the case, but MS Windows users may need to install python themselves. See e.g. this python 3 distribution for instructions. They may also need to install the MS Visual C++ build tools (sorry for this pain).

2.1.3 BIDScoin installation

To install BIDScoin run the following command in your command-shell (institute users may want to activate a virtual / conda python environment first):

```
$ pip install bidscoin
```

This will give you the latest stable release of the software. To get the very latest (development) version of the software you can install the package directly from the github source code repository:

```
$ pip install git+https://github.com/Donders-Institute/bidscoin
```

If you want to edit the code or want to contribute back to the project, you can use the `-e` option:

```
$ pip install -e git+https://github.com/Donders-Institute/bidscoin#egg=bidscoin
```

If you do not have git (or any other version control system) installed you can download and unzip the code yourself in a directory named e.g. `bidscoin` and run (again, with or without the `-e` option):

```
$ pip install -e bidscoin
```

Updating BIDScoin

Run the pip command as before with the additional `--upgrade` option:

```
$ pip install --upgrade bidscoin
```

Caution:

- The bidsmaps are not garanteed to be compatible between different BIDScoin versions.
- After a succesful BIDScoin installation or upgrade, it may be needed to (re)do any adjustments that were done on the Site specific / customized template file(s) (so make a back-up of these before you upgrade).

2.2 Data preparation

2.2.1 Required source data structure

BIDScoin requires that the source data input folder is organized according to a `sub-identifier/[ses-identifier]/sessiondata` structure (NB: the `ses-identifier` subfolder is optional). The `sessiondata` can have various formats, as shown in the following examples:

1. **A 'seriesfolder' organization**. A series folder contains a single data type and are typically acquired in a single run – a.k.a 'Series' in DICOM speak. This is how users receive their data from the (Siemens) scanners at the DCCN:

```
sourcedata
|-- sub-001
|   |-- ses-mri01
|   |   |-- 001-localizer
|   |   |   |-- 00001_1.3.12.2.1107.5.2.19.45416.2017121914582956872274162.IMA
|   |   |   |-- 00002_1.3.12.2.1107.5.2.19.45416.2017121914583757650874172.IMA
|   |   |   `-- 00003_1.3.12.2.1107.5.2.19.45416.2017121914583358068374167.IMA
|   |   |
|   |   |-- 002-t1_mprage_sag_p2_iso_1.0
|   |   |   |-- 00002_1.3.12.2.1107.5.2.19.45416.2017121915051526005675150.IMA
```

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```
|   |   |   |-- 00003_1.3.12.2.1107.5.2.19.45416.2017121915051520026075138.IMA
|   |   |   |-- 00004_1.3.12.2.1107.5.2.19.45416.2017121915051515689275130.IMA
|   |   |   [..]
|   |   [..]
|   |
|   `-- ses-mri02
|       |-- 001-localizer
|       |   |-- 00001_1.3.12.2.1107.5.2.19.45416.2017121914582956872274162.IMA
|       |   |-- 00002_1.3.12.2.1107.5.2.19.45416.2017121914583757650874172.IMA
|       |   `-- 00003_1.3.12.2.1107.5.2.19.45416.2017121914583358068374167.IMA
|       [..]
|
|-- sub-002
|   `-- ses-mri01
|       |-- 001-localizer
|       |   |-- 00001_1.3.12.2.1107.5.2.19.45416.2017121914582956872274162.IMA
|       |   |-- 00002_1.3.12.2.1107.5.2.19.45416.2017121914583757650874172.IMA
|       |   `-- 00003_1.3.12.2.1107.5.2.19.45416.2017121914583358068374167.IMA
|       [..]
[..]
```

2. **A 'DICOMDIR' organization**. A DICOMDIR is dictionary-file that indicates the various places where all the DICOM files are stored of each DICOM Series. This is how data is often exported in clinical settings:

```
sourcedata
|-- sub-001
|   |-- DICOM
|   |   `-- 00001EE9
|   |       `-- AAFC99B8
|   |           `-- AA547EAB
|   |               |-- 00000025
|   |               |   |-- EE008C45
|   |               |   |-- EE027F55
|   |               |   |-- EE03D17C
|   |               |   [..]
|   |               |
|   |               |-- 000000B4
|   |               |   |-- EE07CCDA
|   |               |   |-- EE0E0701
|   |               |   |-- EE0E200A
|   |               |   [..]
|   |               [..]
|   `-- DICOMDIR
|
|-- sub-002
|   [..]
[..]
```

3. **A flat DICOM organization**. In a flat DICOM organization all the DICOM files of all the different Series are simply put in one large directory. This is how data is sometimes exported in clinical settings:

```
sourcedata
|-- sub-001
|   `-- ses-mri01
|       |-- IM_0001.dcm
|       |-- IM_0002.dcm
```

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```
|       |-- IM_0003.dcm
|       [..]
|
|-- sub-002
|   `-- ses-mri01
|       |-- IM_0001.dcm
|       |-- IM_0002.dcm
|       |-- IM_0003.dcm
|       [..]
[..]
```

4. **A PAR/REC organization**. All PAR/REC(/XML) files of all the different Series are put in one directory. This is how users often export their data from Philips scanners in research settings:

```
sourcedata
|-- sub-001
|   `-- ses-mri01
|       |-- TCHC_066_1_WIP_Hanneke_Block_2_SENSE_4_1.PAR
|       |-- TCHC_066_1_WIP_Hanneke_Block_2_SENSE_4_1.REC
|       |-- TCHC_066_1_WIP_IDED_SENSE_6_1.PAR
|       |-- TCHC_066_1_WIP_IDED_SENSE_6_1.REC
|       |-- TCHC_066_1_WIP_Localizer_CLEAR_1_1.PAR
|       |-- TCHC_066_1_WIP_Localizer_CLEAR_1_1.REC
|       [..]
|
|-- sub-002
|   `-- ses-mri01
|       |-- TCHC_066_1_WIP_Hanneke_Block_2_SENSE_4_1.PAR
|       |-- TCHC_066_1_WIP_Hanneke_Block_2_SENSE_4_1.REC
|       |-- TCHC_066_1_WIP_IDED_SENSE_6_1.PAR
|       |-- TCHC_066_1_WIP_IDED_SENSE_6_1.REC
|       |-- TCHC_066_1_WIP_Localizer_CLEAR_1_1.PAR
|       |-- TCHC_066_1_WIP_Localizer_CLEAR_1_1.REC
|       [..]
[..]
```

Note: You can store the `sessiondata` in any of the above data organizations as zipped (`.zip`) or tarzipped (e.g. `.tar.gz`) archive files. BIDScoin workflow tools will unpack/unzip those archive files in a temporary folder and will process the `sessiondata` from there.

2.2.2 Data management utilities

dicomsort

The `dicomsort` command-line tool is a utility to move your flat- or DICOMDIR-organized files (see *above*) into a 'seriesfolder' organization. This can be useful to organise your source data in a more convenient and human readable way, as DICOMDIR or flat DICOM directories can often be hard to comprehend. The BIDScoin tools will run `dicomsort` in a temporary folder if your data is not already organised in series-folders, so in principle you don't really need to run it yourself. Running `dicomsort` beforehand does, however, give you more flexibility in handling special cases that are not handled properly and it can also give you a speed benefit.

```
usage: dicomsort [-h] [-i SUBPREFIX] [-j SESPREFIX] [-f FIELDNAME] [-r]
                 [-e EXT] [-n] [-p PATTERN] [-d]
                 dicomsource

Sorts and / or renames DICOM files into local subdirectories with a (3-digit)
SeriesNumber-SeriesDescription directory name (i.e. following the same listing
as on the scanner console)

positional arguments:
  dicomsource           The name of the root folder containing the
                        dicomsource/[sub/][ses/]dicomfiles and / or the
                        (single session/study) DICOMDIR file

optional arguments:
  -h, --help            show this help message and exit
  -i SUBPREFIX, --subprefix SUBPREFIX
                        Provide a prefix string for recursive searching in
                        dicomsource/subject subfolders (e.g. "sub") (default:
                        None)
  -j SESPREFIX, --sesprefix SESPREFIX
                        Provide a prefix string for recursive searching in
                        dicomsource/subject/session subfolders (e.g. "ses")
                        (default: None)
  -f FIELDNAME, --fieldname FIELDNAME
                        The dicomfield that is used to construct the series
                        folder name ("SeriesDescription" and "ProtocolName"
                        are both used as fallback) (default:
                        SeriesDescription)
  -r, --rename          Flag to rename the DICOM files to a PatientName_Series
                        Number_SeriesDescription_AcquisitionNumber_InstanceNum
                        ber scheme (recommended for DICOMDIR data) (default:
                        False)
  -e EXT, --ext EXT     The file extension after sorting (empty value keeps
                        the original file extension), e.g. ".dcm" (default: )
  -n, --nosort          Flag to skip sorting of DICOM files into SeriesNumber-
                        SeriesDescription directories (useful in combination
                        with -r for renaming only) (default: False)
  -p PATTERN, --pattern PATTERN
                        The regular expression pattern used in
                        re.match(pattern, dicomfile) to select the dicom files
                        (default: .*\.(IMA|dcm)$)
  -d, --dryrun          Add this flag to just print the dicomsort commands
                        without actually doing anything (default: False)

examples:
  dicomsort /project/3022026.01/raw
  dicomsort /project/3022026.01/raw --subprefix sub
  dicomsort /project/3022026.01/raw --subprefix sub-01 --sesprefix ses
  dicomsort /project/3022026.01/raw/sub-011/ses-mri01/DICOMDIR -r -e .dcm
```

rawmapper

Another command-line utility that can be helpful in organizing your source data is `rawmapper`. This utility can show you the overview (map) of all the values of DICOM-fields of interest in your data-set and, optionally, use these fields to rename your source data sub-folders (this can be handy e.g. if you manually entered subject-identifiers as [Additional info] at the scanner console and you want to use these to rename your subject folders).

```
usage: rawmapper [-h] [-s SESSIONS [SESSIONS ...]]
                 [-d DICOMFIELD [DICOMFIELD ...]] [-w WILDCARD]
                 [-o OUTFOLDER] [-r] [-n SUBPREFIX] [-m SESPREFIX]
                 [--dryrun]
                 sourcefolder

Maps out the values of a dicom field of all subjects in the sourcefolder, saves
the result in a mapper-file and, optionally, uses the dicom values to rename
the sub-/ses-id's of the subfolders. This latter option can be used, e.g.
when an alternative subject id was entered in the [Additional info] field
during subject registration (i.e. stored in the PatientComments dicom field)

positional arguments:
  sourcefolder          The source folder with the raw data in
                    sub-#/ses-#/series organisation

optional arguments:
  -h, --help            show this help message and exit
  -s SESSIONS [SESSIONS ...], --sessions SESSIONS [SESSIONS ...]
                    Space separated list of selected sub-#/ses-# names /
                    folders to be processed. Otherwise all sessions in the
                    bidsfolder will be selected (default: None)
  -d DICOMFIELD [DICOMFIELD ...], --dicomfield DICOMFIELD [DICOMFIELD ...]
                    The name of the dicomfield that is mapped / used to
                    rename the subid/sesid foldernames (default:
                    ['PatientComments'])
  -w WILDCARD, --wildcard WILDCARD
                    The Unix style pathname pattern expansion that is used
                    to select the series from which the dicomfield is
                    being mapped (can contain wildcards) (default: *)
  -o OUTFOLDER, --outfolder OUTFOLDER
                    The mapper-file is normally saved in sourcefolder or,
                    when using this option, in outfolder (default: None)
  -r, --rename          If this flag is given sub-subid/ses-sesid directories
                    in the sourcefolder will be renamed to sub-dcmval/ses-
                    dcmval (default: False)
  -n SUBPREFIX, --subprefix SUBPREFIX
                    The prefix common for all the source subject-folders
                    (default: sub-)
  -m SESPREFIX, --sesprefix SESPREFIX
                    The prefix common for all the source session-folders
                    (default: ses-)
  --dryrun              Add this flag to dryrun (test) the mapping or renaming
                    of the sub-subid/ses-sesid directories (i.e. nothing
                    is stored on disk and directory names are not actually
                    changed)) (default: False)

examples:
  rawmapper /project/3022026.01/raw/
  rawmapper /project/3022026.01/raw -d AcquisitionDate
  rawmapper /project/3022026.01/raw -s sub-100/ses-mri01 sub-126/ses-mri01
  rawmapper /project/3022026.01/raw -r -d ManufacturerModelName AcquisitionDate --
↪dryrun
  rawmapper raw/ -r -s sub-1*/* sub-2*/ses-mri01 --dryrun
  rawmapper -d EchoTime -w *fMRI* /project/3022026.01/raw
```

Note: If these data management utilities do not satisfy your needs, then have a look at this reorganize_dicom_files

tool.

2.3 The BIDScoin workflow

Having an organized source data folder, the actual data-set conversion to BIDS is performed by the *(1a)* the `bidsmapper`, *(1b)* the `bidseditor` and *(2)* the `bidscoiner` command-line tools. The `bidsmapper` makes a map of the different kind of datatypes in your source dataset, with the `bidseditor` you can edit this map, and the `bidscoiner` does the actual work to convert the source data into BIDS. By default (but see the `-i` option of the bidsmapper below), step 1a automatically launches step 1b, so in it's simplest form, all you need to do to convert your raw source data into BIDS is to run two simple commands, e.g.:

```
$ bidsmapper sourcefolder bidsfolder
$ bidscoiner sourcefolder bidsfolder
```

2.3.1 Step 1a: Running the bidsmapper

```
usage: bidsmapper [-h] [-b BIDSMAP] [-t TEMPLATE] [-n SUBPREFIX]
                  [-m SESPREFIX] [-i {0,1,2}] [-v]
                  sourcefolder bidsfolder

Creates a bidsmap.yaml YAML file in the bidsfolder/code/bidscoin that maps the␣
↪information
from all raw source data to the BIDS labels. You can check and edit the bidsmap file␣
↪with
the bidseditor (but also with any text-editor) before passing it to the bidscoiner.␣
↪See the
bidseditor help for more information and useful tips for running the bidsmapper in␣
↪interactive
mode (which is the default).

N.B.: Institute users may want to use a site-customized template bidsmap (see the
--template option). The bidsmap_dccn template from the Donders Institute can serve as
an example (or may even mostly work for other institutes out of the box).

positional arguments:
  sourcefolder          The study root folder containing the raw data in
                        sub-#/[ses-#/]data subfolders (or specify --subprefix
                        and --sesprefix for different prefixes)
  bidsfolder            The destination folder with the (future) bids data and
                        the bidsfolder/code/bidscoin/bidsmap.yaml output file

optional arguments:
  -h, --help            show this help message and exit
  -b BIDSMAP, --bidsmap BIDSMAP
                        The bidsmap YAML-file with the study heuristics. If
                        the bidsmap filename is relative (i.e. no "/" in the
                        name) then it is assumed to be located in
                        bidsfolder/code/bidscoin. Default: bidsmap.yaml
  -t TEMPLATE, --template TEMPLATE
                        The bidsmap template with the default heuristics (this
                        could be provided by your institute). If the bidsmap
                        filename is relative (i.e. no "/" in the name) then it
```

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```
                        is assumed to be located in bidsfolder/code/bidscoin.
                        Default: bidsmap_template.yaml
  -n SUBPREFIX, --subprefix SUBPREFIX
                        The prefix common for all the source subject-folders.
                        Default: 'sub-'
  -m SESPREFIX, --sesprefix SESPREFIX
                        The prefix common for all the source session-folders.
                        Default: 'ses-'
  -i {0,1,2}, --interactive {0,1,2}
                        {0}: The sourcefolder is scanned for different kinds
                        of scans without any user interaction. {1}: The
                        sourcefolder is scanned for different kinds of scans
                        and, when finished, the resulting bidsmap is opened
                        using the bidseditor. {2}: As {1}, except that already
                        during scanning the user is asked for help if a new
                        and unknown run is encountered. This option is most
                        useful when re-running the bidsmapper (e.g. when the
                        scan protocol was changed since last running the
                        bidsmapper). Default: 1
  -v, --version         Show the BIDS and BIDScoin version

examples:
  bidsmapper /project/foo/raw /project/foo/bids
  bidsmapper /project/foo/raw /project/foo/bids -t bidsmap_dccn
```

The bidsmapper will scan your `sourcefolder` to look for different runs (scan-types) to create a mapping for each run to a bids output name (a.k.a. the 'bidsmap'). By default (but see the `-i` option above), when finished the bidsmapper will automatically launch *step 1b*, as described in the next section (but step 1b can also always be run separately by directly running the bidseditor).

Tip: Use the `-t bidsmap_dccn` option and see if it works for you. If not, consider opening it with a text editor and adapt it to your needs.

2.3.2 Step 1b: Running the bidseditor

```
usage: bidseditor [-h] [-b BIDSMAP] [-t TEMPLATE] [-d DATAFORMAT]
                  [-n SUBPREFIX] [-m SESPREFIX]
                  bidsfolder

This tool launches a graphical user interface for editing the bidsmap.yaml file
that is e.g. produced by the bidsmapper or by this bidseditor itself. The user can
fill in or change the BIDS labels for entries that are unidentified or sub-optimal,
such that meaningful BIDS output names will be generated from these labels. The saved
bidsmap.yaml output file can be used for converting the source data to BIDS using
the bidscoiner.

positional arguments:
  bidsfolder        The destination folder with the (future) bids data

optional arguments:
  -h, --help        show this help message and exit
  -b BIDSMAP, --bidsmap BIDSMAP
                    The bidsmap YAML-file with the study heuristics. If
```

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```
                    the bidsmap filename is relative (i.e. no "/" in the
                    name) then it is assumed to be located in
                    bidsfolder/code/bidscoin. Default: bidsmap.yaml
  -t TEMPLATE, --template TEMPLATE
                    The bidsmap template with the default heuristics (this
                    could be provided by your institute). If the bidsmap
                    filename is relative (i.e. no "/" in the name) then it
                    is assumed to be located in bidsfolder/code/bidscoin.
                    Default: bidsmap_template.yaml
  -d DATAFORMAT, --dataformat DATAFORMAT
                    The format of the source data, e.g. DICOM or PAR.
                    Default: DICOM
  -n SUBPREFIX, --subprefix SUBPREFIX
                    The prefix common for all the source subject-folders.
                    Default: 'sub-'
  -m SESPREFIX, --sesprefix SESPREFIX
                    The prefix common for all the source session-folders.
                    Default: 'ses-'

examples:
  bidseditor /project/foo/bids
  bidseditor /project/foo/bids -t bidsmap_dccn.yaml
  bidseditor /project/foo/bids -b my/custom/bidsmap.yaml

Here are a few tips & tricks:
-----------------------------

DICOM Attributes
  An (DICOM) attribute label can also be a list, in which case the BIDS labels /␣
↪mapping
  are applied if a (DICOM) attribute value is in this list. If the attribute value is
  empty it is not used to identify the run. Wildcards can also be given, either as a␣
↪single
  '*', or enclosed by '*'. Examples:
       SequenceName: '*'
       SequenceName: '*epfid*'
       SequenceName: ['epfid2d1rs', 'fm2d2r']
       SequenceName: ['*epfid*', 'fm2d2r']
   NB: Editing the DICOM attributes is normally not necessary and adviced against

Dynamic BIDS labels
  The BIDS labels can be static, in which case the label is just a normal string, or␣
↪dynamic,
  when the string is enclosed with pointy brackets like `<attribute name>` or
  `<<argument1><argument2>>`. In case of single pointy brackets the label will be␣
↪replaced
  during bidsmapper, bidseditor and bidscoiner runtime by the value of the (DICOM)␣
↪attribute
  with that name. In case of double pointy brackets, the label will be updated for␣
↪each
  subject/session during bidscoiner runtime. For instance, then the `run` label `<<1>>
↪` in
  the bids name will be replaced with `1` or increased to `2` if a file with runindex␣
↪`1`
  already exists in that directory.

Fieldmaps: suffix
```

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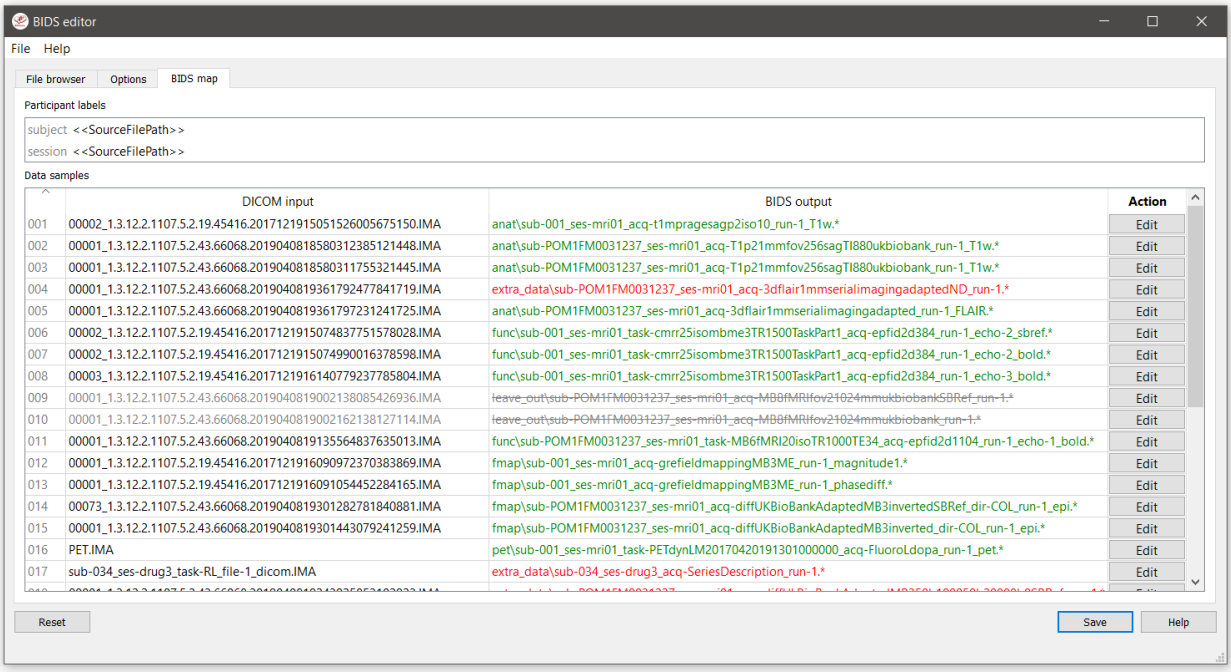
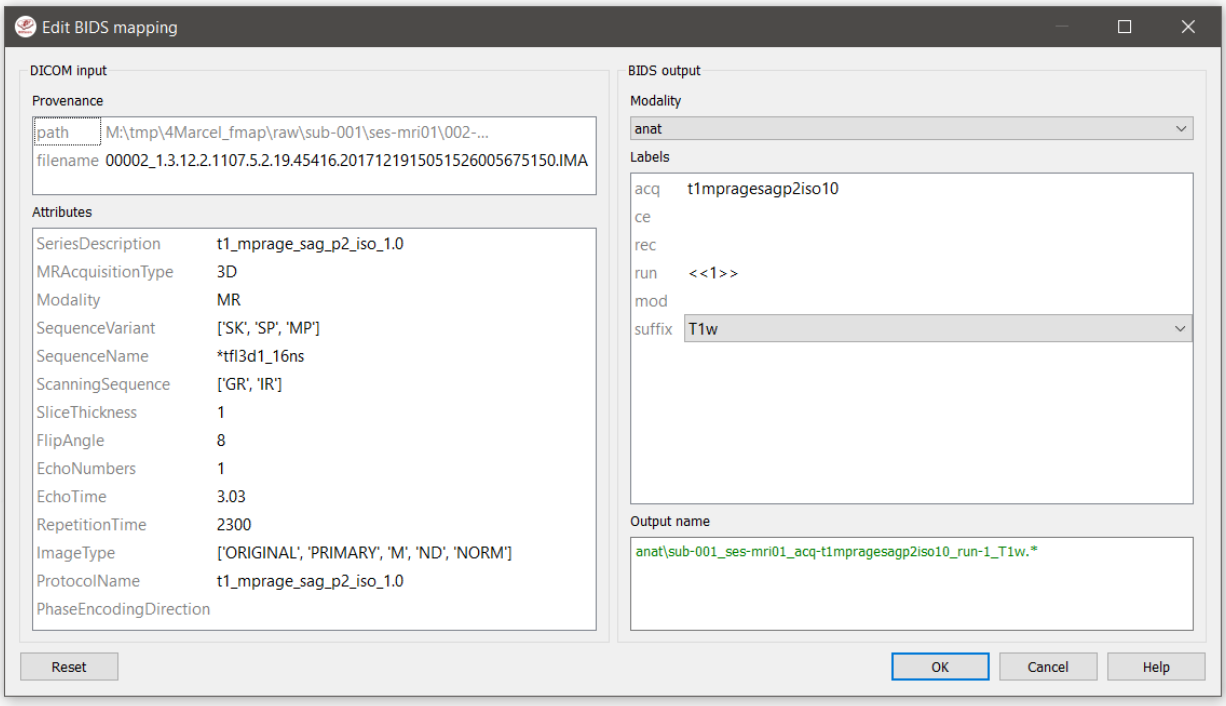
```
  Select 'magnitude1' if you have 'magnitude1' and 'magnitude2' data in one series-
↪folder
  (this is what Siemens does) -- the bidscoiner will automatically pick up the
↪'magnitude2'
  data during runtime. The same holds for 'phase1' and 'phase2' data. See the BIDS
  specification for more details on fieldmap suffixes

Fieldmaps: IntendedFor
  You can use the `IntendedFor` field to indicate for which runs (DICOM series) a␣
↪fieldmap
  was intended. The dynamic label of the `IntendedFor` field can be a list of string␣
↪patterns
  that is used to include all runs in a session that have that string pattern in␣
↪their BIDS
  file name. Example: use `<<task>>` to include all functional runs or `<<Stop*Go>
↪<Reward>>`
  to include "Stop1Go"-, "Stop2Go"- and "Reward"-runs.
  NB: The fieldmap might not be used at all if this field is left empty!

Manual editing / inspection of the bidsmap
  You `can of course also directly edit or inspect the `bidsmap.yaml` file yourself␣
↪with any
  text editor. For instance to merge a set of runs that by adding a wildcard to a␣
↪DICOM
  attribute in one run item and then remove the other runs in the set. See ./docs/
↪bidsmap.md
  and ./heuristics/bidsmap_dccn.yaml for more information.
```

As shown below, the main window of the bidseditor opens with the `BIDS map` tab that contains a list of `input samples` that uniquely represents all the different files that are present in the source folder, together with the associated `BIDS output name`. The path in the `BIDS output name` is shown in red if the modality is not part of the BIDS standard, striked-out gray when the runs will be ignored in the conversion to BIDS, otherwise it is colored green. Double clicking the sample (DICOM) filename opens an inspection window with the full header information (double clicking sample filenames works throughout the GUI).



The user can click the `Edit` button for each list item to open a new edit window, as show below. In this interface, the right BIDS `Modality` (drop down menu) and the `suffix` label (drop down menu) can set correctly, after which the associated BIDS `Labels` can be edited (double click black items). As a result, the new BIDS `Output name` is then shown in the bottom text field. This is how the BIDS output data will look like and, if this looks all fine, the user can store this mapping to the bidsmap and return to the main window by clicking the `OK` button.



Finally, if all BIDS output names in the main window are fine, the user can click on the `Save` button and proceed with running the bidscoiner tool.

2.3.3 Step 2: Running the bidscoiner

```
usage: bidscoiner [-h] [-p PARTICIPANT_LABEL [PARTICIPANT_LABEL ...]] [-f]
                  [-s] [-b BIDSMAP] [-n SUBPREFIX] [-m SESPREFIX] [-v]
                  sourcefolder bidsfolder

Converts ("coins") datasets in the sourcefolder to nifti / json / tsv datasets in the
bidsfolder according to the BIDS standard. Check and edit the bidsmap.yaml file to
your needs using the bidseditor tool before running this function. You can run
bidscoiner after all data is collected, or run / re-run it whenever new data has
been added to the source folder (presuming the scan protocol hasn't changed). If you
delete a (subject/) session folder from the bidsfolder, it will be re-created from the
sourcefolder the next time you run the bidscoiner.

Provenance information, warnings and error messages are stored in the
bidsfolder/code/bidscoin/bidscoiner.log file.

positional arguments:
  sourcefolder          The source folder containing the raw data in
                        sub-#/[ses-#]/data format (or specify --subprefix and
                        --sesprefix for different prefixes)
  bidsfolder            The destination / output folder with the bids data

optional arguments:
  -h, --help            show this help message and exit
  -p PARTICIPANT_LABEL [PARTICIPANT_LABEL ...], --participant_label PARTICIPANT_LABEL␣
↪[PARTICIPANT_LABEL ...]
                        Space seperated list of selected sub-# names / folders
                        to be processed (the sub- prefix can be removed).
                        Otherwise all subjects in the sourcefolder will be
                        selected
  -f, --force           If this flag is given subjects will be processed,
                        regardless of existing folders in the bidsfolder.
                        Otherwise existing folders will be skipped
  -s, --skip_participants
                        If this flag is given those subjects that are in
                        particpants.tsv will not be processed (also when the
                        --force flag is given). Otherwise the participants.tsv
                        table is ignored
  -b BIDSMAP, --bidsmap BIDSMAP
                        The bidsmap YAML-file with the study heuristics. If
                        the bidsmap filename is relative (i.e. no "/" in the
                        name) then it is assumed to be located in
                        bidsfolder/code/bidscoin. Default: bidsmap.yaml
  -n SUBPREFIX, --subprefix SUBPREFIX
                        The prefix common for all the source subject-folders.
                        Default: 'sub-'
  -m SESPREFIX, --sesprefix SESPREFIX
                        The prefix common for all the source session-folders.
                        Default: 'ses-'
  -v, --version         Show the BIDS and BIDScoin version

examples:
  bidscoiner /project/foo/raw /project/foo/bids
  bidscoiner -f /project/foo/raw /project/foo/bids -p sub-009 sub-030
```

Tip: Check your json sidecar files of your fieldmaps, in particular see if they have the expected `IntendedFor`

values.

Note: The provenance of the produced BIDS data-sets is stored in the `bids/code/bidscoin/bidscoiner.log` file. This file is also very useful for debugging / tracking down bidscoin issues.

2.4 Finishing up

After a successful run of `bidscoiner`, the work to convert your data in a fully compliant BIDS dataset is unfortunately not yet fully over and, depending on the complexity of your data-set, additional tools may need to be run and meta-data may need to be entered manually (not everything can be automated).

2.4.1 Adding meta-data

For instance, you should update the content of the `dataset_description.json` and `README` files in your bids folder and you may need to provide e.g. additional `*_scans.tsv`,`*_sessions.tsv` or `participants.json` files (see the BIDS specification for more information). Moreover, if you have behavioural log-files you will find that BIDScoin does not (yet) support converting these into BIDS compliant `*_events.tsv/json` files (advanced users are encouraged to use the `bidscoiner` plug-in possibility and write their own log-file parser).

2.4.2 Data sharing utilities

Multi-echo combination

Before sharing or pre-processing their images, users may want to combine the separate the individual echos of multi-echo MRI acquisitions. The `echcombine`-tool is a wrapper around `mecombine` that writes BIDS valid output.

```
usage: echocombine [-h] [-p PARTICIPANT_LABEL [PARTICIPANT_LABEL ...]]
                   [-o {fmap,anat,func,dwi,beh,pet,extra_data,derivatives}]
                   [-a {PAID,TE,average}] [-w [WEIGHTS [WEIGHTS ...]]]
                   bidsfolder pattern

A wrapper around the 'mecombine' multi-echo combination tool (https://github.com/
↪Donders-Institute/multiecho).

This wrapper is fully BIDS-aware (a 'bidsapp') and writes BIDS compliant output

positional arguments:
  bidsfolder            The bids-directory with the (multi-echo) subject data
  pattern               Globlike recursive search pattern (relative to the
                        subject/session folder) to select the first echo of
                        the images that need to be combined, e.g.
                        '*task-*echo-1*'

optional arguments:
  -h, --help            show this help message and exit
  -p PARTICIPANT_LABEL [PARTICIPANT_LABEL ...], --participant_label PARTICIPANT_LABEL␣
↪[PARTICIPANT_LABEL ...]
                        Space separated list of sub-# identifiers to be
                        processed (the sub- prefix can be left out). If not
```

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```
                        specified then all sub-folders in the bidsfolder will
                        be processed (default: None)
  -o {fmap,anat,func,dwi,beh,pet,extra_data,derivatives}, --output {fmap,anat,func,
↪dwi,beh,pet,extra_data,derivatives}
                        A string that determines where the output is saved. It
                        can be the name of a BIDS modality folder, such as
                        'func', or of the derivatives folder, i.e.
                        'derivatives'. If output = [the name of the input
                        modality folder] then the original echo images are
                        replaced by one combined image. If output is left
                        empty then the combined image is saved in the input
                        modality folder and the original echo images are moved
                        to the extra_data folder (default: None)
  -a {PAID,TE,average}, --algorithm {PAID,TE,average}
                        Combination algorithm (default: TE)
  -w [WEIGHTS [WEIGHTS ...]], --weights [WEIGHTS [WEIGHTS ...]]
                        Weights for each echo (default: None)

examples:
  echocombine /project/3017065.01/bids func/*task-stroop*echo-1*
  echocombine /project/3017065.01/bids *task-stroop*echo-1* -p 001 003
  echocombine /project/3017065.01/bids func/*task-*echo-1* -o func
  echocombine /project/3017065.01/bids func/*task-*echo-1* -o derivatives -w 13 26 39␣
↪52
  echocombine /project/3017065.01/bids func/*task-*echo-1* -a PAID
```

Defacing

Before sharing or pre-processing their images, users may want to deface their anatomical MRI acquisitions as to protect the privacy of their subjects. The `deface`-tool is a wrapper around `pydeface` that writes BIDS valid output.

```
usage: deface [-h] [-p PARTICIPANT_LABEL [PARTICIPANT_LABEL ...]]
              [-o {fmap,anat,func,dwi,beh,pet,extra_data,derivatives}] [-c]
              [-n NATIVESPEC] [-a ARGS]
              bidsfolder pattern

A wrapper around the 'pydeface' defacing tool (https://github.com/poldracklab/
↪pydeface).

This wrapper is fully BIDS-aware (a 'bidsapp') and writes BIDS compliant output

positional arguments:
  bidsfolder            The bids-directory with the (multi-echo) subject data
  pattern               Globlike search pattern (relative to the
                        subject/session folder) to select the images that need
                        to be defaced, e.g. 'anat/*_T1w*'

optional arguments:
  -h, --help            show this help message and exit
  -p PARTICIPANT_LABEL [PARTICIPANT_LABEL ...], --participant_label PARTICIPANT_LABEL␣
↪[PARTICIPANT_LABEL ...]
                        Space separated list of sub-# identifiers to be
                        processed (the sub- prefix can be left out). If not
                        specified then all sub-folders in the bidsfolder will
                        be processed (default: None)
```

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```
  -o {fmap,anat,func,dwi,beh,pet,extra_data,derivatives}, --output {fmap,anat,func,
↪dwi,beh,pet,extra_data,derivatives}
                        A string that determines where the defaced images are
                        saved. It can be the name of a BIDS modality folder,
                        such as 'anat', or of the derivatives folder, i.e.
                        'derivatives'. If output is left empty then the
                        original images are replaced by the defaced images
                        (default: None)
  -c, --cluster         Flag to submit the deface jobs to the high-performance
                        compute (HPC) cluster (default: False)
  -n NATIVESPEC, --nativespec NATIVESPEC
                        DRMAA native specifications for submitting deface jobs
                        to the HPC cluster (default: -l
                        walltime=00:30:00,mem=1gb)
  -a ARGS, --args ARGS  Additional arguments (in dict/json-style) that are
                        passed to pydeface. See examples for usage (default:
                        {})

examples:
  deface /project/3017065.01/bids anat/*_T1w*
  deface /project/3017065.01/bids anat/*_T1w* -p 001 003 -o derivatives
  deface /project/3017065.01/bids anat/*_T1w* -n "-l walltime=00:60:00,mem=2gb"
  deface /project/3017065.01/bids anat/*_T1w* -a '{"cost": "corratio", "verbose": ""}'
```

2.4.3 BIDS validation

If all of the above work is done, you can (and should) run the web-based bidsvalidator to check for inconsistencies or missing files in your bids data-set (NB: the bidsvalidator also exists as a command-line tool).

2.5 Options

BIDScoin has different options and settings (see below) that can be adjusted per study bidsmap. You can use a text editor to edit the bidsmap template `[path_to_bidscoin]/heuristics/bidsmap_template.yaml` if you want to adjust the default)

2.5.1 BIDScoin

- `version`: should correspond with the version in ../bidscoin/version.txt
- `bidsignore`: Semicolon-separated list of entries that are added to the .bidsignore file (for more info, see BIDS specifications), e.g.:
  - `extra_data/;pet/;myfile.txt;yourfile.csv`

2.5.2 dcm2niix

The nifti- and json-files are generated with dcm2niix. Here you can adjust how dcm2niix is used:

- `path`: Command to set the path to dcm2niix, e.g.:
  - `module add dcm2niix/1.0.20180622;` (note the semi-colon at the end)

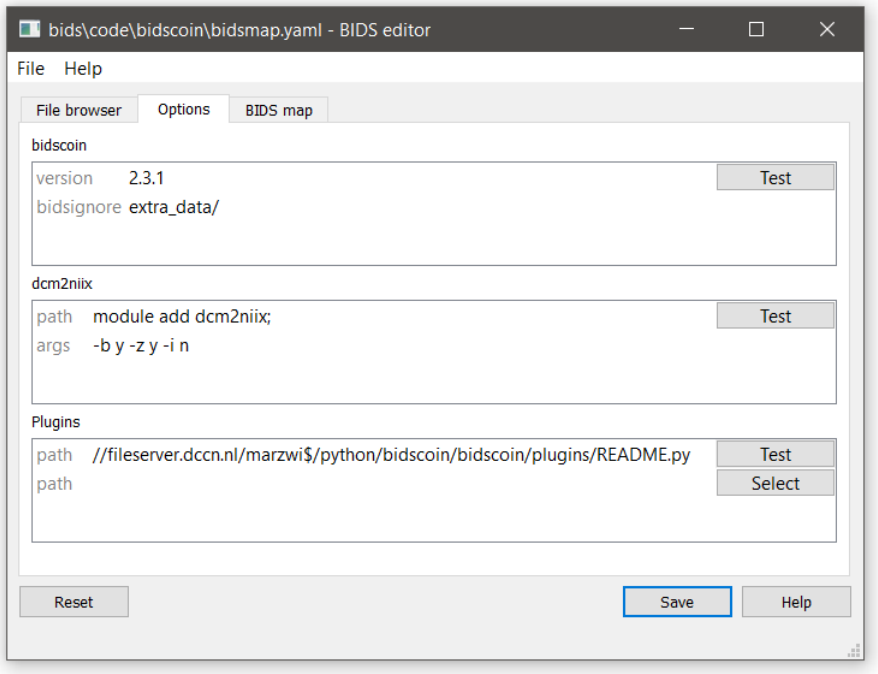

Fig. 1: The bidseditor options window with the different BIDScoin settings

  - `PATH=/opt/dcm2niix/bin:$PATH;` (note the semi-colon at the end)
  - `/opt/dcm2niix/bin/` (note the slash at the end)
  - `'\"C:\\Program Files\\dcm2niix\"'` (note the quotes to deal with the whitespace)
- `args`: Argument string that is passed to dcm2niix. Click [Test] and see the terminal output for usage

Tip: SPM users may want to use '-z n', which produces unzipped nifti's

2.5.3 Plugins

BIDScoin provides the possibility for researchers to write custom python functions that will be executed at bidsmapper and bidscoiner runtime. To use this functionality, enter the name of the module (default location is the plugins-folder; otherwise the full path must be provided) in the bidsmap dictionary file to import the plugin functions. See advanced usage for more details.

2.6 Advanced usage

2.6.1 Site specific / customized template

If you want to convert many studies with similar acquisition protocols then you **may** consider (NB: this is in no way necessary) creating your own customized bidsmap template. This template can then be passed to the bidsmapper tool to automatically identify the different scans in your study and map these to the correct BIDS modality. Creating or editing bidsmaps requires more indepth knowledge of YAML and of how BIDScoin identifies different acquisitions in a protocol given a bidsmap (NB: a bidsmap template is just a void study bidsmap).

Generally speaking, a bidsmap file contains a collection of key-value dictionaries that define unique mappings between different types (runs) of source data onto BIDS outcome data. As illustrated in the figure below, each run item in the bidsmap has a `provenance` value, i.e. the pathname of a representative data sample of that run. Each run item also contains a source data `attributes` object, i.e. a key-value dictionary with keys and values that are extracted from the provenance data sample, as well as a `bids` object, i.e. a key-value dictionary that determines the filename of the BIDS output file. The different key-values in the `attributes` dictionary represent properties of the source data and should uniquely identify the different runs in a session. But these key-values should not vary between sessions, making the length of the bidsmap only dependent on the acquisition protocol and not on the number of subjects and sessions in the data collection. The difference between a bidsmap template and the study bidsmap that comes out of the `bidsmapper` is that the template contains / defines the key-value pairs that will be used by the bidsmapper and that the template contains all possible runs. The study bidsmap contains only runs that were encountered in the study, with key-values that are specific for that study. A bidsmap has different sections for different source data modalities, i.e. `DICOM`, `PAR`, `P7`, `Nifti`, `FileSystem`, as well as a section for the BIDScoin `Options`. Within each source data section there sub-sections for the different BIDS modalities, i.e. for `anat`, `func`, `dwi`, `fmap`, `pet`, `beh` and ‘‘ extra_data‘‘, and for the `participant_label` and `session_label`. The BIDScoin tools, given a data sample, will go through the bidsmap (from top to bottom) until they come across a run with attribute values that match the attribute values of the data sample (NB: empty values are ignored). At that point a bidsmapping is made, i.e. the bids values will be taken to contruct a BIDS output filename.

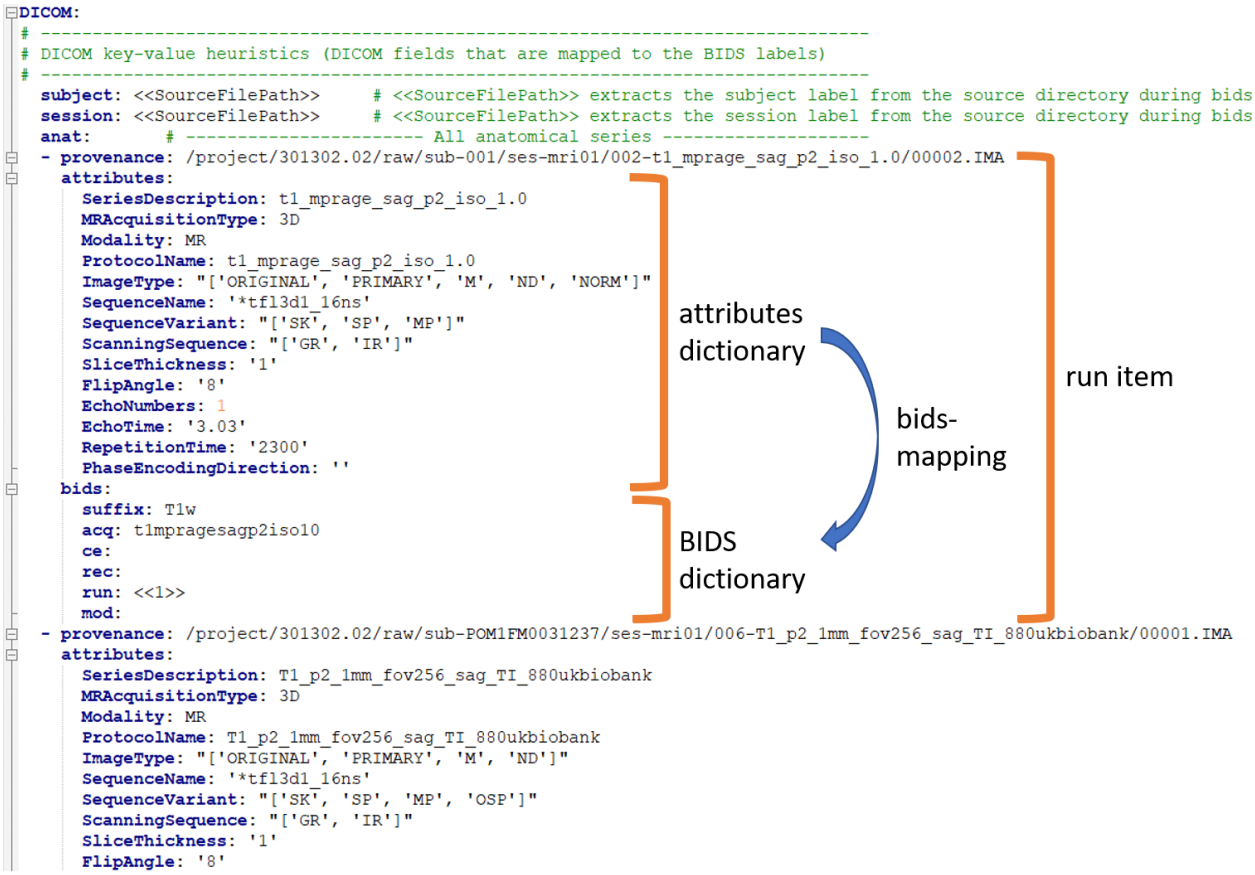

Fig. 2: A snippet of a study bidsmap, showing a `DICOM` section with a few *run* items in the `anat` subsection

A good start to create your own template is to have a look at the DCCN `[path_to_bidscoin]/heuristics/bidsmap_dccn.yaml` template and see if you can adapt that to your needs. If you open the template, there are a few things to take notice of (as shown in the template snippet below). First, you can see that the DCCN template makes use of YAML anchors and aliases (to make maintanance more sustainable). The second thing to notice is that, of the first run, all values of the attribute dictionary are empty, meaning that it won't match any run. In that way, however,

the subsequent runs that alias (`<<: *anatattributes_dicom`) this anchor (`&anatattributes_dicom`) will inherit only the keys and can inject their own values. The first run of each modality sub-section (like `anat`) also serves as the default bidsmapping when users manually overrule / change the bids modality using the bidsmapper GUI. Finally, it is important to take notice of the usage of matching patterns (see `DICOM Attributes`).

```
anat:       # ---------------------- All anatomical runs --------------------
- provenance: ~                  # The first item with empty attributes will not match␣
↪anything but will be used when changing modality in the bidseditor GUI -> suffix =␣
↪T1w
  attributes: &anatattributes_dicom
    Modality: ~
    ProtocolName: ~
    SeriesDescription: ~
    ImageType: ~
    SequenceName: ~
    SequenceVariant: ~
    ScanningSequence: ~
    MRAcquisitionType: ~
    SliceThickness: ~
    FlipAngle: ~
    EchoNumbers: ~
    EchoTime: ~
    RepetitionTime: ~
    PhaseEncodingDirection: ~
  bids: &anatbids_dicom
    acq: <SeriesDescription>
    ce: ~
    rec: ~
    run: <<1>>
    mod: ~
    suffix: T1w
- provenance: ~
  attributes:
    <<: *anatattributes_dicom
    SeriesDescription: ['*mprage*', '*MPRAGE*', '*MPRage*', '*t1w*', '*T1w*', '*T1*']
    MRAcquisitionType: 3D
  bids:
    <<: *anatbids_dicom
    suffix: T1w
```

Snippet from the ''bidsmap_dccn.yaml'' template

2.6.2 Plugins

BIDScoin has the option to import plugins to further automate / complete the conversion from source data to BIDS. The plugin takes is called each time the BIDScoin tool has finished processing a run or session, with arguments containing information about the run or session, as shown in the plugin example code below. The functions in the plugin module should be named `bidsmapper_plugin` to be called by `bidsmapper` and `bidscoiner_plugin` to be called by `bidscoiner`.

```
import logging
from pathlib import Path

LOGGER = logging.getLogger(f'bidscoin.{Path(__file__).stem}')
```

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```
def bidsmapper_plugin(seriesfolder: Path, bidsmap: dict, bidsmap_template: dict) ->␣
↪dict:
    """
    The plugin to map info onto bids labels

    :param seriesfolder:        The full-path name of the raw-data series folder
    :param bidsmap:             The study bidsmap
    :param bidsmap_template:    Full BIDS heuristics data structure, with all options,
↪ BIDS labels and attributes, etc
    :return:                    The study bidsmap with new entries in it
    """

    LOGGER.debug(f'This is a bidsmapper demo-plugin working on: {seriesfolder}')
    return bidsmap


def bidscoiner_plugin(session: Path, bidsmap: dict, bidsfolder: Path, personals:␣
↪dict) -> None:
    """
    The plugin to cast the series into the bids folder

    :param session:     The full-path name of the subject/session raw data source␣
↪folder
    :param bidsmap:     The full mapping heuristics from the bidsmap YAML-file
    :param bidsfolder:  The full-path name of the BIDS root-folder
    :param personals:   The dictionary with the personal information
    :return:            Nothing
    """

    LOGGER.debug(f'This is a bidscoiner demo-plugin working on: {session} ->
↪{bidsfolder}')
```

Plugin example code

2.7 Screenshots

2.7.1 The bidseditor

2.8 Tutorial

This tutorial is specific for researchers from the DCCN and makes use of data-sets stored on its central file-system. However, it should not be difficult to use (at least part of) this tutorial for other data-sets as well.

1. **Preparation.** Activate the bidscoin environment and create a tutorial playground folder in your home directory by executing these bash commands (see also `module help bidscoin`):

```
$ module add bidscoin
$ source activate /opt/bidscoin
$ cp -r /opt/bidscoin/tutorial ~
```

The new `tutorial` folder contains a `raw` source-data folder and a `bids_ref` reference BIDS folder, i.e. the end product of this tutorial.

Let's begin with inspecting this new raw data collection:

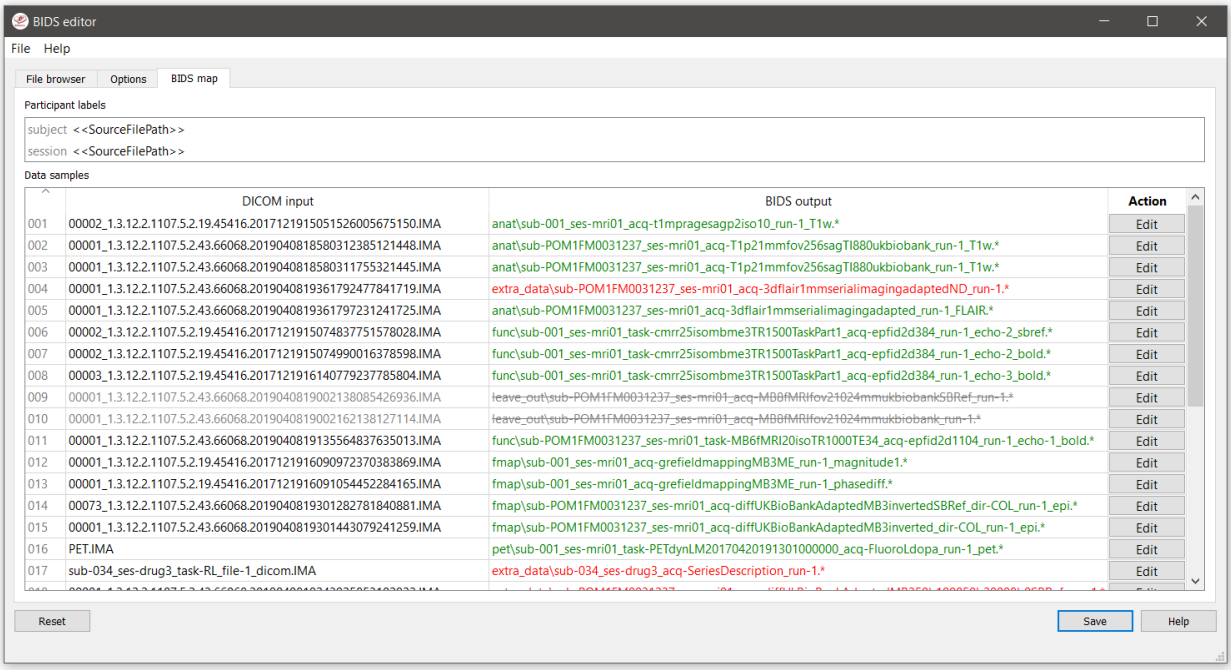

Fig. 3: The main window with the bidsmap overview

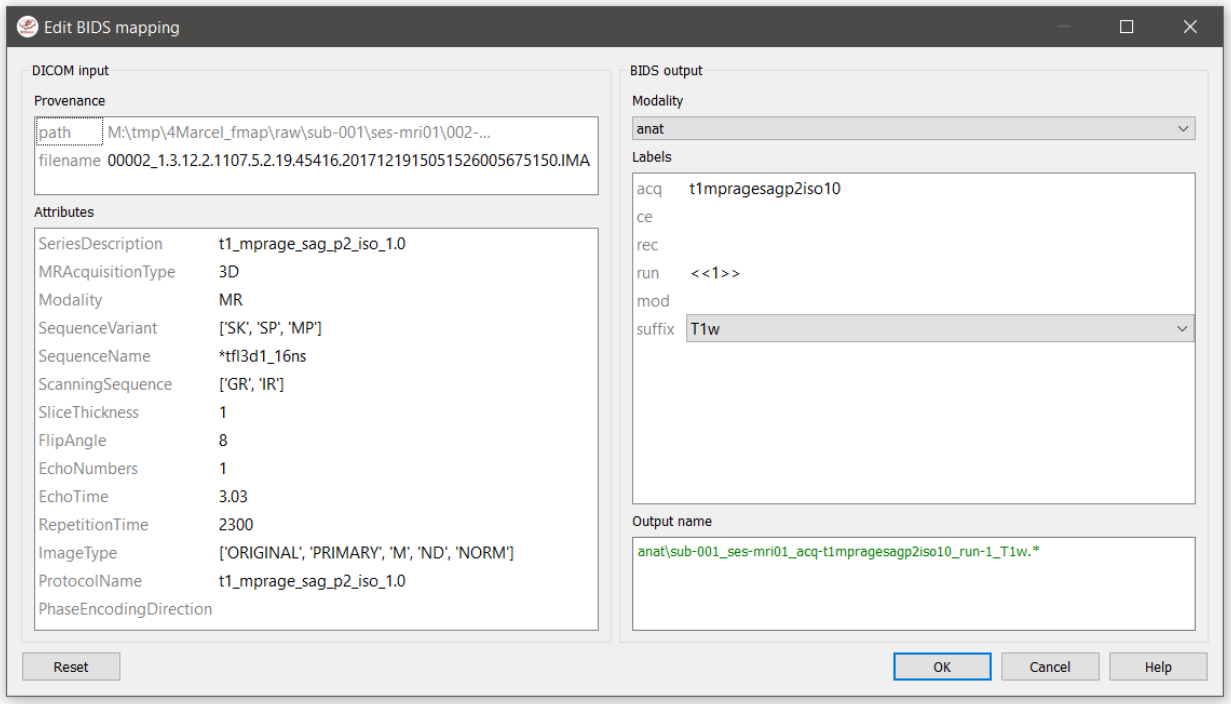

Fig. 4: The editor window for customizing the individual bidsmap entries

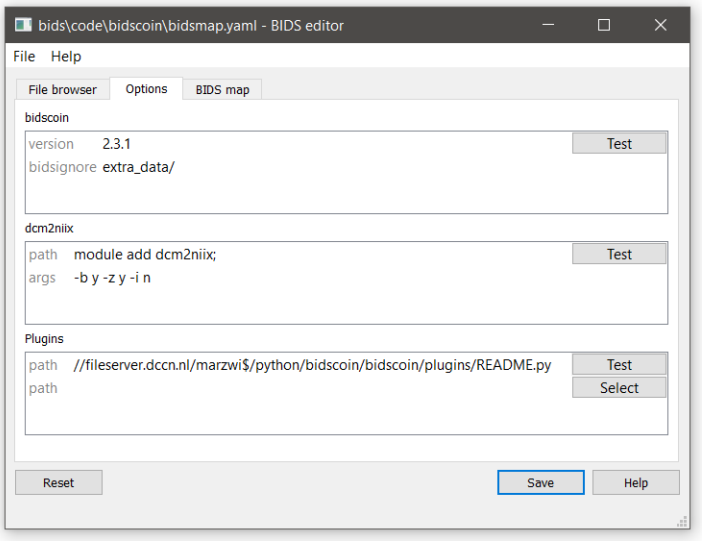

Fig. 5: The options window with BIDScoin settings

- Are the DICOM files for all the sub-/*ses*- folders organised in series-subfolders (e.g. sub-001/ses-01/003-T1MPRAGE/0001.dcm etc)? Use dicomsort if this is not the case
- Use the rawmapper command to print out the DICOM values of the "EchoTime", "Sex" and "AcquisitionDate" of the fMRI series in the `raw` folder

2. **BIDS mapping.** Scan all folders in the raw data collection for unknown data by running the bidsmapper bash command:

```
$ bidsmapper raw bids
```

- Rename the task label of the functional scans into something more readable, e.g. "Reward" and "Stop"
- Add a search pattern to the IntendedFor field such that it will select your fMRI runs (see the bidseditor `fieldmap` section for more details)
- When all done, (re)open the `bidsmap.yaml` file and change the options such that you will get non-zipped nifti data (i.e. `*.nii`instead of `*.nii.gz`) in your BIDS data collection. You can use a text editor or, much better, run the bidseditor command line tool.

3. **BIDS coining.** Convert your raw data collection into a BIDS collection by running the bidscoiner commandline tool (note that the input is the same as for the bidsmapper):

```
$ bidscoiner raw bids
```

- Check your `bids/code/bidscoin/bidscoiner.log` and `bids/code/bidscoin/bidscoiner.errors` files for any errors or warnings
- Compare the results in your `bids/sub-*` subject folders with the in `bids_ref` reference result. Are the file and foldernames the same? Also check the json sidecar files of the fieldmaps. Do they have the right "EchoTime" and "IntendedFor" fields?
- What happens if you re-run the bidscoiner command? Are the same subjects processed again? Re-run "sub-001".
- Inspect the `bids/participants.tsv` file and decide if it is ok.
- Update the `dataset_description.json` and `README` files in your `bids` folder

- As a final step, run the bids-validator on your `~/bids_tutorial` folder. Are you completely ready now to share this dataset?