bids_apps_slides

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1 BIDS Apps

This tutorial aims to introduce BIDS Apps. After briefly introducing some background, we will run the mriqc BIDS App on our laptops to get quality reports for MRI data.

2 Before we start

- Laptop with Docker installed (see guides for mac, windows, linux)
- if possible, already download (pull) the docker container we will be using:
  - open a terminal window/command line
  - paste the following command: `docker pull poldracklab/mriqc:0.10.4`
  - press enter and wait for the download to be finished
- download the this BIDS-formatted example data set (430 MB)

3 Background

3.1 Neuroimaging software

- Installation of neuroimaging software can be painful
- Complex workflows might require to install multiple software packages
- Needs to be repeated for new system (e.g., cloud system)
- Different software version might give different results

Makes it more difficult to reproduce analyses

3.2 What is BIDS

- Brain Imaging Data Structure
- A standardized way to represent data and metadata from neuroimaging studies
- Gorgolewski et al., 2016

3.3 What are BIDS Apps

- Portable neuroimaging pipelines shipped as **software containers**
- Understand BIDS

bids-apps.neuroimaging.io/apps/

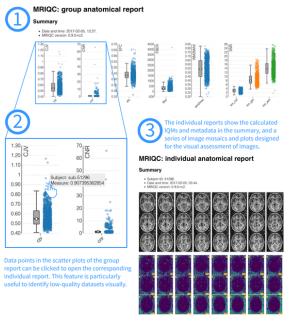
- Developed by different labs all over the world
- `http://bids-apps.neuroimaging.io`, Gorgolewski et al., 2017

3.4 What are software containers

- A box that has software in it
- You don't need to install single software packages
- You just need to download/install
  - the container
  - a software that runs the container

3.5 What is Docker

A software that executes software containers



4 Running BIDS Apps

4.1 BIDS Apps are plug-and-play

To process your data, you only need to specify

- BIDS App
- Input folder (with BIDS-formatted data)
- Output folder that stores the results

4.2 mriqc

- MRI quality control tool
- Developed by the Poldrack Lab
- Structural and functional MRI data

4.3 mriqc

Two analysis levels

- participant
- group

4.4 mriqc

Results

- visual reports
- IQMs (Image Quality Metrics; see Esteban et al., 2017)

Fig 5, Esteban et al., 2017

4.5 BIDS Apps in the cloud

OpenNeuro

5 Hands-on

We will now run mriqc on example data from the ABIDE study.
See `00Info.txt` for furhter details.

Data location Download the example data and unpack it into `~/data` (or adapt the paths in the examples accordingly).

There should now be a folder **`~/databids_apps_data`** with the data inside.

```
|-- 00Info.txt
|-- derivates
|-- sourcedata
```

5.0.1 BIDS sourcedata

```
|-- sourcedata
    |-- T1w.json
    |-- sub-0051160
        |-- anat
            |-- sub-0051160_T1w.nii.gz
```

5.0.2 Precomputed mriqc data

```
|-- derivates
|   |-- mriqc_0.10.4_precomputed
|       |-- 00INFO.txt
|       |-- derivatives
|       |   |-- sub-0051160_T1w.json
|       |   |-- ....
|       |-- logs
|       |-- reports
|           |-- sub-0051160_T1w.html
|           |-- ...
...
```

5.1 Download image with `docker pull`

- BIDS Apps provide images on Docker Hub, e.g., mriqc
- Docker Hub images can be downloaded with the `docker pull` command

`docker pull poldracklab/mriqc:0.10.4`
downloads tag (version) `0.10.4` of image `poldracklab/mriqc`

5.2 Get a list of locally available images

`docker images`
gives you a list of all images that are downloaded to your computer

5.3 Running an analysis

5.3.1 mriqc help

To print help text for mriqc run

```
docker run --rm -ti poldracklab/mriqc:0.10.4 -h
```

5.3.2 Architecture of a command

```
docker run --rm -it \
   -v [...] \
   image_name bids_dir output_dir analysis_level
```

5.3.3 Participant level

```
docker run --rm -it \
-v ~/data/bids_apps_data/sourcedata:/d/in:ro \
-v ~/data/bids_apps_data/derivates/mriqc_0.10.4:/d/out \
poldracklab/mriqc:0.10.4 /d/in /d/out participant
```

5.3.4 Participant level command: line 1

```
docker run --rm -it \
   -v ~/data/bids_apps_data/sourcedata:/d/in:ro \
   -v ~/data/bids_apps_data/derivates/mriqc_0.10.4:/d/out \
   poldracklab/mriqc:0.10.4 /d/in /d/out participant
```

- Run a docker container
- Clean up after the container exits
- Run it in interactive mode

5.3.5 Participant level command: line 2

```
docker run --rm -it \
   -v ~/data/bids_apps_data/sourcedata:/d/in:ro \
   -v ~/data/bids_apps_data/derivates/mriqc_0.10.4:/d/out \
   poldracklab/mriqc:0.10.4 /d/in /d/out participant
```

- By default, docker does not have access to data on the HD
- `-v` (or `--volume`) makes a folder on your HD available inside the docker container
- `-v {folder_name_on_HD}:{folder_name_inside_container}:[{mode, e.g., ro}]`

- `~/data/bids_apps_data/sourcedata` is a folder on my HD, it contains the input data
- the docker container will see this folder as `/d/in`
- it will not be able to write into this folder (`ro`: read only)

5.3.6 Participant level command: line 3

```
docker run --rm -it \
   -v ~/data/bids_apps_data/sourcedata:/d/in:ro \
   -v ~/data/bids_apps_data/derivates/mriqc_0.10.4:/d/out \
   poldracklab/mriqc:0.10.4 /d/in /d/out participant
```

- `~/data/bids_apps_data/derivates/mriqc_0.10.4:` is a folder on my HD, it will be populated with the output data
- the docker container will see this folder as `/d/out`
- no other option is given: docker will be able to write into this folder

5.3.7 Participant level command: line 4

```
docker run --rm -it \
   -v ~/data/bids_apps_data/sourcedata:/d/in:ro \
   -v ~/data/bids_apps_data/derivates/mriqc_0.10.4:/d/out \
   poldracklab/mriqc:0.10.4 /d/in /d/out participant
```

- `poldracklab/mriqc:0.10.4`: software image to use
- `/d/in`: bids_dir, folder with input data (has to be visible inside container)
- `/d/out`: output_dir, folder for output data (has to be visible inside container)
- `participant`: analysis level (options are: `participant`, `group`)

5.3.8 Running the participant level analysis on your laptop

```
docker run --rm -it \
-v ~/data/bids_apps_data/sourcedata:/d/in:ro \
-v ~/data/bids_apps_data/derivates/mriqc_0.10.4:/d/out \
poldracklab/mriqc:0.10.4 /d/in /d/out participant
```

This might take 15 min

5.3.9 Adding options

Take a look at mriqc's help for a list of options

```
docker run --rm -it \
-v ~/data/bids_apps_data/sourcedata:/d/in:ro \
-v ~/data/bids_apps_data/derivates/mriqc_0.10.4:/d/out \
poldracklab/mriqc:0.10.4 /d/in /d/out participant \
--participant_label 0051160 --n_procs 2
```

5.3.10 Participant level outputs

Outputs in derivates/mriqc_0.10.4

- derivatives/sub-{subject}_T1w.json
- reports/sub-{subject}_T1w.html

Open one of the precomputed outputs in `bids_apps_data/derivates/mriqc_0.10.4_precomputed/reports/`

5.3.11 Running the group level analysis on your laptop

Requires participant level analysis. To speed things up, the example data has precomputed participant level data in `derivates/mriqc_0.10.4_precomputed`.

To run the group analysis, just replace **`participant`** with **`group`**.

```
docker run --rm -it \
-v ~/data/bids_apps_data/sourcedata:/d/in:ro \
-v ~/data/bids_apps_data/derivates/mriqc_0.10.4_precomputed:/d/out \
poldracklab/mriqc:0.10.4 /d/in /d/out group
```

This will take a couple of seconds

5.3.12 Group level outputs

Outputs in derivates/mriqc_0.10.4_precomputed

- T1w.csv
- reports/T1w_group.html

5.3.13 Group level outputs

Let's look at `reports/T1w_group.html`

Click on the outlier points