session_demonstration_script

November 25, 2021

1 Example code for using session.Session

Note: This notebook covers several relevant methods of the `Session` and `Stim` objects, detailing some of their arguments, as well. For more details, take a look at the docstring associated with a method of interest.

Import notes:

- These packages should be present if installing the conda environment from `osca.yml`.
- `util` is a Github repo of mine, and the correct branch `osca_mult` is automatically installed from `osca.yml`.

- **Potential updates:** Errors internal to the codebase involving `util` code and occurring *after* new changes have been pulled from the `OpenScope_CA_Analysis` repo *may* be due to an update of the `osca_mult` branch of `util` that breaks backwards compatibility.
  Though I will try to avoid this, check whether there are updates to the utility, if an error occurs, and consider updating your installation, e.g., by running, from the command line: `pip install -U util-colleenjg`

1.1 Plot formatting

If you wish to use the same formatting style as I do:

1.2 Set paths to main data directory and the mouse dataframe

1.2.1 Data directory

The data directory should contain the session data, either in its **original format** or in **NWB format**.
* If in NWB format (production data, only), `datadir` should be a directory that contains the data in NWB format, at any depth.
* If using the data in its original format, `datadir` should specifically be the directory right before the data is split into `prod` (production) and `pilot` (pilot) data.

1.2.2 Mouse dataframe

The mouse dataframe, contains the metadata for each session, including its 9-digit `sessid`, the `mouse_n`, `sess_n`, etc.

Mouse dataframe columns:
* `sessid`: Unique session ID (9-digit)

* **dandi_session_id**: Dandiset session ID for data in NWB format.
* **mouse_n**: Mouse number
* **mouseid**: Unique mouse ID (6-digit)
* **date**: Recording date
* **depth**: Recording depth (um)
* **plane**: Recording plane ("dend" or "soma")
* **line**: Cell line ("L2/3-Cux2" or "L5-Rbp4")
* **runtype**: Type of session ("pilot" or "prod"). Only production data is available in NWB dataset.
* **sess_n**: Session number
* **nrois**: Number of valid ROIs (see ***Note***)
* **nrois_tracked**: Number of ROIs tracked across sessions (-1 for sessions with no tracking).
* **nrois_all**: Same as **nrois**, but including non valid ROIs.
* **nrois_allen**: Number of valid ROIs when using the **allen** segmentation for dendritic ROIs, instead of the **extr** segmentation (see ***Note***).
* **nrois_allen_all**: Same as **nrois_allen**, but including non valid ROIs.
* **pass_fail**: Whether the session passed (**P**) or failed (**F**) quality control.
* **all_files**: Whether all files are available for the session (original data format).
* **any_files**: Whether any files are available for the session (original data format).
* **incl**: Whether the session can be included in analyses (looser criterion than **pass_fail**).
* **stim_seed**: Seed used to initialize stimuli for the session, during recording.
* **notes**: Any notes on the session.

Note: The **allen** segmentations are used for all **somatic** data. The **extr** segmentations are preferred for all **dendritic** data. The **allen** segmentation for **dendritic** data is ***not included*** in the NWB dataset. See **section 6** for details on **allen** and **extr** ROI mask types.

[5]:

	sessid	dandi_session_id	mouse_n	mouseid	date	depth	plane	\
0	712483302	NaN	1	389778	20180621	20	dend	
1	712942208	NaN	1	389778	20180622	375	soma	
2	714893802	NaN	1	389778	20180627	20	dend	
3	715244457	NaN	1	389778	20180628	20	dend	
4	716425232	NaN	1	389778	20180702	375	soma	
..	…	…	…	…	…	…	…	
78	833704570	NaN	13	440889	20190307	175	soma	
79	834403597	20190314T152429	13	440889	20190308	175	soma	
80	836968429	20190314T152429	13	440889	20190314	175	soma	
81	837360280	20190315T152224	13	440889	20190315	175	soma	
82	838633305	NaN	13	440889	20190318	175	soma	

	line	runtype	sess_n	…	nrois_tracked	nrois_all	nrois_allen	\
0	L5-Rbp4	pilot	1	…	-1	1468	232	
1	L5-Rbp4	pilot	2	…	-1	78	62	
2	L5-Rbp4	pilot	3	…	-1	-1	-1	
3	L5-Rbp4	pilot	4	…	-1	949	458	
4	L5-Rbp4	pilot	5	…	-1	79	56	
..	…	…	…	…	…	…	…	
78	L23-Cux2	prod	2	…	147	251	224	
79	L23-Cux2	prod	3	…	147	228	210	

```
80  L23-Cux2    prod       4  …             -1        217          205
81  L23-Cux2    prod       5  …             -1        244          217
82  L23-Cux2    prod       6  …             -1        256          227

    nrois_allen_all  pass_fail all_files  any_files  incl stim_seed  \
0               259          F         1          1   yes       103
1                78          F         1          1   yes       103
2                -1          F         0          1    no       103
3               504          P         1          1   yes       103
4                79          P         1          1   yes       103
..              …         …       …         …   …       …
78              251          P         1          1   yes     16745
79              228          P         1          1   yes     10210
80              217          P         1          1   yes     24253
81              244          F         1          1   yes     19576
82              256          F         1          1    no     30582

                                                 notes
0   dropped beh and eye tracking frames (7), stim …
1   dropped beh and eye tracking frames (6), stim …
2                missing 2P recordings and ROI traces
3                                                 NaN
4                                                 NaN
..                                                …
78  stim2twop alignment shifted corrected with 2nd…
79  dropped beh and eye tracking frames (6), stim …
80  FOV shifted (poor alignment with previous sess…
81                                  z-drift (14 um)
82                    laser wavelength set to 800 um

[83 rows x 21 columns]
```

1.3 1. Basics of initializing a Session object

Sessions can be intialized with their 9-digit `sessid`:

or with their `mouse_n`, `sess_n` and `runtype`:

1.3.1 Data format is identified automatically

During initialization, the code looks first for the session data in NWB format, under its `dandi_session_id`. If it doesn't find it, it looks for the data in its original format. If neither are found, an error is thrown.

1.3.2 Loading the data after initialization.

After creating the session, you must run `self.extract_info()`. This wasn't amalgamated into the `__init__` to reduce the amount of information needed to just create a session object.

1.3.3 Loading ROI/running/pupil info

You can load this information when you call `self.extract_info()` or manually later by calling `self.load_roi_info()`, `self.load_run_data()` and `self.load_pup_data()`.

```
Loading stimulus and alignment info…
Loading ROI trace info…
    WARNING: Session 764704289: 3 noisy ROIs (mean below 0 or median above
midrange) are also included in the NaN ROI attributes (but not set to NaN): 244,
298, 305.
Loading running info…
    WARNING: Session 764704289: 211 dropped running frames (~0.1%) (in pre-
processing).
Loading pupil info…
```

1.3.4 Stimulus dataframe

The stimulus dataframe, stored under `sess.stim_df`, details the stimulus feature for each segment of the presentation.
A **segment** is the minimal subdivision of the stimulus presentation: **0.3 sec** for the Gabor stimulus, and **1s** for the visual flow, and grayscreen stimuli.

If a feature **does not apply** to certain segments (e.g., `gabor_number` for visual flow stimulus segments), the values for those segments will be `None`, `NaN` or `[]`, depending on the column's datatype.

Missing columns: Note that a few columns are missing, since the session was loaded with `full_table=False`. * `"gabor_orientations"`: Specific orientation of each Gabor patch, for each segment. * `"square_locations_x"`: Specific x location of each visual flow square, at **each frame** of each segment. * `"square_locations_y"`: Specific y location of each visual flow square, at **each frame** of each segment.

This is primarily to save memory, when loading a session, as this information is not typically needed. To load all columns, re-run `sess.extract_info()` with `full_table=True`. Data that is already loaded will not be re-loaded.

[9]:

	stimulus_type	stimulus_template_name	unexpected	gabor_frame	\
0	grayscreen	grayscreen	NaN		
1	gabors	gabors	0.0	A	
2	gabors	gabors	0.0	B	
3	gabors	gabors	0.0	C	
4	gabors	gabors	0.0	D	
…	…	…	…	…	
8839	visflow	visflow_right	0.0		
8840	visflow	visflow_right	1.0		
8841	visflow	visflow_right	1.0		
8842	visflow	visflow_right	1.0		
8843	grayscreen	grayscreen	NaN		

	gabor_kappa	gabor_mean_orientation	gabor_number	\
0	NaN	NaN	NaN	

```
1            16.0                    135.0          30.0
2            16.0                    135.0          30.0
3            16.0                    135.0          30.0
4            16.0                    135.0          30.0
…             …                        …             …
8839          NaN                      NaN           NaN
8840          NaN                      NaN           NaN
8841          NaN                      NaN           NaN
8842          NaN                      NaN           NaN
8843          NaN                      NaN           NaN

                                      gabor_locations_x  \
0                                                    []
1     [-957.5664595131418, -573.877007228148, 789.96…
2     [-628.4848961265818, 341.7183469416823, 321.20…
3     [683.6508663589163, -890.7309000633387, -754.8…
4     [579.5453003762645, -499.8681800025132, -951.1…
…                                                     …
8839                                                 []
8840                                                 []
8841                                                 []
8842                                                 []
8843                                                 []

                                      gabor_locations_y  \
0                                                    []
1     [-523.4450587378464, 22.61763399099607, -287.1…
2     [-122.57399381760757, -198.4686150995812, 203…
3     [-270.11244158601005, 574.7874674037628, -168…
4     [322.1656471050667, 97.49426011674268, 244.289…
…                                                     …
8839                                                 []
8840                                                 []
8841                                                 []
8842                                                 []
8843                                                 []

                                           gabor_sizes  …  \
0                                                    []  …
1     [293, 392, 392, 323, 280, 396, 316, 363, 226, …  …
2     [313, 319, 262, 228, 400, 210, 264, 218, 308, …  …
3     [396, 212, 277, 210, 390, 329, 406, 317, 358, …  …
4     [326, 244, 208, 212, 251, 242, 341, 299, 406, …  …
…                                                     …  …
8839                                                 []  …
8840                                                 []  …
8841                                                 []  …
```

```
8842                                                 []  …
8843                                                 []  …

     square_proportion_flipped start_frame_stim  stop_frame_stim  \
0                          NaN                0             1800
1                          NaN             1800             1818
2                          NaN             1818             1836
3                          NaN             1836             1854
4                          NaN             1854             1872
…                          …               …                …
8839                      0.00           249960           250020
8840                      0.25           250020           250080
8841                      0.25           250080           250140
8842                      0.25           250140           250200
8843                       NaN           250200           251999

      num_frames_stim  start_frame_twop  stop_frame_twop  num_frames_twop  \
0                1800               143             1046              903
1                  18              1046             1055                9
2                  18              1055             1064                9
3                  18              1064             1073                9
4                  18              1073             1082                9
…                 …                …                …                …
8839               60            125552           125582               30
8840               60            125582           125612               30
8841               60            125612           125642               30
8842               60            125642           125672               30
8843             1799            125672           126575              903

      start_time_sec  stop_time_sec  duration_sec
0          14.277090      44.301717     30.024627
1          44.301717      44.602241      0.300524
2          44.602241      44.902563      0.300322
3          44.902563      45.202768      0.300204
4          45.202768      45.503007      0.300240
…                …              …              …
8839     4183.741890    4184.742721      1.000831
8840     4184.742721    4185.743529      1.000808
8841     4185.743529    4186.744364      1.000835
8842     4186.744364    4187.745223      1.000860
8843     4187.745223    4217.728557     29.983333

[8844 rows x 24 columns]
```

1.3.5 Stimulus objects

Once `sess.extract_info()`, each Session object now contains `Stim` objects.

These come in one of three subclasses: `Gabors`, `Visflow`, `Grayscr`, and can be accessed with: `sess.stims`, `sess.gabors`, `sess.visflow`, `sess.grayscr`.

The the `Stim` object `stim`, the Session object can be accessed with `stim.sess`.

```
number of rois         : 628
mouse number           : 6
mouse ID               : 413663
gabor object           : Gabors (stimulus from session 764704289)
2p frames per sec      : 30.08
stimulus frames per sec: 59.95
```

1.4 2. Retrieving data of interest

1.4.1 Identifying stimulus segments of interest

From a `Session`'s `Stim`, you can get a list of segments that fit a specific criterion, e.g. **U segments** (unexpected, 3rd Gabor frame).

1.4.2 Identifying frame numbers of interest, to index the data

Then, you can retrieve the exact frame numbers that match these segments.

Specifically, you can access: * `twop` frame numbers, which index the two-photon data and pupil data, and * `stim` frame numbers, which index the running data.

Note: When retrieving the frame numbers, specifying `ch_fl` (check flanks) ensures that only frame numbers whose flanks are within the recording are returned. In other words, any frame number too close to the start or end of the recording (based on `pre`/`post` values), will be dropped.

1.4.3 Retrieving the data of interest

You can now get the **ROI / running / pupil data** corresponding these reference frames and the specified `pre` / `post` periods (in sec).

1.4.4 Retrieving data statistics of interest

You can also directly obtain statistics on the data of interest.

[15]:
```
datatype               roi_traces
nan_rois_removed              yes
scaled                         no
baseline                       no
integrated                    yes
smoothing                      no
fluorescence                  dff
general ROIs sequences
stats   None stat_mean   0.026752
             error_SEM   0.000911
```

1.4.5 Using hierarchical dataframes

Data and statistics are returned in a hierarchical dataframe with **columns** and **indices**.

This has the advantage of allowing metadata to be stored in dummy columns, however extracting data from these dataframes can be tricky, syntaxically.

[16]:
```
datatype                    roi_traces
nan_rois_removed                   yes
scaled                             yes
baseline                            no
integrated                          no
smoothing                           no
fluorescence                       dff
ROIs sequences time_values
0    0         -1.000000    -0.009556
               -0.966102    -0.644810
               -0.932203    -0.214521
               -0.898305    -0.116127
               -0.864407    -0.318214
…                                  …
643  95         0.864407     0.050568
                0.898305     0.445153
                0.932203     0.108850
                0.966102     0.116475
                1.000000     0.213779

[3617280 rows x 1 columns]
```

To **extract a numpy array** with the correct dimensions from a hierarchical dataframe, you can use the following utility function: `gen_util.reshape_df_data()`.

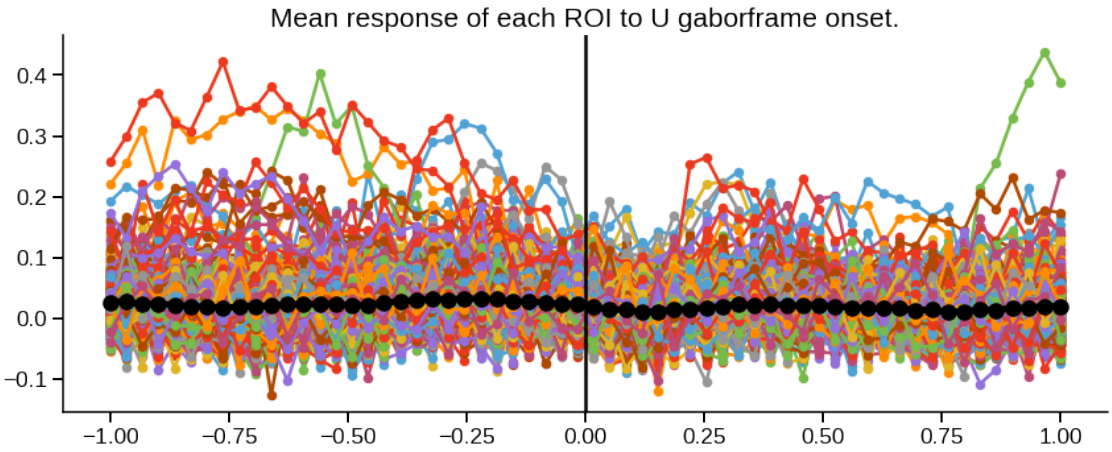
Here, each index level, then column level is turned into a new axis, **i.e. ROIs x sequences x time_values** (In this case, `squeeze_cols` is set to True to prevent each dummy column from becoming its own axis.)

```
ROI data shape: 628 ROIs x 96 sequences x 60 time values
```

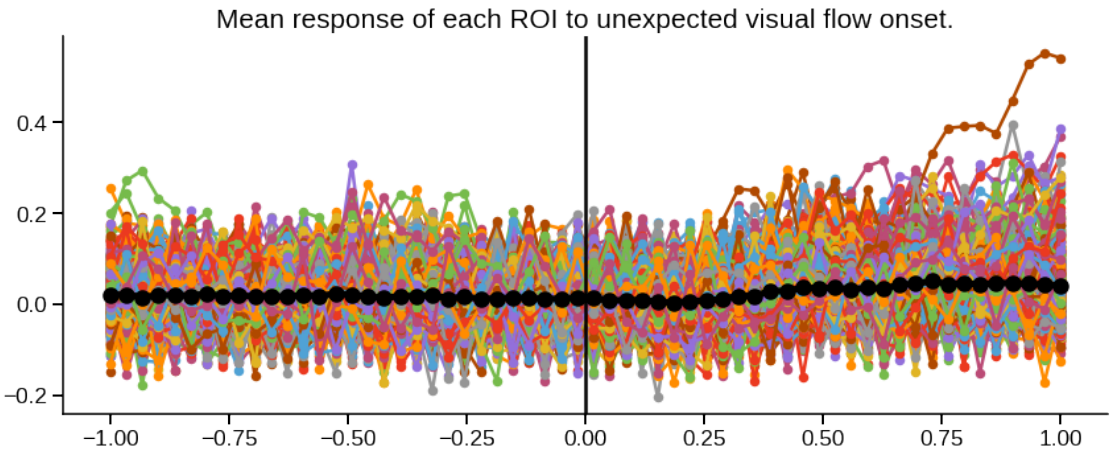
You can also retrieve the time stamps for each frame.

1.4.6 Visualizing the data

Finally, we can plot each ROIs mean activity across sequences, as well as a mean across ROIs.



1.4.7 The same steps apply for Visflow



1.5 3. Tracked ROIs

ROI tracking was performed on the `production` data.
At any point, it is possible to **restrict the data returned** to only the tracked ROIs, called `sess.set_only_tracked_rois(True)`.

Here, we retrieve the data, **integrated over each sequence**.

The dataframe returned contains data only for tracked ROIs.

[23]:
```
datatype          roi_traces
nan_rois_removed         yes
scaled                   yes
baseline                  no
```

```
integrated              yes
smoothing                no
fluorescence            dff
ROIs sequences
0    0            -0.077642
     1             0.002518
     2            -0.076000
     3             0.060652
     4            -0.000458
…                     …
242  28           -0.069519
     29            0.043961
     30            0.051469
     31           -0.011017
     32            0.188034

[4488 rows x 1 columns]
```

1.5.1 Extracting tracked ROI data correctly (!)

Importantly, the ROIs are now sorted in their tracking order, which ensures that they are correctly aligned across sessions.
As a result, the **"ROIs" index** may no longer be in increasing order, like in this example.

```
ROI numbers, ordered for tracking:
0, 3, 5, 8, 9, 11, 23, 24, 32, 45, 49, 52, 53, 55, 64, 66, 67, 70, 75, 91, 111,
123, 155, 205, 213, 215, 218, 221, 222, 223, 225, 227, 228, 229, 230, 232, 234,
238, 240, 245, 246, 247, 251, 253, 254, 257, 264, 269, 270, 273, 294, 300, 308,
315, 336, 346, 347, 350, 371, 372, 373, 374, 376, 377, 378, 379, 381, 382, 383,
386, 389, 391, 392, 394, 398, 404, 406, 409, 413, 417, 428, 432, 434, 435, 446,
449, 453, 464, 482, 518, 523, 528, 529, 530, 531, 532, 533, 536, 538, 539, 540,
543, 547, 549, 552, 554, 555, 556, 557, 558, 562, 563, 565, 571, 572, 575, 579,
580, 582, 585, 596, 608, 625, 643, 63, 72, 85, 332, 405, 188, 129, 267, 486,
616, 1, 242
```

To **ensure that the tracked ROI order is preserved** when extracting the data, the safest option is to use the utility function introduced above, i.e. `gen_util.reshape_data_df()`. It will ensure that the order is preserved.

```
Tracked ROI data shape using the correct method, i.e.,
gen_util.reshape_df_data()
136 ROIs x 33 sequences
```

Do not use the `.unstack()` method for hierarchical dataframes!

Even though the `.unstack()` method is typically a convenient way to extract a 2D array from a hierarchical dataframe, it will cause major problems here. Specifically, `.unstack()` internally triggers a resorting of the hierarchical indices. Thus, using it will completely mess up the tracked ROI order.

```
Tracked ROI data shape using the wrong method, i.e., .unstack()
136 ROIs x 33 sequences
```

As you can see, the dimensions are still correct. However, the **ROI sorting is actually lost!**

For example, **ROI #8**, which should appear as index 3 in the array, is now at index 4.

```
Data for tracked ROI at index 3, when using the correct method: i.e.,
gen_util.reshape_df_data()
0.032, -0.114, -0.035, -0.002, 0.032, -0.081, 0.004, -0.045, 0.046, 0.022 …
```

```
Data for tracked ROI at index 3, when using the wrong method: i.e., .unstack()
-0.009, 0.013, 0.049, 0.026, -0.013, 0.741, -0.074, 0.004, 0.003, -0.035 …
```

```
Data for tracked ROI that should be at index 3 is instead at index 4,
when using the wrong method: i.e., .unstack()
0.032, -0.114, -0.035, -0.002, 0.032, -0.081, 0.004, -0.045, 0.046, 0.022 …
```

1.5.2 Reset the session to start using all ROIs, again

1.6 4. Additional tips on indexing a hierarchical dataframe

[31]:
```
scaled                          yes
baseline                         no
integrated                       no
smoothing                        no
fluorescence                    dff
ROIs sequences time_values
0    1         -1.0        -0.114423
     20        -1.0        -0.502503
     21        -1.0        -0.020213
3    1         -1.0         0.647332
     20        -1.0         0.039799
     21        -1.0         0.066638
4    1         -1.0         0.339988
     20        -1.0         0.644120
     21        -1.0        -0.572354
```

1.7 5. Retrieving several Session objects, based on criteria

1.7.1 Identifying mice or session IDs to omit (pilot data only)

`sess_gen_util.all_omit()` allows keeping track of **which session IDs or mice must be left out**.

This actually **only applies to `pilot` data**, where some mice did not see all the stimuli of interst, and one session has incomplete data.
For the `prod` data, the lists are empy.

1.7.2 Retrieving mouse / session numbers and IDs that fit specific criteria

`sess_gen_util.get_sess_vals()` can be used to retrieve information for sessions that meet certain criteria.
e.g., **session number 1, 2 or 3**, **production**, **dendritic plane**

```
mouse  6: 764704289 (session 1)
mouse  6: 765193831 (session 2)
mouse  6: 766502238 (session 3)
mouse  8: 777914830 (session 1)
mouse  8: 778864809 (session 2)
mouse  8: 779650018 (session 3)
mouse  9: 826187862 (session 1)
mouse  9: 826773996 (session 2)
mouse  9: 827833392 (session 3)
mouse 10: 826338612 (session 1)
mouse 10: 826819032 (session 2)
mouse 10: 828816509 (session 3)
mouse 11: 823453391 (session 1)
mouse 11: 824434038 (session 2)
mouse 11: 825180479 (session 3)
```

1.7.3 Loading the sessions

`sess_gen_util.init_sessions()` can be used to **initialize the sessions** and **extract the requested data**.

```
Creating session 764704289…
Loading stimulus and alignment info…
Loading ROI trace info…
    WARNING: Session 764704289: 3 noisy ROIs (mean below 0 or median above
midrange) are also included in the NaN ROI attributes (but not set to NaN): 244,
298, 305.
Loading running info…
    WARNING: Session 764704289: 211 dropped running frames (~0.1%) (in pre-
processing).
Finished creating session 764704289.

Creating session 765193831…
Loading stimulus and alignment info…
Loading ROI trace info…
    WARNING: Session 765193831: 4 noisy ROIs (mean below 0 or median above
midrange) are also included in the NaN ROI attributes (but not set to NaN): 3,
63, 88, 134.
Loading running info…
    WARNING: Session 765193831: 345 dropped running frames (~0.1%) (in pre-
processing).
Finished creating session 765193831.
```

```
Creating session 766502238…
Loading stimulus and alignment info…
Loading ROI trace info…
    WARNING: Session 766502238: 4 noisy ROIs (mean below 0 or median above
midrange) are also included in the NaN ROI attributes (but not set to NaN): 18,
114, 136, 240.
Loading running info…
    WARNING: Session 766502238: 387 dropped running frames (~0.2%) (in pre-
processing).
Finished creating session 766502238.

Creating session 777914830…
Loading stimulus and alignment info…
Loading ROI trace info…
    WARNING: Session 777914830: 1 noisy ROIs (mean below 0 or median above
midrange) are also included in the NaN ROI attributes (but not set to NaN): 45.
Loading running info…
    WARNING: Session 777914830: 381 dropped running frames (~0.2%) (in pre-
processing).
Finished creating session 777914830.

Creating session 778864809…
Loading stimulus and alignment info…
Loading ROI trace info…
Loading running info…
    WARNING: Session 778864809: 630 dropped running frames (~0.3%) (in pre-
processing).
Finished creating session 778864809.

Creating session 758519303…
Loading stimulus and alignment info…
Loading ROI trace info…
Loading running info…
    WARNING: Session 758519303: 175 dropped running frames (~0.1%) (in pre-
processing).
Finished creating session 758519303.
```

1.7.4 Using the loaded sessions

Now, one can run through the sessions, and run whatever analysis is needed.

Note here that, when calling `stim.get_segs_by_criteria()`, **features that do not apply to the stimulus** (e.g., `gabfr` for the `visflow` stimulus) **are simply ignored**.

```
Session ID: 764704289 (mouse 6, session 1)
    visflow: 33 sequences
    gabors: 96 sequences
Session ID: 765193831 (mouse 6, session 2)
```

```
    visflow: 34 sequences
    gabors: 98 sequences
Session ID: 766502238 (mouse 6, session 3)
    visflow: 29 sequences
    gabors: 94 sequences
Session ID: 777914830 (mouse 8, session 1)
    visflow: 32 sequences
    gabors: 83 sequences
Session ID: 778864809 (mouse 8, session 2)
    visflow: 29 sequences
    gabors: 88 sequences
Session ID: 758519303 (mouse 1, session 1)
    visflow: 31 sequences
    gabors: 94 sequences
```

1.8 6. Retrieving ROI masks from session.

Boolean ROI masks can be obtained for each Session.

1.8.1 Dendritic mask types

For **dendritic sessions**, the Session is built to assume that `extr` (not `allen`) ROI data is to be used. This can be checked by checking `self.dend`. As long as `self.dend` is properly set, the correct ROI data and masks will be loaded.

The `allen` masks were extracted with a pipeline tailored to somatic ROIs, and are therefore not preferred.
In contrast, the `extr` masks were extracted with the EXTRACT pipeline, which specifically enables dendrite-shaped ROIs to be identified.

Note that **only the `extr` dendritic ROIs and masks** are included in the data in NWB format.

```
Dendritic session, ROI type: extr
Somatic session, ROI type: allen
```

1.8.2 Loading masks

Masks can be loaded as follows, with dimensions: **ROI x height x width**, retrieving only masks for ROIs that are valid for dF/F traces.

Note that **if sessions are set to use only tracked ROIs**, as described above, only masks for the tracked ROIs (sorted in the tracking order) will be returned.

In most functions, by default, ROIs that are considered **non valid** are automatically removed (`remnans=True`).
Note that there are **no non valid ROIs in the NWB data or tracked ROIs** (they have been removed, entirely).

These ROIs either:
(1) contain NaN/Infs values or
(2) have been deemed too noisy.

If, for whatever reason, **all masks are needed**, including those for the non valid ROIs,
(1) ensure that the session is currently set to return all ROI data, with `sess.only_tracked_rois(False)`, then
(2) call `self.get_roi_masks(remnans=False)`.

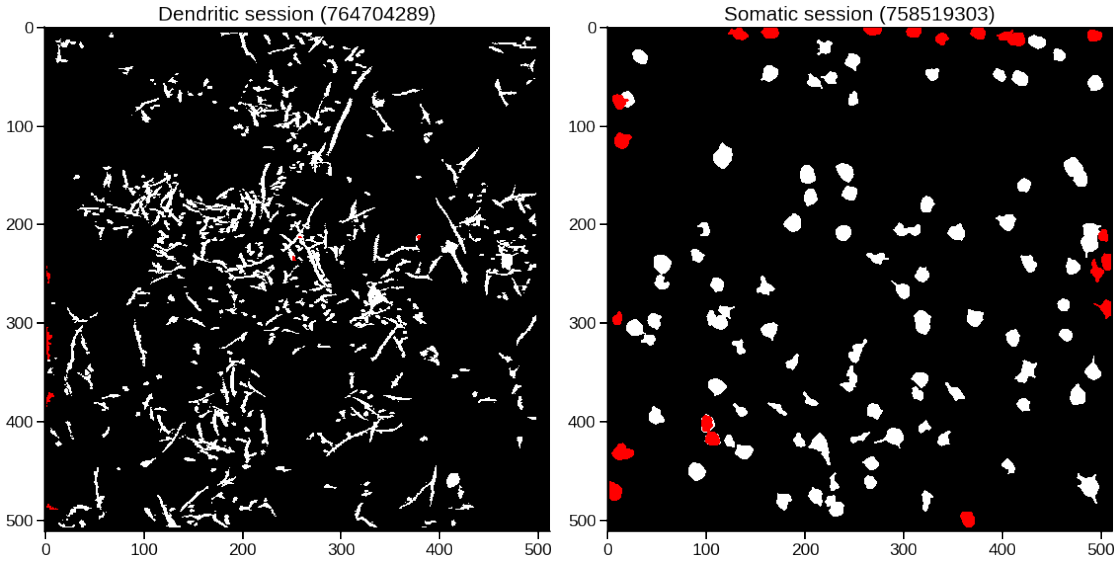
Of course, as explained above, if using the NWB data, there are no non valid ROIs.

1.8.3 Non valid ROIs

When using the data in its original format, one can get a list of non valid ROIs, by using `self.get_nanrois()`

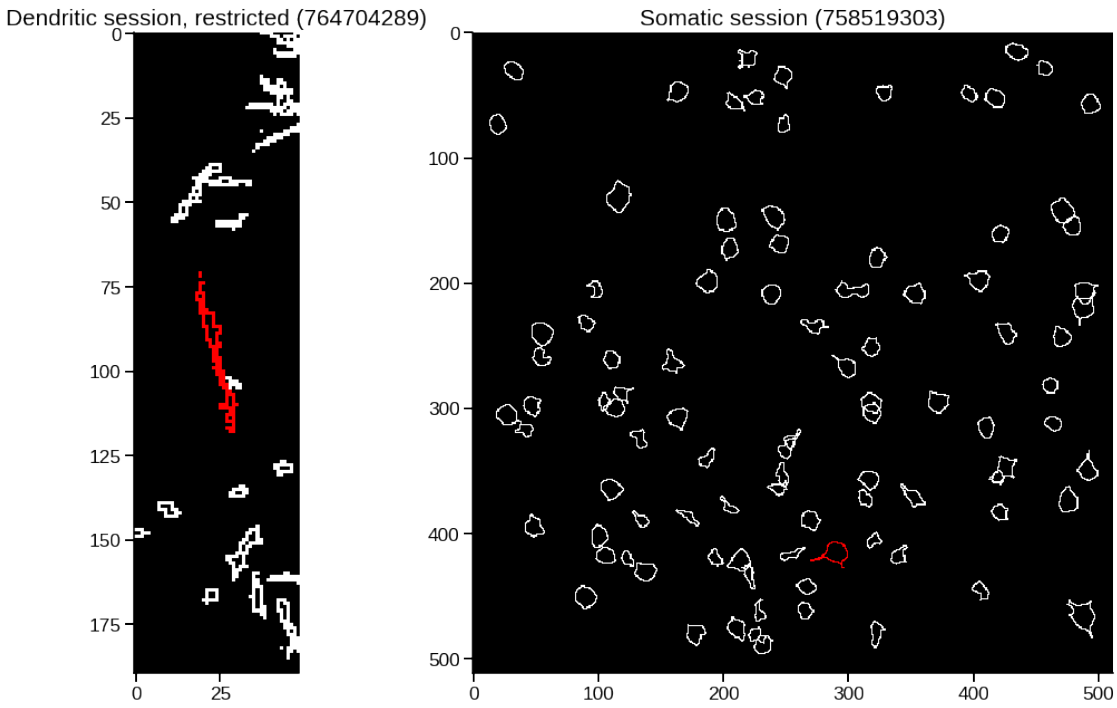
1.8.4 Visualizing ROI masks

`sess_plot_util.plot_ROIs()` can be used to visualize ROIs, where specific ROIs can be set to red using a `valid_mask`.



1.8.5 Visualizing ROI mask contours

`sess_plot_util.plot_ROI_contours()` can be used to visualize ROI contours, optionally restricted to around an ROI of interest.



1.9 7. Last notes

There is much more to the codebase, and even to the `Session` and `Stim` objects, and almost all functions and methods are thoroughly documented.

When looking to implement a new analysis, consider checking to see whether relevant functions have already been implemented in:
* `analysis/session.py`
* `analysis/basic_analys.py`
* `sess_util/sess_gen_util.py`

1.9.1 Methods/properties attached to `Session` and `Stim` objects.

```
Session (758519303)

  Public properties:
    self.align_pkl
    self.all_files
    self.any_files
    self.behav_video_h5
    self.correct_data_h5
    self.date
    self.dend
    self.depth
    self.dir
    self.drop_tol
```

```
self.expdir
self.expid
self.gabors
self.grayscr
self.home
self.line
self.max_proj
self.max_proj_png
self.mouse_df
self.mouse_dir
self.mouse_n
self.mouseid
self.n_stims
self.notes
self.nwb
self.only_tracked_rois
self.pass_fail
self.plane
self.procdir
self.pup_data_h5
self.pup_video_h5
self.roi_extract_json
self.roi_facts_df
self.roi_mask_file
self.roi_masks
self.roi_names
self.roi_objectlist
self.roi_trace_dff_h5
self.roi_trace_h5
self.run_data
self.runtype
self.segid
self.sess_n
self.sessid
self.stim2twopfr
self.stim_df
self.stim_fps
self.stim_pkl
self.stim_seed
self.stim_sync_h5
self.stims
self.stimtypes
self.time_sync_h5
self.tot_stim_fr
self.tot_twop_fr
self.tracked_rois
self.twop2stimfr
self.twop_fps
```

```
    self.visflow
    self.zstack_h5

  Public methods:
    self.check_flanks()
    self.convert_frames()
    self.data_loaded()
    self.extract_info()
    self.get_active_rois()
    self.get_fr_ran()
    self.get_frames_timestamps()
    self.get_nanrois()
    self.get_nrois()
    self.get_plateau_roi_traces()
    self.get_pup_data()
    self.get_roi_masks()
    self.get_roi_seqs()
    self.get_roi_trace_path()
    self.get_roi_traces()
    self.get_run_velocity()
    self.get_run_velocity_by_fr()
    self.get_single_roi_trace()
    self.get_stim()
    self.load_pup_data()
    self.load_roi_info()
    self.load_run_data()
    self.set_only_tracked_rois()
Gabors (stimulus from session 758519303)

  Public properties:
    self.all_gabfr
    self.all_gabfr_mean_oris
    self.block_params
    self.deg_per_pix
    self.exp_gabfr
    self.exp_gabfr_mean_oris
    self.exp_max_s
    self.exp_min_s
    self.kappas
    self.n_patches
    self.n_segs_per_seq
    self.ori_ran
    self.phase
    self.seg_len_s
    self.sess
    self.sf
    self.size_ran
```

```
    self.stim_fps
    self.stim_params
    self.stimtype
    self.unexp_gabfr
    self.unexp_gabfr_mean_oris
    self.unexp_max_s
    self.unexp_min_s
    self.win_size

  Public methods:
    self.get_A_frame_1s()
    self.get_A_segs()
    self.get_all_unexp_segs()
    self.get_all_unexp_stim_fr()
    self.get_fr_by_seg()
    self.get_frames_by_criteria()
    self.get_n_fr_by_seg()
    self.get_pup_diam_data()
    self.get_pup_diam_stats_df()
    self.get_roi_data()
    self.get_roi_stats_df()
    self.get_run()
    self.get_run_data()
    self.get_run_stats_df()
    self.get_segs_by_criteria()
    self.get_segs_by_frame()
    self.get_start_unexp_segs()
    self.get_start_unexp_stim_fr_trans()
    self.get_stats_df()
    self.get_stim_beh_sub_df()
    self.get_stim_df_by_criteria()
    self.get_stim_par_by_frame()
    self.get_stim_par_by_seg()

Visflow (stimulus from session 758519303)

  Public properties:
    self.block_params
    self.deg_per_pix
    self.exp_max_s
    self.exp_min_s
    self.main_flow_direcs
    self.n_squares
    self.prop_flipped
    self.seg_len_s
    self.sess
    self.speed
    self.square_sizes
```

```
    self.stim_fps
    self.stim_params
    self.stimtype
    self.unexp_max_s
    self.unexp_min_s
    self.win_size

  Public methods:
    self.get_all_unexp_segs()
    self.get_all_unexp_stim_fr()
    self.get_dir_segs_exp()
    self.get_fr_by_seg()
    self.get_frames_by_criteria()
    self.get_n_fr_by_seg()
    self.get_pup_diam_data()
    self.get_pup_diam_stats_df()
    self.get_roi_data()
    self.get_roi_stats_df()
    self.get_run()
    self.get_run_data()
    self.get_run_stats_df()
    self.get_segs_by_criteria()
    self.get_segs_by_frame()
    self.get_start_unexp_segs()
    self.get_start_unexp_stim_fr_trans()
    self.get_stats_df()
    self.get_stim_beh_sub_df()
    self.get_stim_df_by_criteria()
Grayscr (session 758519303)

  Public properties:
    self.sess

  Public methods:
    self.get_all_fr()
    self.get_start_fr()
    self.get_stop_fr()
```

1.9.2 Example `Session` and `Stim` object property values.

Properties with long values (e.g., long dataframes, arrays, lists, strings) as skipped, for brevity.

```
Session (758519303)

  Public property values:
    self.all_files: True
    self.any_files: True
    self.date: 20180926
```

```
    self.dend: allen
    self.depth: 175
    self.drop_tol: 0.0003
    self.expid: 759038671
    self.gabors: Gabors (stimulus from session 758519303)
    self.grayscr: Grayscr (session 758519303)
    self.home: ../../data/OSCA
    self.line: L23-Cux2
    self.mouse_dir: True
    self.mouse_n: 1
    self.mouseid: 408021
    self.n_stims: 2
    self.notes: nan
    self.nwb: False
    self.only_tracked_rois: False
    self.pass_fail: P
    self.plane: soma
    self.roi_mask_file: None
    self.runtype: prod
    self.segid: 759205610
    self.sess_n: 1
    self.sessid: 758519303
    self.stim_fps: 59.95049782968851
    self.stim_seed: 30587
    self.stimtypes: ['gabors', 'visflow']
    self.tot_stim_fr: 251999
    self.tot_twop_fr: 126741
    self.twop2stimfr: [nan nan nan … nan nan nan]
    self.twop_fps: 30.078378454283577

Gabors (stimulus from session 758519303)

  Public property values:
    self.all_gabfr: ['A', 'B', 'C', 'D', 'G', 'U']
    self.all_gabfr_mean_oris: [0.0, 45.0, 90.0, 135.0, 180.0, 225.0]
    self.deg_per_pix: 0.06251912565744862
    self.exp_gabfr: ['A', 'B', 'C', 'D', 'G']
    self.exp_gabfr_mean_oris: [0.0, 45.0, 90.0, 135.0]
    self.exp_max_s: 90
    self.exp_min_s: 30
    self.kappas: [16]
    self.n_patches: 30
    self.n_segs_per_seq: 5
    self.ori_ran: [0, 360]
    self.phase: 0.25
    self.seg_len_s: 0.3
    self.sess: Session (758519303)
    self.sf: 0.04
```

```
    self.size_ran: [204.0, 408.0]
    self.stim_fps: 59.95049782968851
    self.stim_params: ['gabor_kappa']
    self.stimtype: gabors
    self.unexp_gabfr: ['U']
    self.unexp_gabfr_mean_oris: [90.0, 135.0, 180.0, 225.0]
    self.unexp_max_s: 6
    self.unexp_min_s: 3
    self.win_size: [1920, 1200]

Visflow (stimulus from session 758519303)

  Public property values:
    self.deg_per_pix: 0.06251912565744862
    self.exp_max_s: 90
    self.exp_min_s: 30
    self.main_flow_direcs: ['left (nasal)', 'right (temp)']
    self.n_squares: [105]
    self.prop_flipped: 0.25
    self.seg_len_s: 1
    self.sess: Session (758519303)
    self.speed: 799.7552664756905
    self.square_sizes: [128]
    self.stim_fps: 59.95049782968851
    self.stimtype: visflow
    self.unexp_max_s: 4
    self.unexp_min_s: 2
    self.win_size: [1920, 1200]

Grayscr (session 758519303)

  Public property values:
    self.sess: Session (758519303)
```