session_demonstration_script

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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`. 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`. Though I will try to avoid this, consider updating the utility under those circumstances.

1.1 Set paths to main data directory and the mouse dataframe

If you wish to use the same formatting style (and logging format) as I do:

1.2 1. Basics of initializing a Session object

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

1.2.1 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…
Creating stimulus objects…
Loading ROI trace info…
    WARNING: 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: 211 dropped running frames (~0.1%) (in pre-processing).
Loading pupil info…
Loading pupil tracking information.
```

```
[5]:       stimType stimPar1      stimPar2 surp stimSeg gabfr start2pfr end2pfr  \
     0          -1       -1            -1   -1      -1    -1       143     143
     1           g      135            16    0       0     0      1046    1055
     2           g      135            16    0       1     1      1055    1064
     3           g      135            16    0       2     2      1064    1073
     4           g      135            16    0       3     3      1073    1082
     …         …       …             …   …      …     …       …
     7476        b      128  right (temp)    0    2035    -1    125522  125552
     7477        b      128  right (temp)    0    2036    -1    125552  125582
     7478        b      128  right (temp)    1    2037    -1    125582  125612
     7479        b      128  right (temp)    1    2038    -1    125612  125642
     7480        b      128  right (temp)    1    2039    -1    125642  125672

           num2pfr  display_sequence_n  block_n
     0           0                 NaN      NaN
     1           9                 0.0      0.0
     2           9                 0.0      0.0
     3           9                 0.0      0.0
     4           9                 0.0      0.0
     …      …                  …       …
     7476       30                 1.0      1.0
     7477       30                 1.0      1.0
     7478       30                 1.0      1.0
     7479       30                 1.0      1.0
     7480       30                 1.0      1.0

     [7481 rows x 11 columns]
```

1.2.2 Some information contained in the session object

Note: `Stim` objects (subclasses: `Gabors`, `Bricks`, `Grayscr`) are a separate class from `Session` objects. However, each can by accessed from the other using: - from `Session objects`: `self.stims`, `self.gabors`, `self.bricks` - from `Stim objects`: `self.sess`

```
number of rois: 644
mouse number: 6
mouse ID: 413663
gabor object: Gabors (stimulus 0 of session 764704289)
gabor orientation standard deviation(s): 0.25
2p frames per sec: 30.08
pupil frames per sec: 30.00
stimulus frames per sec: 60.00
```

1.3 2. Identifying segments of interest

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

Then, you can access the frame numbers.

Note: 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 of end of the recording (based on `pre`/`post` values), will be dropped.

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

You can also directly obtain statistics on the data of interest

[11]:
```
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
```

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.

[12]:
```
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]
```

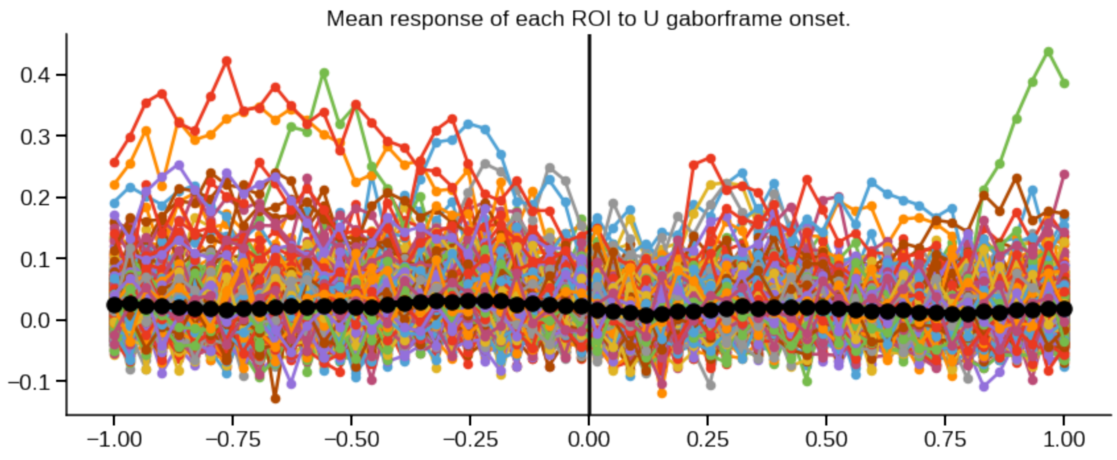
To **extract a numpy array** with the correct dimensions from a hierarchical dataframe, you can use the following utility.

Here, each index level, then column level becomes an 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 an axis.)

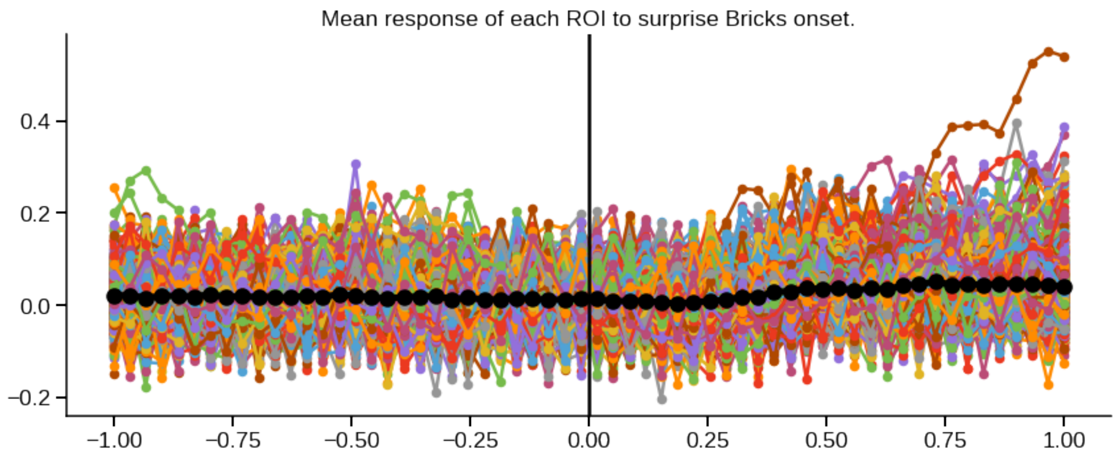
```
ROI data shape: 628 ROIs x 96 sequences x 60 time values
```

You can also retrieve the time stamps for each frame.

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



1.3.1 The same steps apply for Bricks



1.4 3. Additional tips on indexing a hierarchical dataframe

[17]:
```
scaled                              yes
baseline                             no
integrated                           no
smoothing                            no
```

```
fluorescence                    dff
ROIs sequences time_values
0    0         -1.000000    0.045433
               -0.966102   -0.303140
               -0.932203   -0.301464
               -0.898305   -0.219794
               -0.864407    0.065587
…                              …
643  4          0.864407   -0.513739
                0.898305   -0.143983
                0.932203    0.000693
                0.966102    0.140502
                1.000000    0.283351

[113040 rows x 1 columns]
```

1.4.1 4. Retrieving several Session objects, based on criteria

This function keeps track of which Sessions or Mice must be left out (e.g., due to a problem with the session data or the mouse didn't see the stimulus of interest <- the latter only comes up with pilot data).

You can now retrieve the mouse number, session number and ID that fit specific the criteria,

e.g., **session number 1, 2 or 3**, **production**, **dendritic plane**

```
WARNING: Sorted and unique will be set to False as multiple labels are
requested.
```

```
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)
```

You can now **initialize the Sessions** using this function which does the additional extraction steps automatically.

```
Creating session 764704289…
```

```
Loading stimulus and alignment info…
Creating stimulus objects…
Loading ROI trace info…
    WARNING: 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: 211 dropped running frames (~0.1%) (in pre-processing).
Finished creating session 764704289.

Creating session 765193831…
Loading stimulus and alignment info…
Creating stimulus objects…
Loading ROI trace info…
    WARNING: 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: 345 dropped running frames (~0.1%) (in pre-processing).
Finished creating session 765193831.

Creating session 766502238…
Loading stimulus and alignment info…
Creating stimulus objects…
Loading ROI trace info…
    WARNING: 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: 387 dropped running frames (~0.2%) (in pre-processing).
Finished creating session 766502238.

Creating session 777914830…
Loading stimulus and alignment info…
Creating stimulus objects…
Loading ROI trace info…
    WARNING: 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: 381 dropped running frames (~0.2%) (in pre-processing).
Finished creating session 777914830.

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

Creating session 758519303…
```

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

Then run through the sessions and do whatever with them.

```
Session ID: 764704289 (mouse 6, session 1)
    bricks: 33 sequences
    gabors: 96 sequences
Session ID: 765193831 (mouse 6, session 2)
    bricks: 34 sequences
    gabors: 98 sequences
Session ID: 766502238 (mouse 6, session 3)
    bricks: 29 sequences
    gabors: 94 sequences
Session ID: 777914830 (mouse 8, session 1)
    bricks: 32 sequences
    gabors: 83 sequences
Session ID: 778864809 (mouse 8, session 2)
    bricks: 29 sequences
    gabors: 88 sequences
Session ID: 758519303 (mouse 1, session 1)
    bricks: 31 sequences
    gabors: 94 sequences
```

1.4.2 5. Retrieving ROI masks from session.

Boolean ROI masks can be obtained for Session.

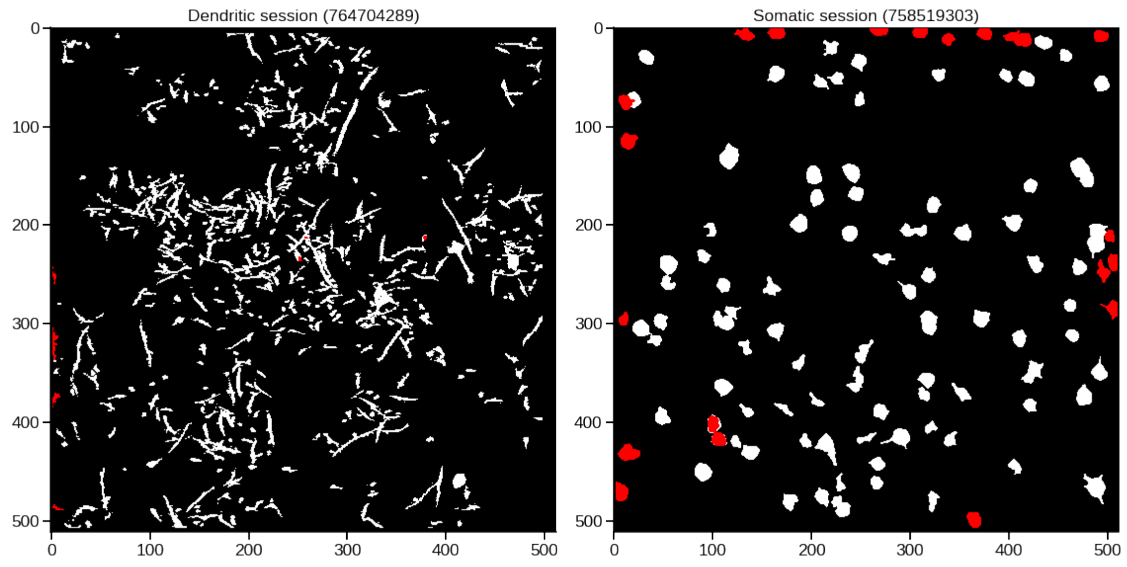
For **dendritic sessions**, the Session is built to assume that `EXTRACT` (not `allen`) ROI data is to be used. This can be checked by checking `self.dend`. As long as `self.dend` is properly set, the correct masks will be loaded.

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

Calling the attribute loads the boolean mask into the object: **ROI x height x width**

One way to check which ROIs are not valid, is using `self.get_nanrois()`

This is a tool to visualize ROIs, where specific ROIs can be set to red using a `valid_mask`.



This is a tool to visualize ROI contours, optionally localized around an ROI of interest.

1.4.3 6. Last notes

List of the methods/attributes attached to `Session` and `Stim` objects.