

session_demonstration_script

January 13, 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` (where **3** refers to Python 3).
- `util` is a [Github repo](#) of mine, and the correct branch `osca_mult` is automatically installed from `osca3.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 dictionary...
```

```
Loading alignment dataframe...
```

```
NOTE: Stimulus alignment pickle already exists in  
../data/OSCA/prod/mouse_413663/ophys_session_764704289
```

```
Loading sync h5 info...
```

```
Creating stimulus objects...
```

```
Loading ROI trace info...
```

```
WARNING: Noisy ROIs (mean below 0, median above midrange) are also included
```

in NaN ROI attributes (but not set to NaN): 244, 298, 305.

Loading running info...

WARNING: 211 running values were dropped, i.e., set to NaN (211 from pre-processing, 0 from diff thresh).

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

You can now get the **ROI/running/pupil data** corresponding to 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, syntactically.

```
[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]
```

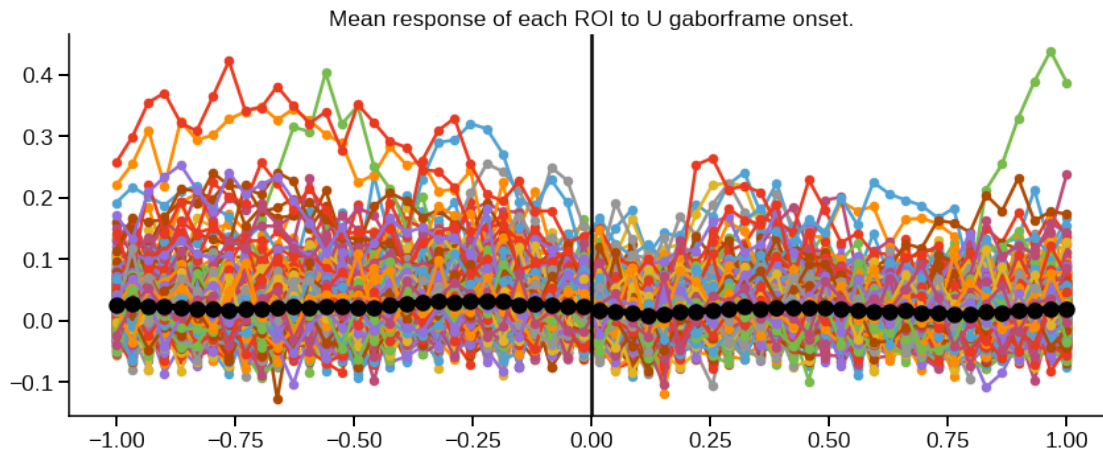
To **extract a numpy array** with the correct dimensions from a hierarchical dataframe, you can use the following utility.

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.)

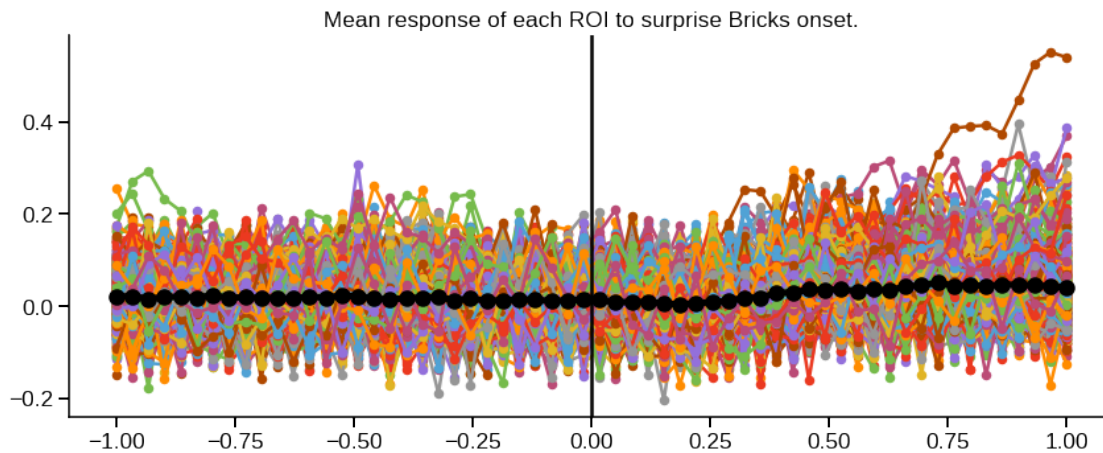
ROI data shape: 628 ROIs x 96 sequences x 60 time values

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 7: 777914830 (session 1)
mouse 7: 778864809 (session 2)
mouse 7: 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 dictionary...

Loading alignment dataframe...

NOTE: Stimulus alignment pickle already exists in
../data/OSCA/prod/mouse_413663/ophys_session_764704289

Loading sync h5 info...

Creating stimulus objects...

Loading ROI trace info...

WARNING: Noisy ROIs (mean below 0, median above midrange) are also included
in NaN ROI attributes (but not set to NaN): 244, 298, 305.

Loading running info...

WARNING: 211 running values were dropped, i.e., set to NaN (211 from pre-
processing, 0 from diff thresh).

Finished session 764704289.

Creating session 765193831...

Loading stimulus dictionary...

Loading alignment dataframe...

NOTE: Stimulus alignment pickle already exists in
../data/OSCA/prod/mouse_413663/ophys_session_765193831

Loading sync h5 info...

Creating stimulus objects...

Loading ROI trace info...

WARNING: Noisy ROIs (mean below 0, median above midrange) are also included
in NaN ROI attributes (but not set to NaN): 3, 63, 88, 134.

Loading running info...

WARNING: 345 running values were dropped, i.e., set to NaN (345 from pre-
processing, 0 from diff thresh).

Finished session 765193831.

Creating session 766502238...

Loading stimulus dictionary...

Loading alignment dataframe...

NOTE: Stimulus alignment pickle already exists in
../data/OSCA/prod/mouse_413663/ophys_session_766502238

Loading sync h5 info...

Creating stimulus objects...

Loading ROI trace info...

WARNING: Noisy ROIs (mean below 0, median above midrange) are also included

in NaN ROI attributes (but not set to NaN): 18, 114, 136, 240.
Loading running info...
WARNING: 387 running values were dropped, i.e., set to NaN (387 from pre-processing, 0 from diff thresh).
Finished session 766502238.

Creating session 777914830...

Loading stimulus dictionary...
Loading alignment dataframe...
NOTE: Stimulus alignment pickle already exists in
../data/OSCA/prod/mouse_420011/ophys_session_777914830
Loading sync h5 info...
Creating stimulus objects...
Loading ROI trace info...
WARNING: Noisy ROIs (mean below 0, median above midrange) are also included
in NaN ROI attributes (but not set to NaN): 45.
Loading running info...
WARNING: 381 running values were dropped, i.e., set to NaN (381 from pre-processing, 0 from diff thresh).
Finished session 777914830.

Creating session 778864809...

Loading stimulus dictionary...
Loading alignment dataframe...
NOTE: Stimulus alignment pickle already exists in
../data/OSCA/prod/mouse_420011/ophys_session_778864809
Loading sync h5 info...
Creating stimulus objects...
Loading ROI trace info...
WARNING: Noisy ROIs (mean below 0, median above midrange) are also included
in NaN ROI attributes (but not set to NaN): None.
Loading running info...
WARNING: 630 running values were dropped, i.e., set to NaN (630 from pre-processing, 0 from diff thresh).
Finished session 778864809.

Creating session 758519303...

Loading stimulus dictionary...
Loading alignment dataframe...
NOTE: Stimulus alignment pickle already exists in
../data/OSCA/prod/mouse_408021/ophys_session_758519303
Loading sync h5 info...
Creating stimulus objects...
Loading ROI trace info...
WARNING: Noisy ROIs (mean below 0, median above midrange) are also included

in NaN ROI attributes (but not set to NaN): None.

Loading running info...

WARNING: 175 running values were dropped, i.e., set to NaN (175 from pre-processing, 0 from diff thresh).

Finished 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 7, session 1)

bricks: 32 sequences

gabors: 83 sequences

Session ID: 778864809 (mouse 7, 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.

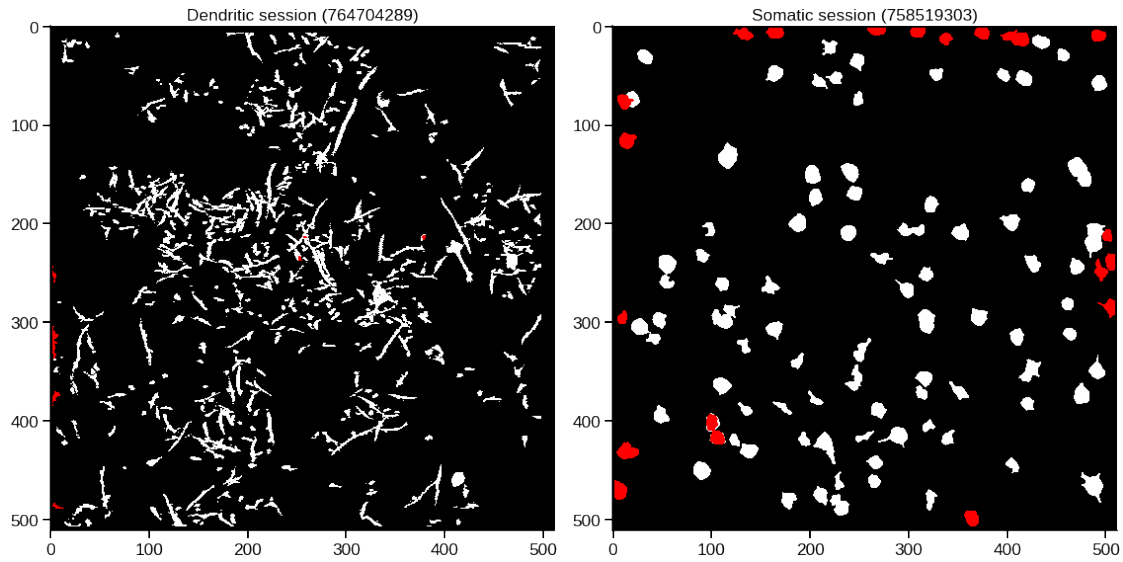
Dendritic session, ROI type: `extr`

Somatic session, ROI type: `allen`

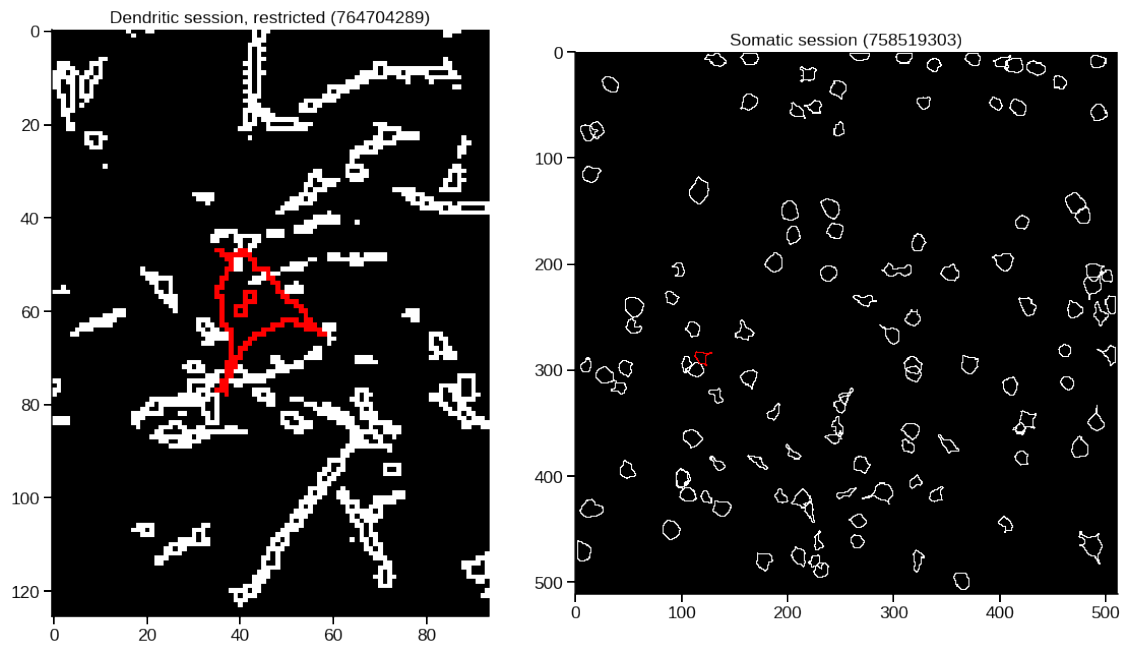
Calling the attribute loads the boolean mask into the object: **ROI x height x width**

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.

`Session`: `_align_df_loaded`, `_dend`, `_get_roi_facts`, `_init_directory`,
`_init_roi_facts_df`, `_load_align_df`, `_load_stim_dict`, `_load_stims`,
`_load_sync_h5_data`, `_roi_masks`, `_set_dend_type`, `_set_nanrois`,

_set_roi_attributes, _stim_dict_loaded, _sync_h5_loaded, align_pkl, all_files,
 any_files, behav_video_h5, bricks, check_flanks, correct_data_h5, date, dend,
 depth, dir, drop_stim_fr, droptol, expdir, expid, extract_info,
 extract_sess_attribs, gabors, get_active_rois, get_frames_timestamps,
 get_nanrois, get_nrois, get_plateau_roi_traces, get_pup_data,
 get_pup_fr_by_twop_fr, get_roi_seqs, get_roi_traces, get_run_velocity,
 get_run_velocity_by_fr, get_stim, get_stim_twop_fr_ns, get_twop_fr_ran, grayscr,
 home, line, load_pup_data, load_roi_info, load_run_data, mouse_dir, mouse_n,
 mouseid, n_drop_stim_fr, n_stims, nanrois_dff, notes, nrois, pass_fail, plane,
 post_blank, pre_blank, procdir, pup_data_h5, pup_fps, pup_fr_interv,
 pup_video_h5, roi_extract_json, roi_facts_df, roi_mask_file, roi_masks,
 roi_names, roi_objectlist, roi_trace_dff_h5, roi_trace_h5, run_data, runtime,
 segid, sess_gen, sess_n, sess_stim_seed, sess_within, sessid, stim2twopfr,
 stim_df, stim_dict, stim_fps, stim_pkl, stim_sync_h5, stims, stimtype_order,
 stimtypes, time_sync_h5, tot_pup_fr, tot_run_fr, tot_stim_fr, tot_twop_fr,
 twop2bodyfr, twop2pupfr, twop_fps, twop_fr_stim, zstack_h5

Gabors: _add_stim_fr_info, _add_twop_fr_info, _check_brick_prod_params,
 _set_block_params, _update_block_params, act_n_blocks, blank_per, block_params,
 deg_per_pix, disp_seq, exp_block_len_s, exp_n_blocks, extra_segs,
 get_A_frame_1s, get_A_segs, get_all_surp_segs, get_all_surp_stim_fr,
 get_first_surp_segs, get_first_surp_stim_fr_trans, get_n_twop_fr_by_seg,
 get_pup_diam_data, get_pup_diam_stats_df, get_roi_data, get_roi_stats_df,
 get_run, get_run_data, get_run_stats_df, get_segs_by_criteria,
 get_segs_by_twopfr, get_stats_df, get_stim_beh_sub_df, get_stim_df_by_criteria,
 get_stim_fr_by_criteria, get_stim_fr_by_seg, get_stim_par_by_seg,
 get_stim_par_by_twopfr, get_twop_fr_by_seg, n_patches, n_seg_per_set, ori_kaps,
 ori_ran, ori_std, oris, oris_pr, phase, pos_x, pos_x_ran, pos_y, pos_y_ran,
 post, pre, reg_max_s, reg_min_s, seg_len_s, seg_ps_nobl, seg_ps_wibl, sess,
 set_len_s, sf, size_ran, sizes_pr, stim_fps, stim_n, stim_seg_list, stimtype,
 surp_max_s, surp_min_s, units, win_size

Bricks: _add_stim_fr_info, _add_twop_fr_info, _check_brick_prod_params,
 _set_block_params, _update_block_params, act_n_blocks, blank_per, block_params,
 deg_per_pix, direcs, disp_seq, exp_block_len_s, exp_n_blocks, extra_segs,
 flipfrac, get_all_surp_segs, get_all_surp_stim_fr, get_dir_segs_reg,
 get_first_surp_segs, get_first_surp_stim_fr_trans, get_n_twop_fr_by_seg,
 get_pup_diam_data, get_pup_diam_stats_df, get_roi_data, get_roi_stats_df,
 get_run, get_run_data, get_run_stats_df, get_segs_by_criteria,
 get_segs_by_twopfr, get_stats_df, get_stim_beh_sub_df, get_stim_df_by_criteria,
 get_stim_fr_by_criteria, get_stim_fr_by_seg, get_twop_fr_by_seg, n_bricks,
 reg_max_s, reg_min_s, seg_len_s, seg_ps_nobl, seg_ps_wibl, sess, sizes, speed,
 stim_fps, stim_n, stim_n_all, stim_seg_list, stimtype, surp_max_s, surp_min_s,
 units