Visual Behavior Project SDK Documentation
Jump Link Table of Contents

Cache Tables:

Datasets:

Cache Tables:

Description:

The `VisualBehaviorOphysProjectCache` object in the AllenSDK is the easiest way to interact with the released data. This object abstracts away the details of on-disk file storage and delivers the data to you as ready-to-analyze Python objects. The cache will automatically keep track of which files are stored locally and will download additional files on an as-needed basis.

As part of the cache there are three tables which provide a summary level view of all the currently released datasets. Each of the summary tables of information is organized according to it's filename (ophys_experiment_table is organized by ophys_experiment_id).

Ophys Experiment table
Ophys Session table
Behavior session table

Ophys Experiment Table:

The `ophys_experiment_table` contains metadata and experimental conditions for each imaging plane recorded in each imaging session in the dataset, which is associated with a unique ophys_experiment_id. Only ophys_experiments that passed ophys QC are included in this table.

Access/Loading:

The ophys_experiment_table can be accessed through the `VisualBehaviorOphysProjectCache` using the `.get_ophys_experiment_table()` method. The index of the dataframe is the ophys_experiment_id

column	data type	description
age_in_days	int	age of mouse in days
behavior_session_id	int	unique identifier for a behavior session
cre_line	string	cre driver line for a transgenic mouse
date_of_acquisition	date time object	date and time of experiment acquisition, yyyy-mm-dd hh:mm:ss.
driver_line	list of string	all driver lines for transgenic mouse
equipment_name	string	identifier for equipment data was collected on
file_id	int	lookup id to retrieve NWB file from S3 or the local cache.
full_genotype	string	full genotype of transgenic mouse
imaging_depth	int	depth in microns from the cortical surface, where the data was collected
indicator	string	transgenic mouse indicator
mouse_id	int	unique identifier for a mouse
ophys_container_id	int	unique identifier for an ophys container (grouping of ophys experiments by FOV)
ophys_experiment_id [index]	int	unique identifier for an ophys experiment
ophys_session_id	int	unique identifier for a ophys session
prior_exposures_to_image_set	float 64	number of sessions (training / behavior sessions or experiment/ophys) where the mouse used that image set. Starts at 0 for first exposure

prior_exposures_to_omissions	int 64	number of sessions (behavior sessions or experiment/ophys) where the mouse exposed to omissions. Starts at 0 for first exposure. Omissions do not occur during training
prior_exposures_to_session_type	int 64	Number of previous sessions (training / behavior sessions or experiment/ophys) the mouse was exposed to specific session type. Starts at 0 for first exposure
project_code	string	dataset variant the mouse belongs to (scientifica vs. mesoscope, trained on stim A vs. B)
reporter_line	string	reporter line for transgenic mouse
session_number	float 64	For ophys (non-training) sessions only, session number is the number associated with the session type. (Eg. OPHYS_2_images_A_passive has session_number 2)
session_type	string	visual stimulus type displayed during behavior session
sex	string	sex of the mouse
targeted_structure	string	visual area targeted by the experiment field of view

Ophys Session Table

Description:

The ophys_session_table describes metadata and experimental conditions for all 2-photon imaging sessions, which can contain one or more imaging planes (ophys_experiment_ids) depending on the microscope that was used for that session. Only ophys sessions containing ophys experiments that passed QC are included in this table.

Access/Loading:

The `ophys_session_table` can be accessed through the `VisualBehaviorOphysProjectCache` using the `.get_ophys_session_table()` method. The index for the dataframe is the ophys_session_id.

Column	data type	description
age_in_days	int	age of mouse in days
behavior_session_id	int	unique identifier for a behavior session
cre_line	string	cre driver line for a transgenic mouse
date_of_acquisition	date time object	date and time of experiment acquisition, yyyy-mm-dd hh:mm:ss.
Driver_line	list of string	all driver lines for transgenic mouse
equipment_name	string	identifier for equipment data was collected on
full_genotype	string	full genotype of transgenic mouse
indicator	string	transgenic mouse indicator
mouse_id	int	unique identifier for a mouse
ophys_container_id	int	unique identifier for an ophys container (grouping of ophys experiments by FOV)
ophys_experiment_id	int	unique identifier for an ophys experiment
ophys_session_id	int	unique identifier for a ophys session
prior_exposures_to_image_set	float 64	Number of sessions (training / behavior sessions or experiment/ophys) where the mouse used that image set. Starts at 0 for first
prior_exposures_to_omissions	int 64	Number of sessions (behavior sessions or experiment/ophys) where the mouse exposed to

		omissions. Starts at 0 for first exposure. Omissions do not occur during training
prior_exposures_to_session_type	int 64	Number of previous sessions (training / behavior sessions or experiment/ophys) the mouse was exposed to specific session type. Starts at 0 for first exposure
project_code	string	dataset variant the mouse belongs to (scientifica vs. mesoscope, trained on stim A vs. B)
reporter_line	string	reporter line for transgenic mouse
session_number	float 64	For ophys (non-training) sessions only, session number is the number associated with the session type. (Eg. OPHYS_2_images_A_passive has session_number 2). NaN for training sessions.
Session_type	string	visual stimulus type displayed during behavior session
sex	string	sex of the mouse

Behavior Session Table

The `behavior_session_table` describes metadata and experimental conditions for behavioral sessions, including behavioral training, and behavior concurrent with 2-photon imaging. This contains all sessions experienced by each mouse in the dataset, including those that did not pass ophys QC and are excluded from the `ophys_session_table` and `ophys_eperiment_table`.

Access/Loading:

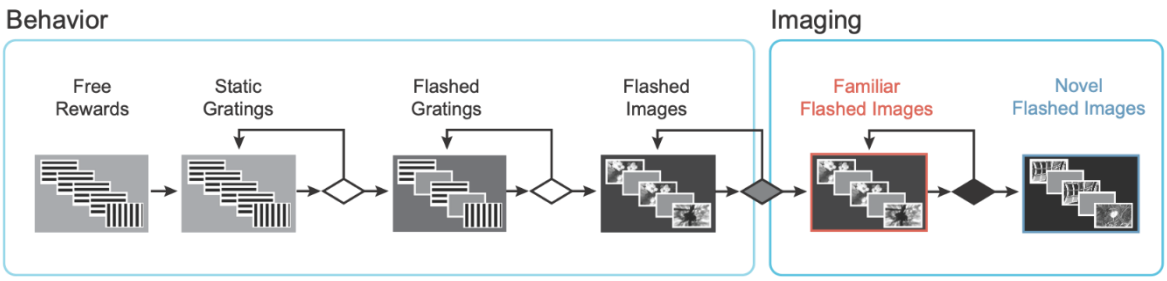
The `behavior_session_table` can be accessed through the `VisualBehaviorOphysProjectCache` using the `.get_behavior_session_table()` method. The index for the dataframe is the behavior_session_id.

column	data type	description
age_in_days	int	age of mouse in days
behavior_session_id [index]	int	unique identifier for a behavior session
cre_line	string	cre driver line for a transgenic mouse
date_of_acquisition	date time object	date and time of experiment acquisition, yyyy-mm-dd hh:mm:ss.
driver_line	list of string	all driver lines for transgenic mouse
equipment_name	string	identifier for equipment data was collected on
file_id	int	lookup id to retrieve NWB file from S3 or the local cache.
full_genotype	string	full genotype of transgenic mouse
indicator	string	transgenic mouse indicator
mouse_id	int	unique identifier for a mouse
ophys_container_id	int	unique identifier for an ophys container (grouping of ophys experiments by FOV)
ophys_experiment_id	int	unique identifier for an ophys experiment
ophys_session_id	int	unique identifier for a ophys session
prior_exposures_to_image_set	float 64	number of sessions (training / behavior sessions or experiment/ophys) where the mouse used that image set. Starts at 0 for first exposure
prior_exposures_to_omissions	int 64	number of sessions (training / behavior sessions or experiment/ophys) where the mouse exposed

		to omissions. Starts at 0 for first exposure. Omissions do not occur during training
prior_exposures_to_session_type	int 64	Number of previous sessions (training / behavior sessions or experiment/ophys) the mouse was exposed to specific session type. Starts at 0 for first exposure
project_code	string	dataset variant the mouse belongs to (scientifica vs. mesoscope, trained on stim A vs. B)
reporter_line	string	reporter line for transgenic mouse
session_number	float 64	For ophys (non-training) sessions only, session number is the number associated with the session type. (Eg. OPHYS_2_images_A_passive has session_number 2). NaN for training sessions.
session_type	string	visual stimulus type displayed during behavior session
sex	string	sex of the mouse

Datasets:

There are two datasets associated with the visual behavior project. The Behavior Session dataset and the Experiment Session dataset. The Behavior Session dataset contains the data streams associated with the behavior of the mouse and it's task performance while the Experiment Session dataset contains data streams associated with the collection of two photon optical physiology data for that mouse. During the training of the mice, only behavior data was collected, and thus, training sessions only have Behavior Session datasets. However, an imaging/ optical physiology (known as an Experiment Session) has both the Behavior Session dataset and the Experiment Session dataset.



This schematic from the white paper illustrates the task progression. The section labeled 'Behavior' indicates the behavior training process, and all sessions taking place in that phase of the task would only have Behavior Session datasets. The section labeled 'Imaging' is the optical physiology portion of the task and sessions in that phase will have both Behavior Session datasets and Experiment Session datasets.

Behavior Session Dataset

A dataset containing attributes that only pertain to the behavior data, such as running, licks, stimulus presentation etc. If this data was collected in conjunction with optical physiology it will have a separate experiment dataset that will have ophys experiment specific data and overlapping behavior data. However, it may have been collected without optical physiology as part of behavior training and would not have a corresponding behavior session dataset. Behavior session dataset timestamps are not aligned to external 'synchronization' reference timestamps. Synchronized timestamps are only available for experiment datasets.

Access/Loading:

The behavior session dataset object can be accessed through the `VisualBehaviorOphysProjectCache` using the `.get_behavior_session()` method, as well as by initializing the class directly after importing (`from allensdk.brain_observatory.behavior.behavior_session import BehaviorSession`)

attribute	data type	description
Behavior session id	int	9 digit unique identifier for the behavior session
licks	table	a dataframe containing lick times
metadata	dictionary	behavior session specific metadata including genotype, equipment name, etc
performance metrics	table	a dataframe containing session scale behavior response performance metrics
raw running speed	table	a table containing timestamps and unfiltered running speed

rewards	table	timestamps and delivered rewards
reward rate	array	array of calculated reward rates
rolling performance	table	a dataframe of trial scale behavior response performance metrics
running speed	table	a table containing timestamps and filtered running speed
stimulus presentations	table	times of every stimulus presentation/image flash as well as associate metadata
stimulus templates	table	a table containing stimulus images presented
stimulus timestamps	array	timestamps associated with the stimulus presentations on the monitor
task parameters	dictionary	parameters used to define task runtime behavior
trials	table	behavior trial data including change time and trial type

Behavior Session Id

Description:
A 9-digit unique identifier for a behavior session

Access/Loading:
```
behavior_session_dataset.behavior_session_id
experiment_dataset.behavior_session_id
```

Licks

Description:
A dataframe containing lick timestamps and frames, sampled at 60Hz.

Access/Loading:
```
behavior_session_dataset.licks
experiment_dataset.licks
```

Table:

column	data type	description
timestamps	float 64	time of lick, in seconds
frame	int	frame of lick

Metadata

Description:
A dictionary containing behavior session specific metadata.

Access/Loading:
```
behavior_session_dataset.metadata
```

Dictionary:

key	value data type	description
age_in_days	int	age of mouse in days
behavior_session_id	int	unique identifier for a behavior session
behavior_session_uuid	uuid	unique identifier for a behavior session
cre_line	string	cre driver line for a transgenic mouse

date_of_acquisition	date time object	date and time of experiment acquisition, yyyy-mm-dd hh:mm:ss.
driver_line	list of string	all driver lines for transgenic mouse
equipment_name	string	identifier for equipment data was collected on
full_genotype	string	full genotype of transgenic mouse
mouse_id	int	unique identifier for a mouse
reporter_line	string	reporter line for transgenic mouse
session_type	string	visual stimulus type displayed during behavior session
sex	string	sex of the mouse
stimulus_frame_rate	float	frame rate (Hz) at which the visual stimulus is displayed

Performance Metrics

Description:
a dataframe containing session scale behavior response performance metrics

Access/Loading:
```
behavior_session_dataset.get_performance_metrics()
experiment_dataset.get_performance_metrics()
```

Table:

key	value data type	description
trial_count	int	The length of the trial dataframe (including all go, catch and aborted trials)
go_trial_count	int 64	number of go trials in a behavior session
catch_trial_count	int 64	number of catch trial types during a behavior session
hit_trial_count	int 64	number of trials with a hit behavior response type in a behavior session
miss_trial_count	int 64	number of trials with a miss behavior response type in a behavior session
false_alarm_trial_count	int 64	number of trials where the mouse had a false alarm behavior response
correct_reject_trial_count	int 64	number of trials with a correct reject behavior response during a behavior session
auto_rewarded_trial_count	int 64	number of trials where the mouse received an auto reward of water.
rewarded_trial_count	int 64	number of trials where the mouse was eligible to receive a water reward (go trials) and did receive an earned water reward
total_reward_count	int	number of trials where the mouse received a water reward (earned or auto rewarded)
total_reward_volume	float 64	volume of all water rewards received during a behavior session (earned and auto rewarded)
maximum_reward_rate	float 64	The peak of the rolling reward rate (rewards/minute)
engaged_trial_count	int 64	number of trials where the mouse is engaged (reward rate > 2 rewards/minute)
mean_hit_rate	float 64	The mean of the rolling hit_rate
mean_hit_rate_uncorrected	float 64	The mean of the rolling hit_rate_raw

mean_hit_rate_engaged	float 64	The mean of the rolling hit_rate, excluding epochs when the rolling reward rate was below 2 rewards/minute
mean_false_alarm_rate	float 64	The mean of the rolling false_alarm_rate, excluding epochs when the rolling reward rate was below 2 rewards/minute
mean_false_alarm_rate_uncorrected	float 64	The mean of the rolling false_alarm_rate_raw
mean_false_alarm_rate_engaged	float 64	The mean of the rolling false_alarm_rate, excluding epochs when the rolling reward rate was below 2 rewards/minute
mean_dprime	float 64	The mean of the rolling d_prime
mean_dprime_engaged	float 64	The mean of the rolling d_prime, excluding epochs when the rolling reward rate was below 2 rewards/minute
max_dprime	float 64	The peak of the rolling d_prime
max_dprime_engaged	float 64	The peak of the rolling d_prime, excluding epochs when the rolling reward rate was below 2 rewards/minute

Rolling Performance

Description:
Trial by trial behavior response performance metrics.

Access/Loading:
```
behavior_session_dataset.get_rolling_performance_df()
experiment_dataset.get_rolling_performance_df()
```

Table:

column	data type	description
trials_id [index]	int 64	Index of the trial. All trials, including aborted trials, are assigned an index starting at 0 for the first trial.
reward_rate	float 64	Rewards earned in the previous 25 trials, normalized by the elapsed time of the same 25 trials. Units are rewards/minute
hit_rate_raw	float 64	fraction of go trials where the mouse licked in the response window, calculated over the previous 100 non-aborted trials. Without trial count correction applied.
hit_rate	float 64	fraction of go trials where the mouse licked in the response window, calculated over the previous 100 non-aborted trials. With trial count correction applied.
false_alarm_rate_raw	float 64	fraction of catch trials where the mouse licked in the response window, calculated over the previous 100 non-aborted trials. Without trial count correction applied.
false_alarm_rate	float 64	fraction of catch trials where the mouse licked in the response window, calculated over the previous 100 non-aborted trials. Without trial count correction applied.
rolling_dprime	float 64	d prime calculated using the rolling hit_rate and rolling false_alarm _rate

Raw Running Speed

Description:
Unfiltered running speed and timestamps sampled at 60Hz.

Access/Loading
```
behavior_session_dataset.raw_running_speed
experiment_dataset.raw_running_speed
```

Table:

column	data type	description
timestamps	float	time in seconds
speed	float	speed in cm/sec

Rewards

Description:
A dataframe containing timestamps of delivered rewards in absolute sync time. Timestaps are sampled at 60 Hz.

Access/Loading:
```
behavior_session_dataset.rewards
experiment_dataset.rewards
```

Table:

column	data type	description
volume	float	volume of individual water reward in ml. 0.007 if earned reward, 0.005 if auto reward
timestamps	float	time in seconds
autorewarded	bool	True if free reward was delivered for that trial. Occurs during the first 5 trials of a session and throughout as needed.

Reward Rate

Description:
An array of calculated reward rates. Reward rate is calculated of a 25 trial rolling window and provides a measure of the rewards earned per unit time (in unites of rewards/min)

Access/Loading:
```
behavior_dataset.get_reward_rate()
experiment_dataset.get_reward_rate()
```

Running speed

Description:
Running speed and timestamps sampled at 60hz. A 10Hz low pass filter has been applied to the data. To get the running speed without the filter, use `raw_running_speed`.

Access/Loading:
```
behavior_session_dataset.running_speed
experiment_dataset.running_speed
```

Table:

column	data type	description
timestamps	float	time in seconds

speed	float	speed in cm/sec

Stimulus Presentations

Description:
Table whose rows are stimulus presentations (i.e. flashes of a given image, for a given duration, typically 250 ms) and whose columns are presentation characteristics. Table contains every image presented , including those associated with trials that were aborted.

Access/Loading:
```
behavior_session_dataset.stimulus_presentations
experiment_dataset.stimulus_presentations
```

Table:

column	data type	description
stimulus_presentations_id [index]	int 64	identifier for a stimulus presentation (presentation of an image)
duration	float 64	duration of image flash in seconds (stop time - start time), NaN if omitted
end_frame	float 64	image presentation end frame
image_index	int 64	image index (0-7) for a given session, corresponding to each image name
image_name	string	name of image presented, if 'omitted' then no image was presented
image_set	string	image set for this session
index	int 64	An index assigned to each stimulus presentation
omitted	bool	True if no image was shown for this stimulus presentation
start_frame	int 64	image presentation start frame
start_time	float 64	image presentation start time in seconds
stop_time	float 64	image presentation end time in seconds

Stimulus Templates

Description:
A pandas DataFrame object containing the stimulus images for the experiment. Indices are image names, 'warped' and 'unwarped' columns contain image arrays.

Access/Loading:
```
behavior_session_dataset.stimulus_templates
experiment_dataset.stimulus_templates
```

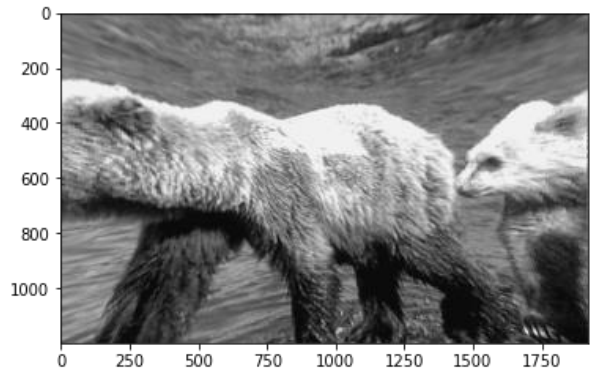
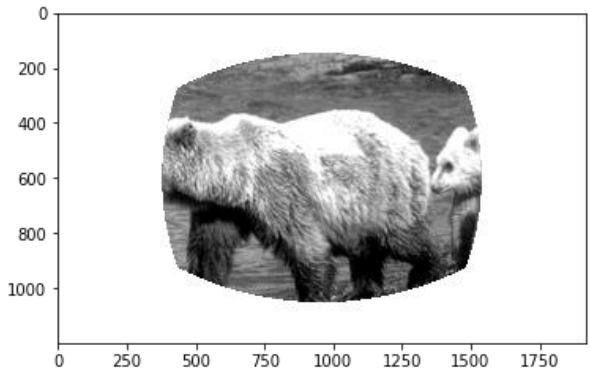
Table:

column	data type	description
image_name [index]	string	name of image presented, if 'omitted' then no image was presented
unwarped	array of int	image array of unwarped stimulus image
warped	array of int	image array of warped stimulus image

Display:
use matplotlib.pyplot:

plt.imshow(BehaviorOphysDataset.stimulus_templates['unwarped']['im065'], cmap = 'gray')

Example Images:

	
warped image example	unwarped image example

Stimulus Timestamps

Description:
Timestamps associate with the stimulus presentations on the monitor. Sampled at 60Hz. An array of float 64.

Access/Loading:
```
behavior_session_dataset.stimulus_timestamps
experiment_dataset.stimulus_timestamps
```

Task Parameters

Description:
Parameters used to define the task runtime behavior

Access/Loading:
```
behavior_session_dataset.task_parameters
experiment_dataset.task_parameters
```

Table:

column	data type	description
blank_duration_sec	list of float	Duration in seconds of inter stimulus interval. Inter-stimulus interval is chosen as a uniform random value between the range defined by the two values. Values are ignored if `stimulus_duration_sec` is null
stimulus_duration_sec	float	duration in seconds of each stimulus image presentation
omitted_flash_fraction	float	Probability that a stimulus image presentations is omitted. Change stimuli, and the stimulus immediately preceding the change, are never omitted.
response_window_sec	list of float	The range of the period following an image change, in seconds, where mouse response influences trial outcome. The irst value represents response window start. The second value represents response window end. The values represent time before display lag is accounted for and applied.

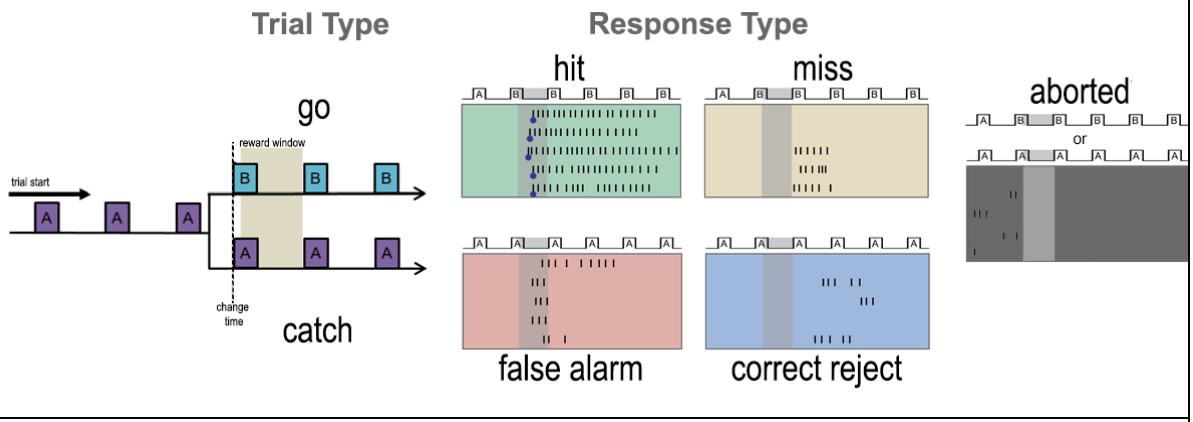
reward_volume	float	volume of earned water reward in ml (0.007)
auto_reward_volume	float	volume of auto rewards in ml (0.005ml)
session_type	string	visual stimulus type displayed during behavior session
stimulus	string	stimulus type
stimulus_distribution	string	distribution for drawing change times. Either ‘exponential’ or ‘geometric’
task	string	type of visual stimulus task, 'change detection'
n_stimulus_frames	int	total number of visual stimulus frames presented during a behavior session

Trials

Description:
A dataframe containing trial and behavioral response data, organized by cell specimen id.

Access/Loading:
```
behavior_session_dataset.trials
experiment_dataset.trials
```

Supplementary Images:



Trial and response type diagrams

Table:

column	data type	description
trials_id [index]	int 64	trial identifier
lick_times	array of float	array of lick times in seconds during that trial. Empty array if no licks occurred during that trial.
reward_time	NaN or float	Time the reward is delivered following a correct response or on autorewarded trials.
reward_volume	float	volume of reward in ml. (0.005 for auto reward and 0.007 for earned reward)
hit	bool	[behavior response type] on a go trial, mouse licks within reward window
false_alarm	bool	[behavior response type] on a catch trial, mouse licks within reward window
miss	bool	[behavior response type] on a go trial, mouse either does not lick at all, or licks after reward window

stimulus_change	bool	True if an image change occurs during the trial (if the trial was both a 'go' trial and the trial was not aborted)
aborted	bool	[behavior response type] True if mouse licks before the scheduled change time .
go	bool	[trial type] True if there was a change in stimulus image identitye on this trial
catch	bool	[trial type] True if there was not a change in stimulus image identity on this trial
auto_rewarded	bool	True if free reward was delivered for that trial. Occurs during the first 5 trials of a session and throughout as needed.
correct_reject	bool	[behavior response type] on a catch trial, mouse either does not lick at all or licks after reward window
start_time	float 64	start time of the trial in seconds
stop_time	float 64	end time of the trial in seconds
trial_length	float 64	duration of trial, in seconds (stop time - start time)
response_time	float 64	time of first lick in trial in seconds, and NaN if trial aborted
change_frame	float 64	frame of image change
change_time	float 64	time of image change in seconds
response_latency	float 64	time of first lick relative to the change time and NaN if trial aborted. (response_time - change_time)
initial_image_name	string	name of image presented at start of trial
change_image_name	string	name of image that is changed to at the change time, on go trials

Behavior Ophys Experiment dataset:

A dataset that combines both behavior session data such as running, licks, and rewards etc., as well as optical physiology data collected from a single imaging field of view(referred to as an experiment). Timescales of all data streams are aligned to a common time clock and tables that contain information about cells are filtered such that only rois that are considered cells are included (please see the white paper ROI filtering section for more information).

Access/Loading:

The behavior ophys experiment dataset object can be accessed through the `VisualBehaviorOphysProjectCache` using the `.get_behavior_ophys_experiment()` method, as well as by initializing the class directly after importing (`from allensdk.brain_observatory.behavior.behavior_ophys_experiment import BehaviorOphysExperiment`)

attribute	data type	description
average projection	image	2D image of the microscope field of view, averaged across the experiment
behavior session id	int	unique identifier for the behavior session
cell specimen table	table	cell roi information organized into a dataframe
corrected fluorescence traces	table	traces of change in fluorescence
dff traces	table	traces of dff (change in fluorescence / fluorescence)
events	table	A dataframe containing spiking events in traces derived from the two photon movies.
eye tracking	table	ellipse fit parameters for eye tracking
licks	table	a dataframe containing lick times
max projection	image	2D maximum intensity projection image of the ophys movie
metadata	dictionary	dataset specific metadata including genotype, imaging depth, etc.
motion correction	table	x and y offsets/shifts applied during motion correction
ophy experiment id	int	unique identifier for the ophys experiment
ophys session id	int	unique identifier for the ophys session
ophys timestamps	array	timestamps associated with frames captured by the microscope
performance metrics	table	a dataframe containing session scale behavior response performance metrics
raw running speed	table	a table containing timestamps and unfiltered running speed
rewards	table	timestamps and delivered rewards
reward rate	array	array of calculated reward rates
rolling performance	table	a dataframe of trial scale behavior response performance metrics
running speed	table	a table containing timestamps and filtered running speed
segmentation mask image	image	a 2D binary image of all ROI masks
stimulus presentations	table	times of every stimulus presentation/image flash as well as associate metadata
stimulus templates	table	a table containing stimulus images presented
stimulus timestamps	array	timestamps associated with the stimulus presentations on the monitor
task parameters	dictionary	parameters used to define task runtime behavior

trials	table	behavior trial data including change time and trial type

***** rows in light green are attributes unique to the experiment datasets. All other attributes overlap and can also be found in the behavior session dataset attributes.

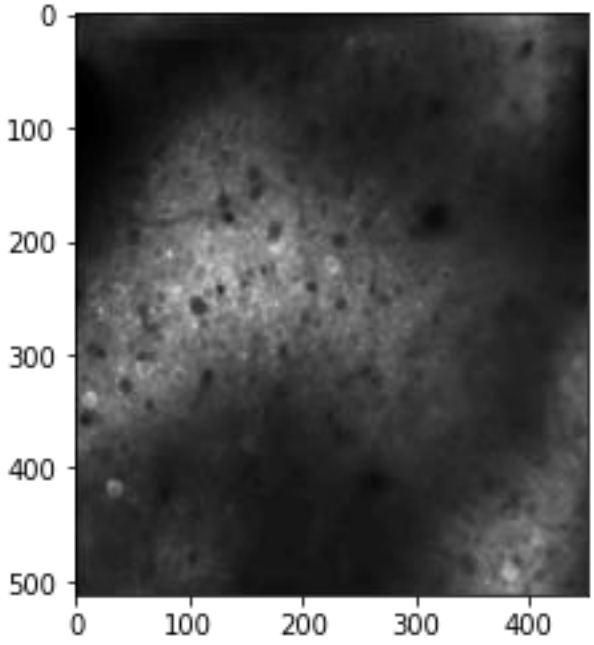
Average Projection:

Description:
2D image of the 2-photon microscope field of view, averaged across the experiment

Access/Loading:
`experiment_dataset.average_projection`

Display:
use matplotlib.pyplot:
`plt.imshow(experiment_dataset.average_projection, cmap = 'gray')`

Example Image:



An example of an average intensity projection image from a

Cell Specimen Table

Description:
Cell information organized into a dataframe. Table only contains roi_valid = True entries, as invalid ROIs/ non cell segmented objects have been filtered out.

Access/Loading:
`experiment_dataset.cell_specimen_table`

Table:

Columns	data type	description

cell_specimen_id [index]	int 64	unified id of segmented cell across experiments (assigned after cell matching)
cell_roi_id	int	experiment specific id of segmented roi (assigned before cell matching)
height	int 64	height of ROI in pixels
mask_image_plane	int 64	which image plane an ROI resides on. Overlapping ROIs are stored on different mask image planes
max_correction_down	float 64	max motion correction in down direction in pixels
max_correction_left	float 64	max motion correction in left direction in pixels
max_correction_right	float 64	max motion correction in right direction in pixels
max_correction_up	float 64	max motion correction in up direction in pixels
roi_mask	array of bool	an image array that displays the location of the roi mask in the field of view
valid_roi	bool	indicates if cell classification found the ROI to be a cell or not (True = cell, False = not cell).
width	int 64	width of ROI in pixels
x	float 64	x position of ROI in Image Plane in pixels (top left corner)
y	float 64	y position of ROI in Image Plane in pixels (top left corner)

Corrected Fluorescence Traces

Description:

Dataframe that contains the corrected fluorescence traces for all valid cells. corrected fluorescence traces are neuropil corrected and demixed. Sampling rate can be found in metadata 'ophys_frame_rate'.

Access/Loading:

```
experiment_dataset.corrected_fluorescence_traces
```

Table:

column	data type	description
cell_specimen_id [index]	int 64	unified id of segmented cell across experiments (assigned after cell matching)
cell_roi_id	int	experiment specific id of segmented roi (assigned before cell matching)
corrected_fluorescence	list of float	fluorescence values (arbitrary units)

Dff Traces

Description:

Baseline normalized and detreded fluorescence traces for all valid cells in a ophys experiment, organized by cell_specimen_id.For more information on dF/F calculation see white paper dF/F calculation section. Sampling rate can be found in metadata 'ophys_frame_rate'.

Access/Loading:

```
experiment_dataset.dff_traces
```

Table:

column	data type	description
cell_specimen_id [index]	int 64	unified id of segmented cell across experiments (assigned after cell matching)

cell_roi_id	int 64	experiment specific id of segmented roi (assigned before cell matching)
dff	list of float	fluorescence fractional values relative to baseline (arbitrary units)

Events

Description:

A dataframe containing spiking events in traces derived from the two photon movies, organized by cell specimen id. For more infomration on event detection processing please see the event detection portion of the white paper.

Access/Loading:

```
experiment_dataset.events
```

Table:

column	data type	description
cell_specimen_id [index]	int 64	unified id of segmented cell across experiments (assigned after cell matching)
cell_roi_id	int 64	experiment specific id of segmented roi (assigned before cell matching)
events	array of float	event trace where events correspond to the rise time of a calcium transient in the dF/F trace, with a magnitude roughly proportional the magnitude of the increase in dF/F.
filtered_events	array of float	Events array with a 1d causal half-gaussian filter to smooth it for visualization. Uses a halfnorm distribution as weights to the filter
lambda	float 64	regularization value selected to make the minimum event size be close to N * noise_std
noise_std	float 64	estimated noise standard deviation for the events trace

Eye Tracking

Description:

A dataframe containing ellipse fit parameters for the eye, pupil and corneal reflection (cr). Fits are derived from tracking points from a DeepLabCut model (trained on hand-annotated data from a subset of imaging sessions on optical physiology rigs) applied to video (collected at 30hz) frames of a subject's right eye. Raw tracking points and raw video frames are not publicly available.

definitions and calculations:

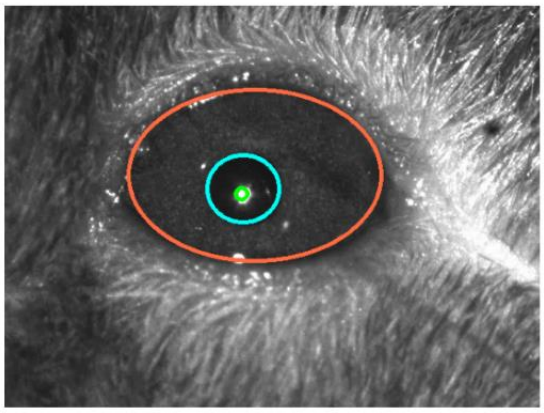
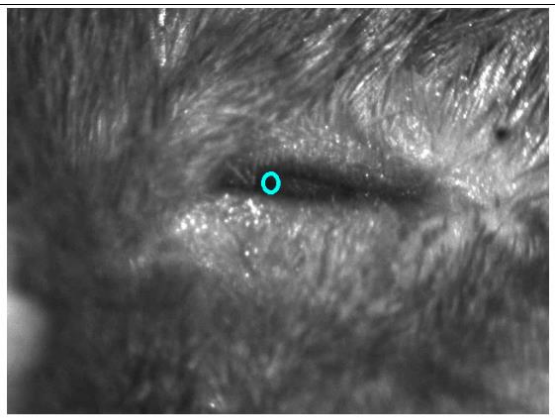
- 'cr' refers to the corneal reflection, which is caused by an infrared LED positioned near the eye tracking camera.
- area: for a the eye and corneal reflection, area is calculated directly upon the ellipses. However, for pupil, a circle is calculated from the major axis of the ellipse. We use the major axis of the ellipse and not the ellipse itself to calculate a circle because we assume the pupil is circular.
- height: minor axis of the ellipse ◦ width: major axis of the ellipse
- phi: angle, in radians, between the x-axis and the ellipse axis within +/- pi/4 rad of the x-axis.
- likely blink: frames where the pupil fit failed or eye fit failed or an outlier fit was identified

units & values:

- NaNs occur when DeepLabCut didn't output enough points to fit an ellipse.
- all positions (width, height, center_x, center_y) are in units of pixels
- all areas are in units of pixels^2

- All values are in the coordinate space of the eye tracking camera, NOT the coordinate space of the stimulus display (i.e. this is not gaze location), with (0, 0) being the upper-left corner of the eye-tracking image.

Supplemental Images:

	
Example ellipse fits. red: eye ellipse cyan: pupil ellipse green: corneal reflection ellipse	example of a likely blink frame

Access/Loading:

```
experiment_dataset.eye_tracking
```

Table:

column	data type	description
frame [index]	int 64	frame of eye tracking video
timestamps	float 64	time in seconds
cr_area	float 64	area of corneal reflection ellipse in pixels squared
eye_area	float 64	area of eye ellipse in pixels squared
pupil_area	float 64	area of pupil ellipse in pixels squared
likely_blink	bool	True if frame has outlier ellipse fits, which is often caused by blinking / squinting of the eye.
pupil_area_raw	float 64	pupil area with no outliers/likely blinks removed.
cr_area_raw	float 64	corneal reflection area with no outliers/likely blinks removed.
eye_area_raw	float 64	eye area with no outliers/likely blinks removed.
cr_center_x	float 64	center of corneal reflection on x axis in pixels
cr_center_y	float 64	center of corneal reflection on y axis in pixels
cr_height	float 64	corneal reflection height (minor axis of the CR ellipse) in pixels
cr_phi	float 64	corneal reflection rotation angle in radians
cr_width	float 64	corneal reflection width (major axis of the CR ellipse) in pixels
eye_center_x	float 64	center of eye ellipse on x axis in pixels
eye_center_y	float 64	center of eye ellipse on y axis in pixels
eye_height	float 64	eye height (minor axis of the eye ellipse) in pixels
eye_phi	float 64	eye rotation angle in radians
eye_width	float 64	eye width (major axis of the eye ellipse) in pixels
pupil_center_x	float 64	center of pupil ellipse on x axis in pixels
pupil_center_y	float 64	center of pupil ellipse on y axis in pixels
pupil_height	float 64	pupil height (minor axis of the pupil ellipse) in pixels
pupil_phi	float 64	pupil rotation angle in radians

pupil_width	float 64	pupil width (major axis of the pupil ellipse) in pixels

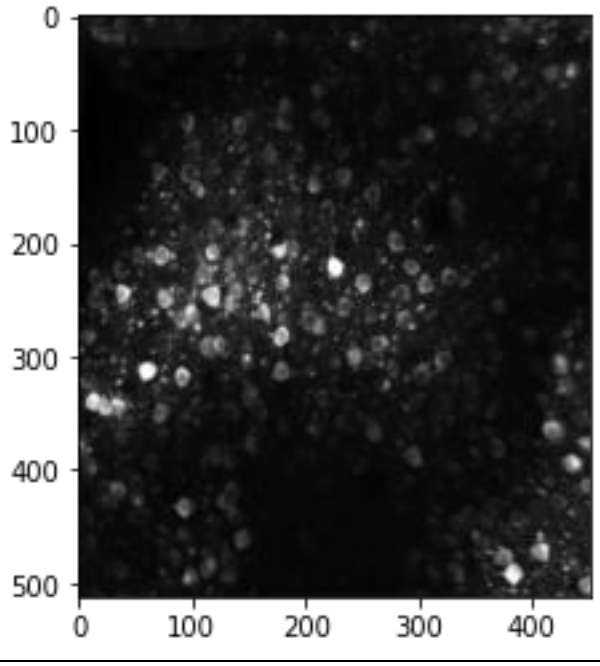
Max Projection

Description:
A 2D maximum intensity projection image of the ophys movie.

Access/Loading:
`experiment_dataset.max_projection`

Display:
use matplotlib.pyplot:
`plt.imshow(experiment_dataset.max_projection, cmap = 'gray')`

Example Image:



Example of a max intensity projection

Metadata

Description:
A dictionary containing behavior session and experiment session specific metadata.

Access/Loading:
`experiment_dataset.metadata`

Dictionary:

key	value data type	description
age_in_days	int	age of mouse in days
behavior_session_id	int	unique identifier for a behavior session

behavior_session_uuid	uuid	unique identifier for a behavior session
cre_line	string	cre driver line for a transgenic mouse
date_of_acquisition	date time object	date and time of experiment acquisition, yyyy-mm-dd hh:mm:ss.
driver_line	list of string	all driver lines for transgenic mouse
emission_lambda	float	wavelength (in nm) the 2 photon microscope is tuned to based on transgenic reporter line
equipment_name	string	identifier for equipment data was collected on
excitation_lambda	float 64	wavelength (in nm) of the two photon laser
experiment_container_id	int	unique identifier for a container
field_of_view_height	int	field of view height in pixels
field_of_view_width	int	field of view width in pixels
full_genotype	string	full genotype of transgenic mouse
imaging_depth	int	depth in microns from the cortical surface, where the data was collected
imaging_plane_group	none or int	a grouping number assigned to grouped planes (experiments) for multiscope sessions
imaging_plane_group_count	int	total number of imaging groups for multiscope session
indicator	string	transgenic mouse indicator
mouse_id	int	unique identifier for a mouse
ophys_experiment_id	int	unique identifier for an ophys experiment
ophys_frame_rate	float 64	rate (in Hz) that the two photon microscope collected frames for an individual imaging plane / field of view (in Hz)
ophys_session_id	int	unique identifier for a ophys session
reporter_line	string	reporter line for transgenic mouse
session_type	string	visual stimulus type displayed during behavior session
sex	string	sex of the mouse
stimulus_frame_rate	float	rate (in Hz) that the visual stimulus was displayed
targeted_structure	string	visual area targeted by the experiment field of view

***** rows in light green are attributes unique to the experiment session dataset metadata attribute. All other keys can also be found in the behavior session dataset metadata keys

Motion correction

Description:
A dataframe containing the x and y offsets applied during motion correction

Access/Loading:
`experiment_dataset.motion_correction`

Table:

column	data type	description
x	int	frame shift on x axis
y	int	frame shift on y axis

Ophy Experiment Id

Description:
9 digit unique identifier for an ophys experiment (single field of view, optical physiology data)

Access/Loading
`experiment_dataset.ophys_experiment_id`

Ophys Session Id

Description:

9 digit unique identifier for an ophys session.

Access/Loading:

```
experiment_dataset.ophys_session_id
```

Ophys Timestamps

Description:

Timestamps associated with 2-photon frames captured by the microscope. Sampled at different rates depending upon the microscope.

Access/Loading:

```
experiment_dataset.ophys_timestamps
```

Segmentation Mask Image

Description:

A 2d binary image of all valid cell masks

Access/Loading:

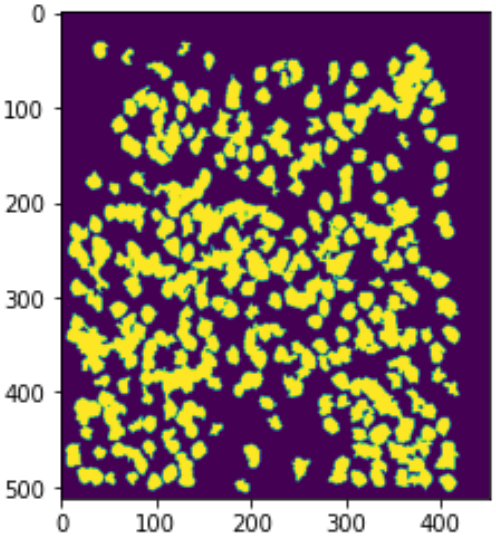
```
experiment_dataset.segmentation_mask_image
```

Display:

use matplotlib.pyplot

```
plt.imshow(experiment_dataset.segmentation_mask_image)
```

Example Image:



example of segmentation mask image