

Loading Cache Tables

from allensdk.brain_observatory.behavior.behavior_project_cache import VisualBehaviorOphysProjectCache

To load the Visual Behavior cache on AWS:

cache = VisualBehaviorOphysProjectCache.from_local_cache(cache_dir=data_storage_directory, use_static_cache=True)
Where data_storage_directory = "/data/visual-behavior-ophys_data"

To load the Visual Behavior cache on a local drive:

cache = VisualBehaviorOphysProjectCache.from_s3_cache(cache_dir=cache_dir)
Where cache_dir is a folder on your local drive

To load the cache tables:

ophys_experiment_table = cache.get_ophys_experiment_table()
ophys_session_table = cache.get_ophys_session_table()
behavior_session_table = cache.get_behavior_session_table()
ophys_cell_table = cache.get_ophys_cell_table()

Cache Summary Tables

table/pandas dataframe

The cache contains 4 tables which provide a summary level view of all the currently released datasets:

ophys_experiment_table, ophys_session_table, behavior_session_table and, ophys_cells_table. These tables contain roughly the same information but are organized differently. Each table is indexed by its corresponding id type

			ophys_experiment_table	ophys_session_table	behavior_session_table	ophys_cell_table
column name	data type	description				
age_in_days	int	age of mouse in days	x	x	x	
behavior_session_id	int	unique identifier for a behavior session	x	x	x	
cell_roi_id	int	experiment specific id of segmented roi				x
cell_specimen_id	int 64	unified id of segmented cell matched across experiments				x
cre_line	string	cre driver line for a transgenic mouse	x	x	x	
date_of_acquisition	datetime	date and time of data acquisition, yyyy-mm-dd hh:mm:ss.	x	x	x	
driver_line	list	all driver lines for transgenic mouse	x	x	x	
equipment_name	string	identifier for equipment data was collected on	x	x	x	
		'Familiar': image set mouse was trained on (not novel)	x			
experience_level	string	'Novel 1': first exposure to novel image set				
		'Novel >1': novel image set but not first exposure				
file_id	int	lookup id to retrieve NWB file from S3 or the local cache.	x		x	
full_genotype	string	full genotype of transgenic mouse	x	x	x	
image_set		image set shown for a particular session	x			
imaging_depth	int	depth of the imaging plane in microns from the cortical surface	x			
indicator	string	transgenic mouse indicator	x	x	x	
mouse_id	int	unique identifier for a mouse	x	x	x	
ophys_container_id	int	unique identifier for an ophys container (grouping of ophys experiments by FOV)	x	x	x	
ophys_experiment_id	int	unique identifier for an ophys experiment	x	x	x	x
ophys_session_id	int	unique identifier for a ophys session	x	x	x	
passive	bool	True if the session was passive (no lickspout), False if the session was active (lickspout with water rewards)	x			
prior_exposures_to_image_set	float 64	Number of prior sessions (during training or ophys) where the mouse was exposed to the image set shown in the current session. Starts at 0 for first exposure		x	x	
prior_exposures_to_omissions	int 64	Number of prior sessions where the mouse was exposed to omissions. Starts at 0 for first exposure.		x	x	
prior_exposures_to_session_type	int 64	Number of previous sessions where the mouse was exposed to the current session type. Starts at 0 for first exposure	x	x	x	
project_code	string	Dataset variant the mouse belongs to (scientifica vs. mesoscope, trained on stim A vs. B)	x	x	x	
reporter_line	string	Reporter line for transgenic mouse	x	x	x	
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)	x	x	x	
session_type	string	Visual stimulus type displayed during behavior session	x	x	x	
sex	string	Sex of the mouse	x	x	x	
targeted_structure	string	Visual area targeted by the experiment field of view	x	x	x	

Loading Dataset Objects

To load a behavior session from the cache:

behavior_session = cache.get_behavior_session(behavior_session_id)

To load an ophys_experiment from the cache:

ophys_experiment = cache.get_behavior_ophys_experiment(ophys_experiment_id)

Note: Attributes associated with both **ophys_experiment** datasets and **behavior_session** datasets (such as running speed) will be shown as **dataset.attribute** in the tables in this cheat sheet, while attributes associated only with the **ophys_experiment** datasets (such as cell fluorecence traces) will use **ophys_experiment.attribute**

Dataset attributes

color coded by data type

attributes and methods associated with a visual behavior dataset object.

* are only available for a behavior ophys experiment dataset object and not the behavior session dataset object.

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

cell specimen table		table/pandas dataframe
Table of cell information where non-cell segmented rois have been filtered out (only contains roi_valid = True entries)		
column name	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 in data processing file; irrelevant for analysi
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)

dff traces		table/pandas dataframe
Baseline normalized and detreded fluorecence 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’.		
column name	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	array of float 64	fluorescence fractional values relative to baseline (arbitrary units)

events		table/pandas dataframe
A dataframe containing spiking events in traces derived from the two photon movies, organized by cell specimen id. For more information on event detection processing please see the event detection portion of the white paper.		
column name	data type	description
cell_specimen_id	int 64	[index] 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

ophys timestamps		numpy array
Timestamps associated with 2-photon frames captured by the microscope. Sampled at different rates depending upon the microscope. Sampling rate can be found in metadata ‘ophys_frame_rate’.		

max_projection	image
2D maximum intensitty projection image of the microscope field of view.	

average_projection	image
2D average intensity projection image of the microscope field of view.	

segmenation_mask_image	image
Binary mask image showing all segmented ROIs in the imaging plane	

motion correction		table/pandas dataframe
x and y offsets (in pixels) applied during motion correction		
column name	data type	description
x	int	frame shift on x axis
y	int	frame shift on y axis

raw running speed		table/pandas dataframe
Unfiltered running speed and timestamps sampled at 60Hz.		
column name	data type	description
speed	float 64	speed in cm/sec
timestamps	float 64	time in seconds

stimulus templates			table/pandas dataframe
A table containing the stimulus images for a session. Indices are image names, 'warped' and 'unwarped' columns contain image arrays.			
column name	data type	description	
image_name [index]	string	name of image presented	
unwarped	array of int	image array of unwarped stimulus image	
warped	array of int	image array of warped stimulus image	

stimulus presentations			table/pandas dataframe
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.			
column name	data type	description	
stimulus_presentations_id	int 64	[index] 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	

licks		table/pandas dataframe
lick timestamps (in seconds) and frames, sampled at 60Hz.		
column name	data type	description
timestamps	float 64	time of a lick, in seconds
frame	int	frame of lick

running speed		table/pandas dataframe
Running speed and timestamps sampled at 60hz.		
column name	data type	description
speed	float 64	speed in cm/sec
timestamps	float 64	time in seconds

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

rewards		table/pandas dataframe
A dataframe containing timestamps of delivered rewards in absolute sync time. Timestamps are sampled at 60 Hz.		
column name	data type	description
timestamps	float 64	time in seconds
volume	float 64	volume of water reward in ml.
autorewarded	bool	True if free reward was delivered for that trial. Occurs during the first 5 trials.

reward rate		numpy array
Reward rate is calculated of a 25 trial rolling window and provides a measure of the rewards earned per unit time (in units of rewards/min)		

task parameters		dictionary
Parameters used to define the task runtime behavior		
key	Value dtype	value
blank_duration_sec	list of float	Duration in seconds of inter stimulus interval.
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 first 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_voume	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			table/pandas dataframe
trial and behavioral response data			
column name	data type	description	
trials_id [index]	int 64	Unique identifier for each cell	
lick_times	int_64	Trial identifier	
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	
miss	bool	[behavior response type] on a go trial, mouse does not lick at all, or licks after reward window	
correct_reject	bool	[behavior response type] on a catch trial, mouse does not lick at all or licks after reward window	
false_alarm	bool	[behavior response type] on a catch trial, mouse licks within reward window	
aborted	bool	[behavior response type] True if mouse licks before the scheduled change time .	
stimulus_change	bool	True if an image change occurs during the trial (if the trial was both a 'go' trial and not aborted)	
go	bool	[trial type] True if there was a change in stimulus image identity 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.	
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	

performance metrics			table/pandas dataframe
Table with session scale summary behavior response performance metrics			
column name	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 trial types	
hit_trial_count	int 64	number of catch trial types	
miss_trial_count	int 64	number of trials with a hit behavior response	
false_alarm_trial_count	int 64	number of trials with a miss behavior response	
correct_reject_trial_count	int 64	number of trials with a false alarm behavior response	
auto_rewarded_trial_count	int 64	number of trials with a correct reject behavior response	
rewarded_trial_count	int 64	number of trials where the mouse received an auto reward of water.	
total_reward_count	int	number of trials where the mouse was eligible to receive a water reward (go trials) and did receive an earned water reward	
total_reward_volume	float 64	volume of all water rewards received (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 the mouse was engaged (reward rate > 2 rewards/min)	
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/min	
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/min	
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/min	
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/min	
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/min	

metadata			dictionary
dataset specific metadata. keys with * are only found in behavior ophys experiment datasets and not behavior ophys session datasets			
key	Value dtype	value	
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 mouse 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	2-photon imaging frame rate (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	
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	

eye tracking			table/pandas dataframe
Ellipse fit parameters for the eye, pupil and corneal reflection (cr). Fits are derived from tracking points from a DeepLabCut model applied to video (collected at 30hz) frames of a subject’s right eye.			
column name	data type	description	
frame [index]	int 64	frame of eye tracking video	
timestamps	float 64	time in seconds	
likely_blink	float 64	True if frame has outlier ellipse fits, which is often caused by blinking / squinting of the eye.	
eye_area	float 64	area of eye ellipse in pixels squared	
eye_area_raw	float 64	pupil area with no outliers/likely blinks removed.	
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_width	float 64	eye width (major axis of the eye ellipse) in pixels	
eye_phi	float 64	eye rotation angle in radians	
pupil_area	float 64	area of pupil ellipse in pixels squared	
pupil_area_raw	float 64	pupil area with no outliers/likely blinks removed.	
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_width	float 64	pupil width (major axis of the pupil ellipse) in pixels	
pupil_phi	float 64	pupil rotation angle in radians	
cr_area	float 64	area of corneal reflection ellipse in pixels squared	