TO DO LISTS

TODO JR

- [ ] Neuropil signal pre Get Josh to do this?
- [ ] Participation ratio
- [ ] Does largest SV correspond to any of the variances?
- [ ] Fix the model and run on all the data
- [ ] 9th Jan
- [x] Add the other variances
- [x] Add a note to the table about whether there's an effect
- [x] More PCs? as many as the number of neurons?
- [x] Thick lines for the PCs. Generally improve graphics
- [x] Dropout repeated cross-folds
- [x] Same number of it and miss trials in the firing rate plot
- [x] Distribution of all neuron firing rates hit vs miss
- [x] Distribution of all neuron correlations etc
- [x] Make the plot matrix (some e.g. populations metrics wont be possible)
- [x] A flag for S1 and S2
- [x] The hit and miss eigenspectrum plots
- [x] Check how the churchlands measure variance
- [x] Make a function to print flags and sessions included etc
- [x] Does the variance predict propagation?
- [x] Distribution plots of different variance flavours
- [x] Classifier plot of different variance flavours
- [x] Discard licks 250ms
- [x] Churchland 2010 natneuro (Do our results match?)
- [x] Log the covariates that are better fit by the logs
- [x] RERUN WITH NEW PCA Viola's PC plot -> trace of the first PC before hit and miss
- [x] Factor analysis
- [x] Merge multiple sessions for the logistic classifier
- [x] Fix markdown checklist
- [x] Make the IO plot to Saxey's recommendation
- [x] Show the distributions of PC loadings before hit and before miss
- [x] Cross-correlation: take the absolute value of each element of cov matrix

TODO ML

- [ ] Email Johannas about the oasis nan
- [ ] Do fun stuff with the PCs
- [ ] Put the deconvolved spike data through the pipeline
- [ ] Photostim period length

Glossary

Neural activity matrix

- *symbol*: X
- *size* ($n_{neurons}$ x n_{times})
- *defined by:* neural recordings

Synonyms:

- The activity of 1 neuron i is row i: $x_i(t)$
- Neural dynamics

Covariance matrix

- *symbol*: C
- *size*: ($n_{neurons}$ x $n_{neurons}$)
- *defined by*: covariance of activity matrix X

Synonyms:

- pairwise covariance

Principal directions

- *symbol*: V
- *size matrix*: (n_{comps} x $n_{neurons}$)
- *defined by*: eigendecomposition $C = VLV^T$, where L is the (diagonal) matrix with eigenvalues

Synonyms:

- Loading matrix
- principal axes
- Eigenvectors
- right singular vectors

Eigenvalues of Covariance matrix

- *symbol*: L
- *size*: (n_{comps}, n_{comps}) = ($n_{neurons}$, $n_{neurons}$) (equal in case of full eigendecomposition)
- *defined by*: eigendecomposition $ = V L V^T$, where V is the matrix of eigenvectors

Synonyms:

- eigenvalues λ_k are on the diagonal
- variance explained = eigenvalues / sum(eigenvalues) = $\frac{\lambda_k}{\sum_k \lambda_k}$

Principal Component (Dynamic Activity)

- *symbol*: Z
- *size matrix*: (n_comps x n_times)
- *defined by*: $Z = V \cdot X$ (Principal directions *dot* Neural activity)

Synonyms:

- The activity of one PC k is row k: $z_k(t)$
- Neural activity projected onto Principal axes
- Data projected on Principal axes
- Principal components
- PC scores
- Latent activity
- Latent components
- left singular vector *dot* (diagonal) singular value matrix

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Variances

- variance_pop_mean: take the population mean across cells -> [time]. What is the variance of this vector?
- variance_cell_rates: take the mean across time for all cells -> [n_cells]. What is the variance of this vector?
- mean_cell_variance: take the variance of each cell through time -> [n_cells]. What is the mean of all the cell variances?

References:

- https://stats.stackexchange.com/questions/134282/relationship-between-svd-and-pca-how-to-use-svd-to-perform-pca
- https://stats.stackexchange.com/questions/311908/what-is-pca-components-in-sk-learn
- https://jakevdp.github.io/PythonDataScienceHandbook/05.09-principal-component-analysis.html