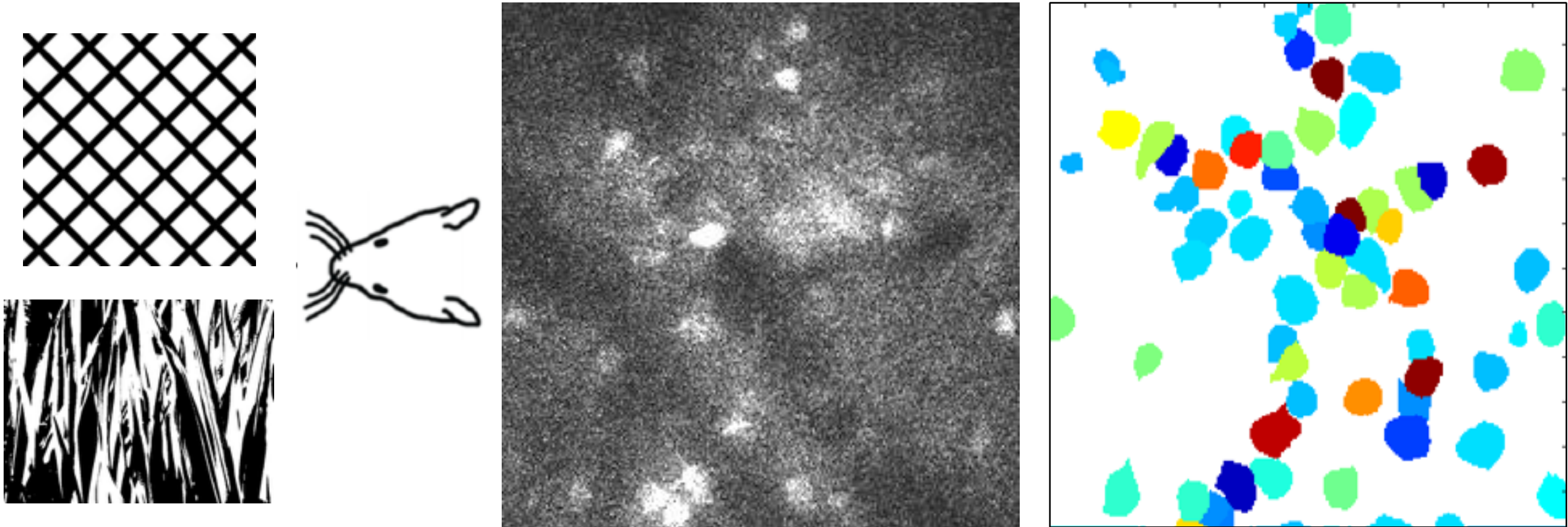
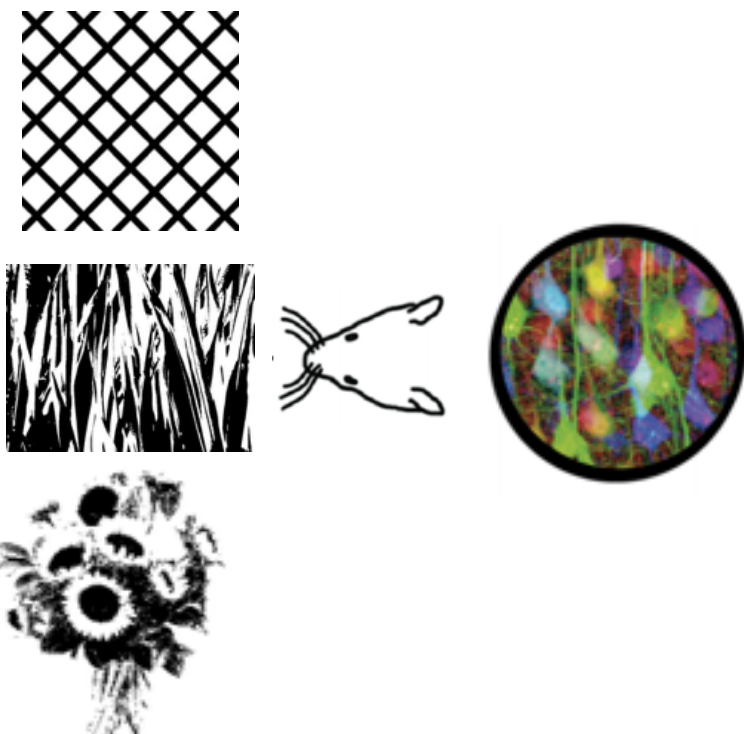


Functional Models of Mouse Visual Cortex

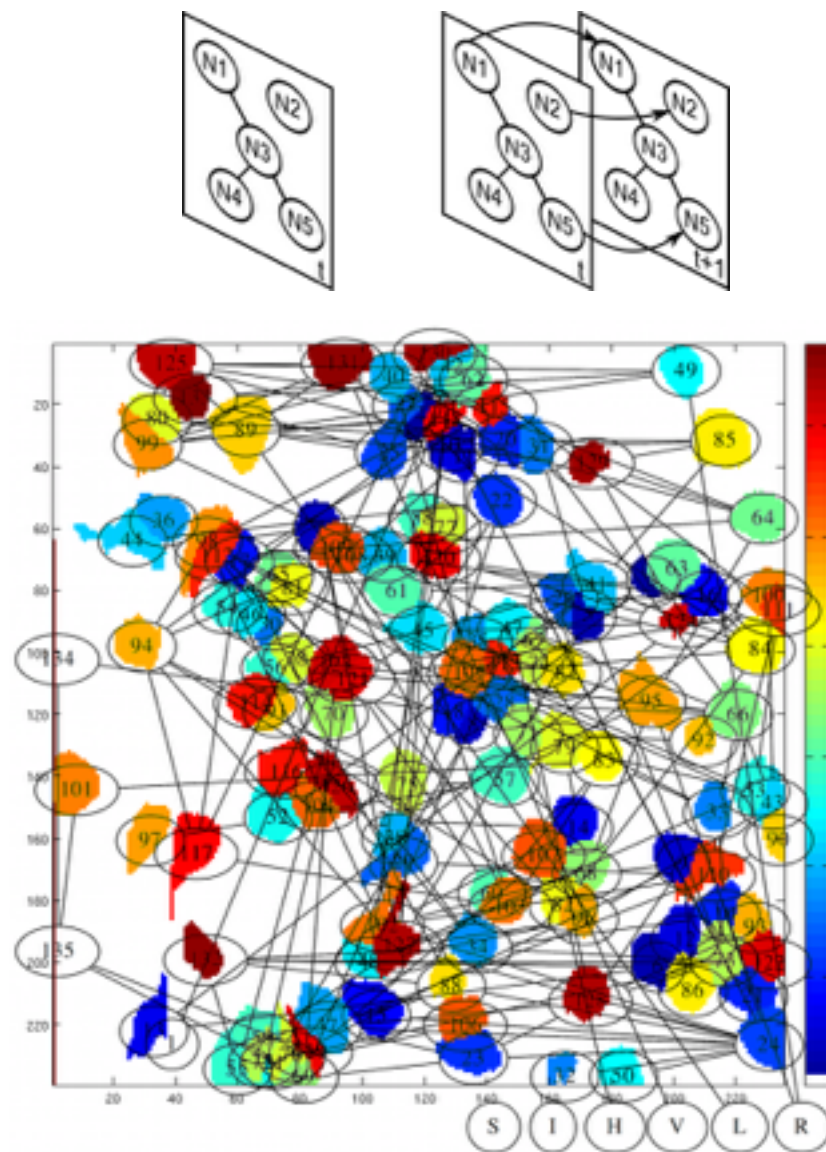
Ekaterina Taralova, Tony Jebara, Rafael Yuste



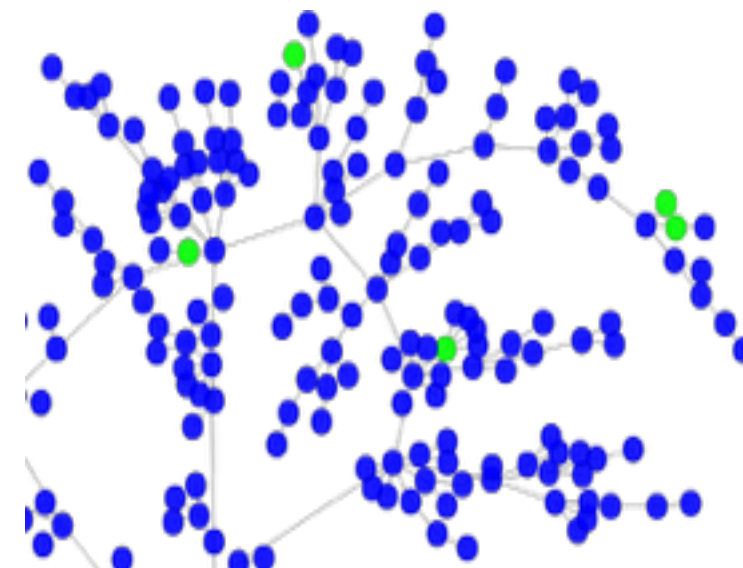
Data



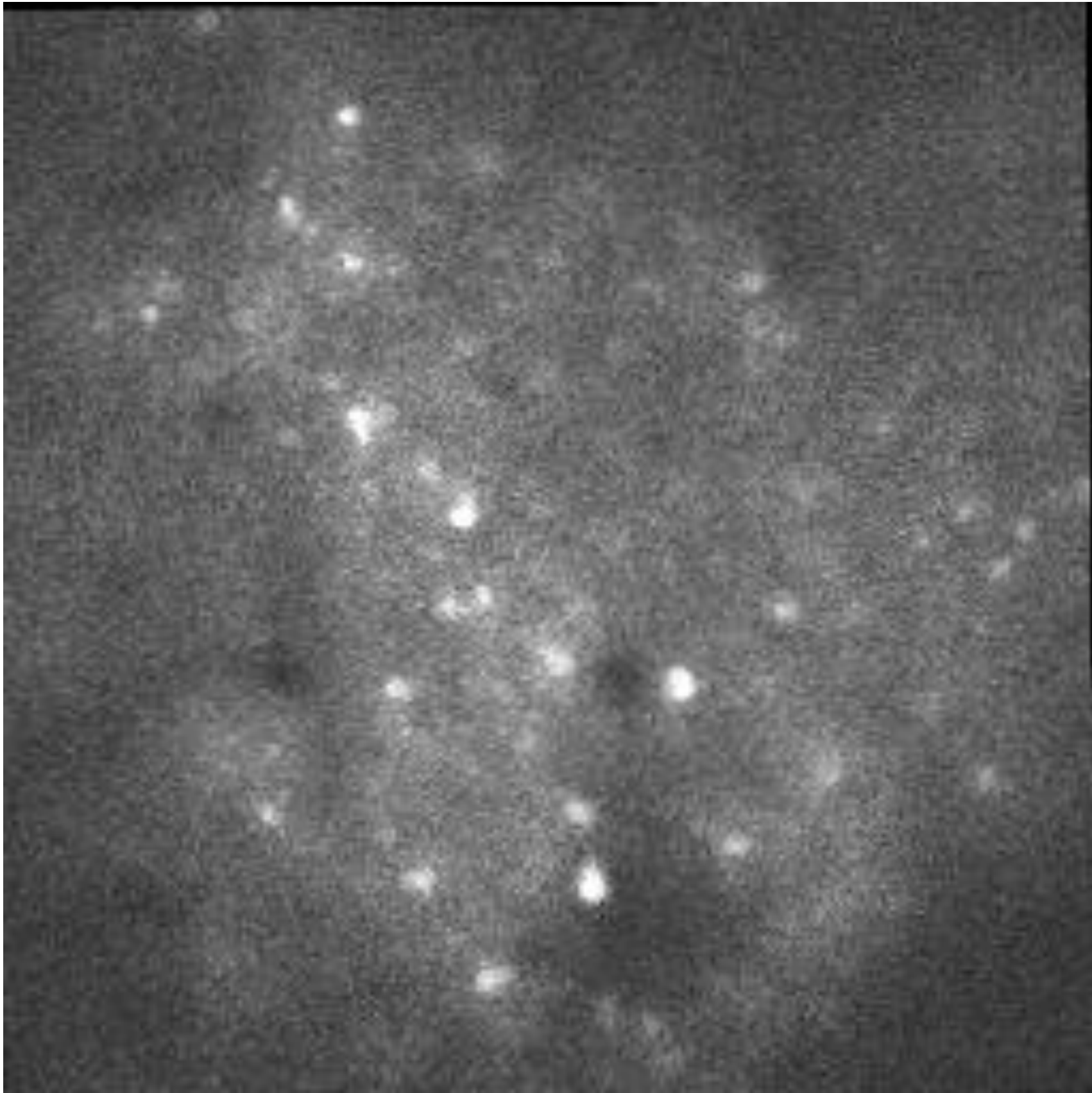
Model



Validation

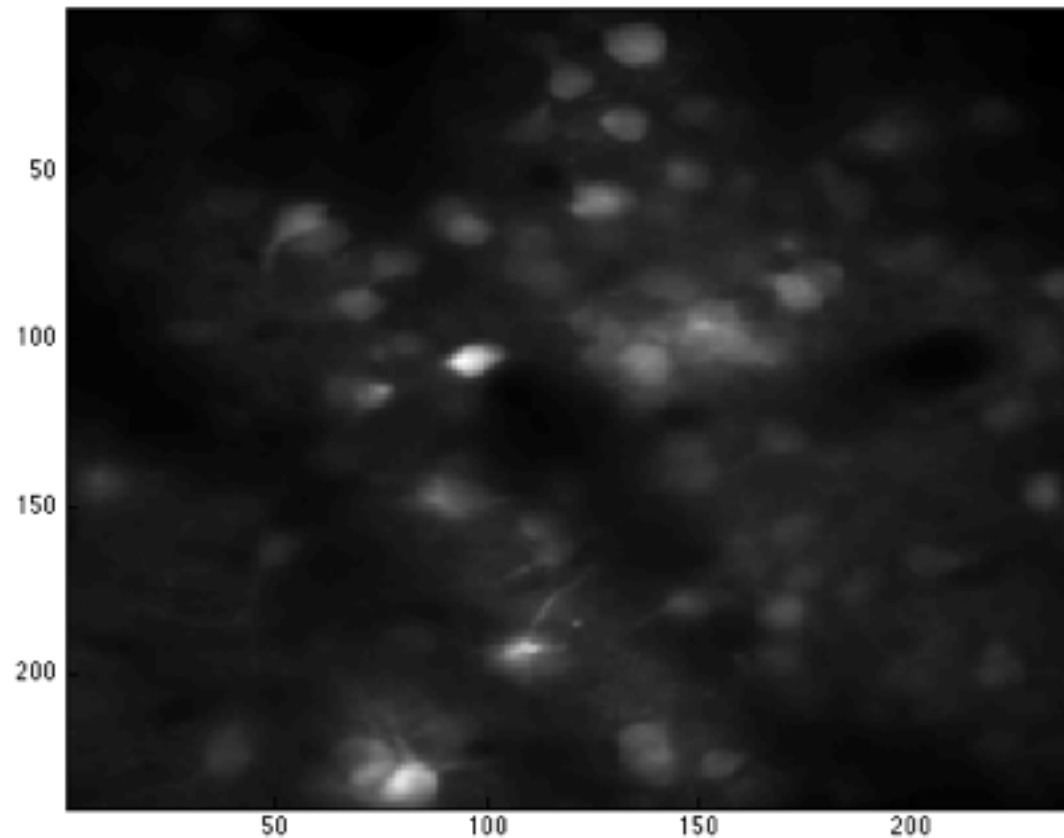


Data

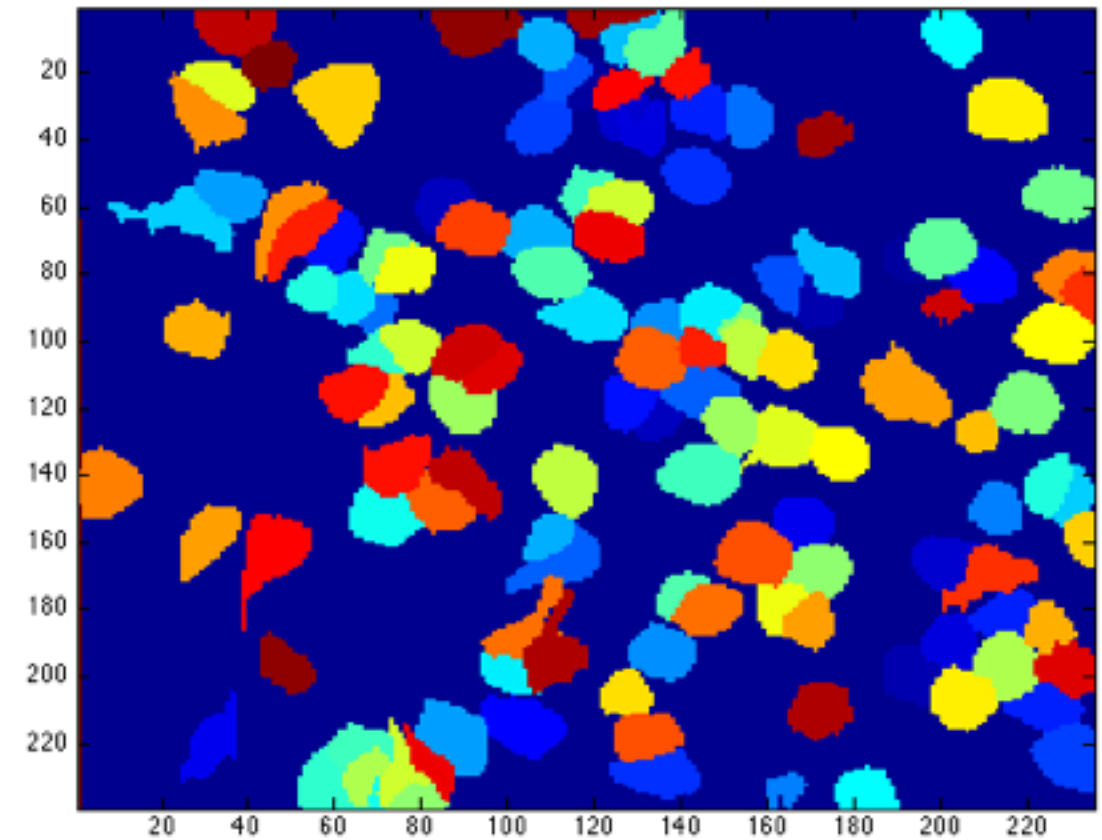


Data collected at 3.7fps, video playing at 30fps.

Data

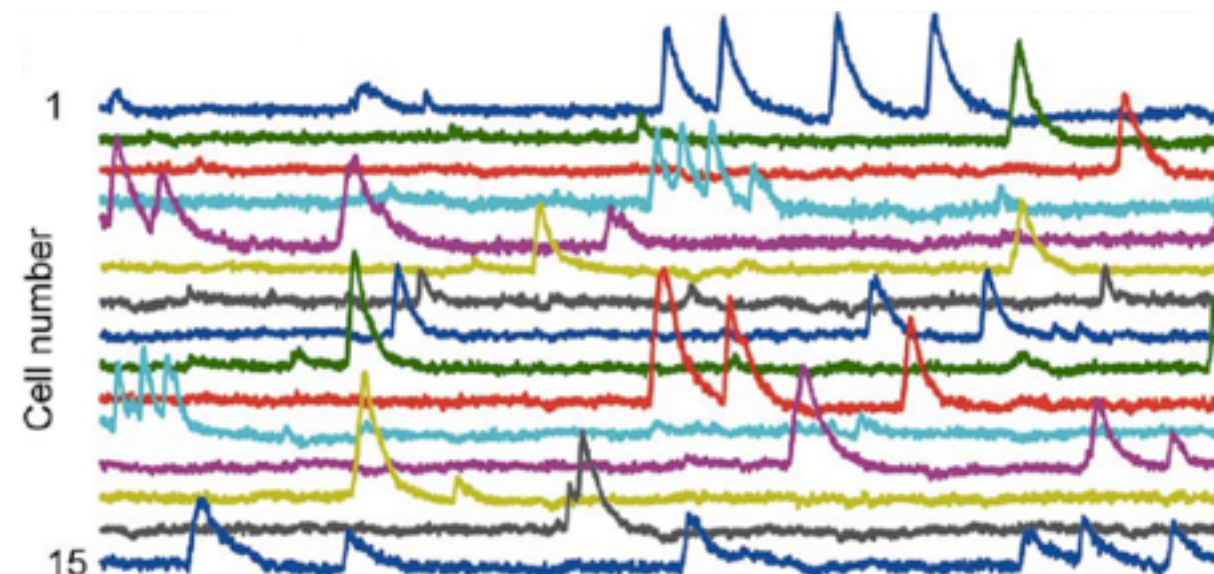


Average of spontaneous and evoked Calcium activity (7.6K samples at 3.7 fps).

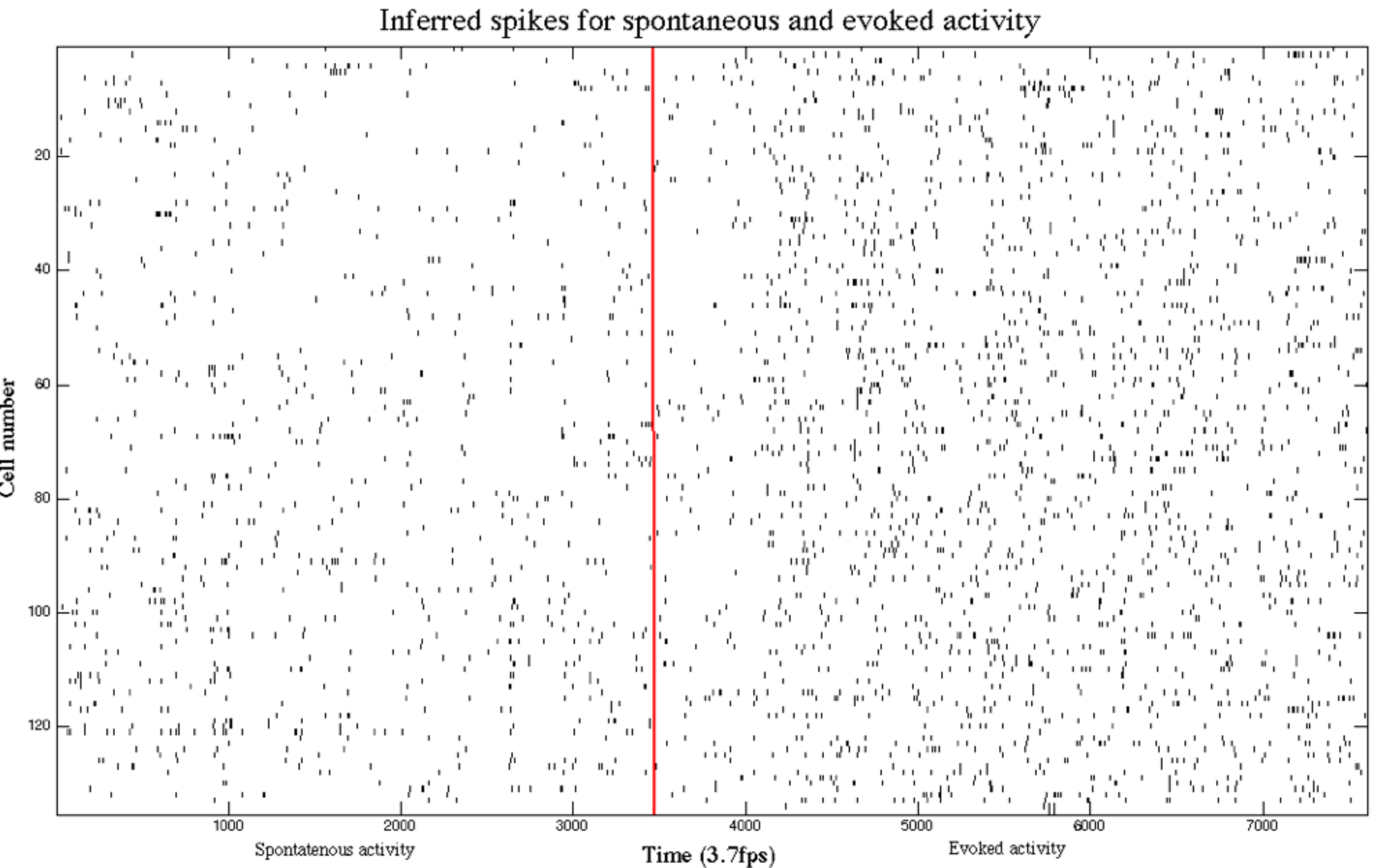


Automatically extracted ROIs (cell hypothesis) using Foopsi.

~100 neurons



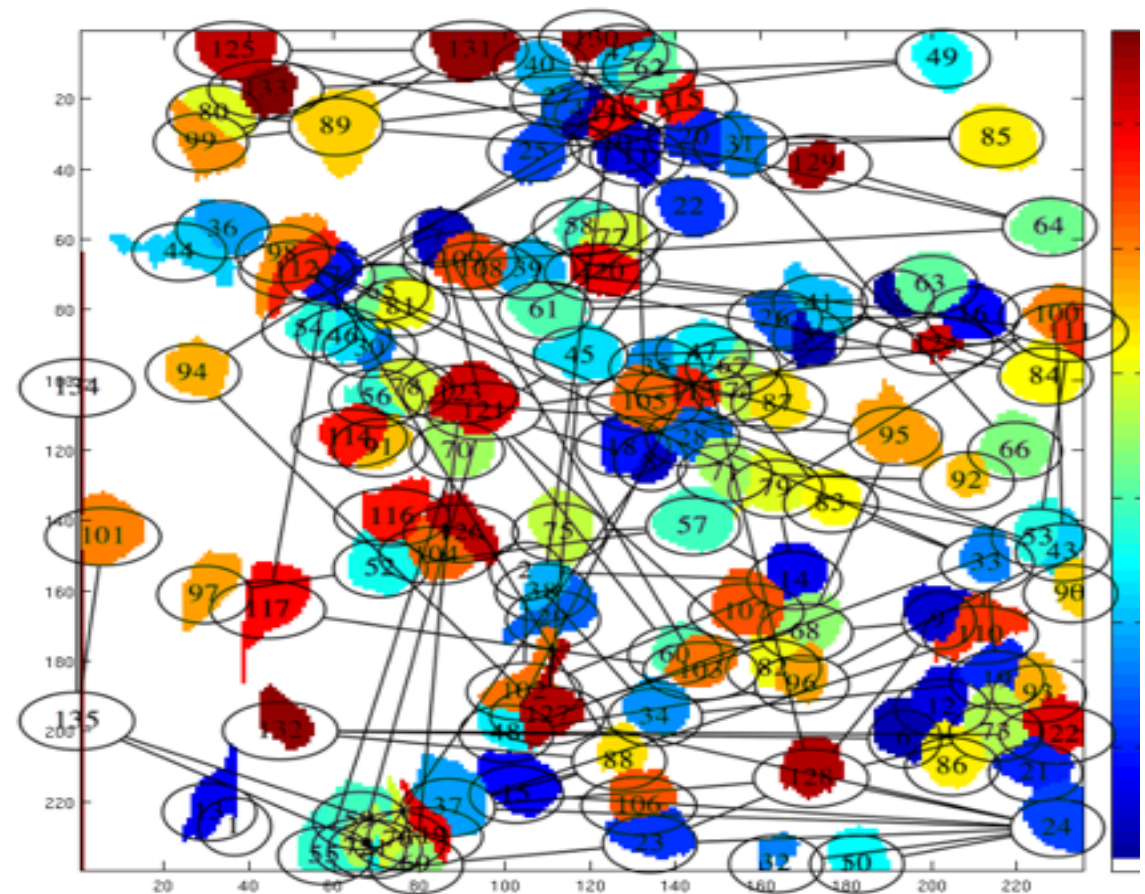
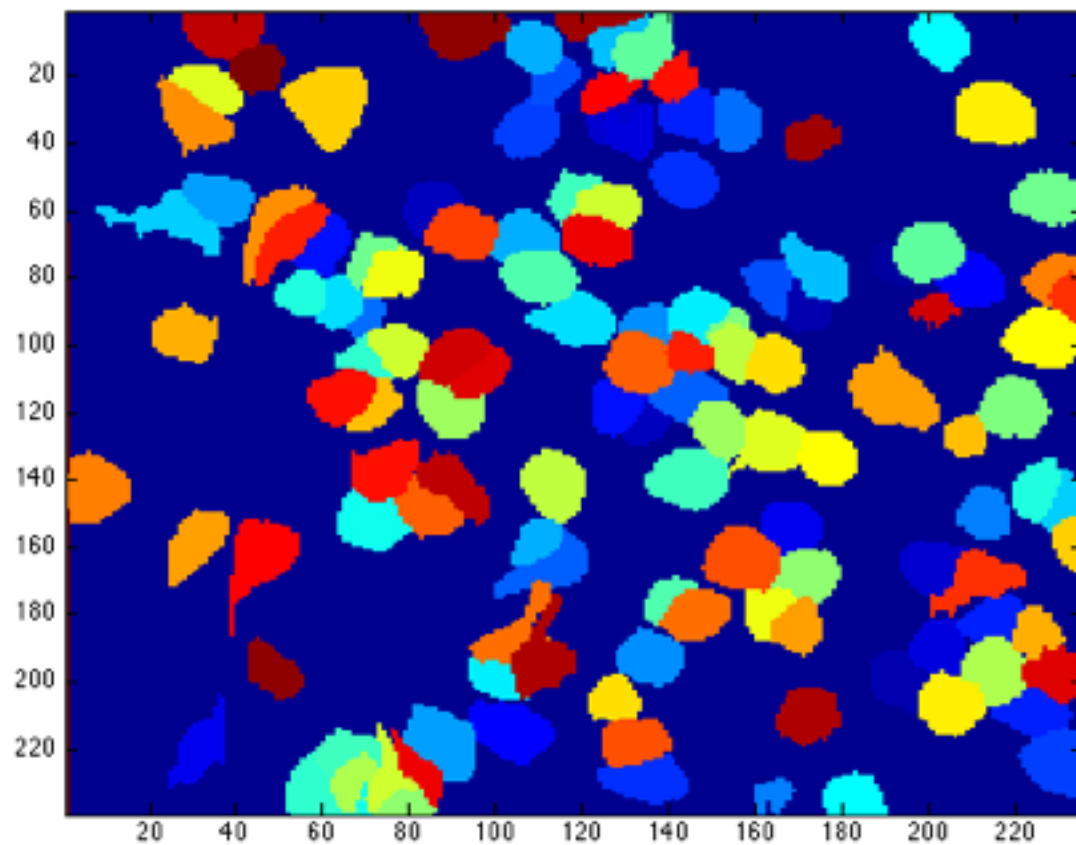
Data



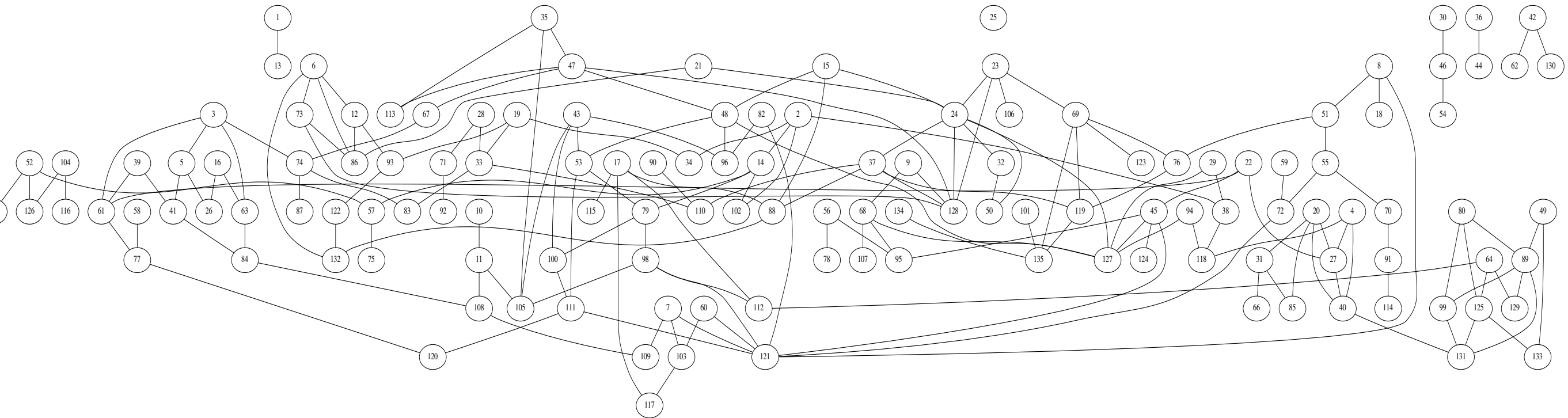
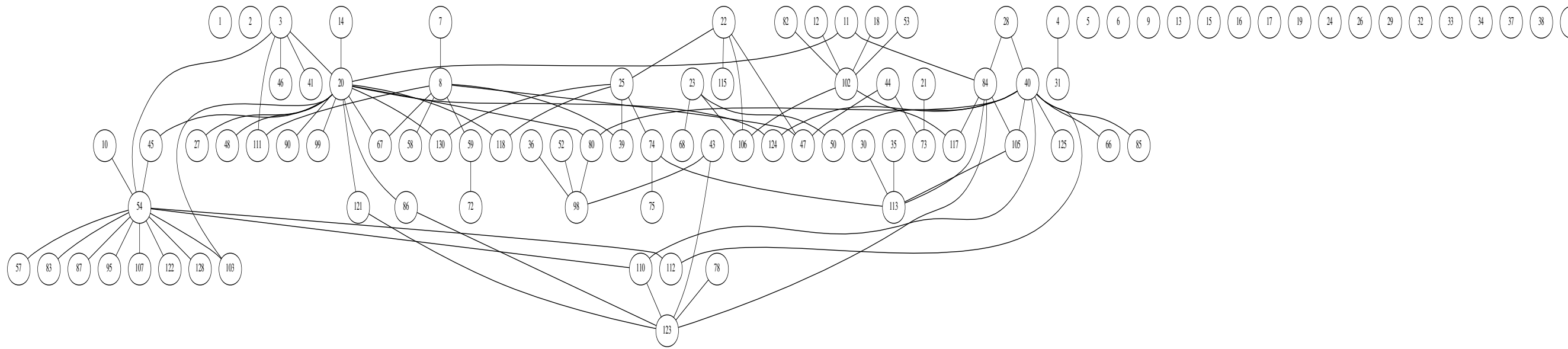
Automatically inferred spikes using Foopsi for spontaneous and evoked activity. Gratings start after red line.

CRF model

- Each neuron is a node in a graph
- Edges encode conditional functional dependencies
- No hidden nodes
- Static model



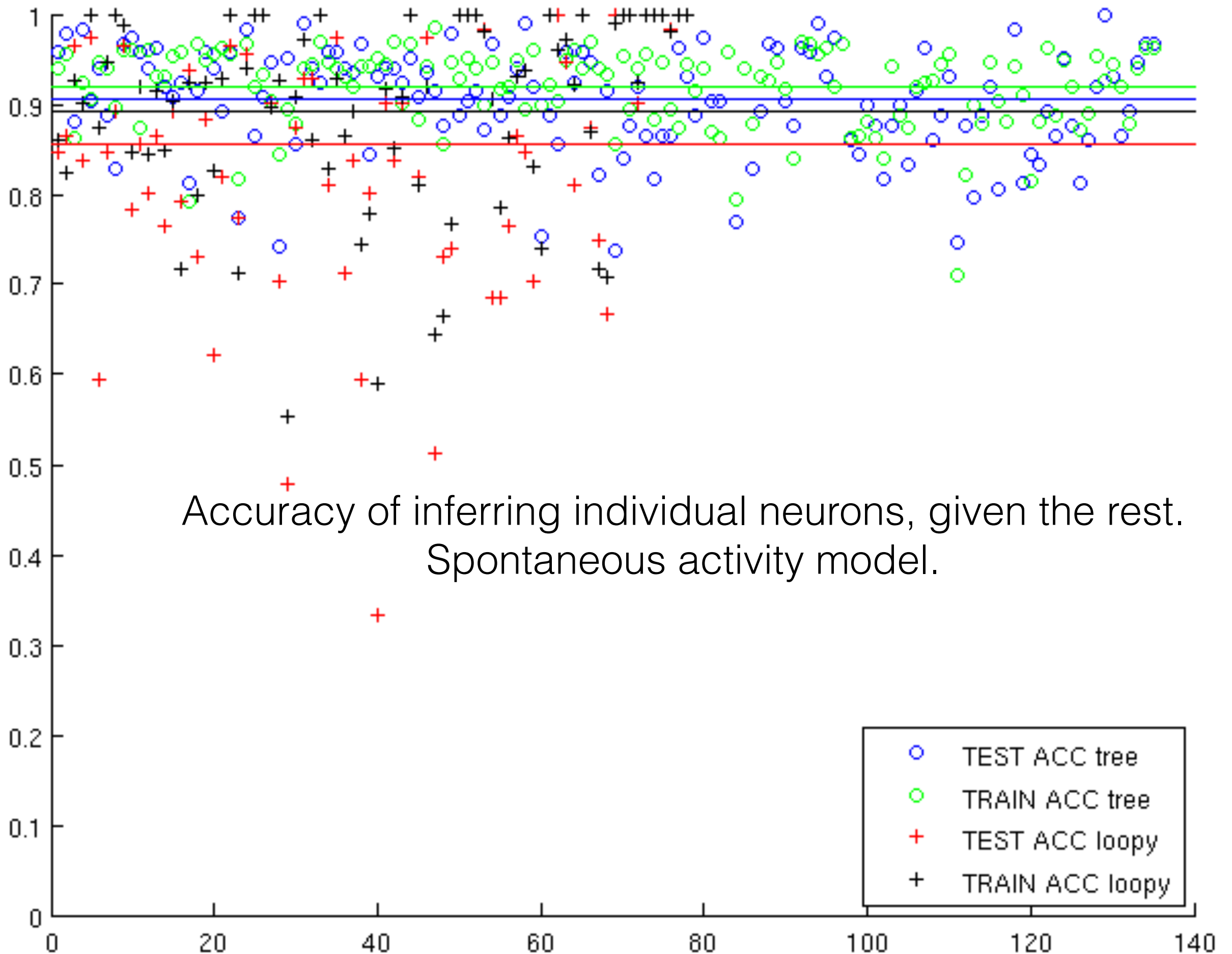
CRF model



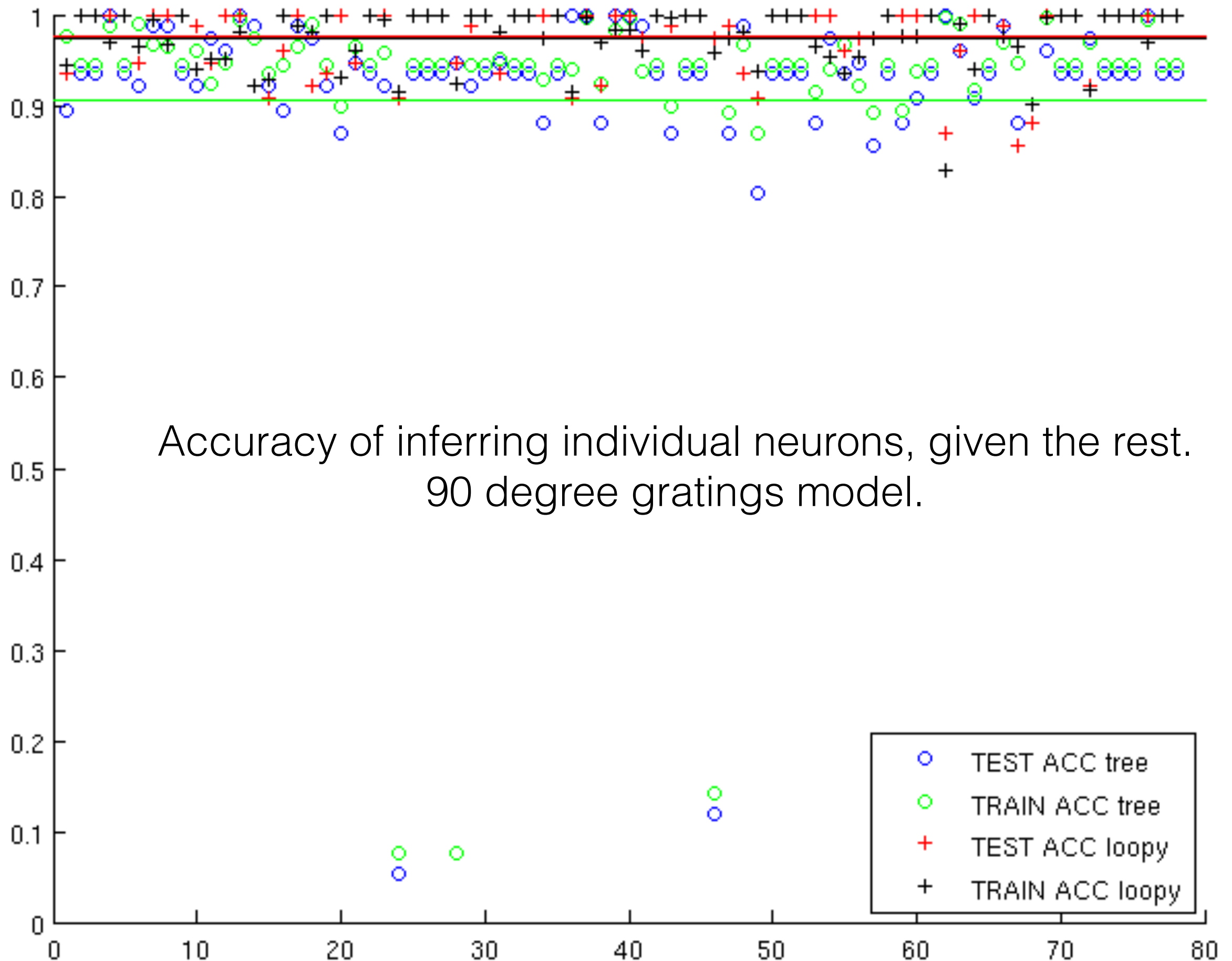
Tree model:
train likelihood: -5.3206
test likelihood: -6.4686
true test likelihood: -15.7394

Loopy model:
train likelihood: -3.0674
test likelihood: -4.8702
true test likelihood: -16.0309

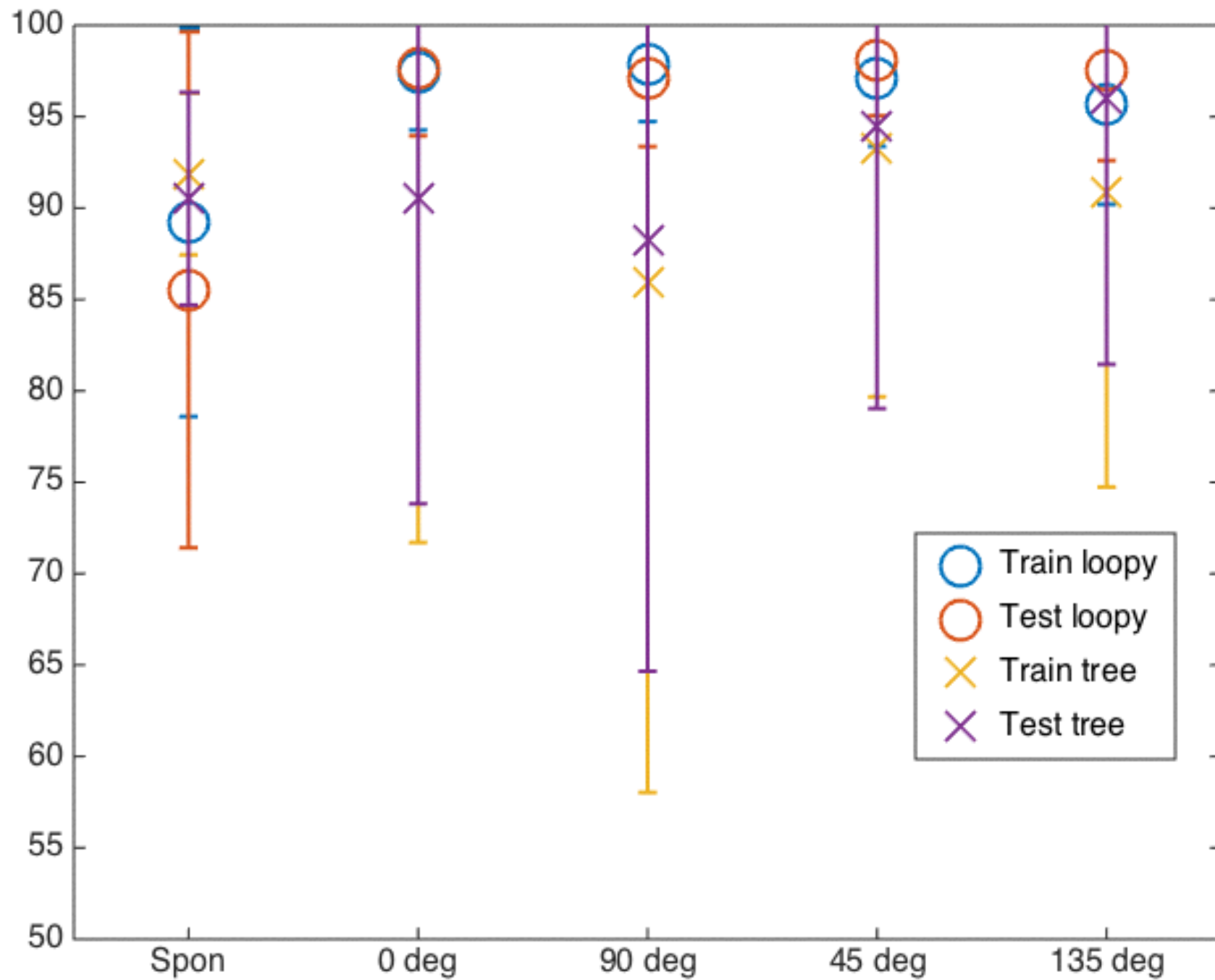
Validation



Validation

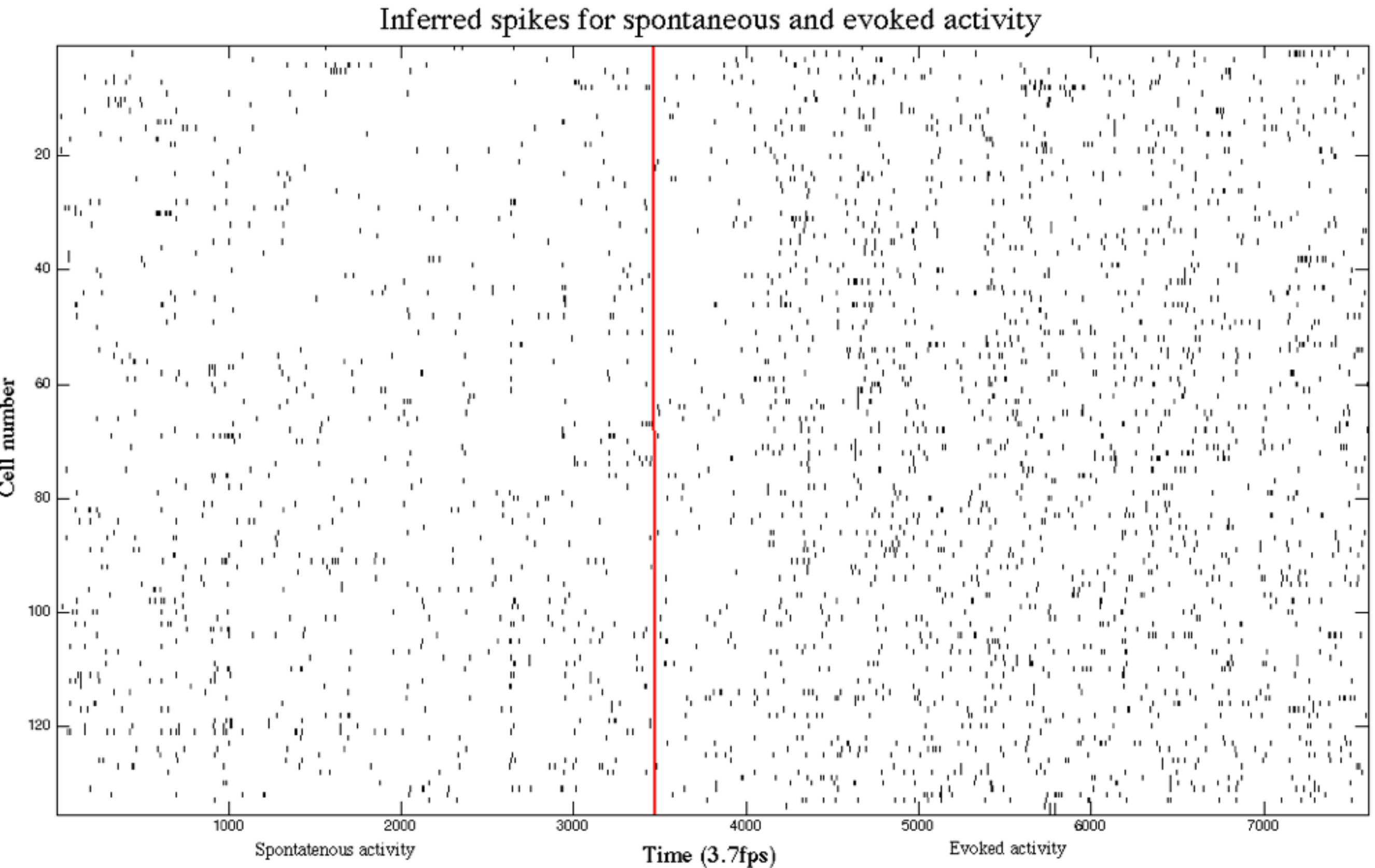


Validation



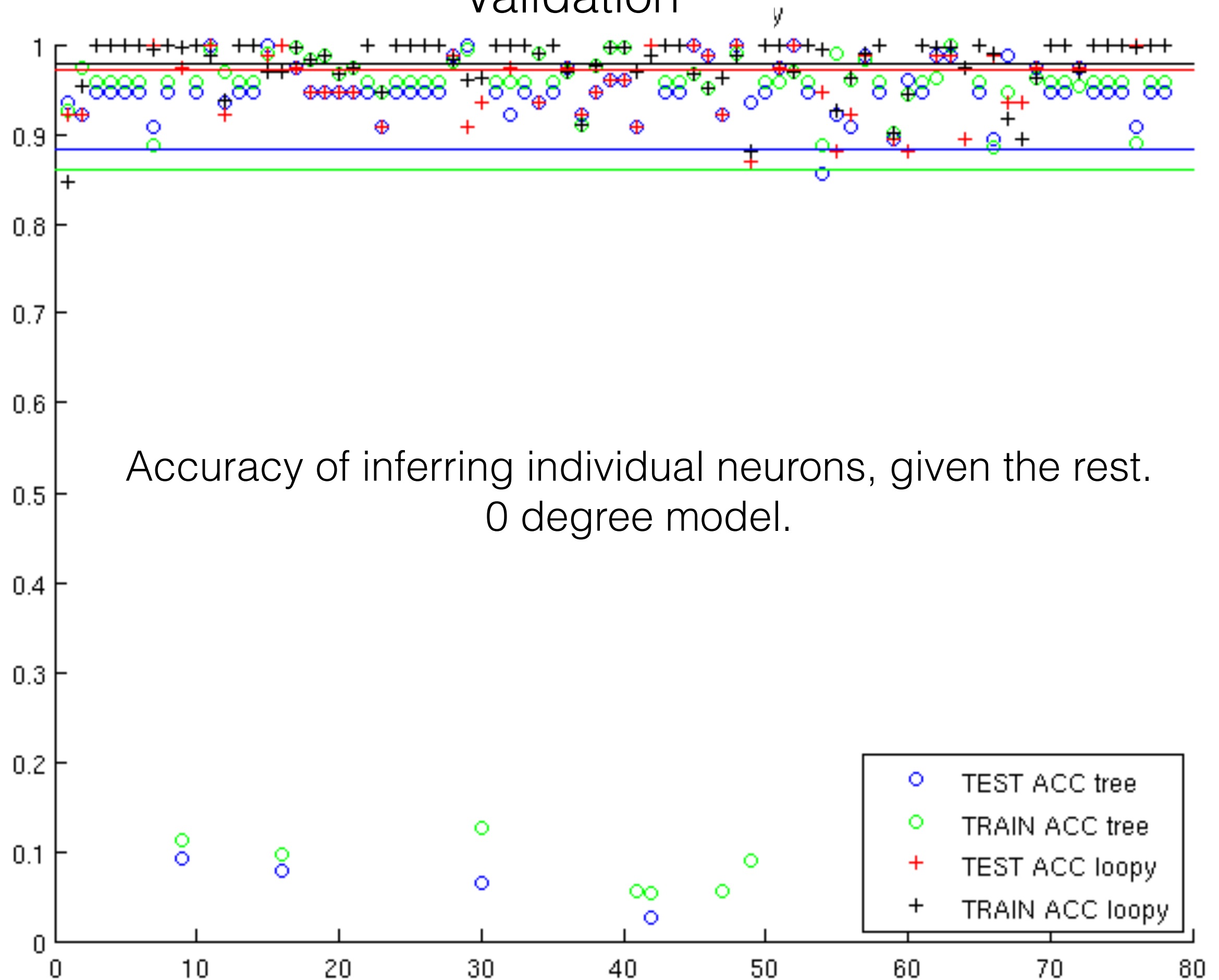
Mean accuracy of inferring individual neurons over 120 test frames.

Data

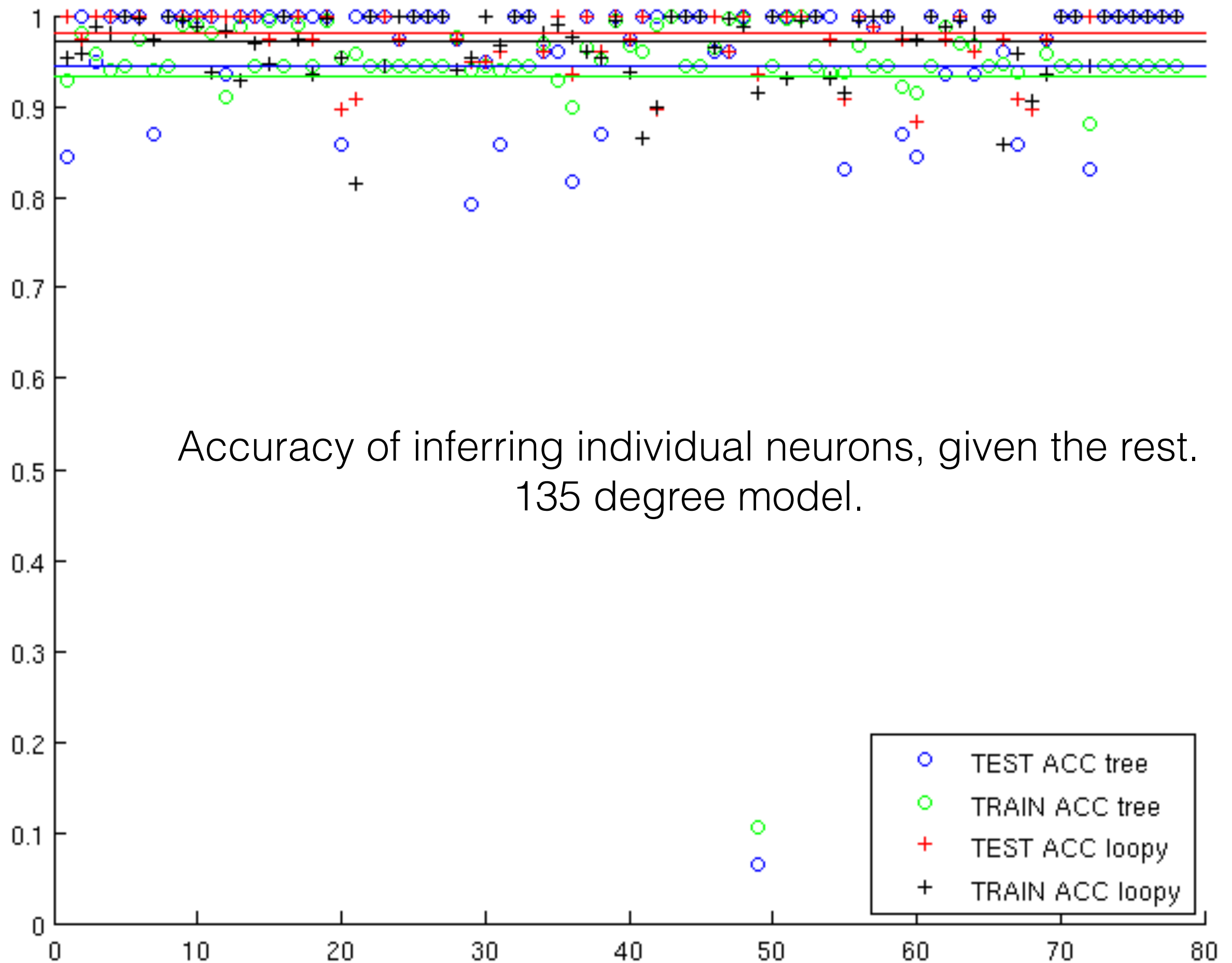


Automatically inferred spikes using Foopsi for spontaneous and evoked activity. Gratings start after red line.

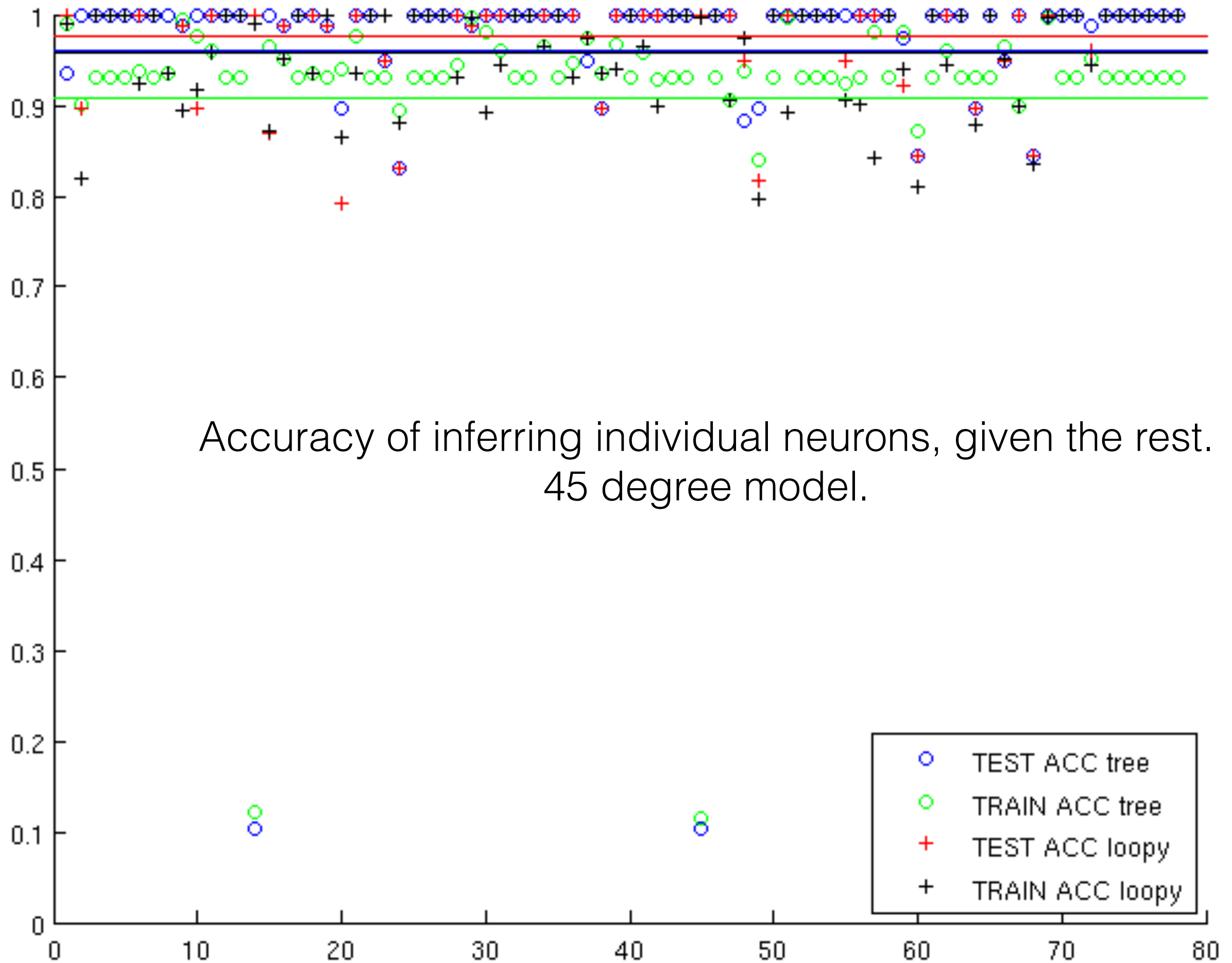
Validation



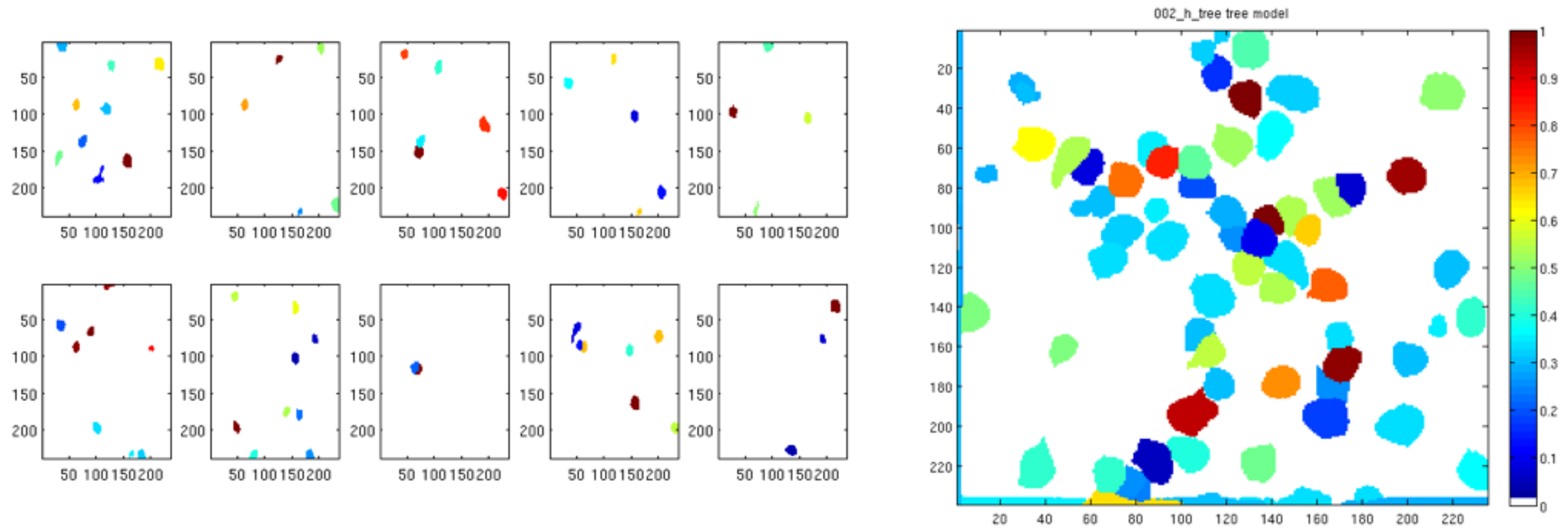
Validation



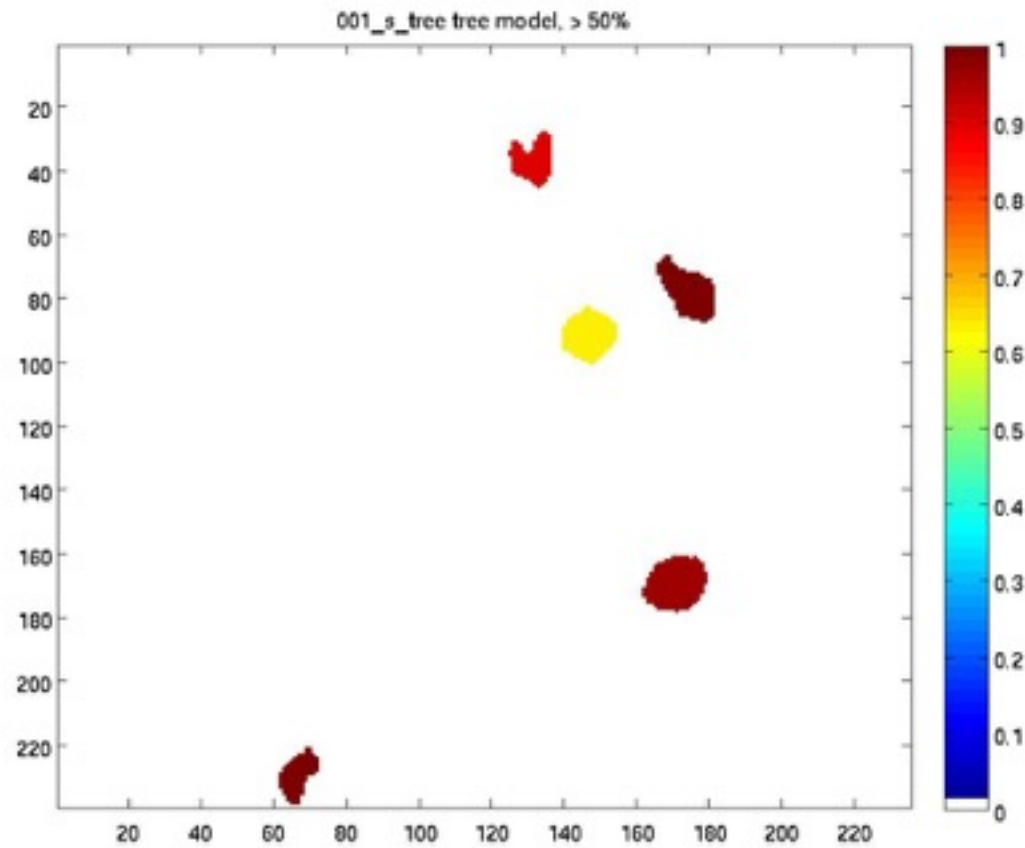
Validation



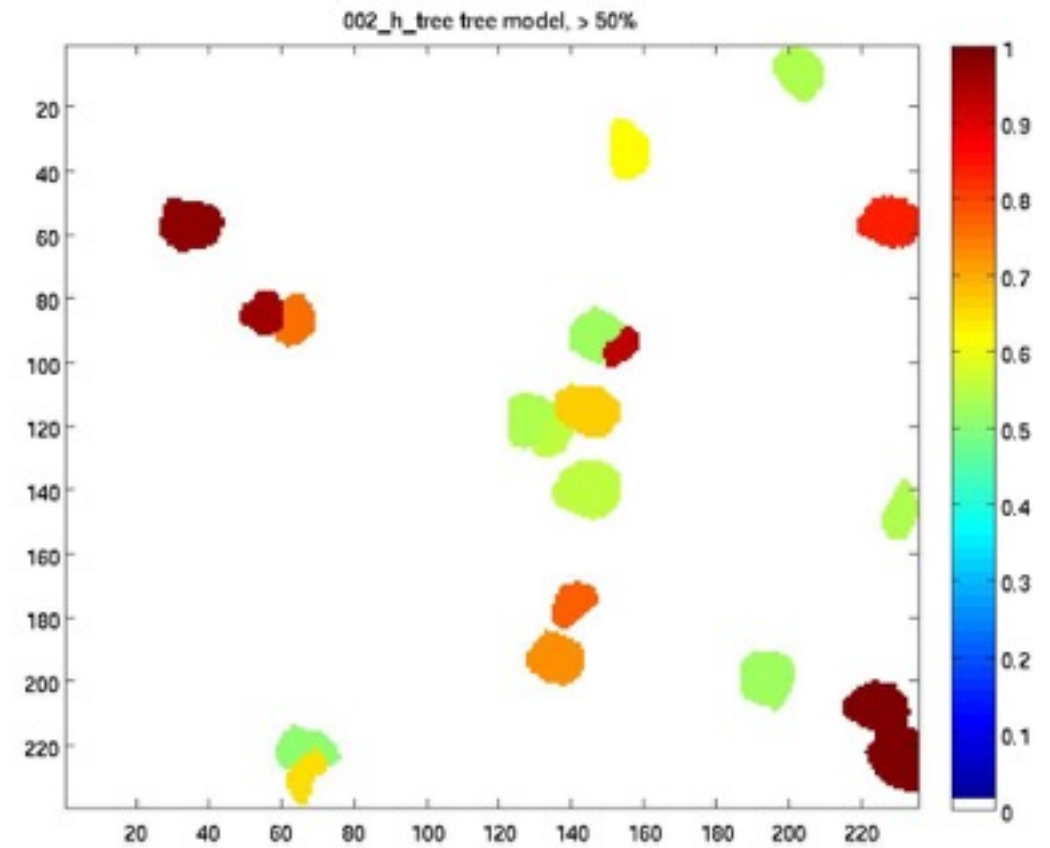
Sampled neural activity from tree model



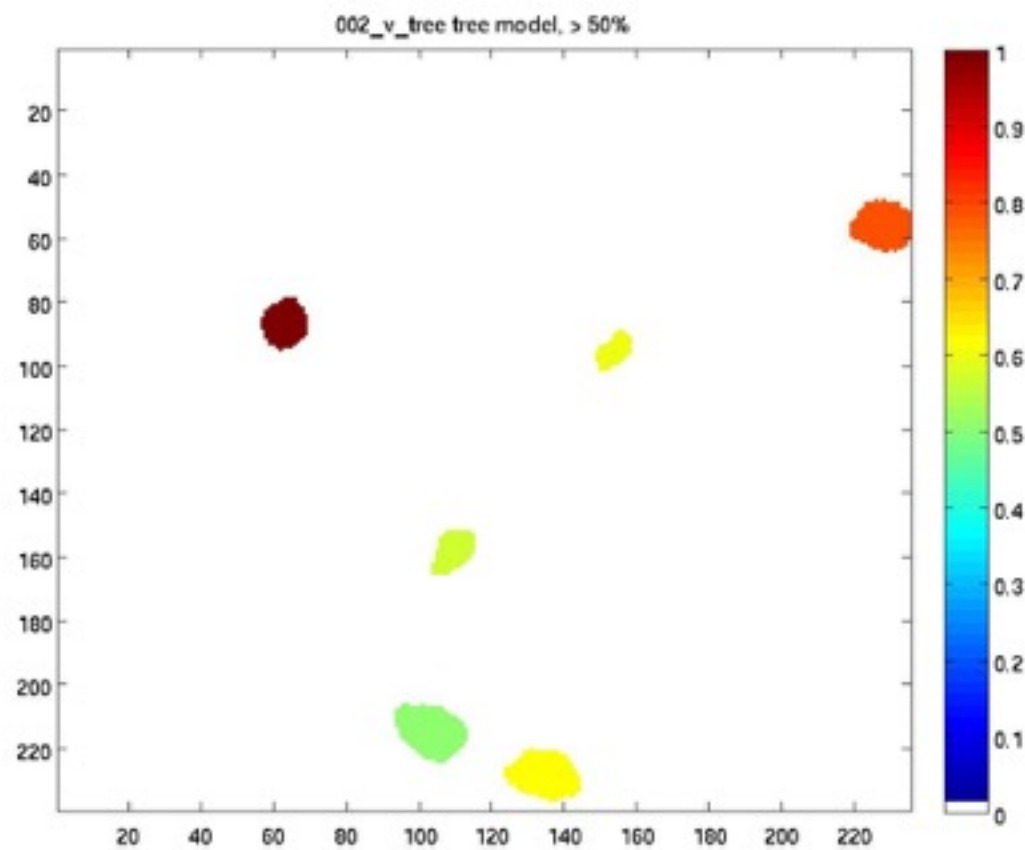
Neurons that fire > 50% of the time, per stimulus model



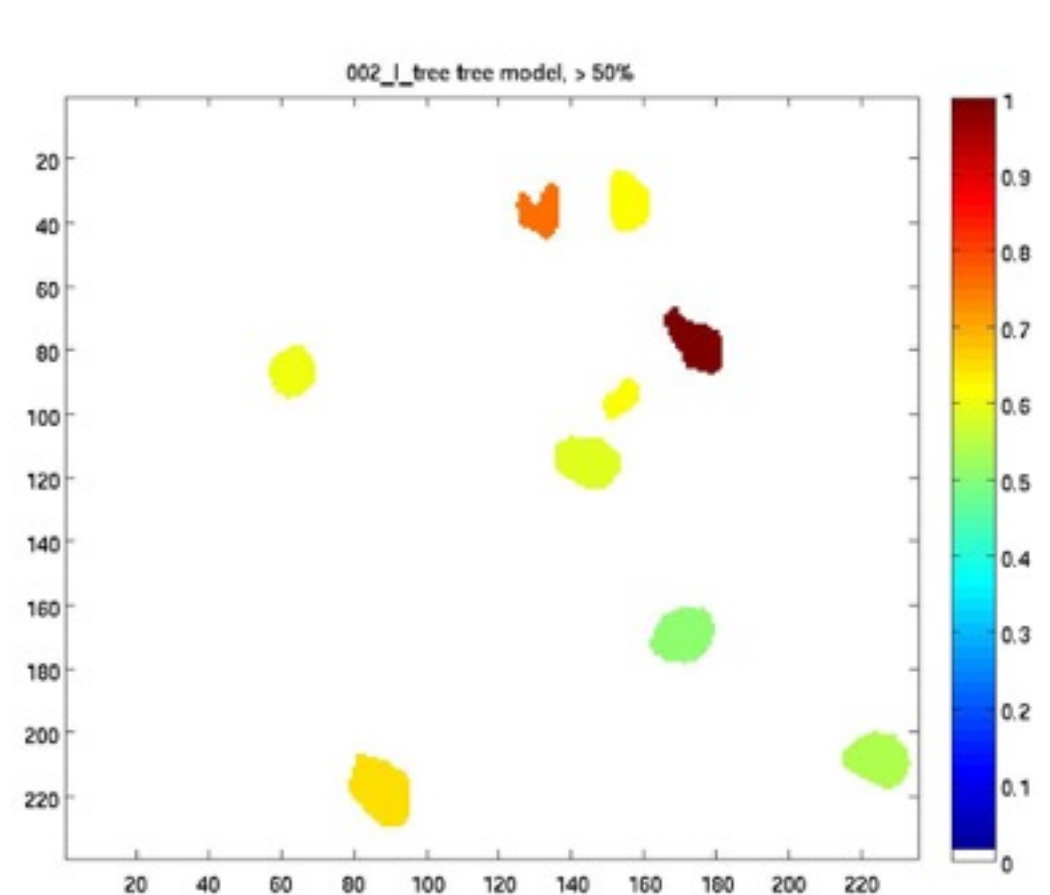
Spontaneous



0 degree



45 degree

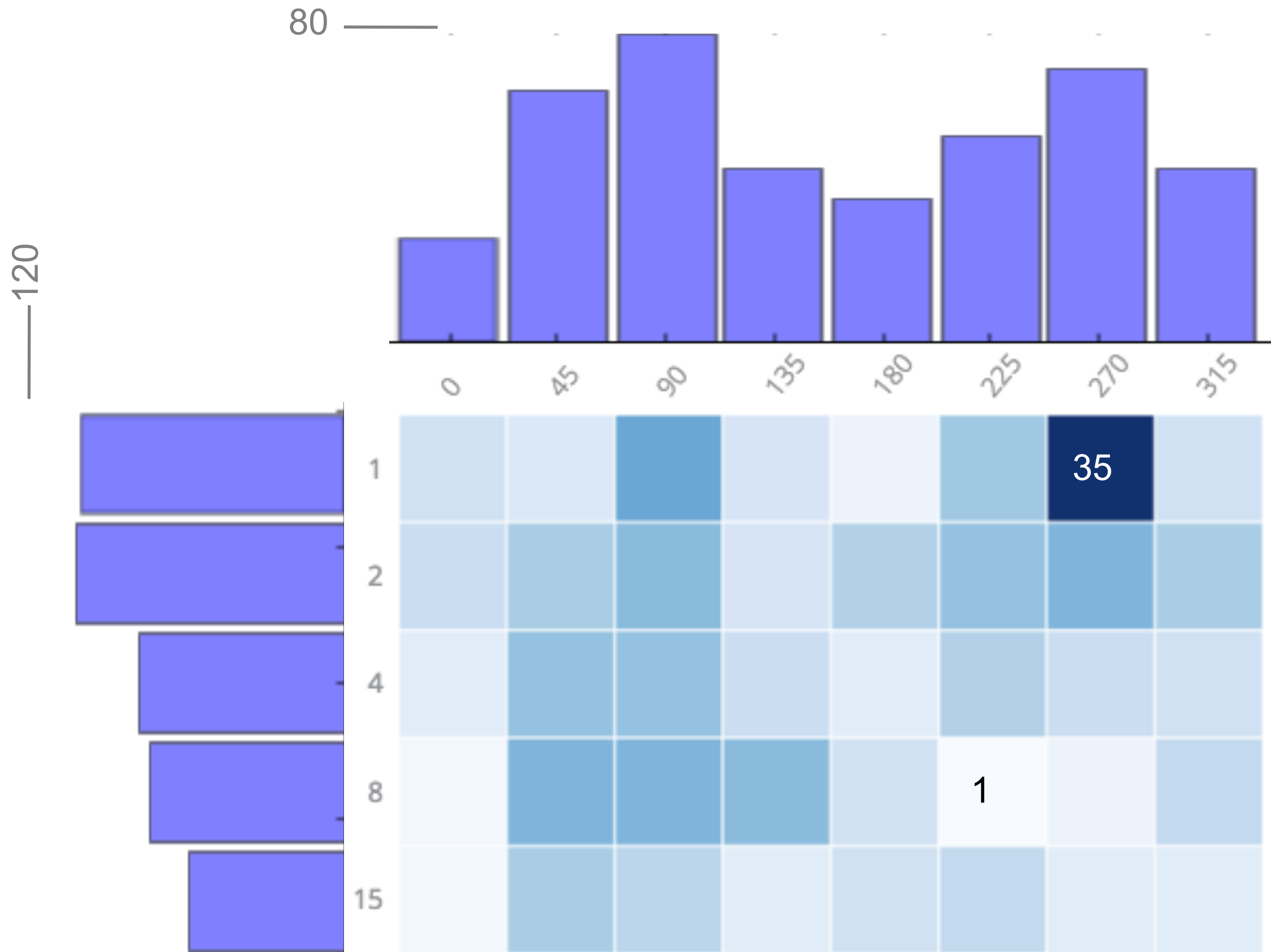


135 degree

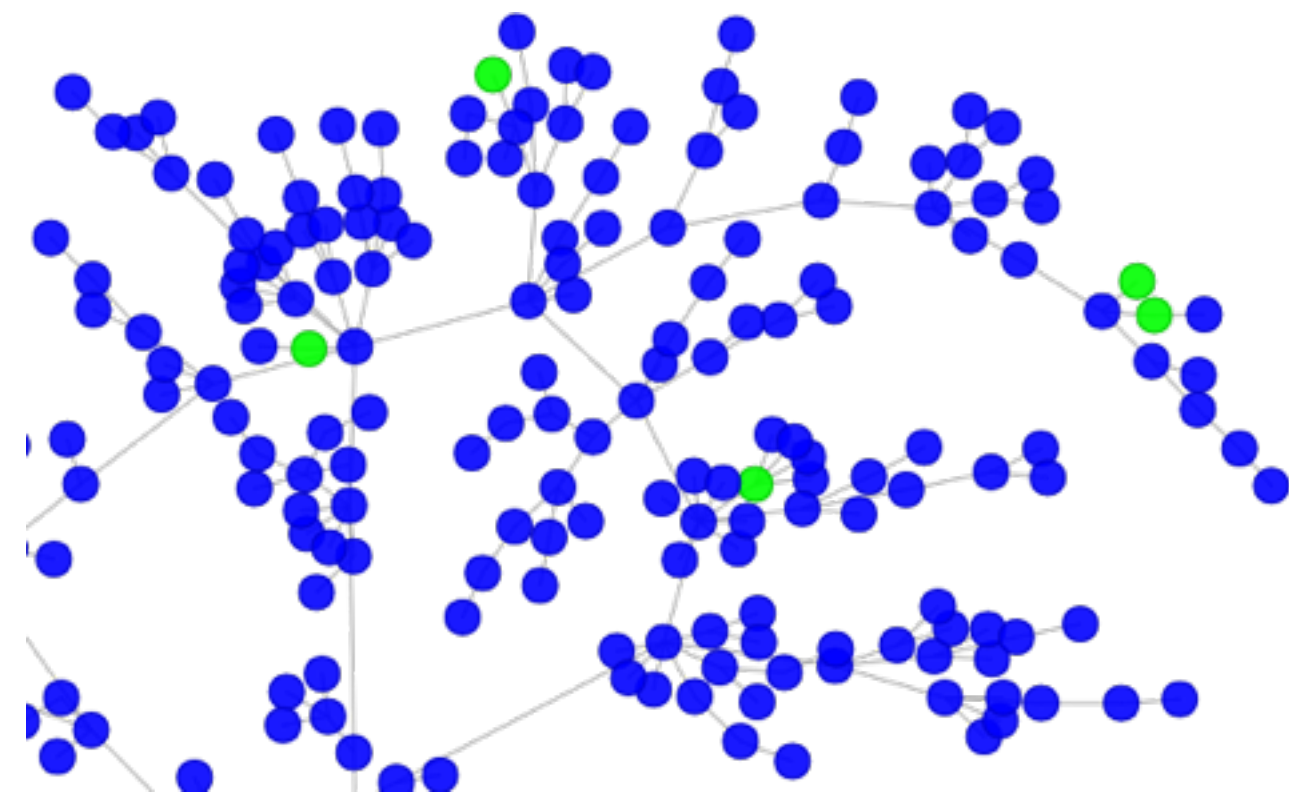
Work in progress

- Models for natural image stimuli.
- Models across V1 layers, 300-500 neurons per layer, ~4K per animal (Paul Allen Institute dataset).
- Encode expert knowledge during structure learning.

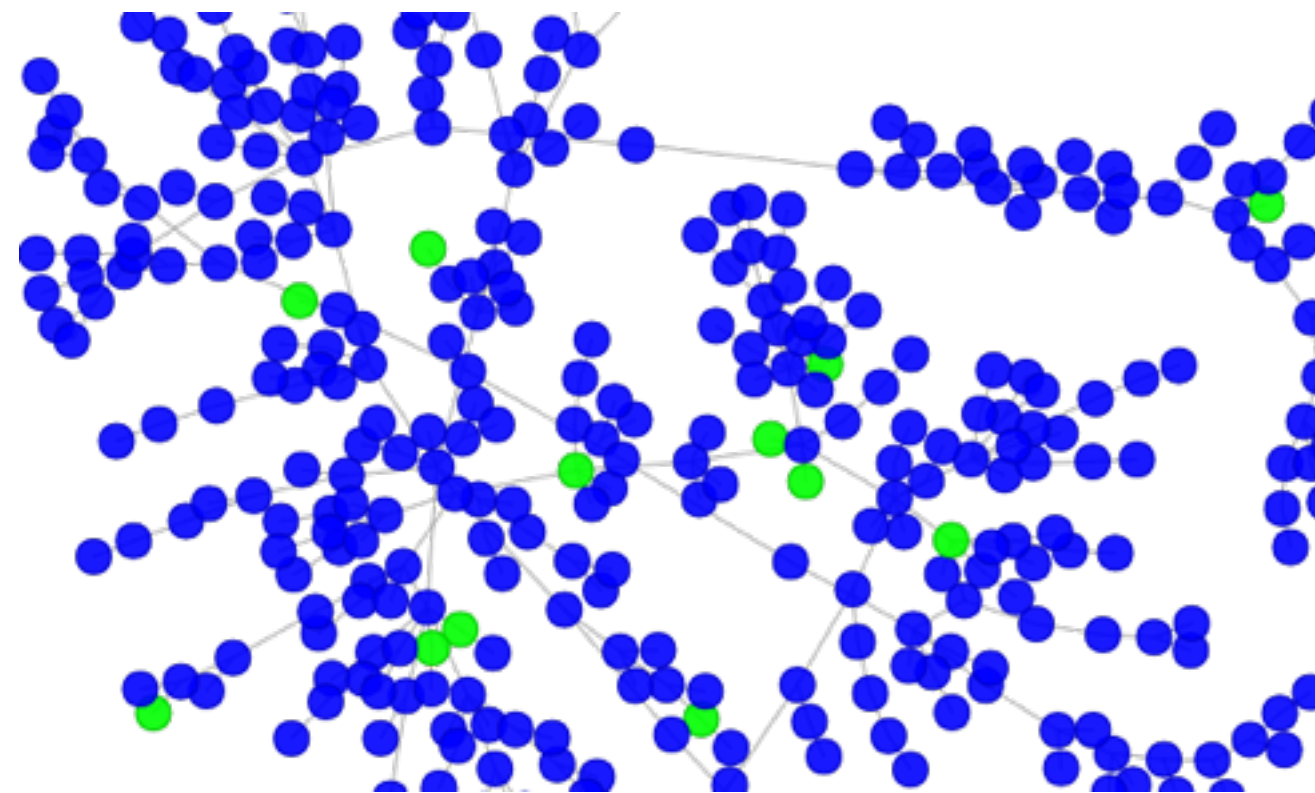
V1 orientation tuning



V1 orientation tuning



90 degree, layer 1 tree model,
orientation selectivity

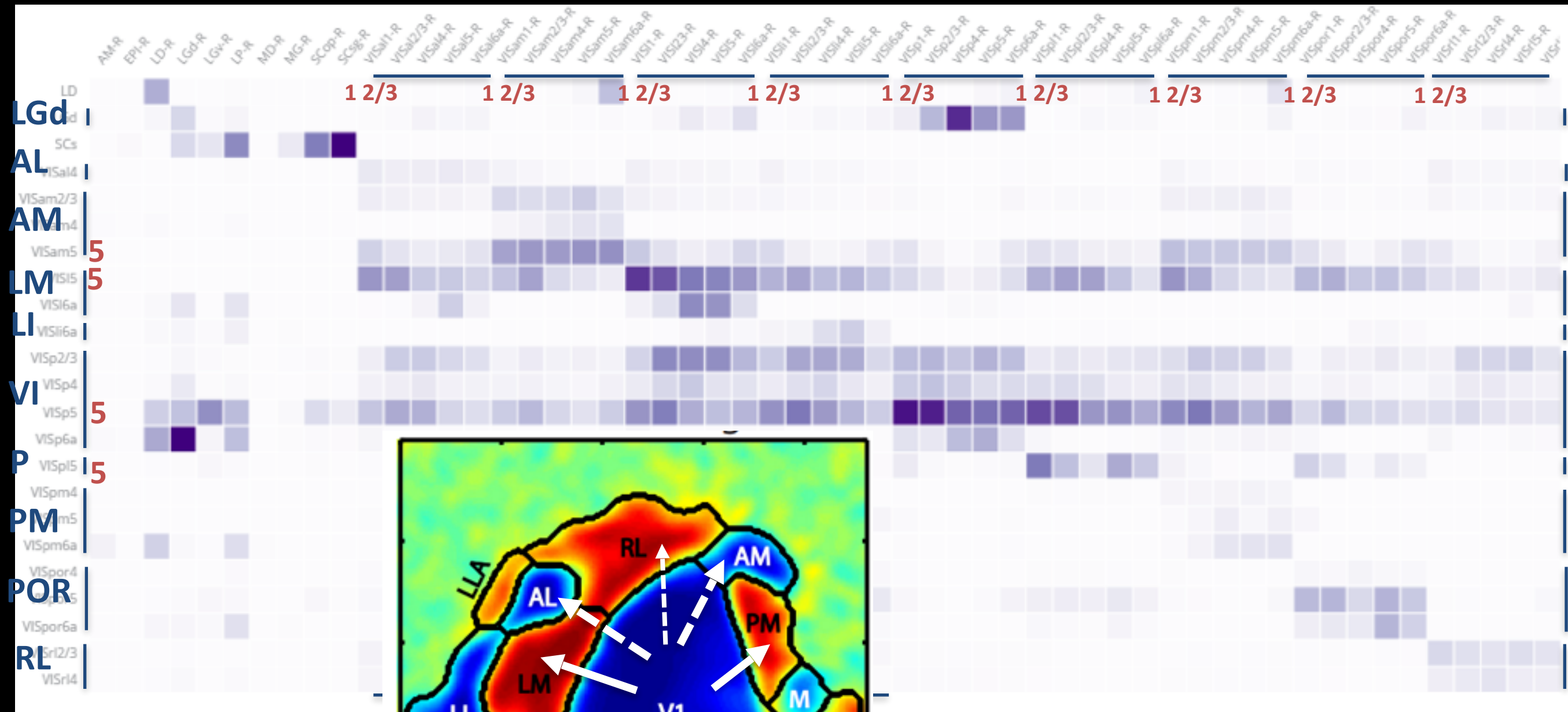


135 degree, layer 1 tree model,
orientation selectivity

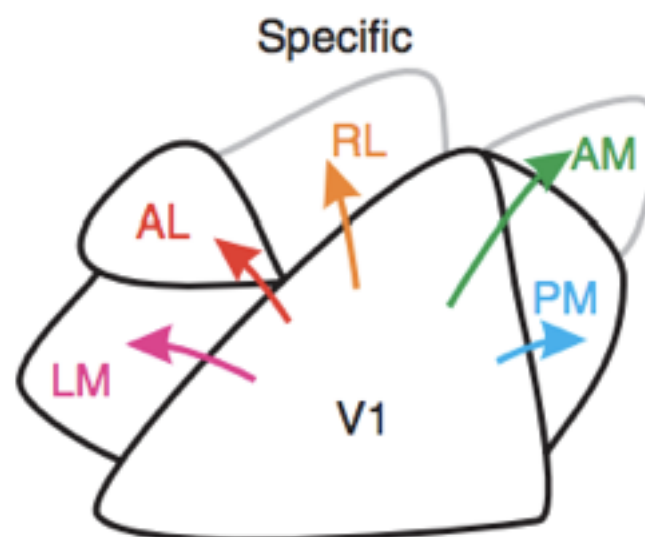
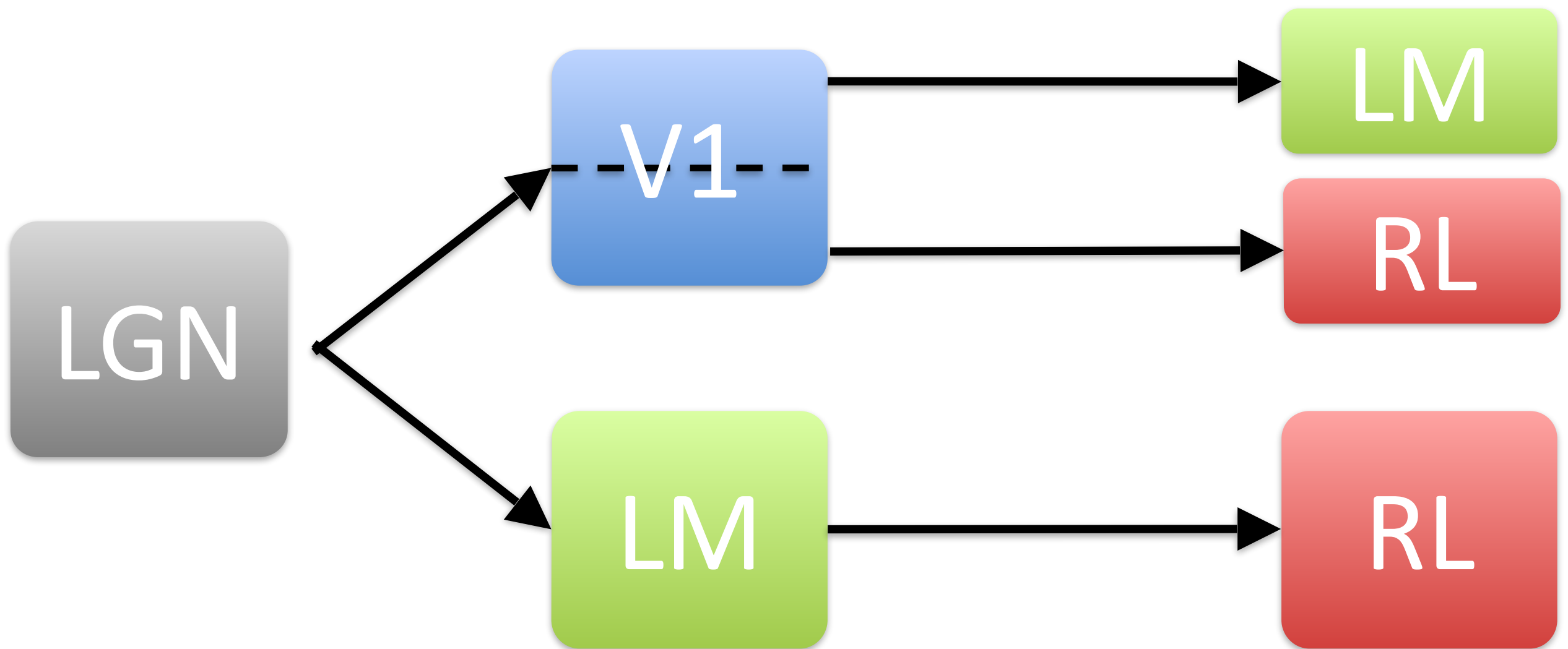
- Encode expert knowledge during structure learning.

$$\text{Normalized Projection Density} = (\text{NPV}) \frac{\text{Source volume}}{\text{Target volume}} = \frac{\text{Target fluor.}}{\text{Target vol.}} \bigg/ \frac{\text{Source fluor.}}{\text{Source vol.}}$$

LGd LD LP SC AL AM LM LI VI P PM POR RL

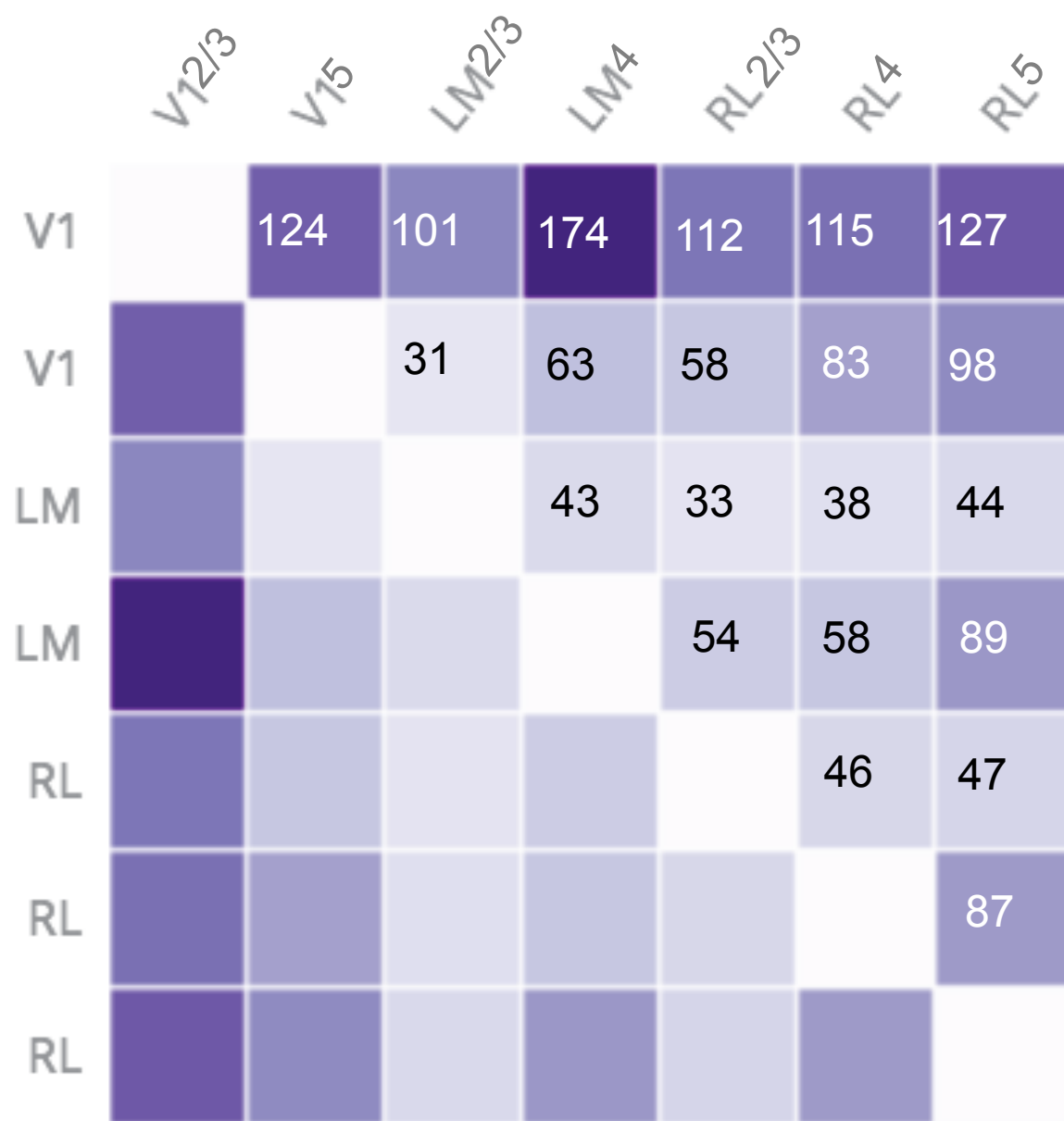


“Wiring diagram”

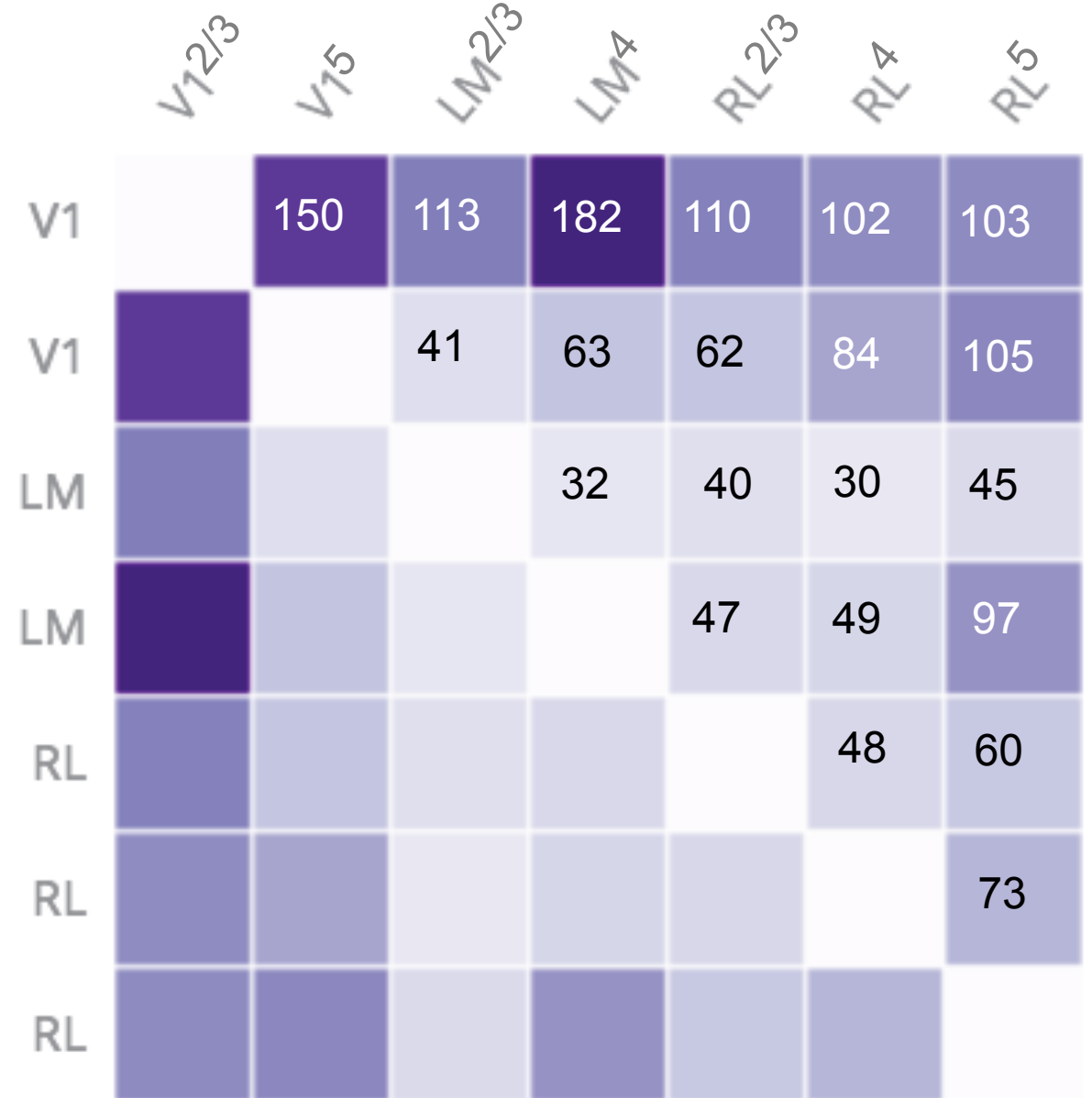


Glickfeld et al 2013

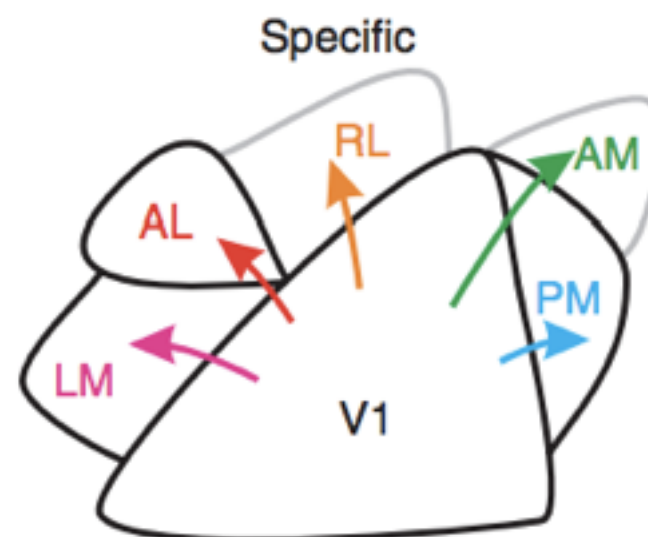
“Wiring diagram”



90° Stimulus



180° Stimulus



Glickfeld et al 2013

Functional Models of Mouse Visual Cortex

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Thank you!

