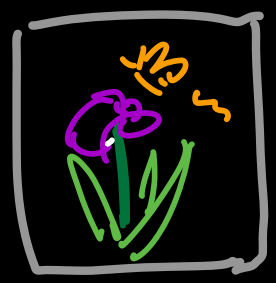
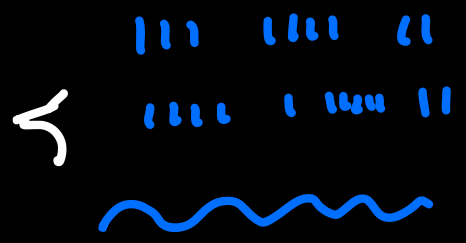
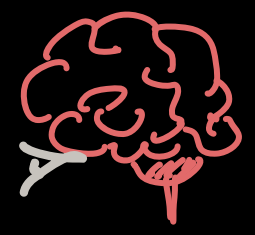


some common problems in neuroscience =



stimuli



neural response

perception

behavior

decision making

...

P1. (45 min)

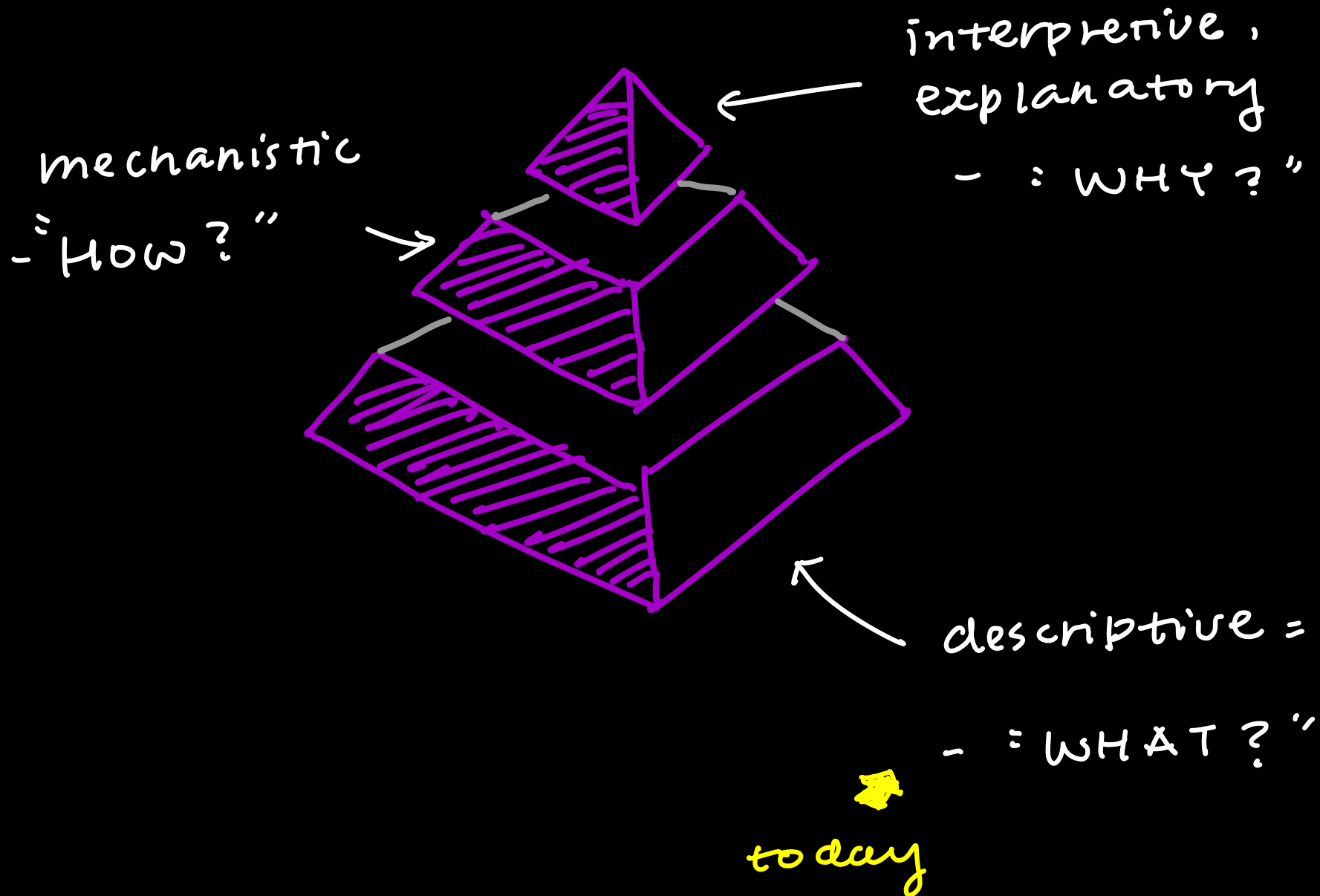
An example experiment,  
some typical data,  
and some explorations.

P2. (45 min)

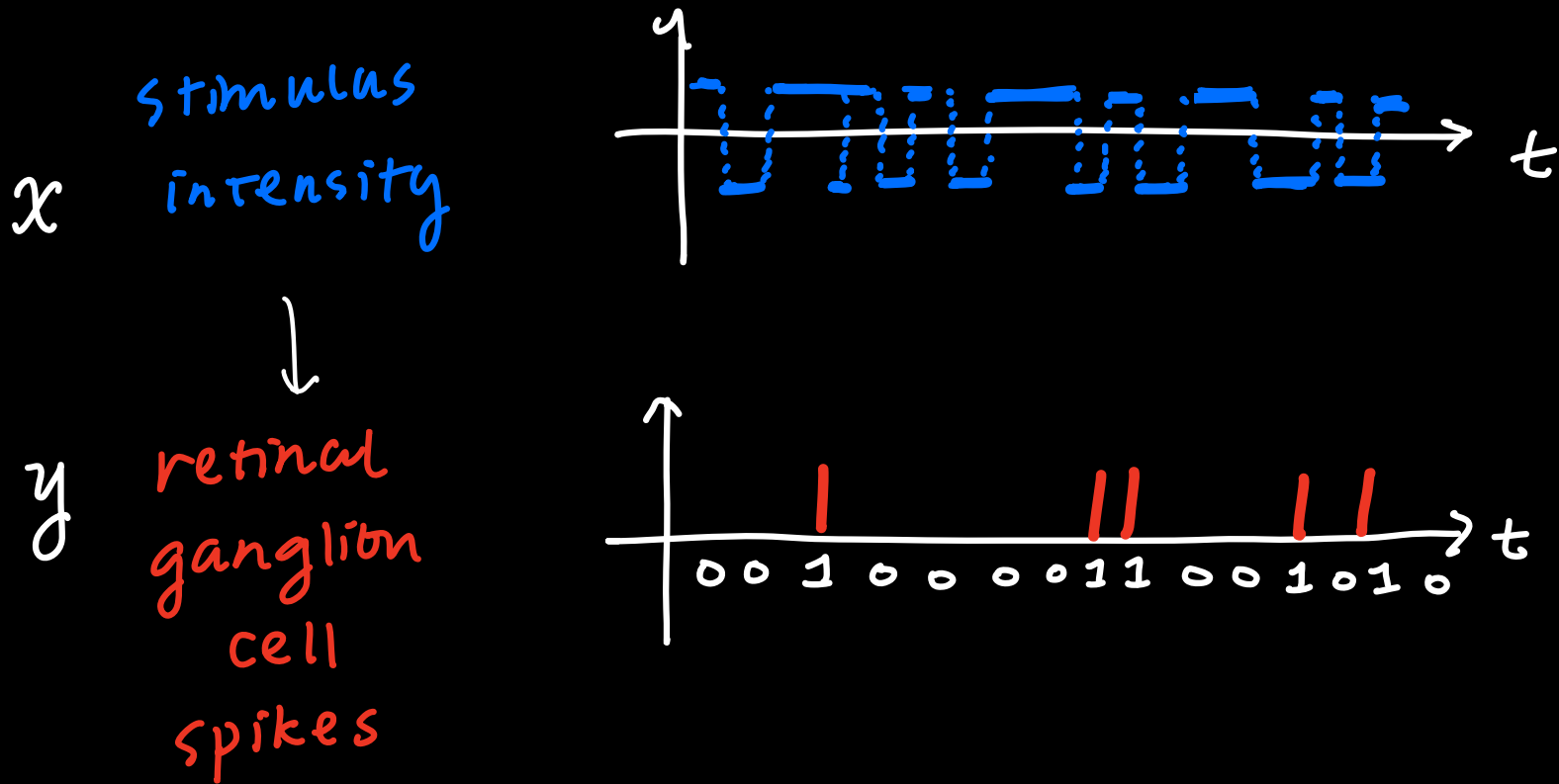
A classic model

for neural encoding

# The model Universe =



Question Today =

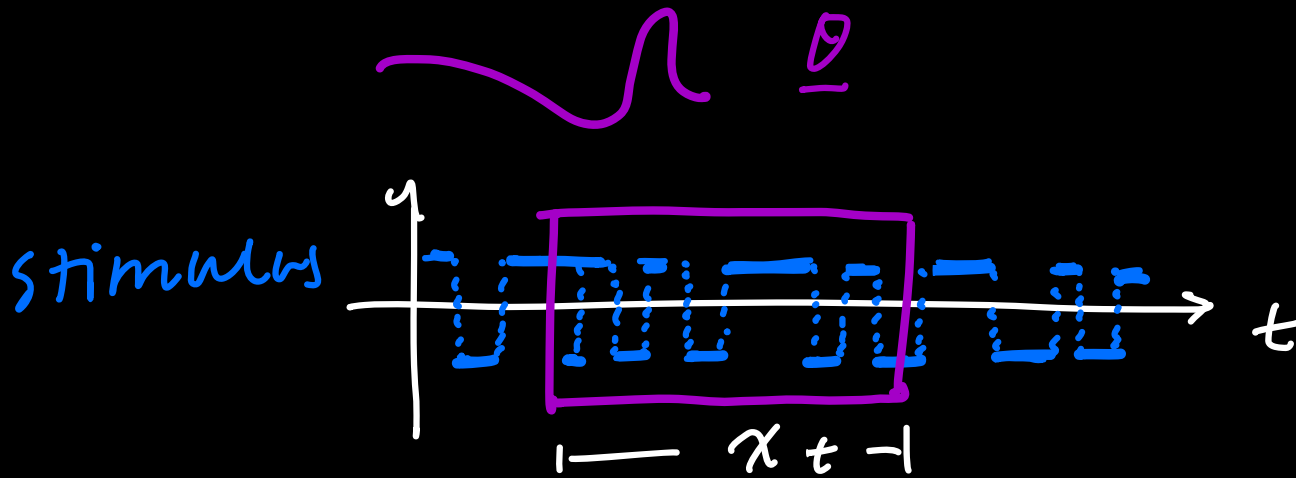


What's the cell activity given the stimulus intensity preceding it?

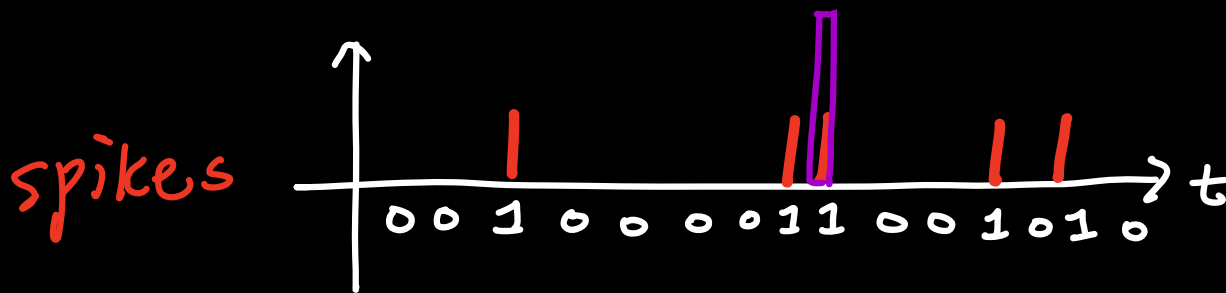
Proposed "WHAT" model =

A temporal filter!

- $\lambda$ : firing rate
- $y$ : spike
- $\eta$ : Gaussian noise.



$$\lambda_t = \theta^T x_t$$



$$y_t = \lambda_t + \eta_t$$

In equations,  $\underline{y} = X \underline{\theta} + \underline{\eta}$  (linear model)

$$\begin{bmatrix} 0 \\ 1 \\ 0 \\ 0 \\ \vdots \end{bmatrix} = \begin{bmatrix} \text{window} \\ \text{size} \\ \vdots \end{bmatrix} \begin{bmatrix} \theta_1 \\ \theta_2 \\ \vdots \end{bmatrix} + \begin{bmatrix} \eta_1 \\ \eta_2 \\ \vdots \end{bmatrix}$$

— window —  
size

$$\eta \sim \mathcal{N}(0, \sigma^2)$$

$$\theta^* = \arg \max_{\theta} \log \mathcal{L}(\theta | X, y)$$

$$\rightarrow \theta_{MLE}^* = (X^T X)^{-1} X^T y$$

But spike noise isn't Gaussian!



non-negative, discrete



we need GLMs (Generalized Linear Model)

