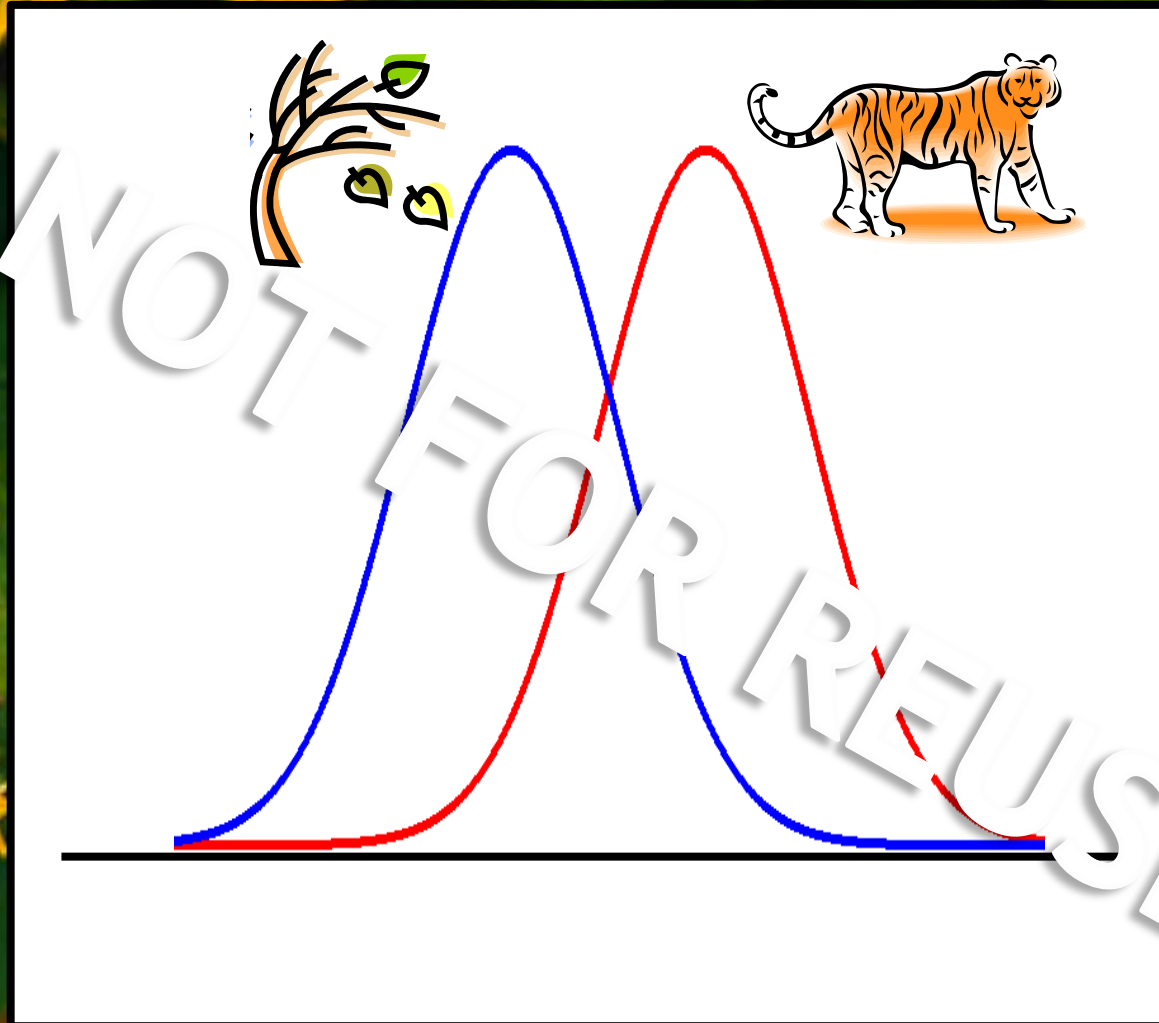


Decoding

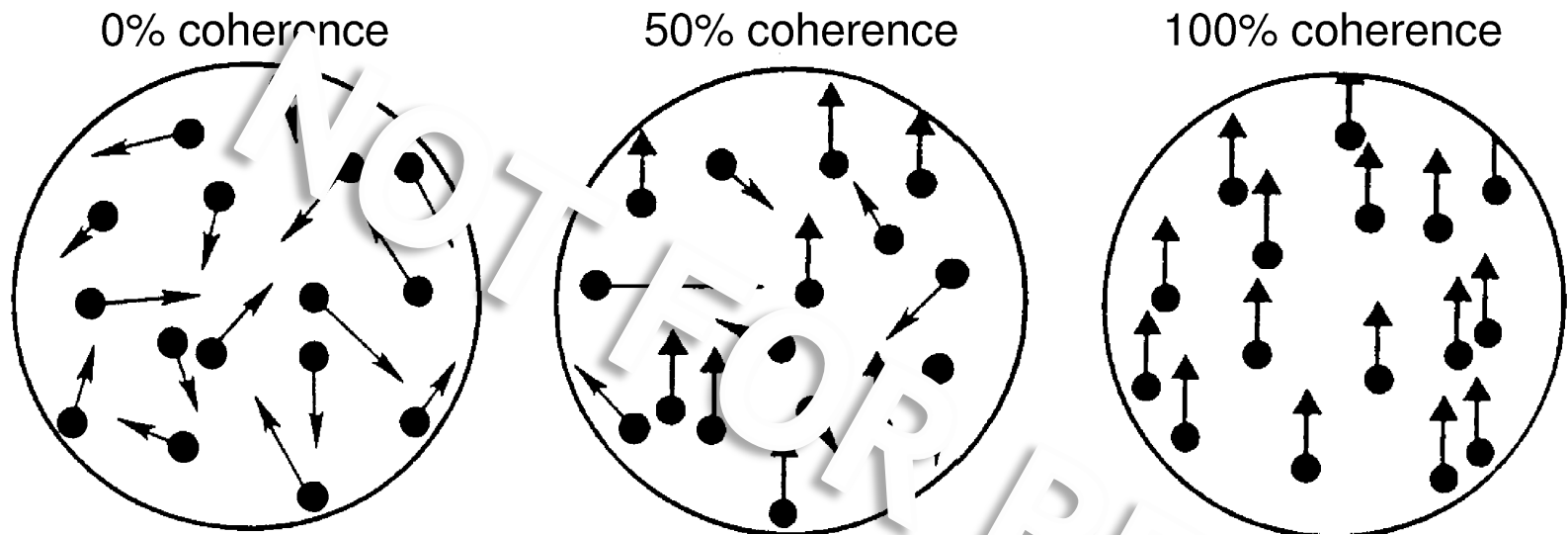
How well can we learn what the stimulus is by looking at the neural responses?

NOT FOR REUSE

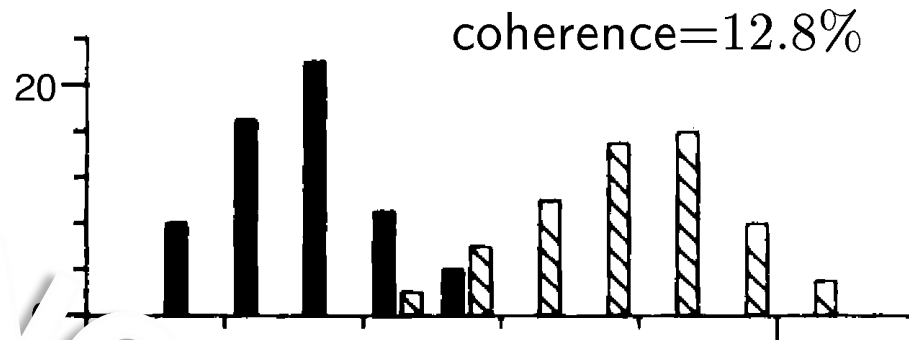
Do I stay or do I go?



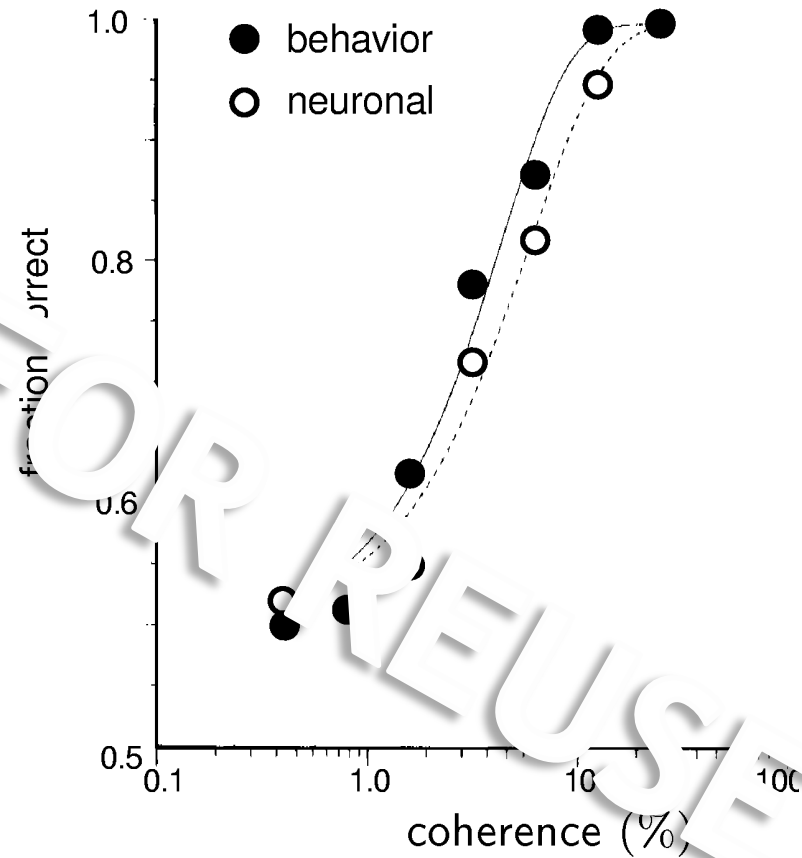
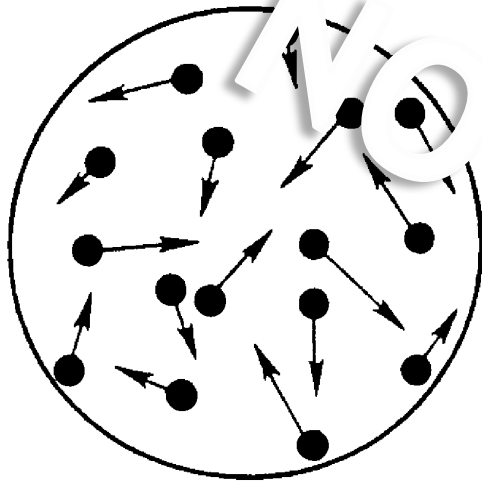
Making a decision



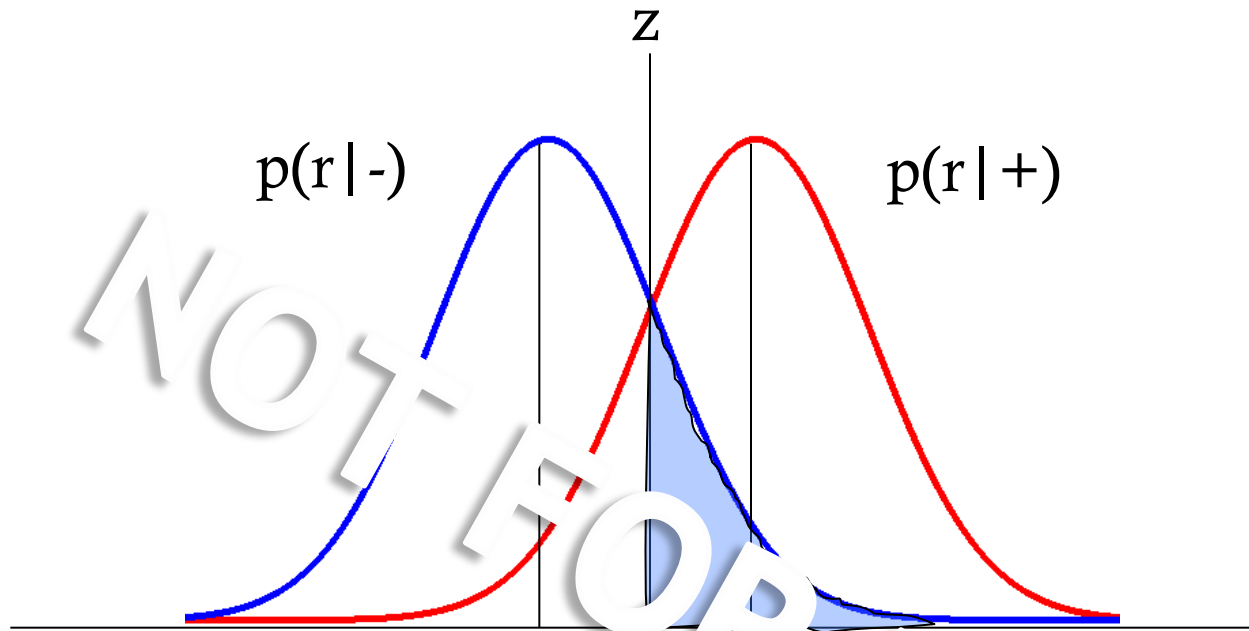
Predictable from neural activity?



Behavioral performance



Signal detection theory



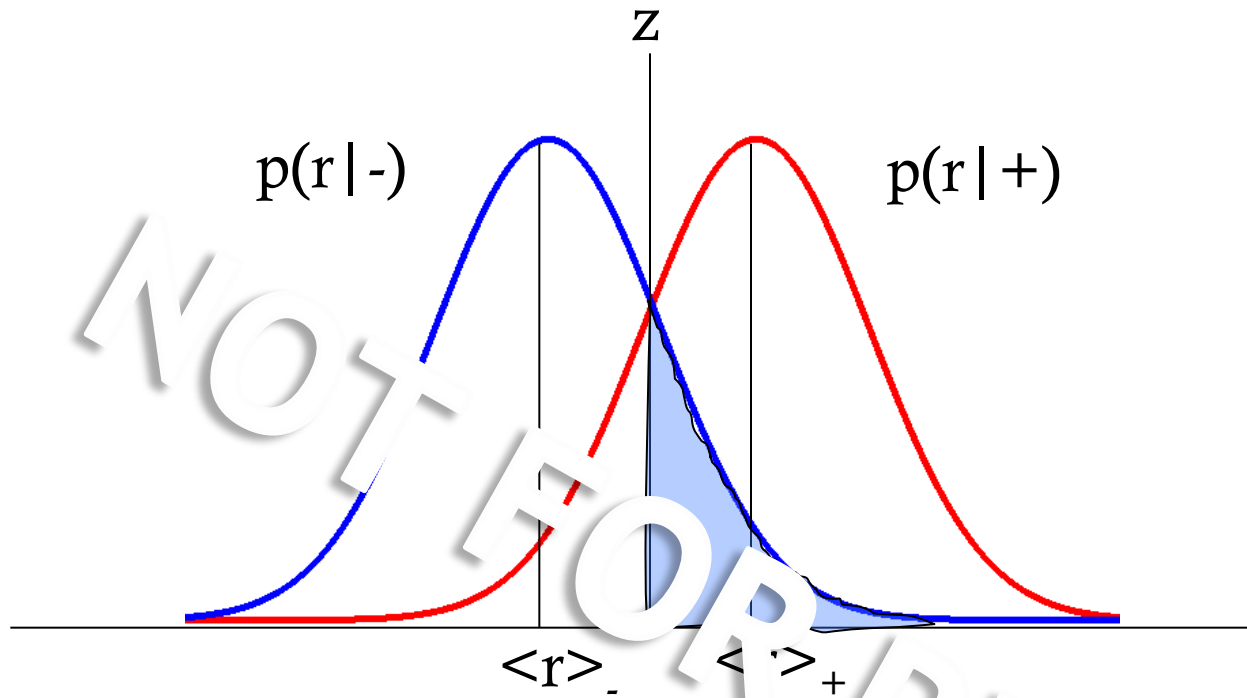
How many errors are you going to make

False alarms: $P[r \geq z|-]$

Good calls = $P[r \geq z|+]$

This choice of z maximizes $P[\text{correct}]$

Likelihood ratio



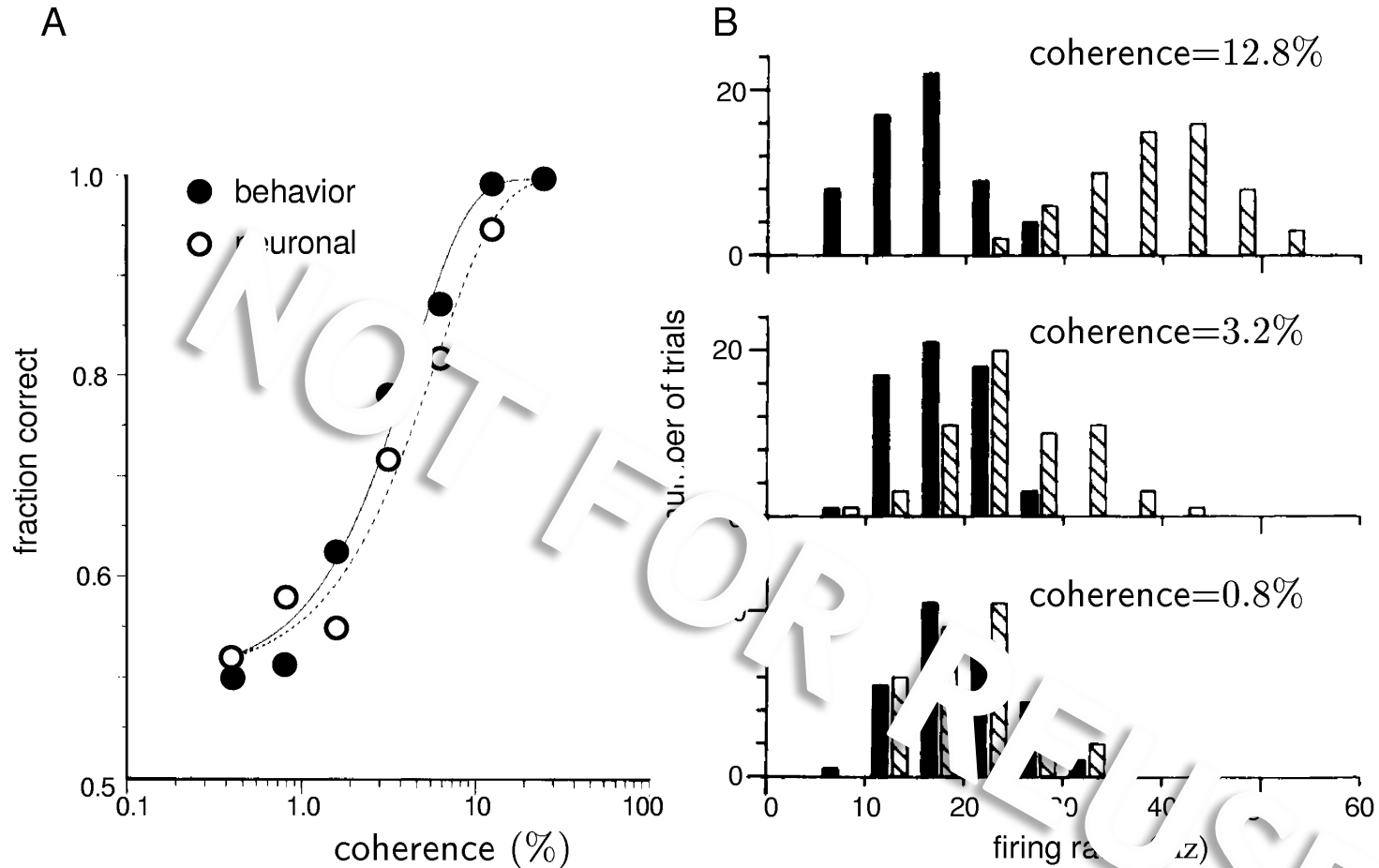
The likelihood ratio test is the most efficient statistic, in that it has the most power for a given size.

Power = probability of a false negative

Size = probability of a false positive

Neyman-Pearson lemma

Neurons vs organisms

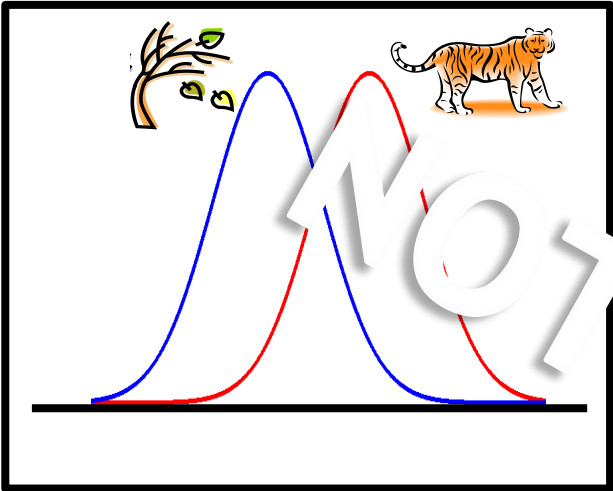


Close correspondence between neuron decoding and behavior..

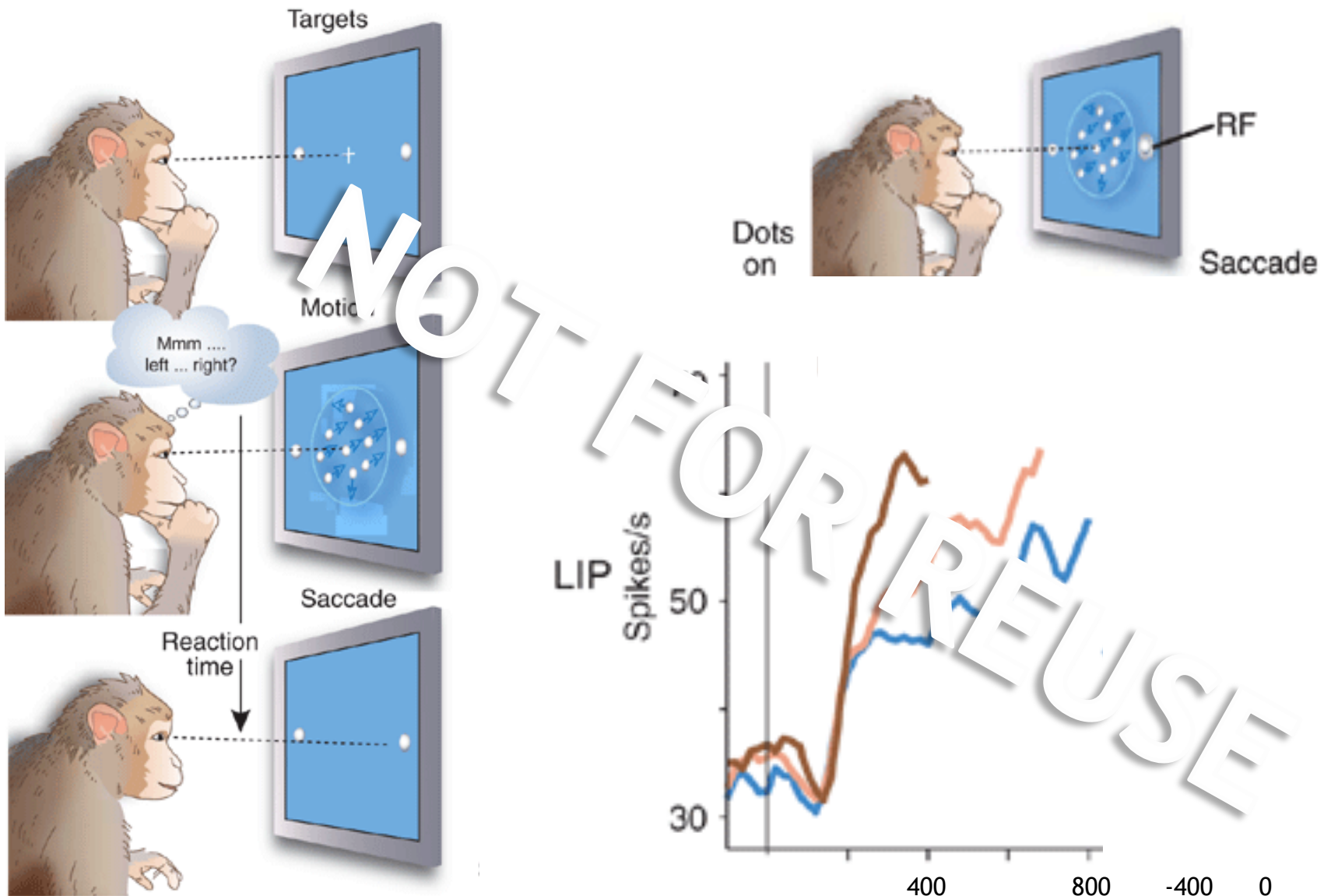
So why so many neurons?

Let's just consider for a moment

Now let's say we don't have to decide immediately...

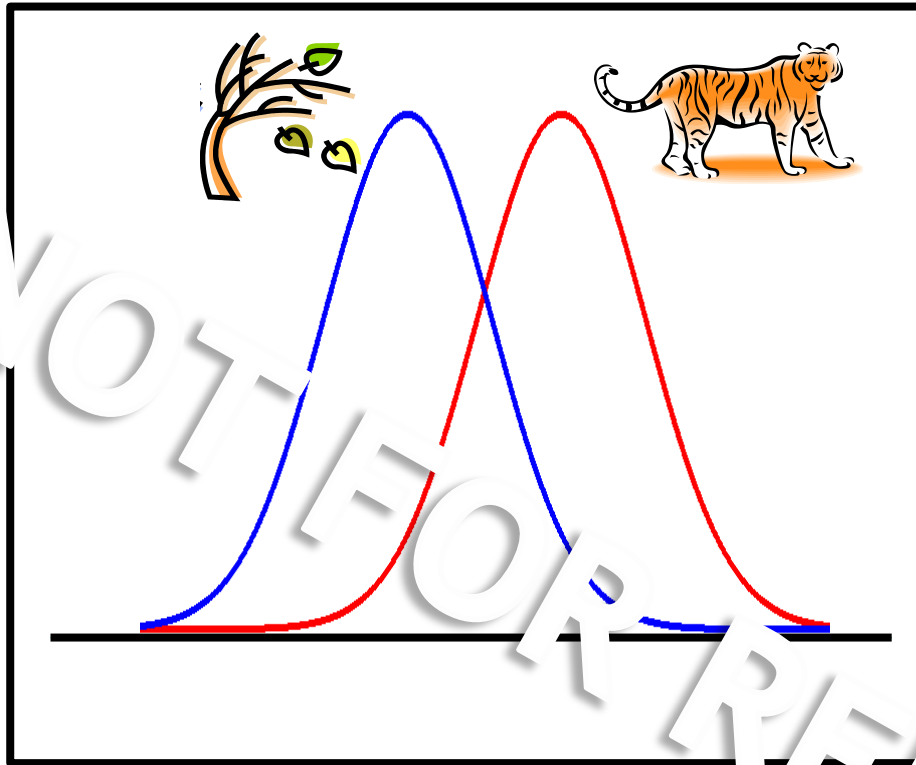


Accumulated evidence for accumulated evidence



Kiani, Hanks & Shadlen, Nature Neuroscience (2006)

Back to one trial: building in what we already know

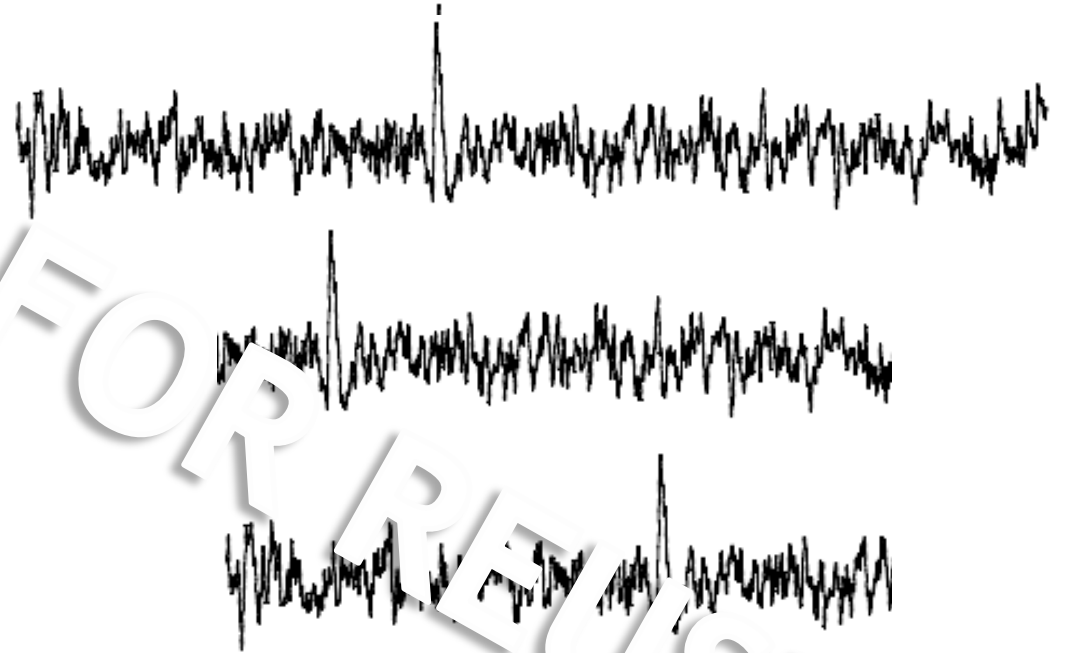
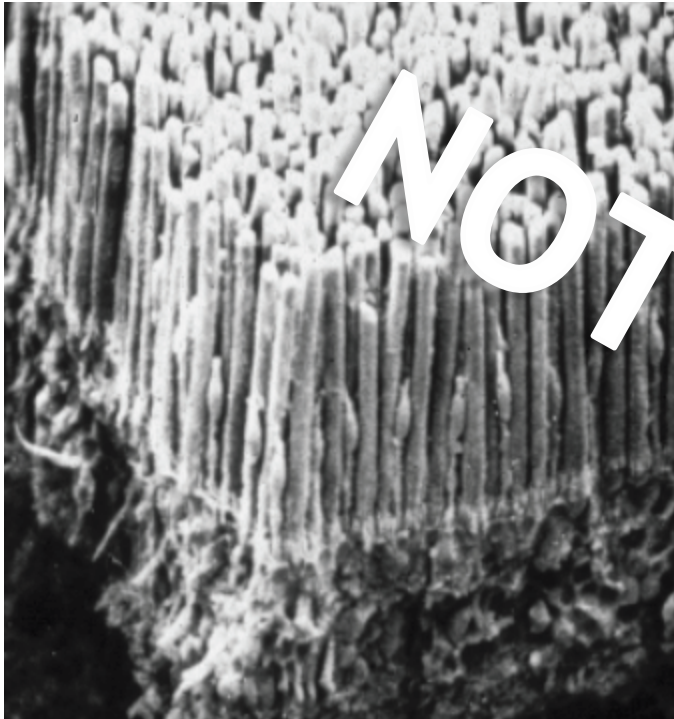


Role of *priors*:

Find z by maximizing $P[\text{correct}] = p[+] b(z) + p[-](1 - a(z))$

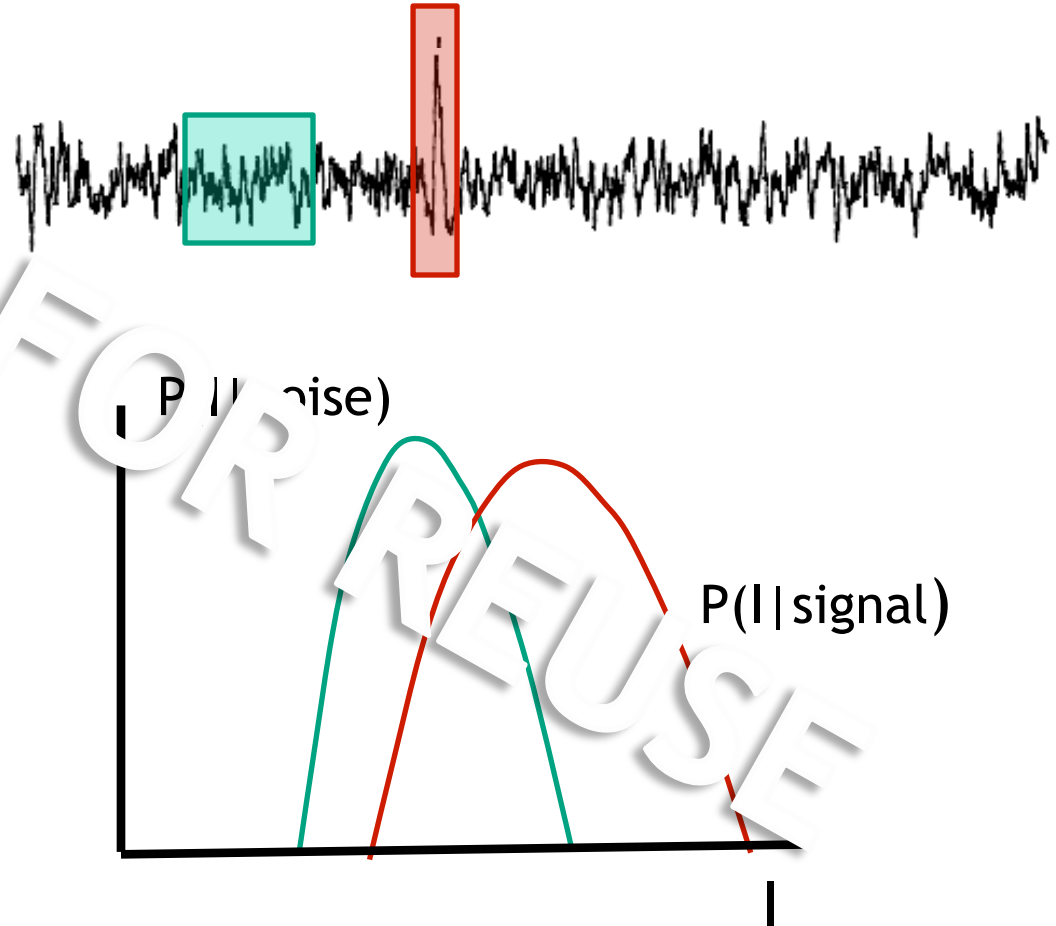
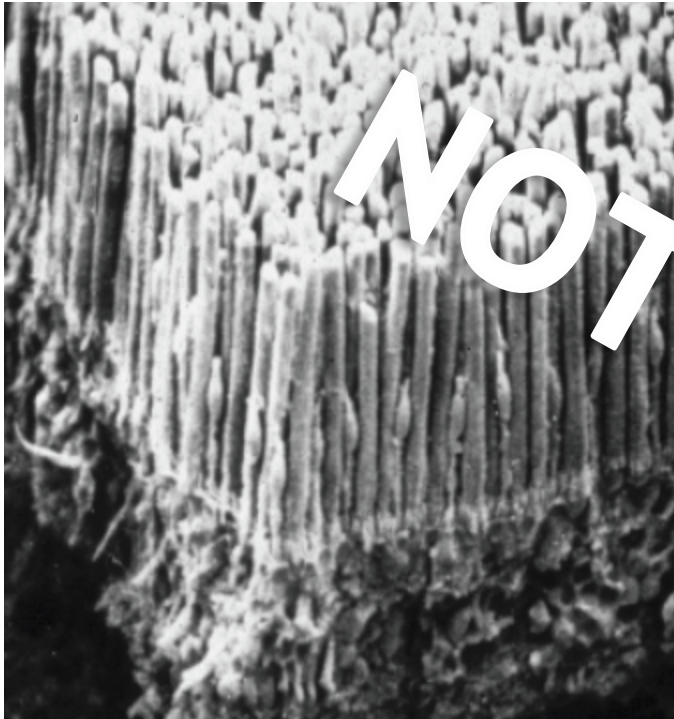
The wind or a tiger?

Classification of noisy data: single photon responses



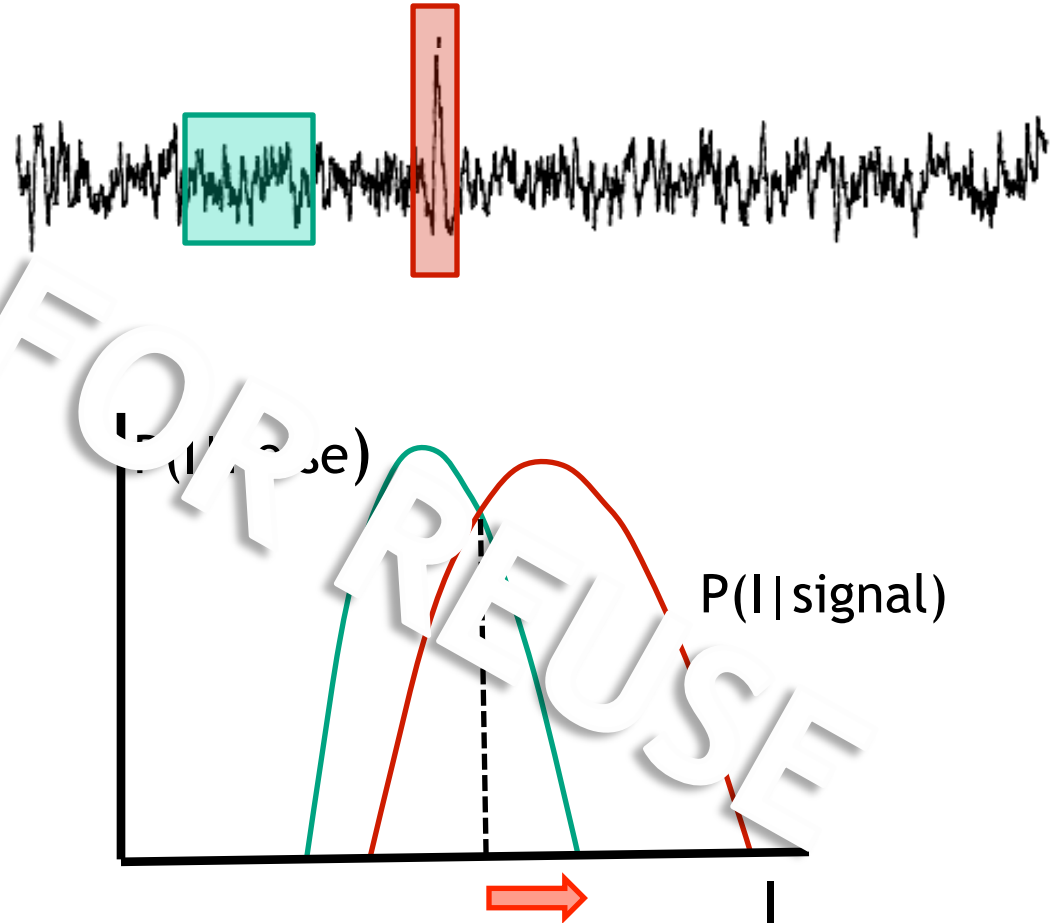
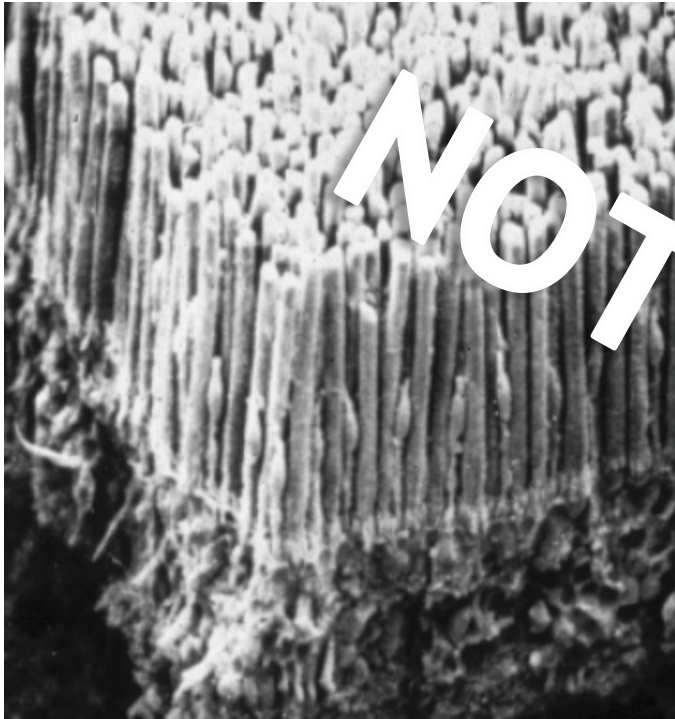
Nonlinear separation of signal and noise

Classification of noisy data: single photon responses



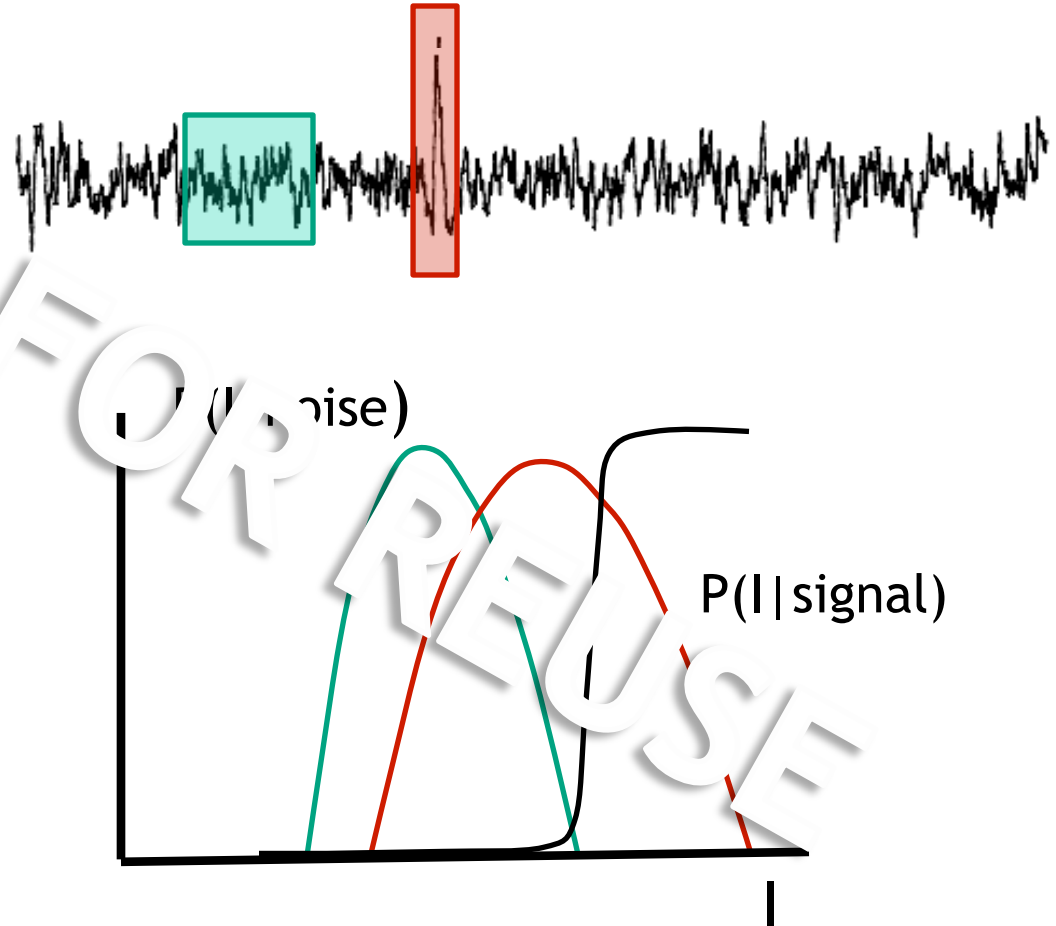
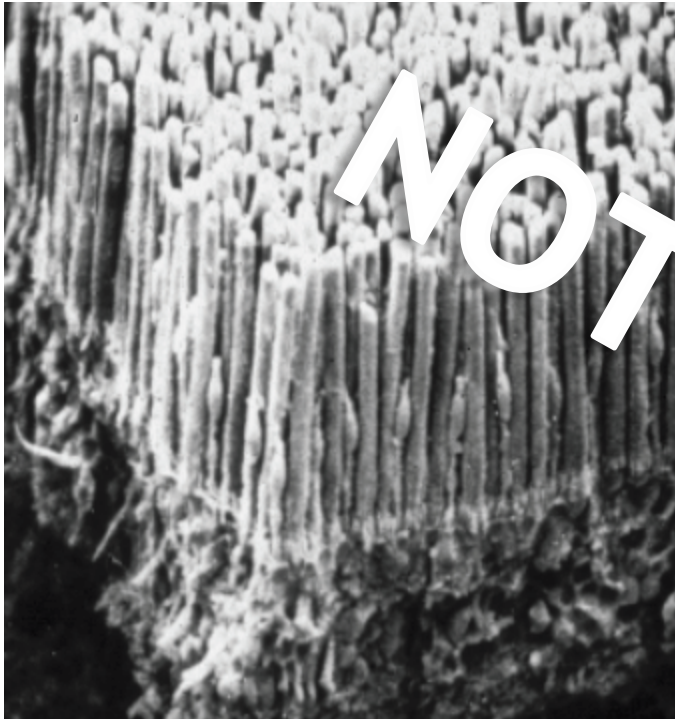
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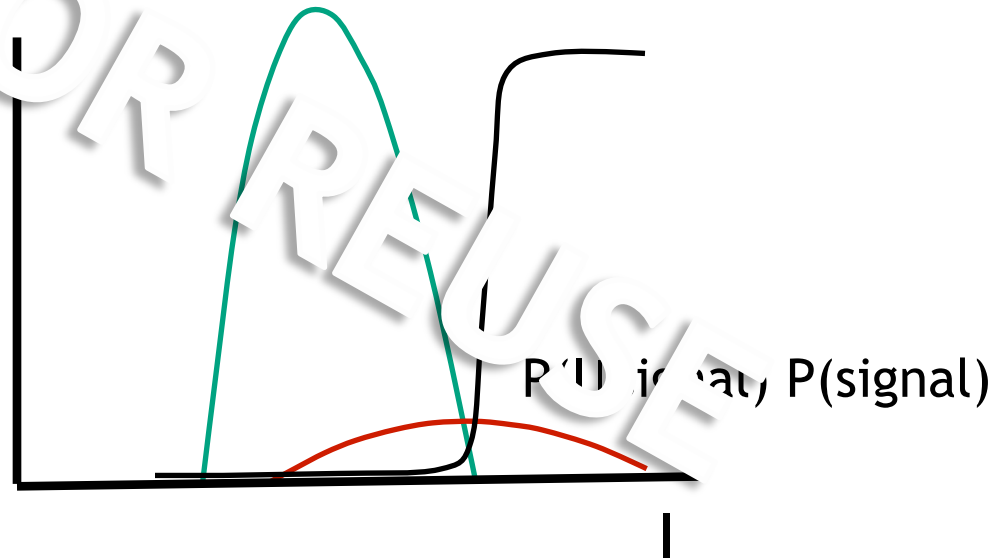
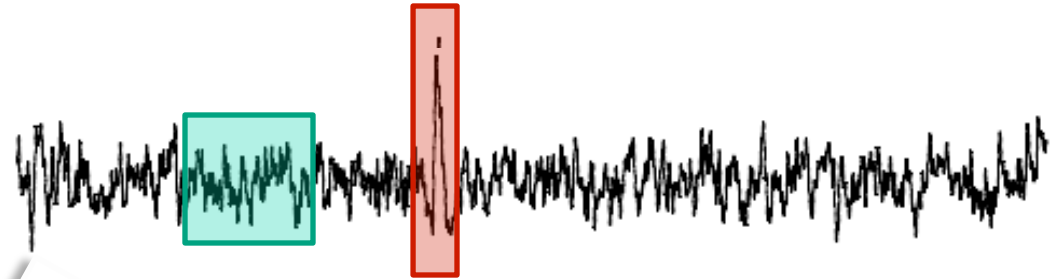
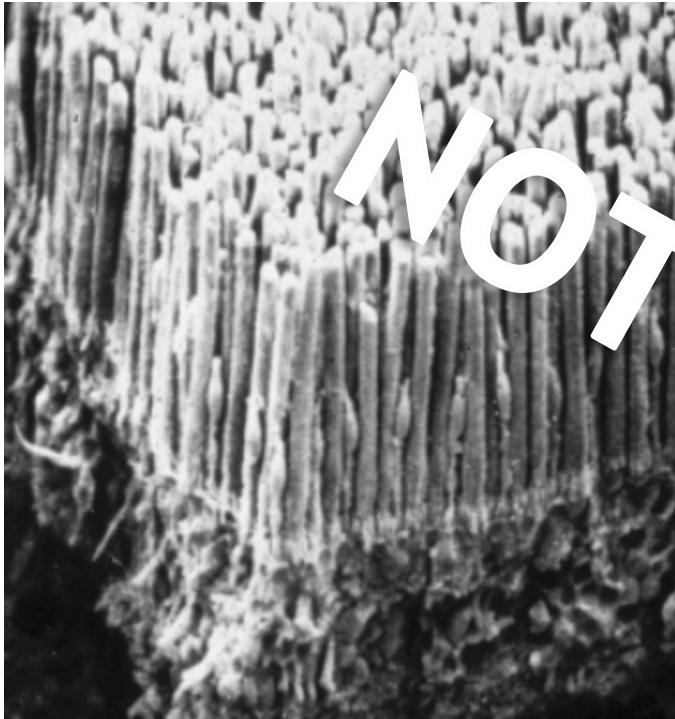
Nonlinear separation of signal and noise

Classification of noisy data: single photon responses



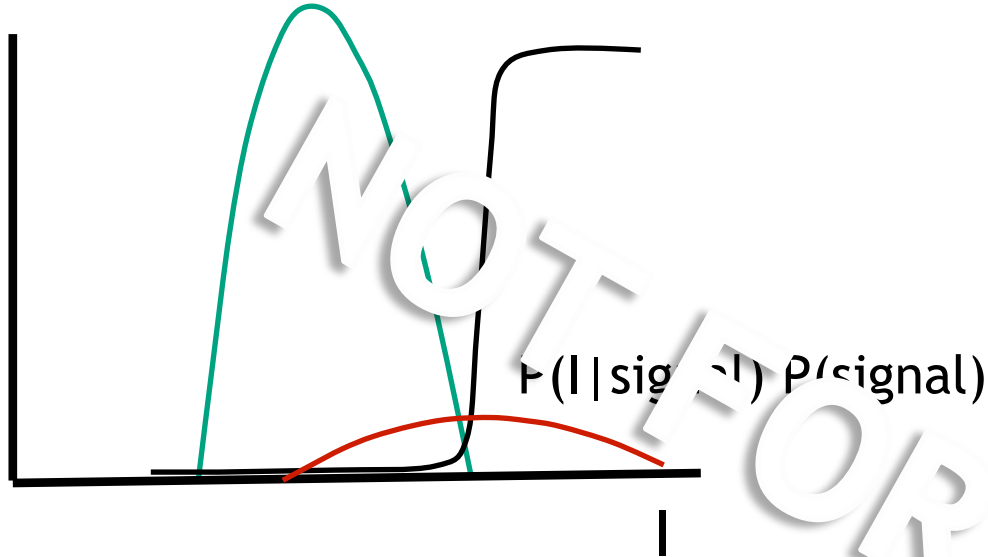
Nonlinear separation of signal and noise

Classification of noisy data: single photon responses



That's prior knowledge: how about costs?

$P(I|\text{noise})$ $P(\text{noise})$



*the signal and the
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why so many are
predictions fail—
but some don't t
the noise and
the signal and the
nate silver noise
noise and the no*

Building in cost



Cut your losses: answer + when Loss₊ < Loss₋

i.e. $L_+P[- | r] < L_-P[+ | r]$.

$$\rightarrow p[r | +] / p[r | -] > L_+P[-] / L_-P[+]$$