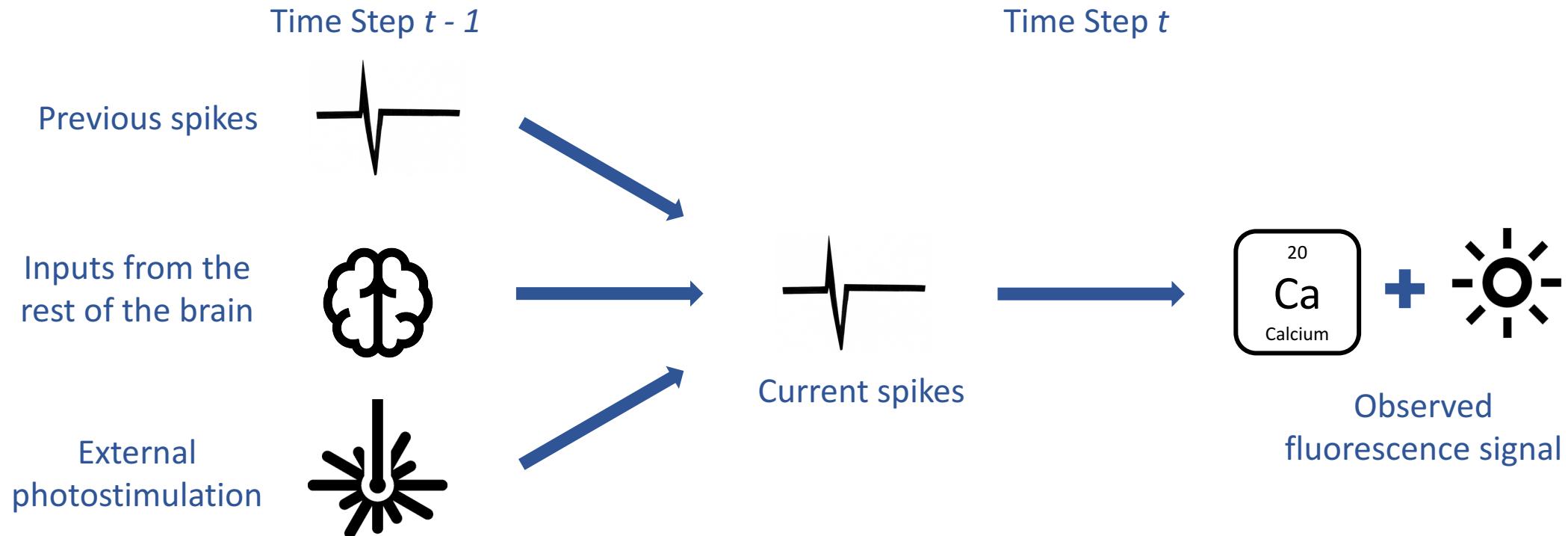


Broad Overview of Generative Model

Part 1: Generate spikes at time step t

Part 2: Generate calcium fluorescence signals from the spikes



Key Equations

Generative Model

$$P(f(t)) = N(f(t); r(t), \Sigma^f)$$

Fluorescence signals at time t Reconstruction with Gaussian noise Learned, diagonal covariance matrix

Reconstruction

$$r(t) = W^{re} e(t) + A \sum_{t'=0}^t k(t-t') \odot s(t') + b^r$$

Optogenetic stimulation
Diagonal scaling matrix

Convolution kernel (cell-specific)
Spikes
Additive offset

Convolution Kernel (unique to each cell)

$$k_c(t) = e^{-t/\tau_c^{decay}} - e^{-t/\tau_c^{rise}}$$

Spiking Depends on the Input

$$P(s(t)|u(t)) = Bernoulli(s(t); \sigma(u(t)))$$

Input

Weighted matrices

$$u(t) = W^{se} e(t) + W^{ss} \sum_{t'=t-4}^{t-1} k^s(t-t') s(t') + W^{sl} l(t) + b^s$$

External photostimulation
Normalized, exponentially decaying kernel
Learned offset

Dynamical System Generates Low-Dimensional Input Representing Activity in the Rest of the Brain

$$P(l(t)|l(t-1)) = N(l(t); W^{ll} l(t-1), \Sigma^l)$$