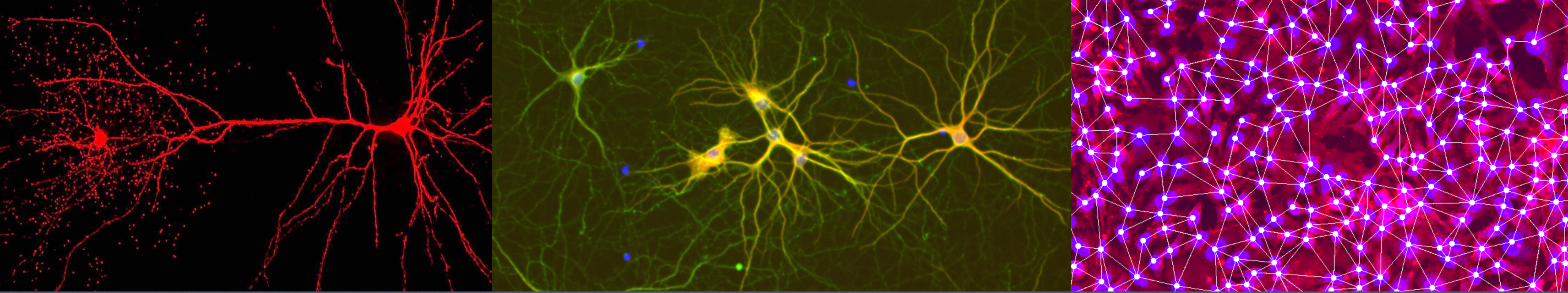


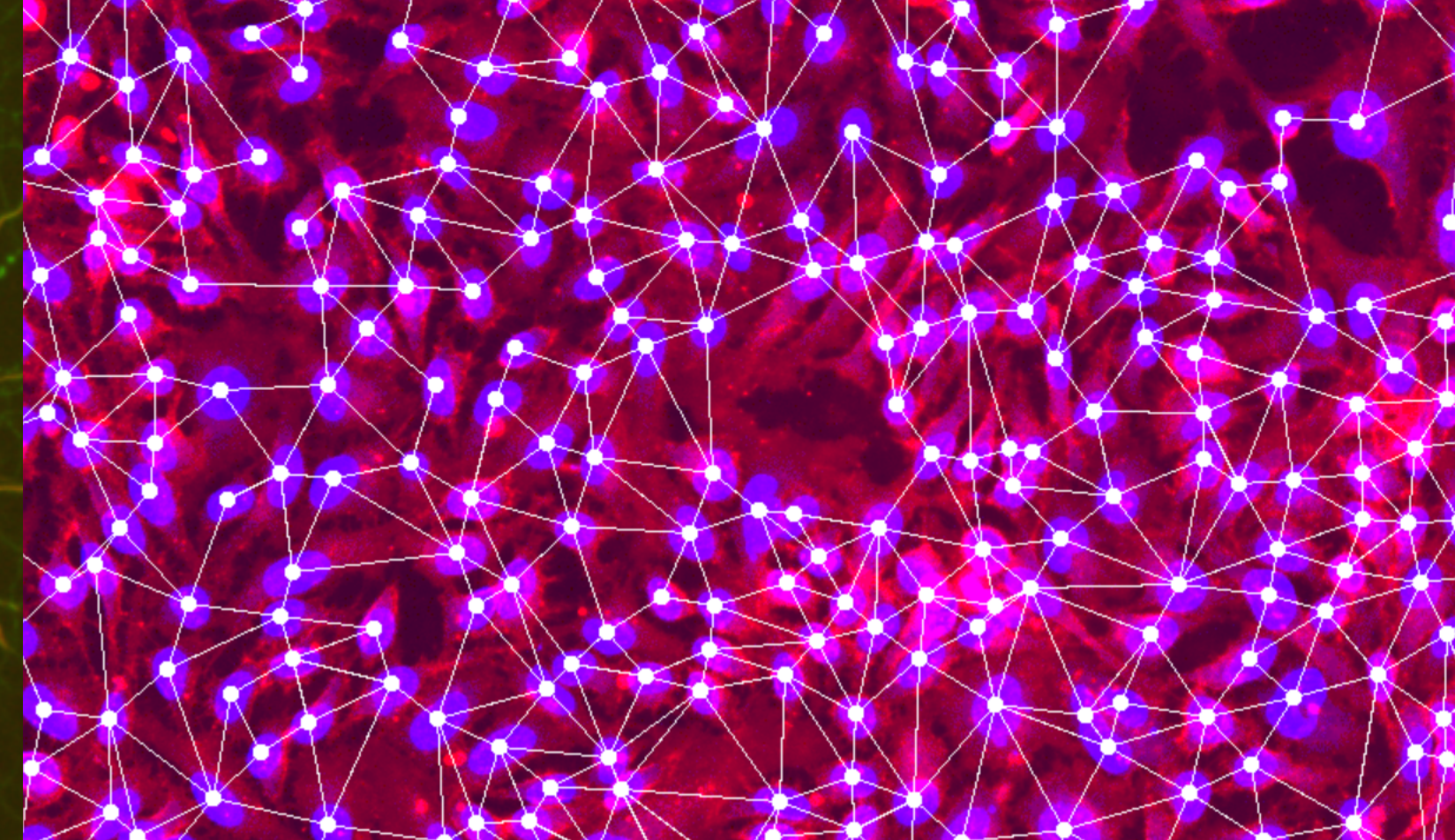
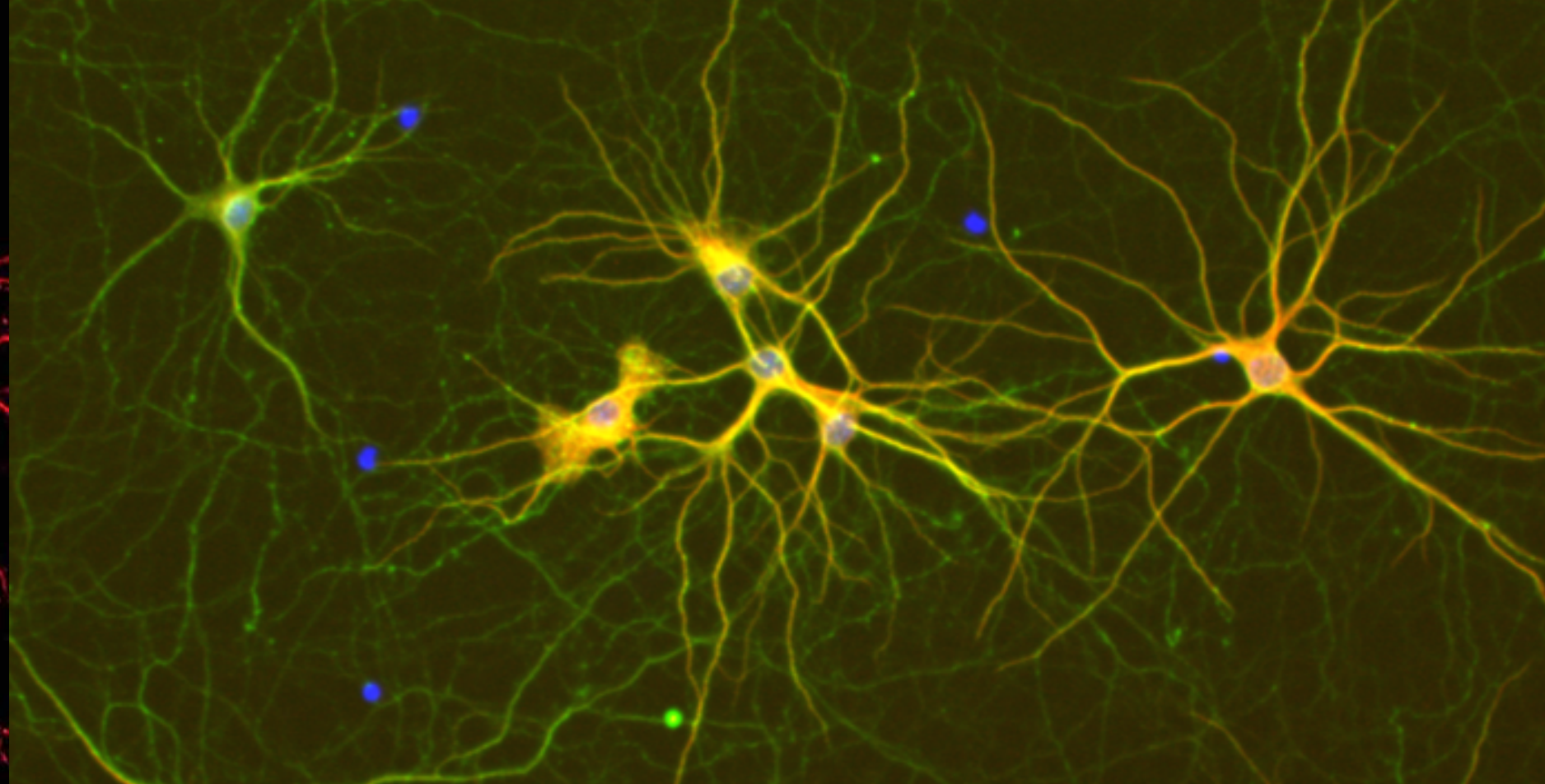
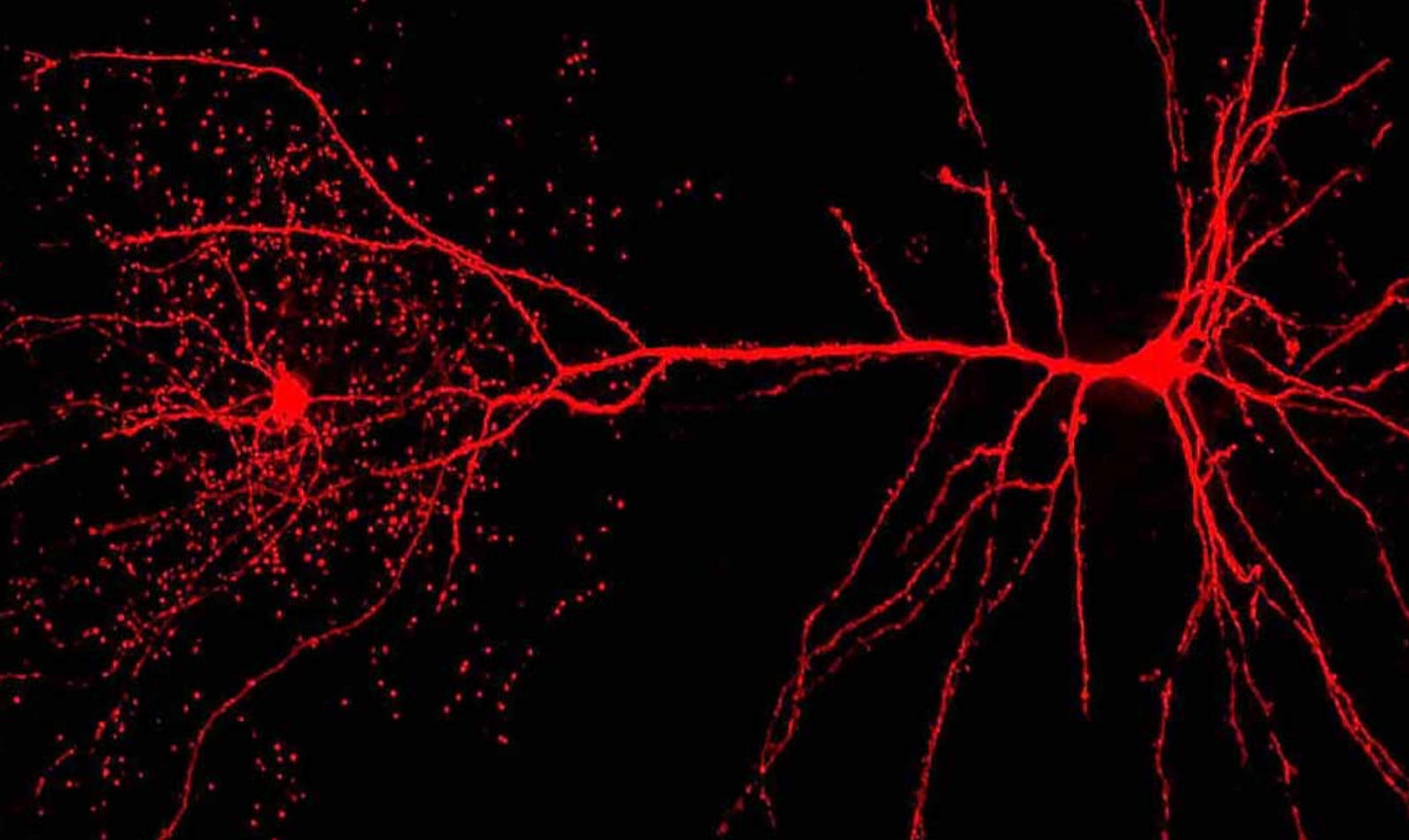
# Exploring Biological Neuronal Correlations with Quantum Generative Models

Eliska Greplova and Vinicius Hernandez





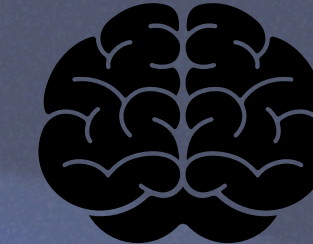
**“Understanding how biological neural networks process information is one of the biggest open scientific questions of our time.”**



“How do brains process information?”



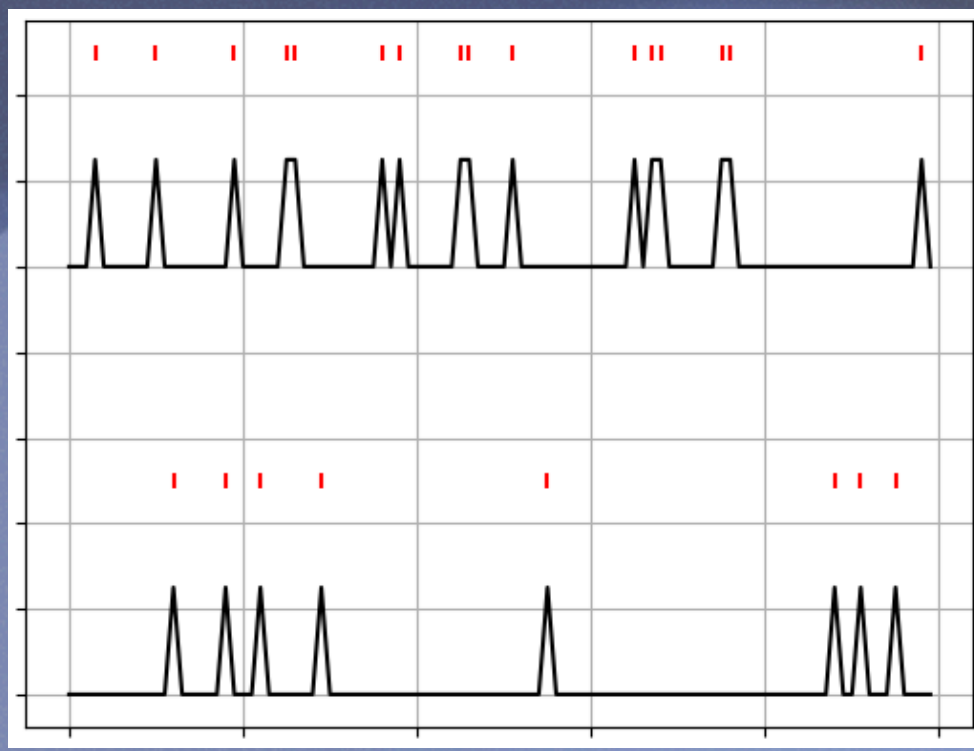
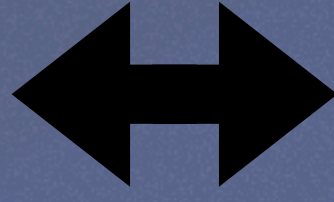
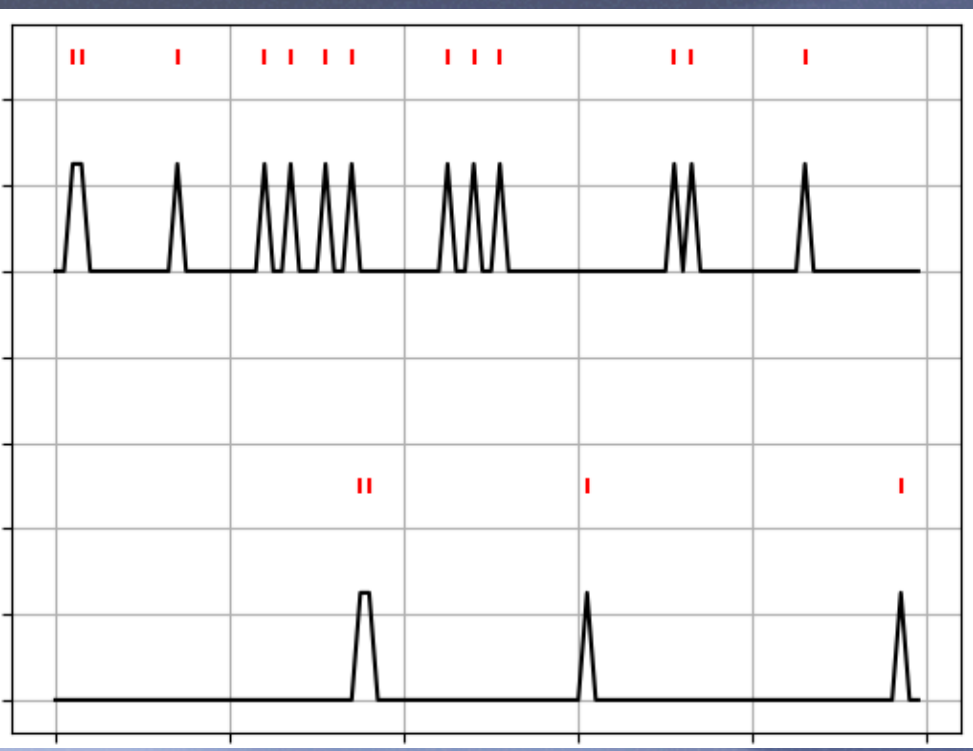
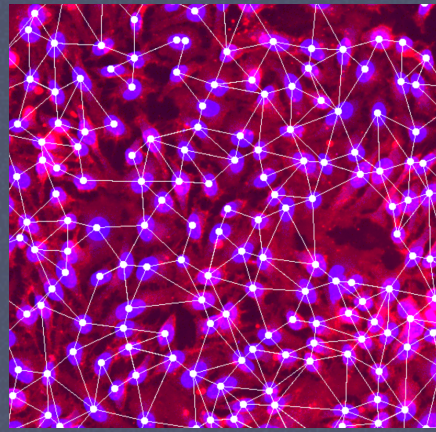
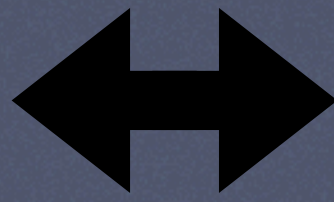
“Exceptional efficiency of biological systems?”



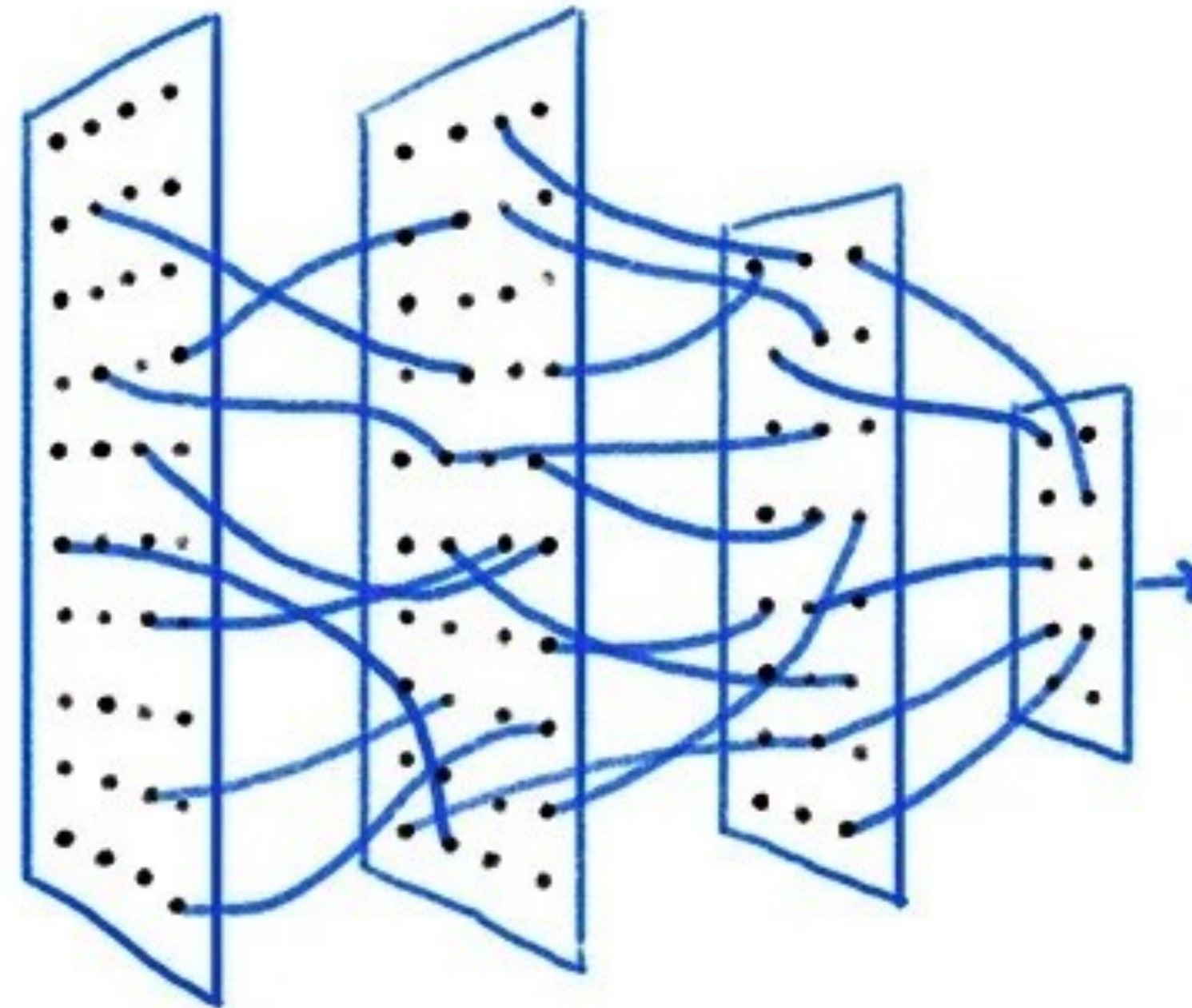
“New models for computation?”

# Modeling biological neuronal systems

model

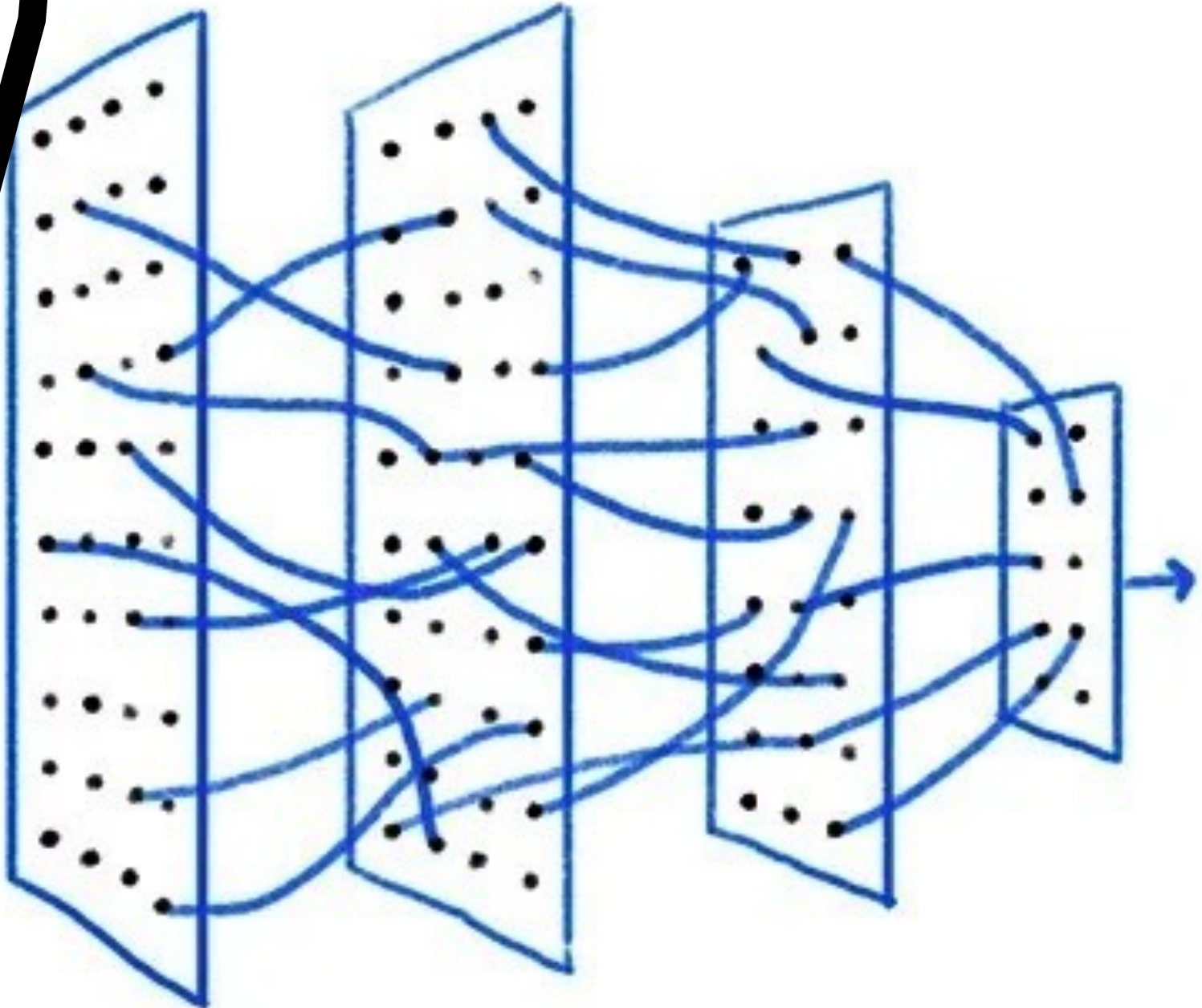
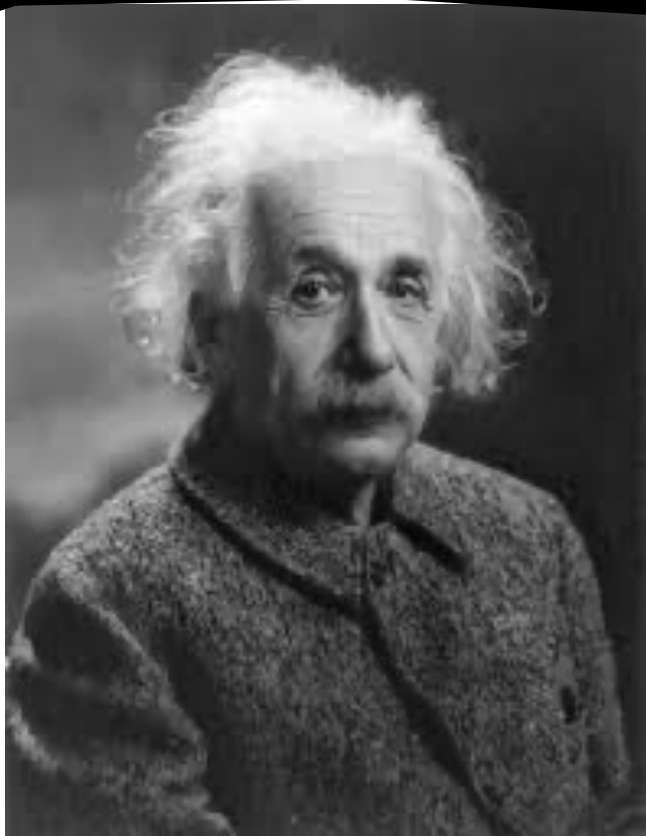
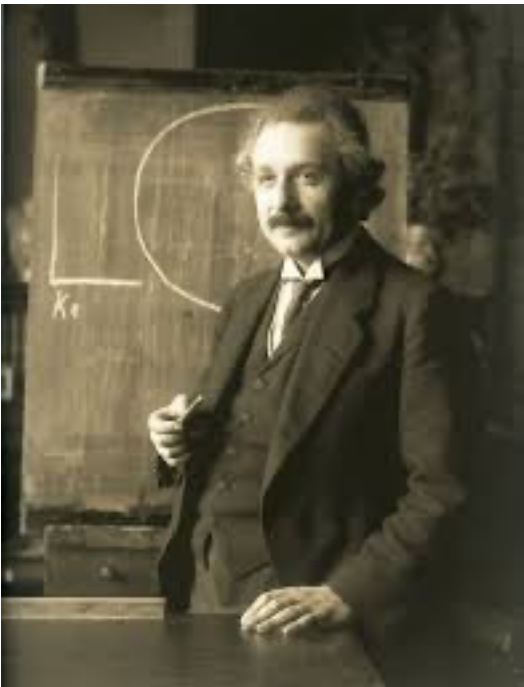


# Machine Learning Models



$$y = f_{\theta}(x)$$

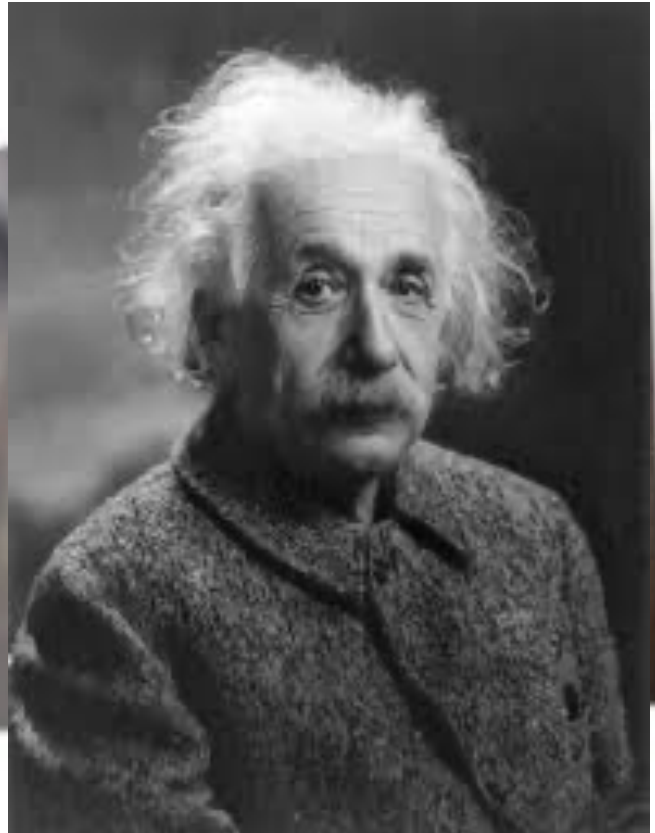
# Machine Learning Models



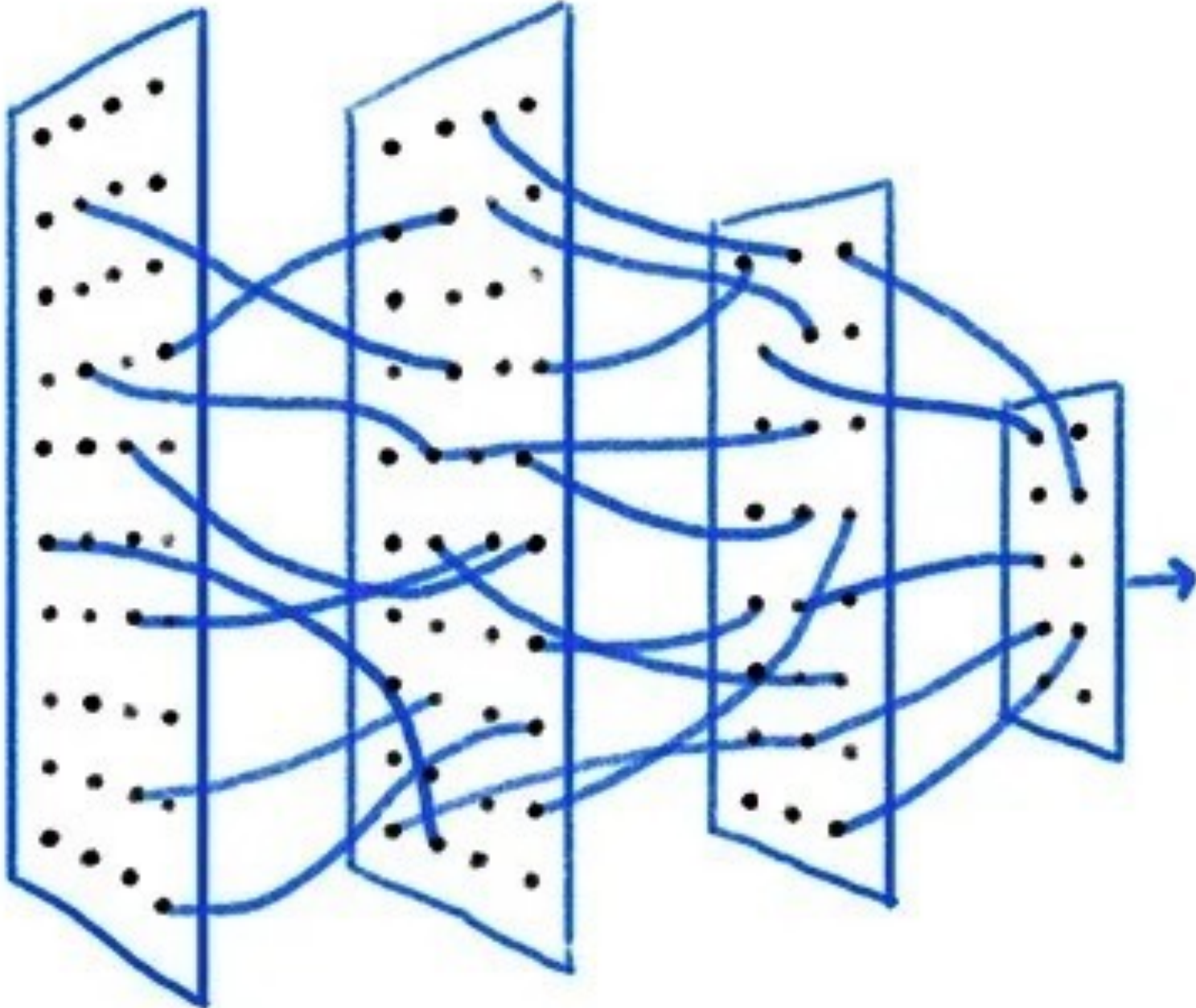
$$y = f_{\theta}(x)$$

# Machine Learning Models

einstein



girl with  
pearl earring

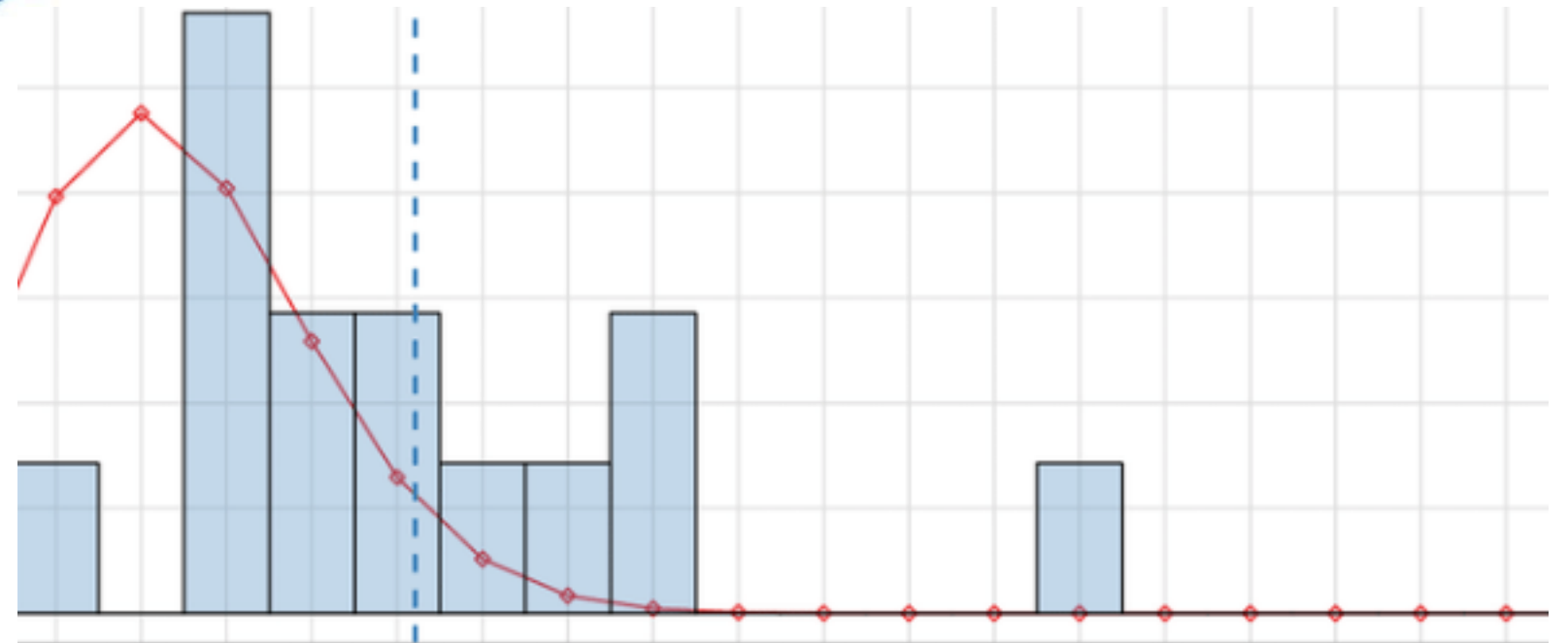
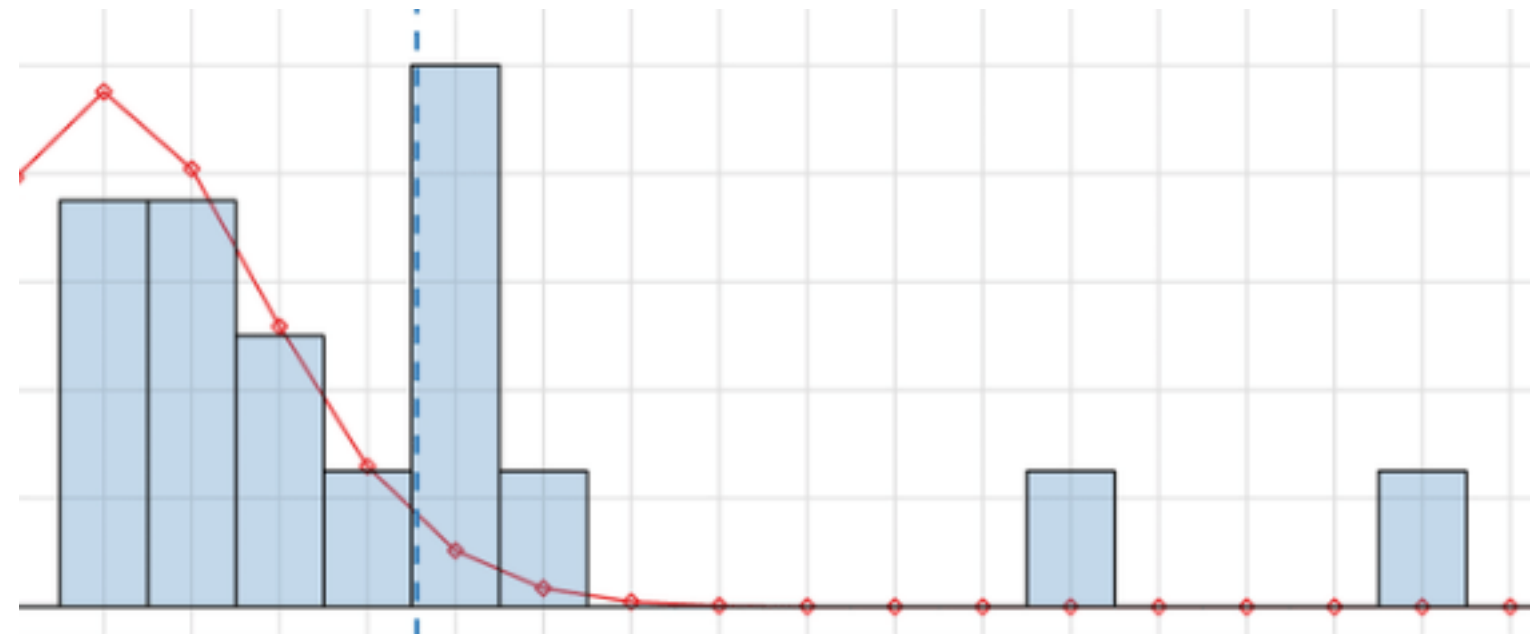
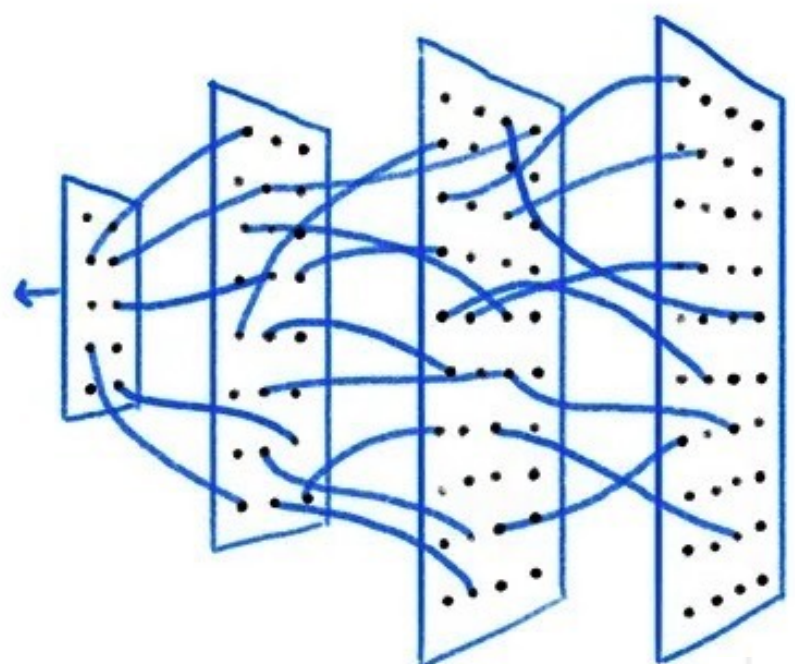
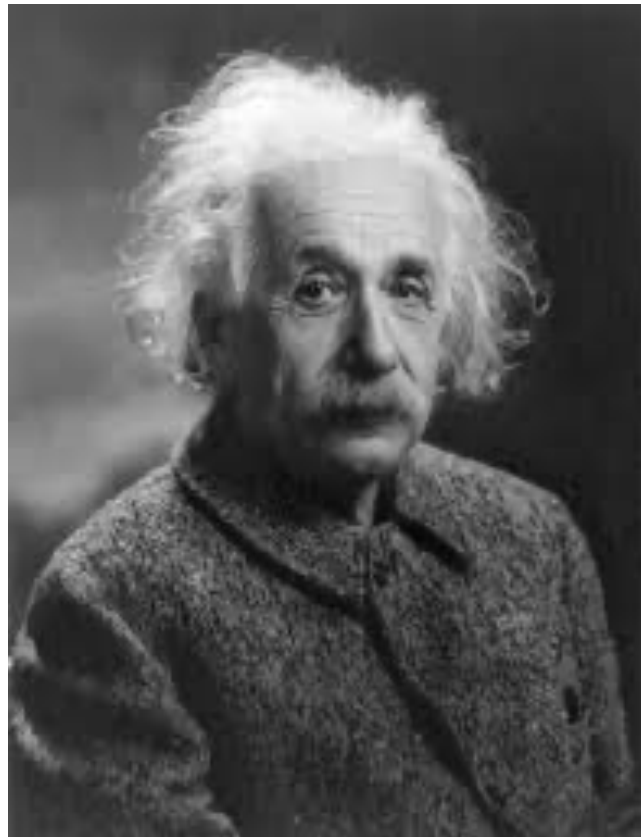
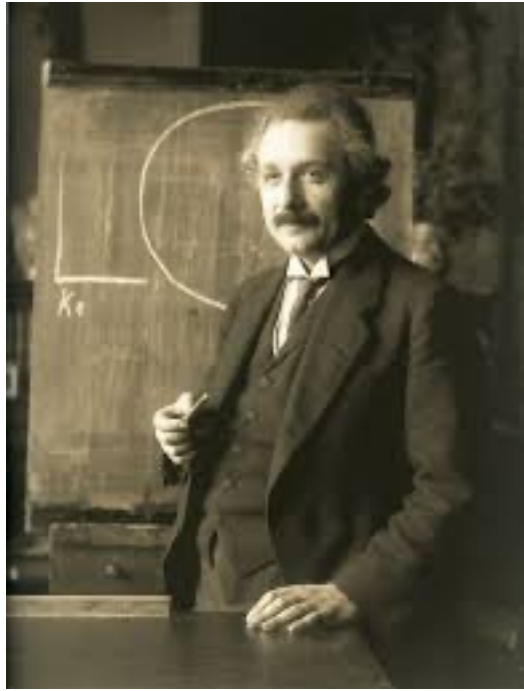
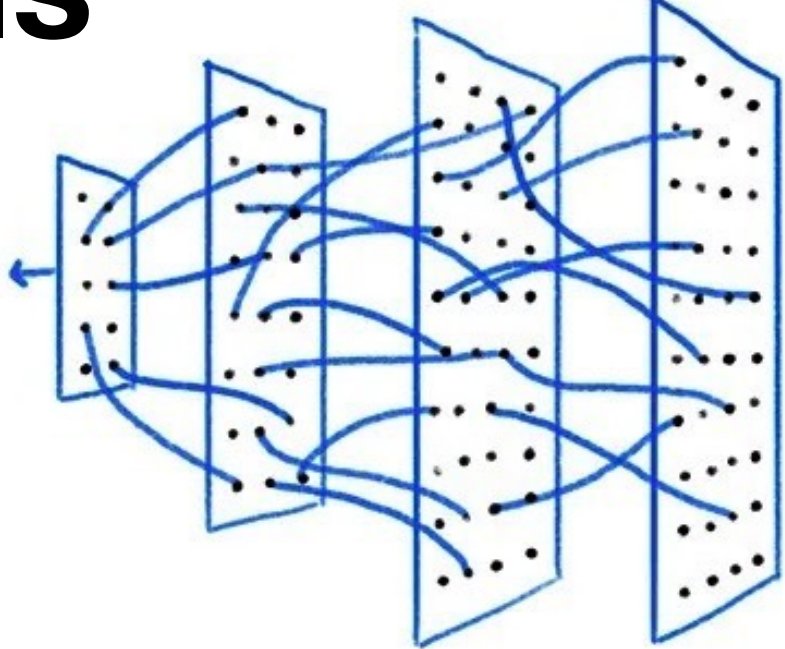


Output

**einstein**

$$y = f_{\theta}(x)$$

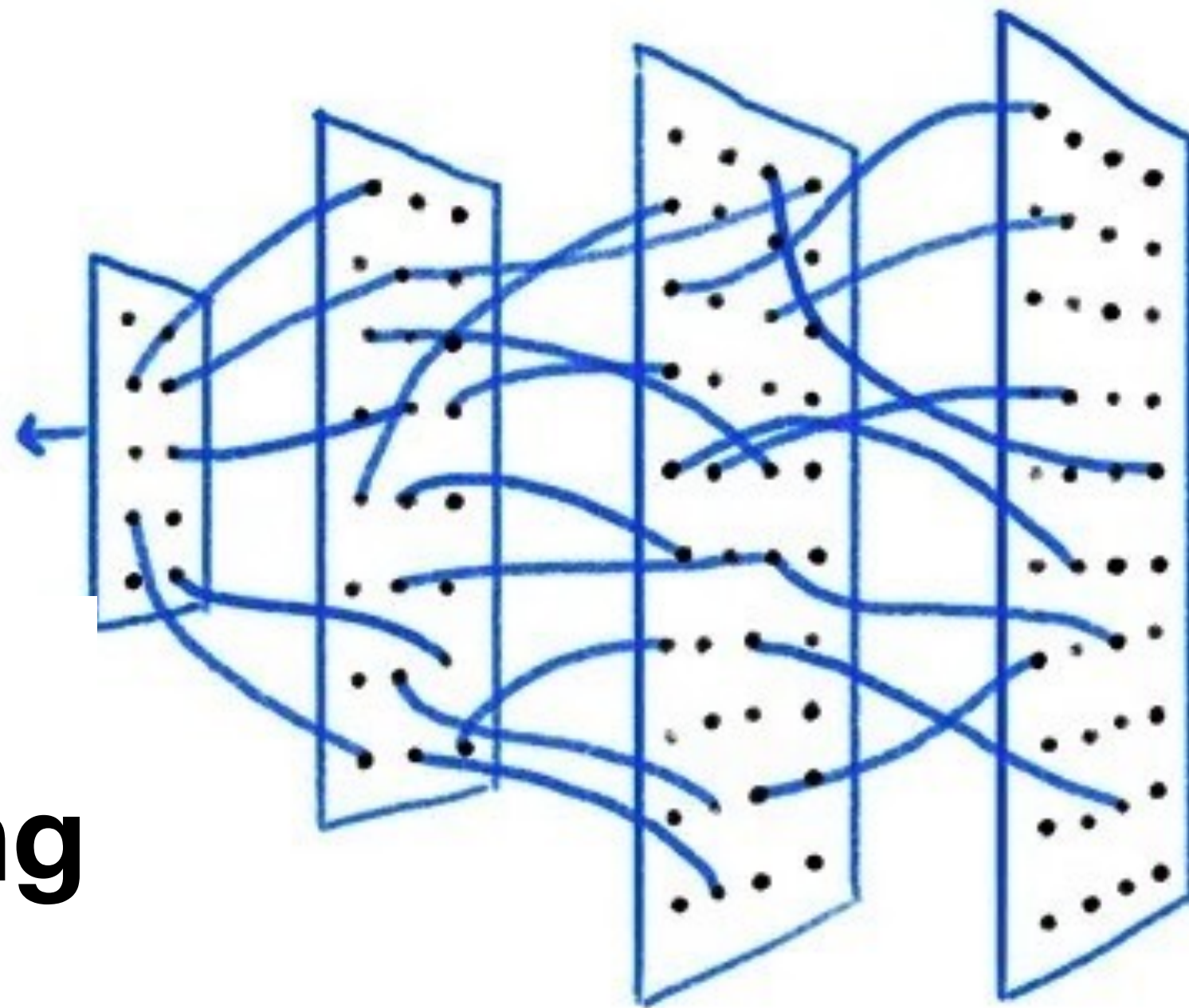
# Generative Learning Models

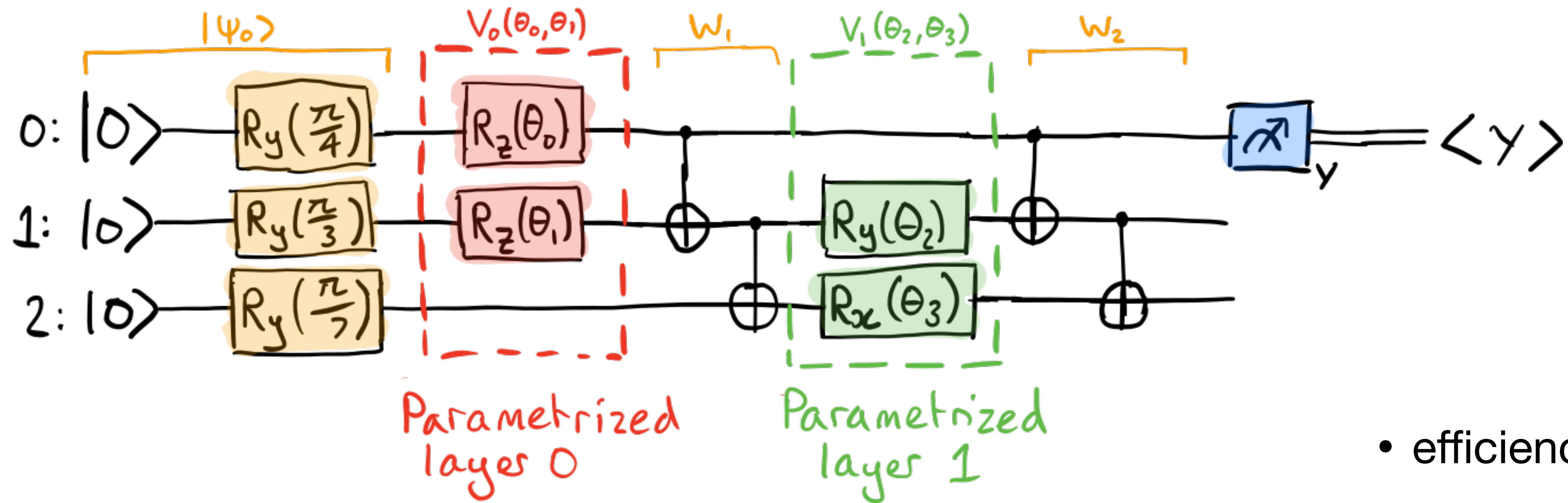




# Generative Learning Models

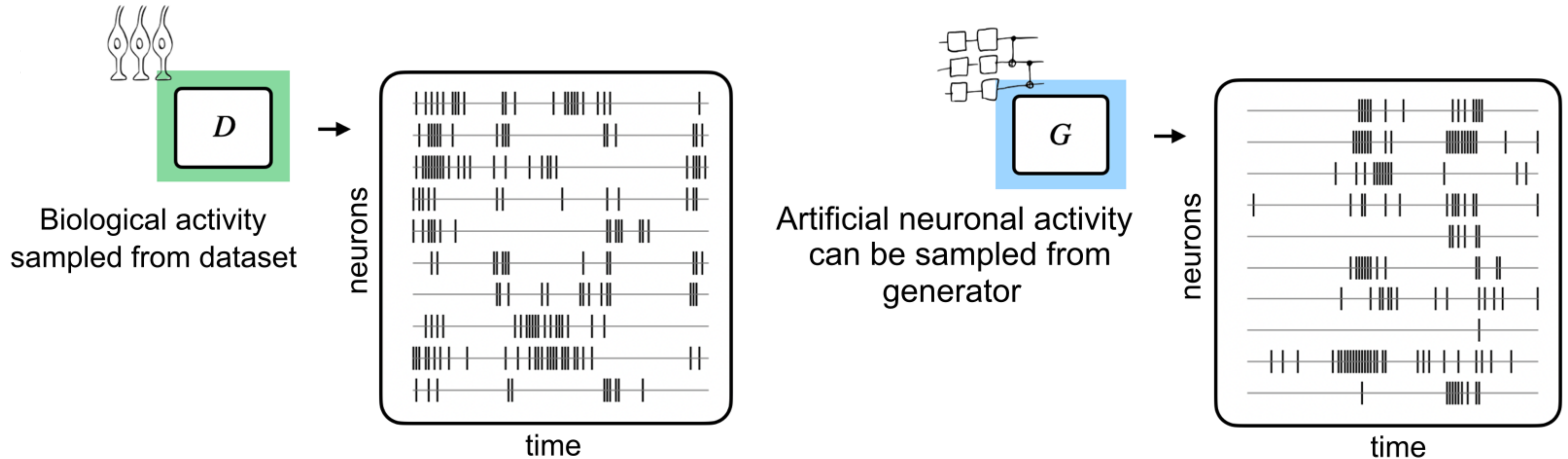
**einstein**  
+  
**girl with**  
**pearl earring**





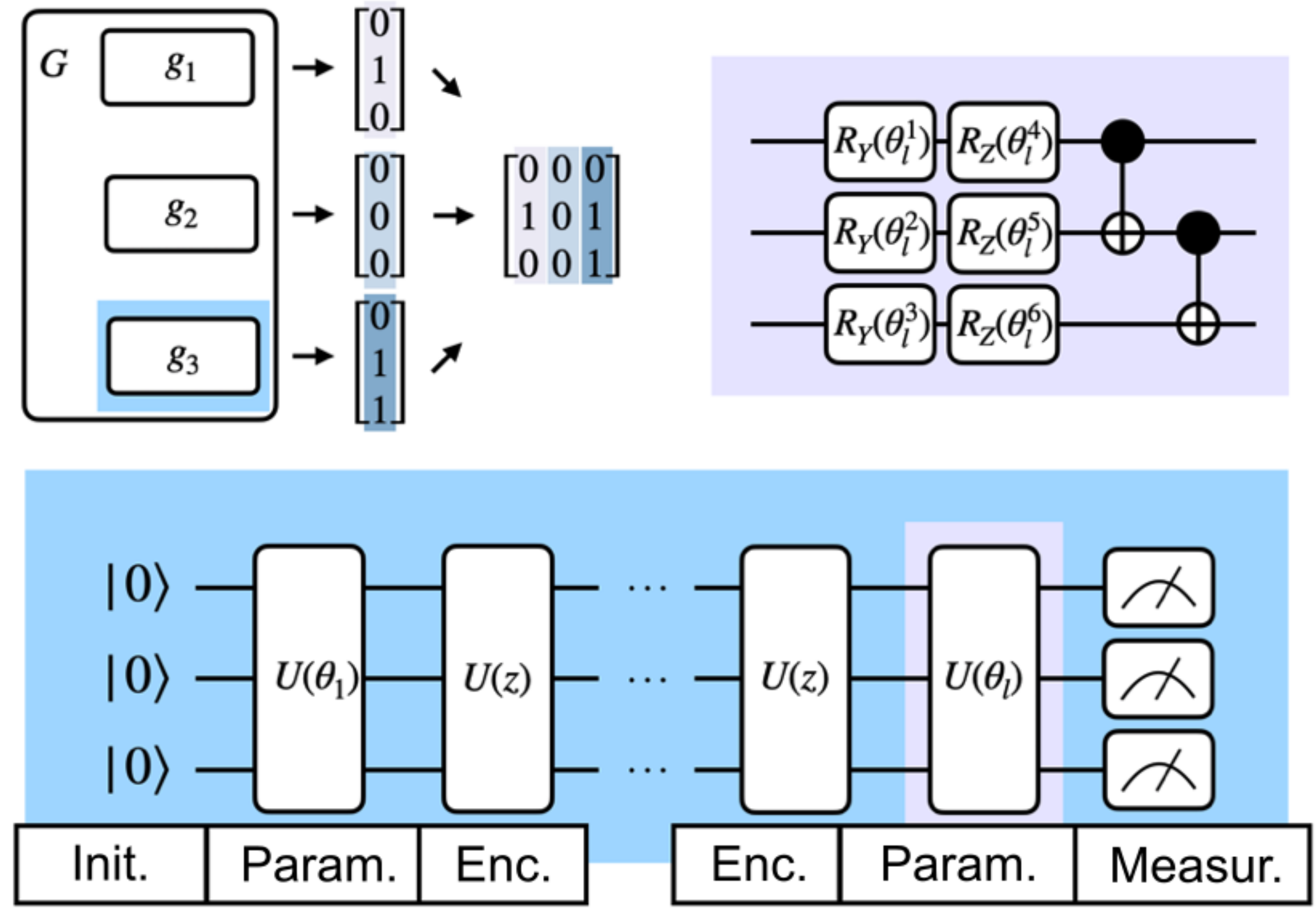
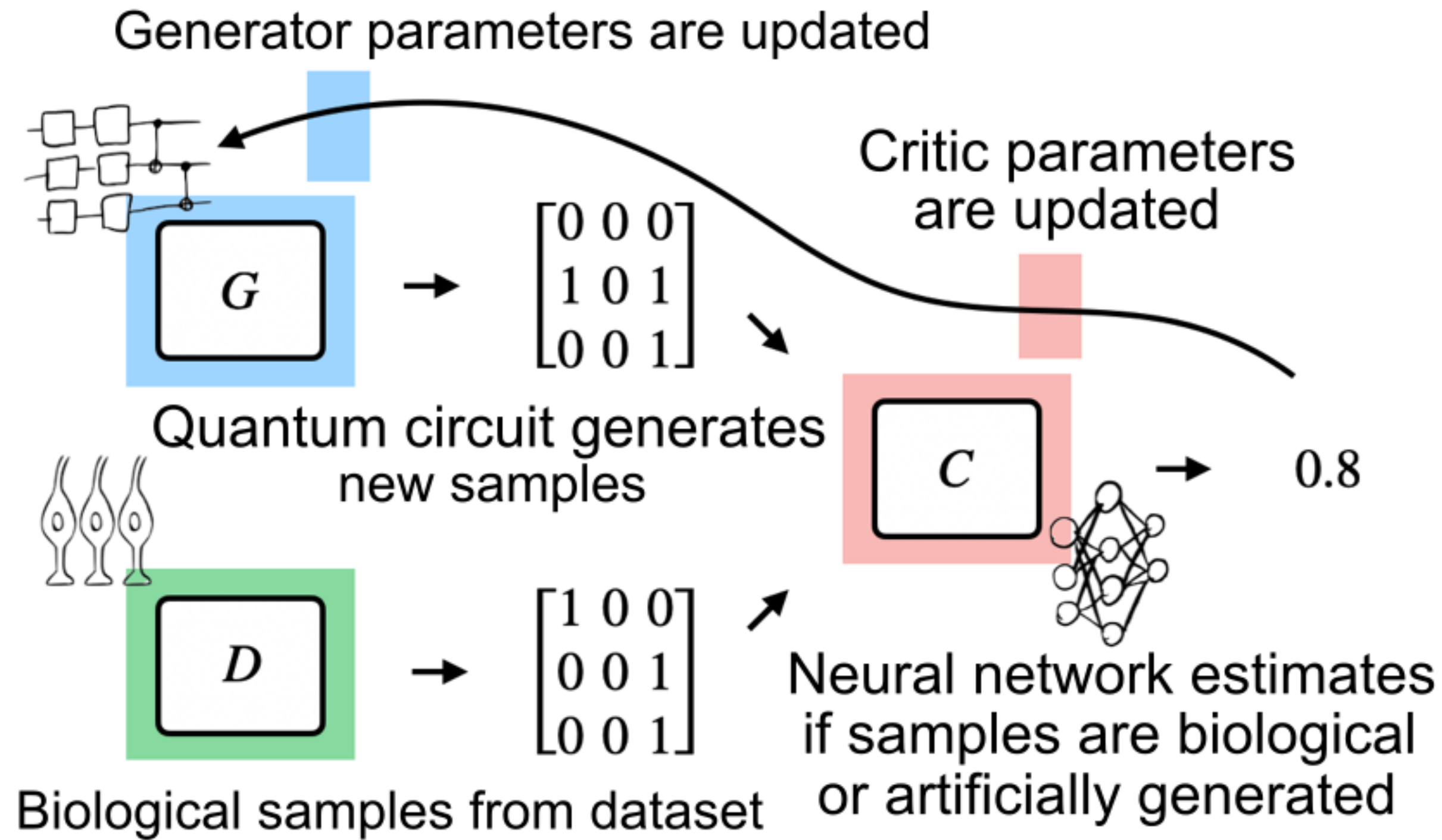
- efficiency
- expressivity
- interpretability  
reduced number of parameters

# Exploring Biological Neuronal Correlations with Quantum Generative Models

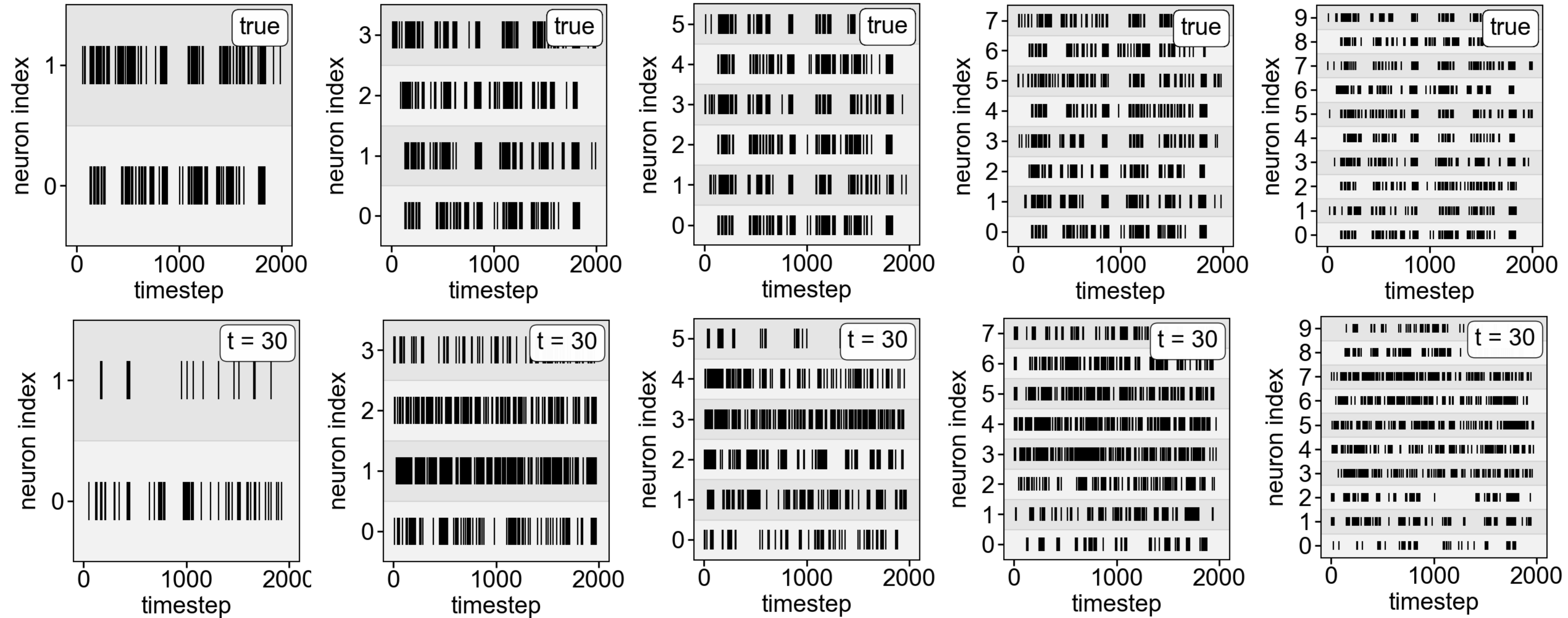


**Design a quantum generative model that produces neuronal activity indistinguishable from the real biological data!**

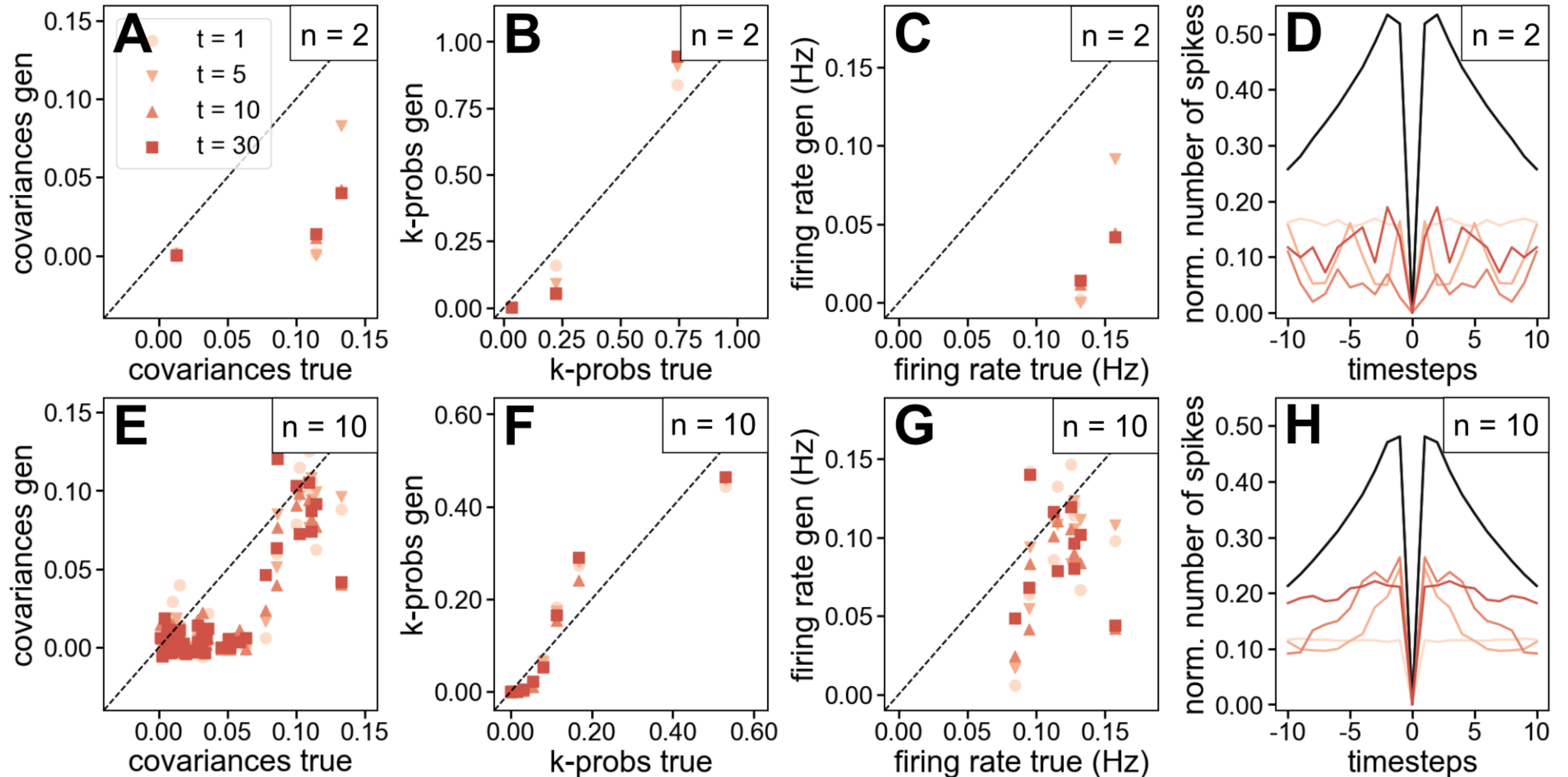
# Quantum Generative Adversarial Model: SpiQGAN



# Our model reproduces both spacial and temporal correlations in neuronal activity with **linear number of trainable parameters!**



# Our model reproduces both spacial and temporal correlations in neuronal activity with **linear number of trainable parameters!**



- **QML: Many open Q's**
- **Interesting applications?**
- **Challenging neuroscience task: QML is successful and cheaper to train**
- **Let's explore QML for compact, more energetically efficient models!**