Introduction aux Signaux et Systèmes

Motivation and background

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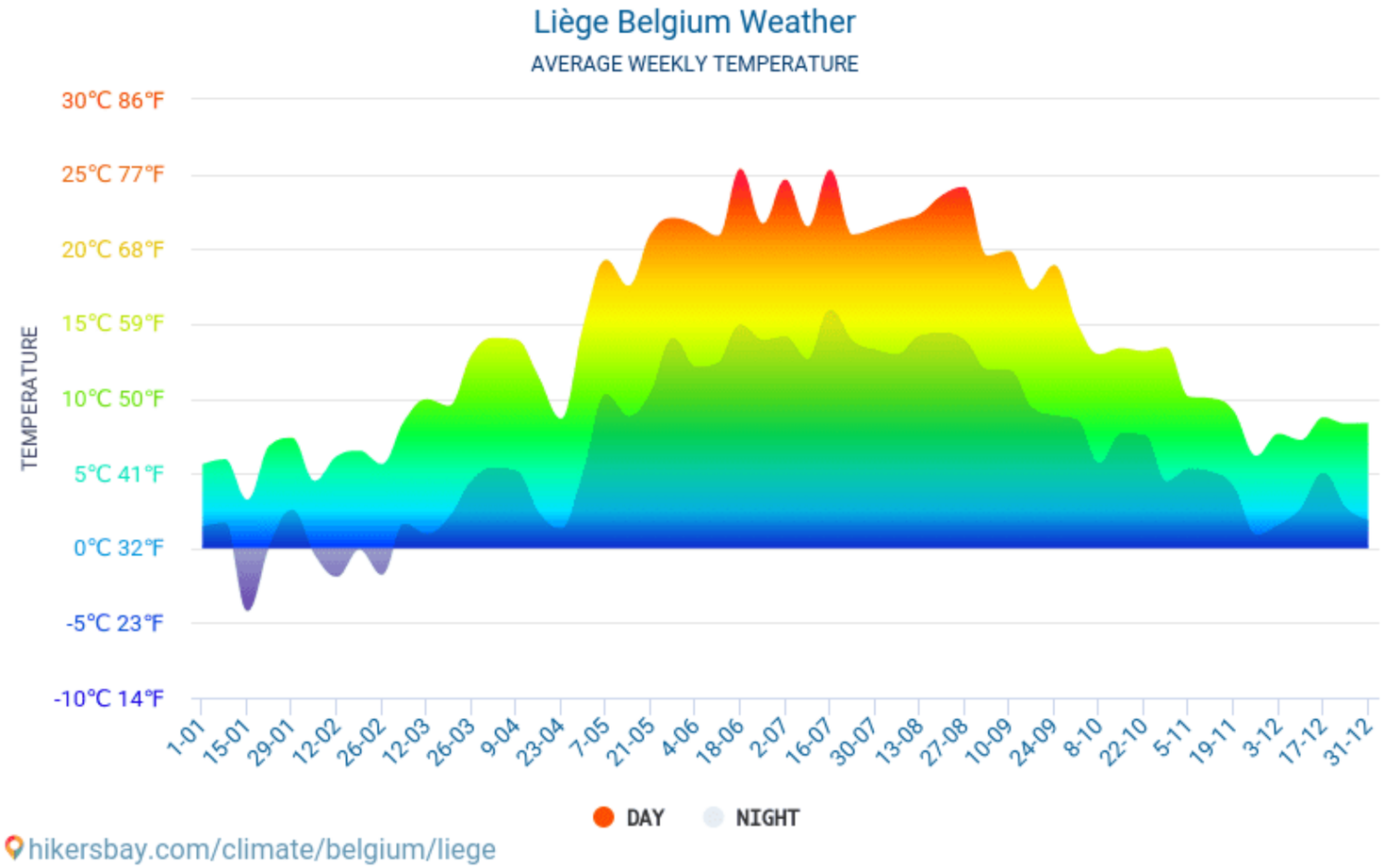
What are Signals and Systems?

Signals

Any time-varying quantity

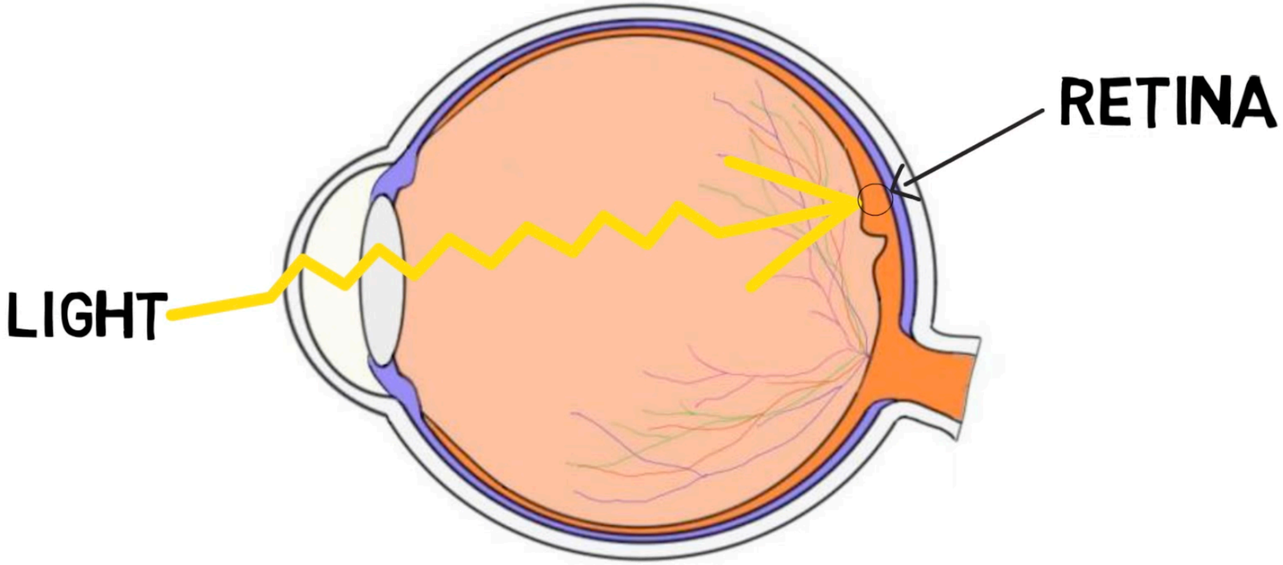
- **Liege temperature**



Signals

Any time-varying quantity

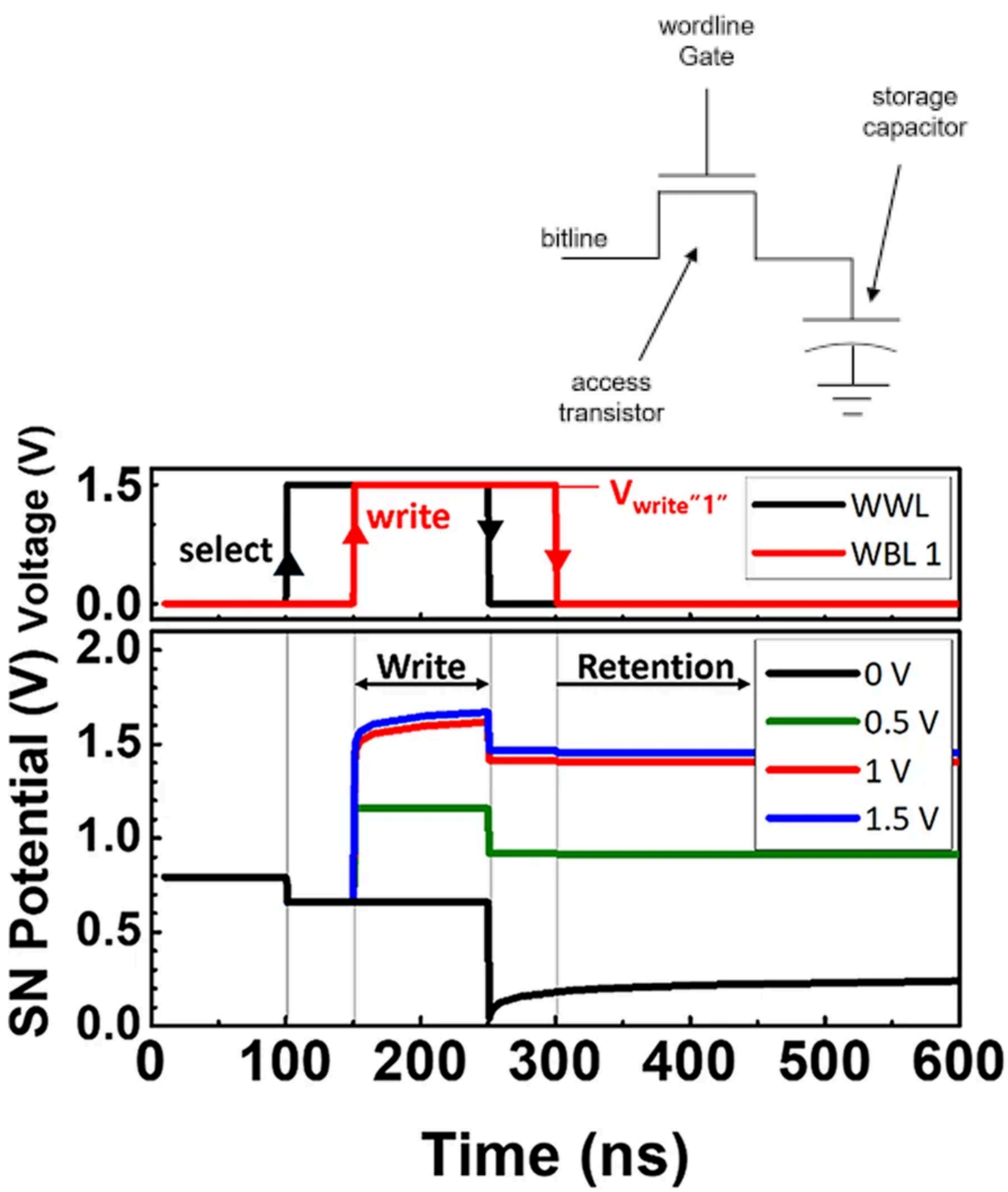
- Liege temperature
- **The amount of light hitting the retina**



Signals

Any time-varying quantity

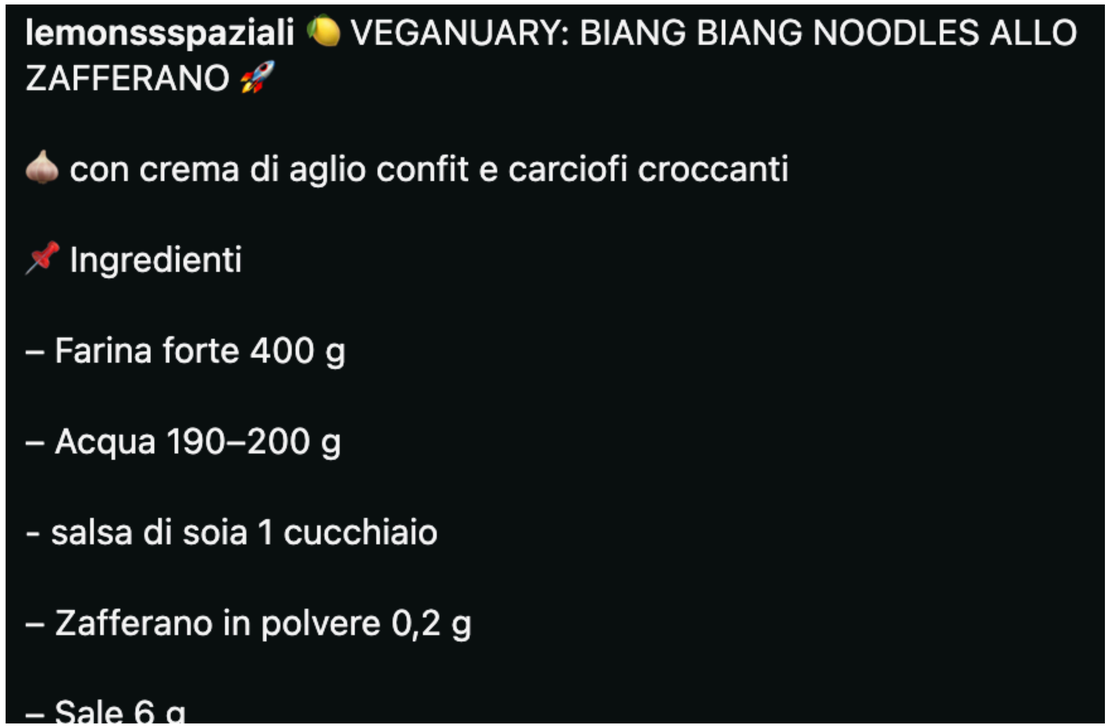
- Liege temperature
- The amount of light hitting the retina
- **The voltage of a DRAM cell capacitor**



Signals

Any time-varying quantity

- Liege temperature
- The amount of light hitting the retina
- The voltage of a DRAM cell capacitor
- **The series of symbols in a social media post**



Signals

Any time-varying quantity

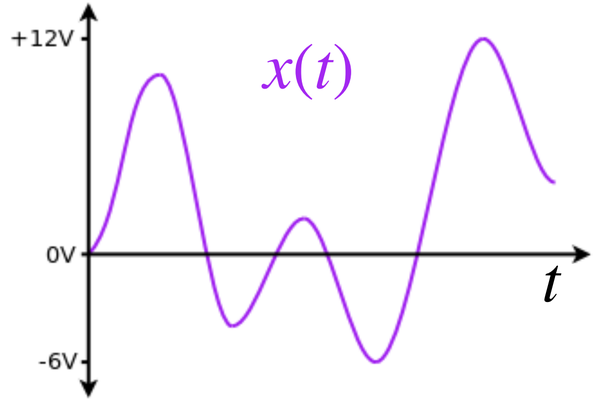
- Liege temperature
- The amount of light hitting the retina
- The voltage of a DRAM cell capacitor
- The series of symbols in a social media post
- **The strings of 0’s and 1’s in our digital devices**
- …

Signals

Analog vs digital

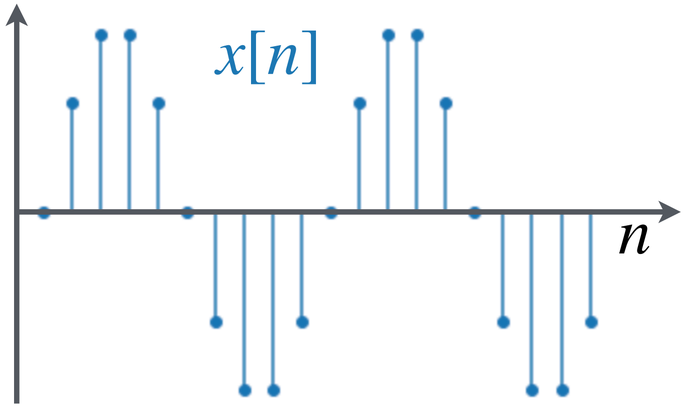
- Liege temperature
- The amount of light hitting the retina
- The voltage of a DRAM cell capacitor

- The series of symbols in a social media post
- The strings of 0s and 1s in our digital devices



Analog = Varying continuously
(both in time and in value)

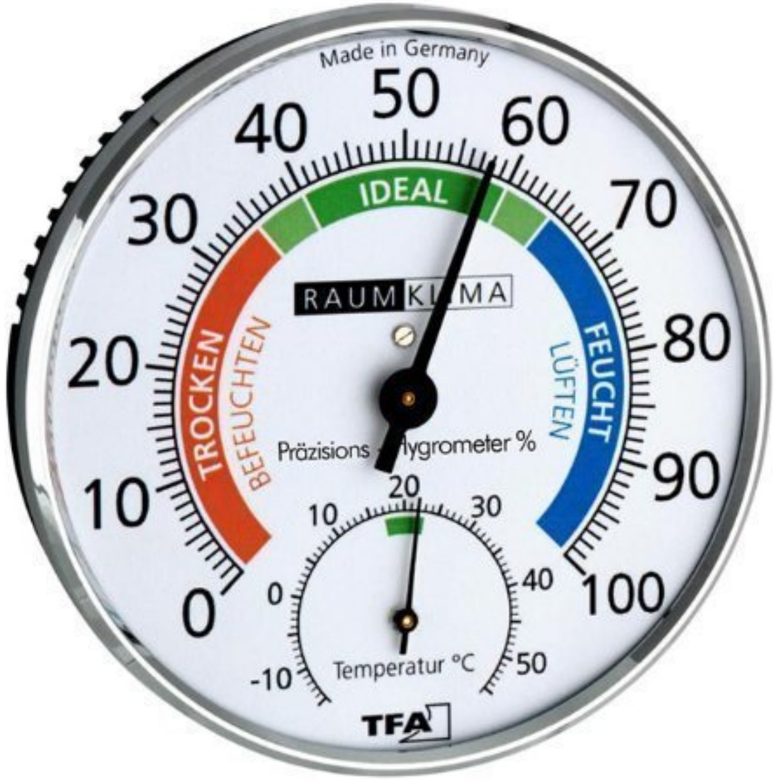
Digital = Varying in discrete steps
(both in time and in value)



Systems

Any entity that can process/transform signals

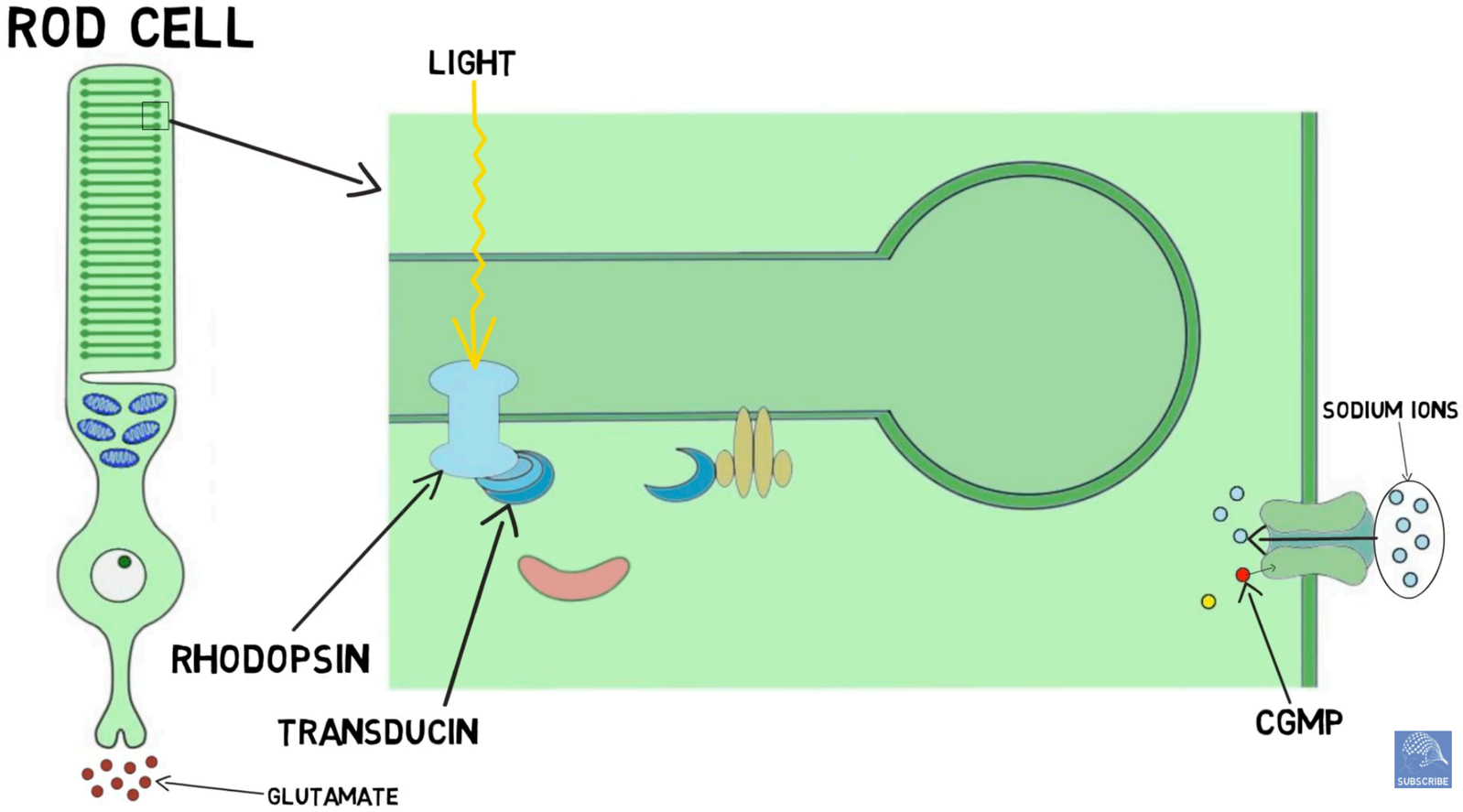
- **A thermometer**



Systems

Any entity that can process/transform signals

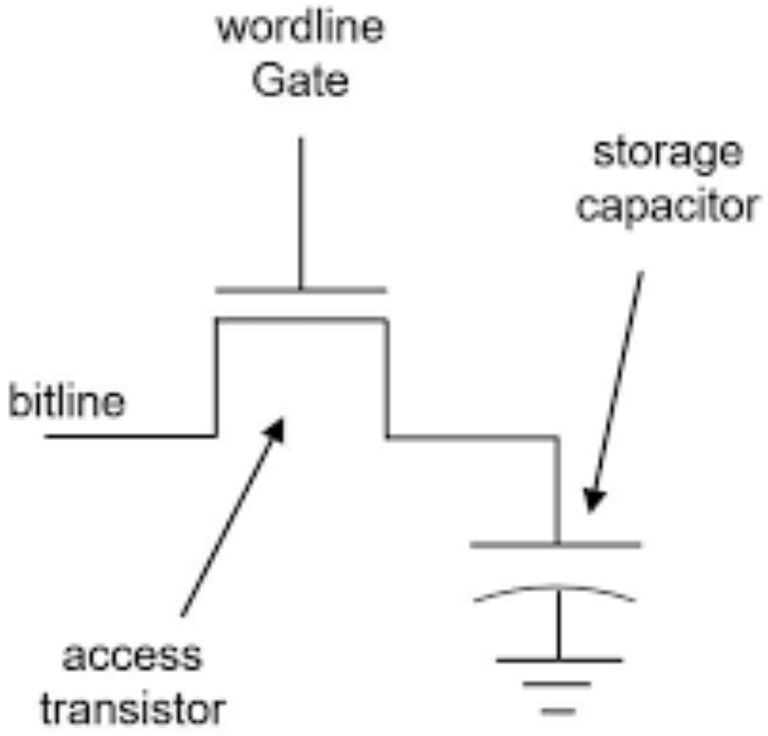
- A thermometer
- **A retinal photoreceptor**



Systems

Any entity that can process/transform signals

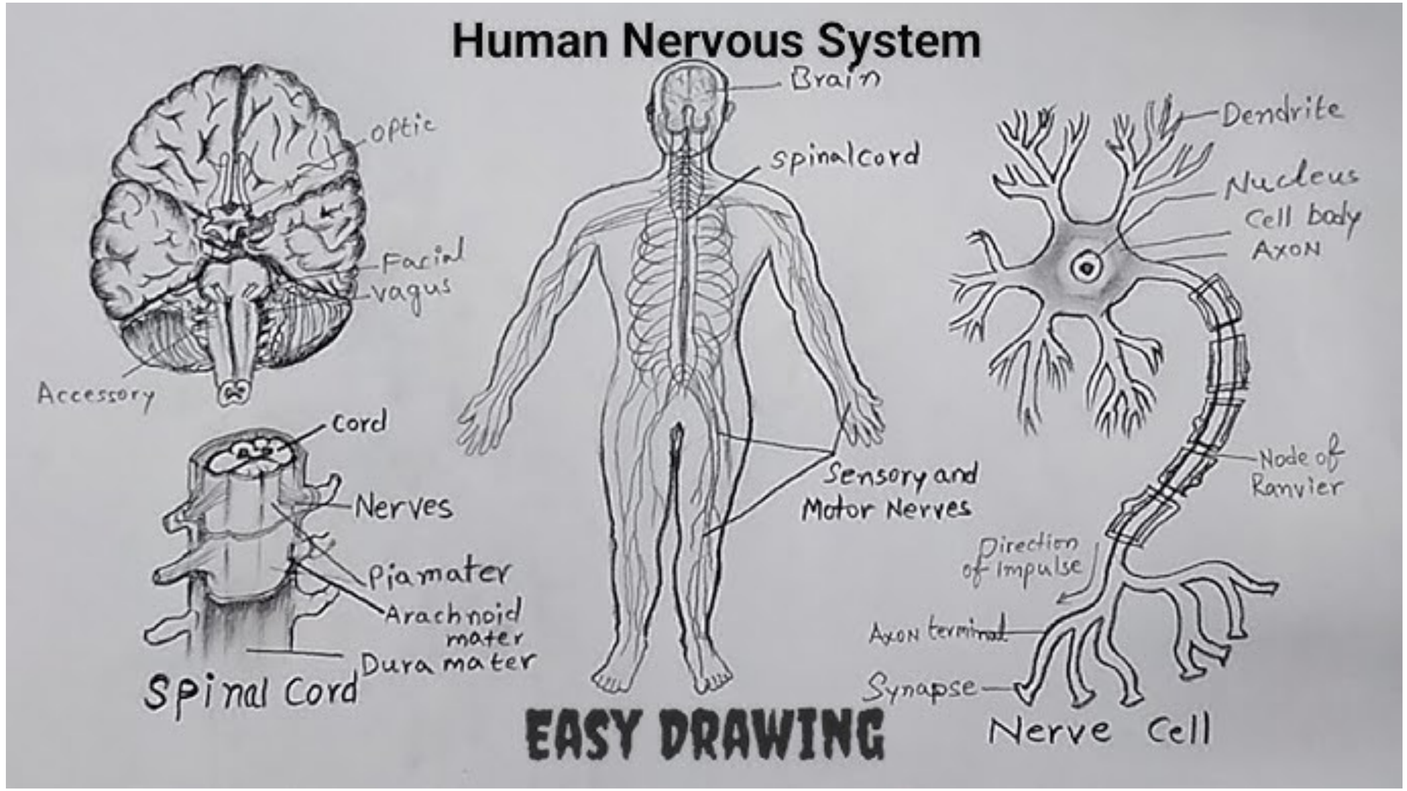
- A thermometer
- A retinal photoreceptor
- **A DRAM cell access transistor**



Systems

Any entity that can process/transform signals

- A thermometer
- A retinal photoreceptor
- A DRAM cell access transistor
- **Our nervous system**



Systems

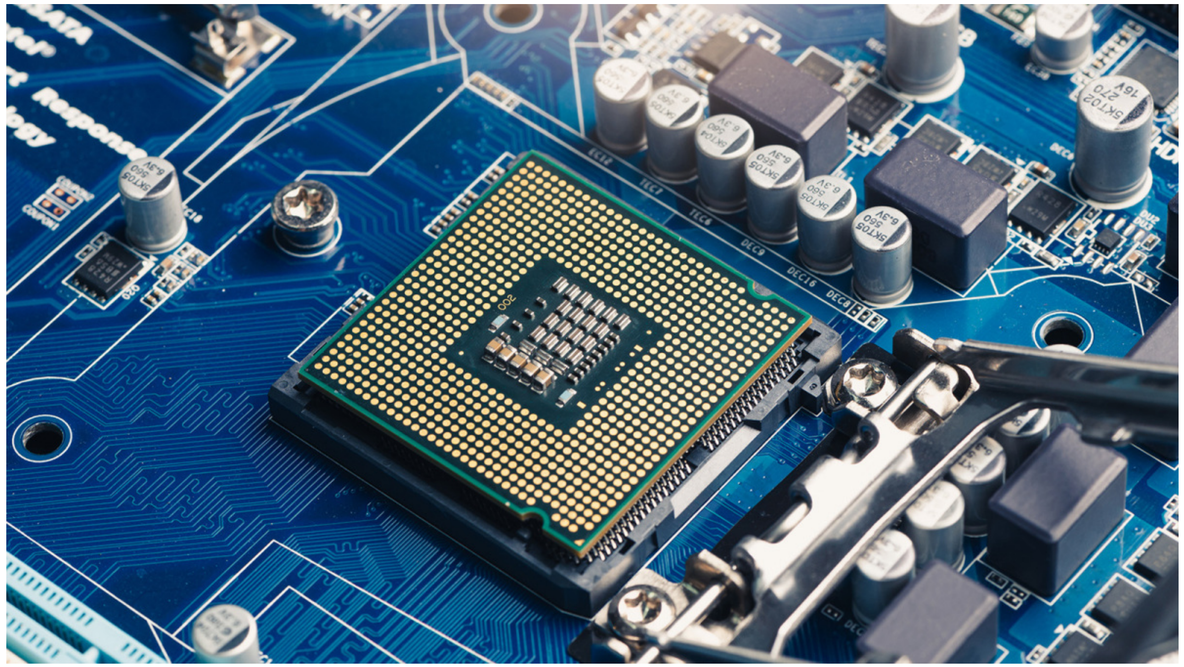
Any entity that can process/transform signals

- A thermometer
- A retinal photoreceptor
- A DRAM cell access transistor
- Our nervous system
- **A Large Language Model**

Systems

Any entity that can process/transform signals

- A thermometer
- A retinal photoreceptor
- A DRAM cell access transistor
- Our nervous system
- A Large Language Model
- **A CPU**
- …



Systems

Any entity that can process/transform signals

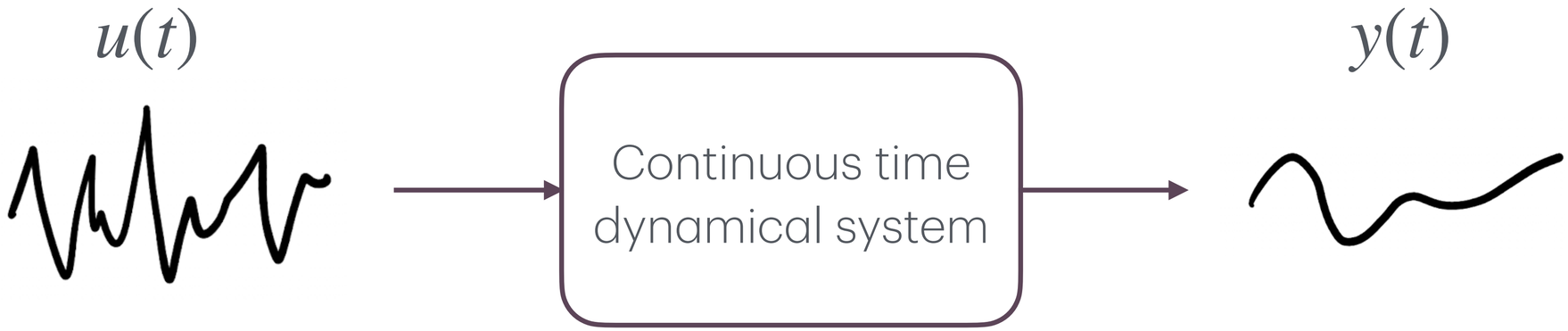
- A thermometer
- A retinal photoreceptor
- A DRAM cell access transistor
- Our nervous system

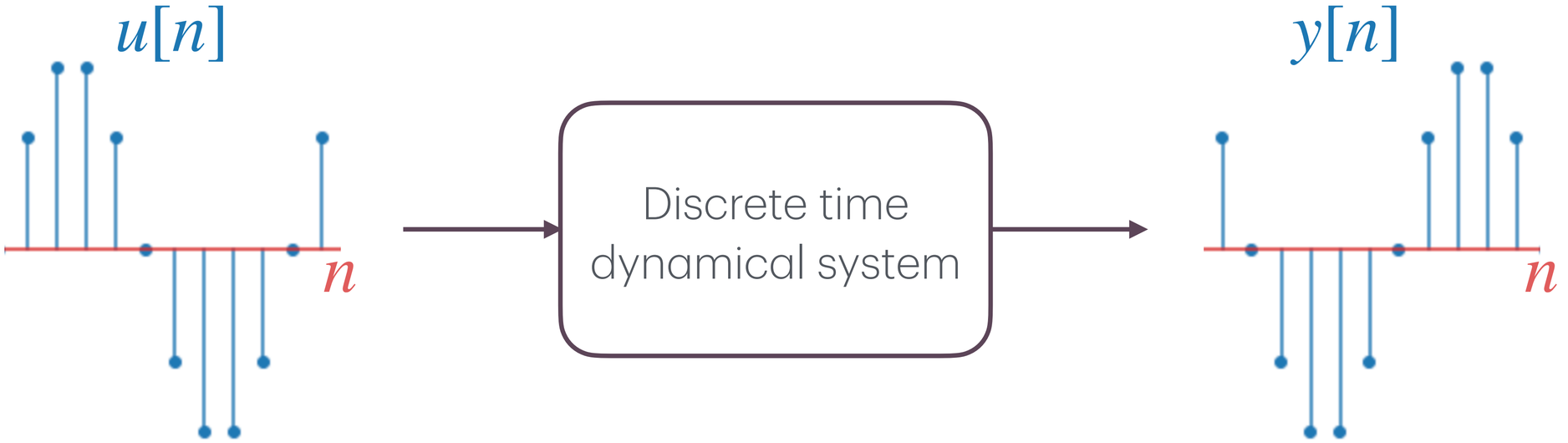
Continuous time systems

- A Large Language Model
- A CPU

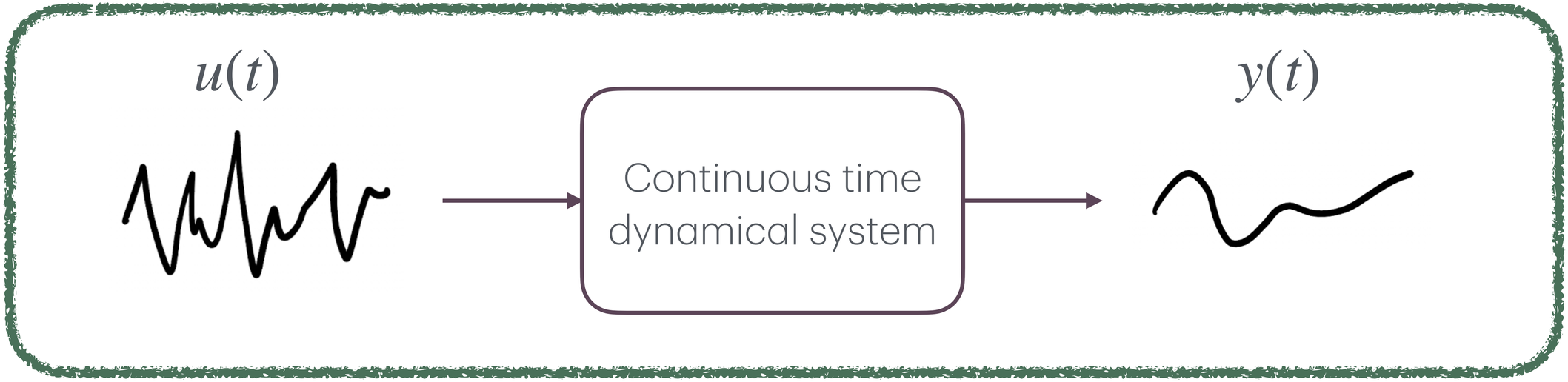
Discrete time systems

Continuous vs discrete time systems



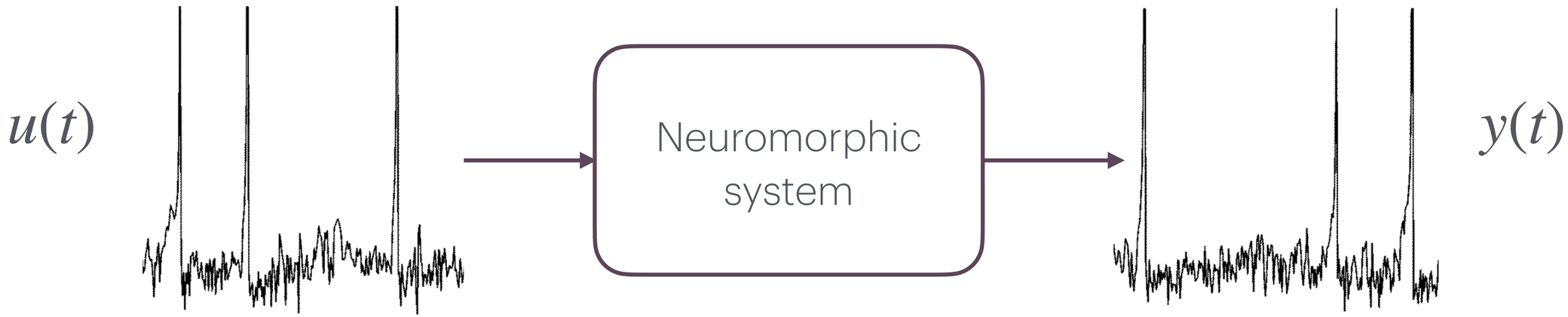


The signals and systems we will study

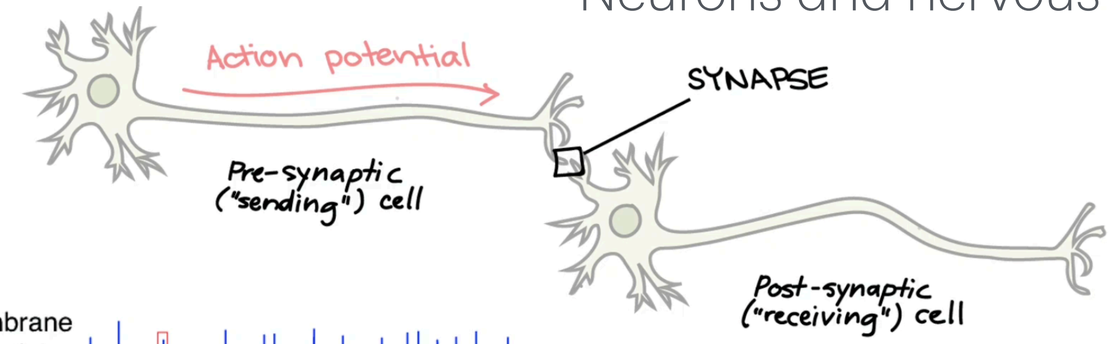


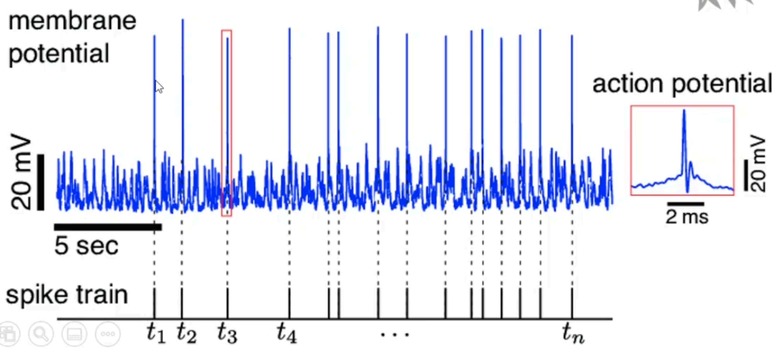
The signals and systems we study in the NeuroEngineering Lab

Neuromorphic systems

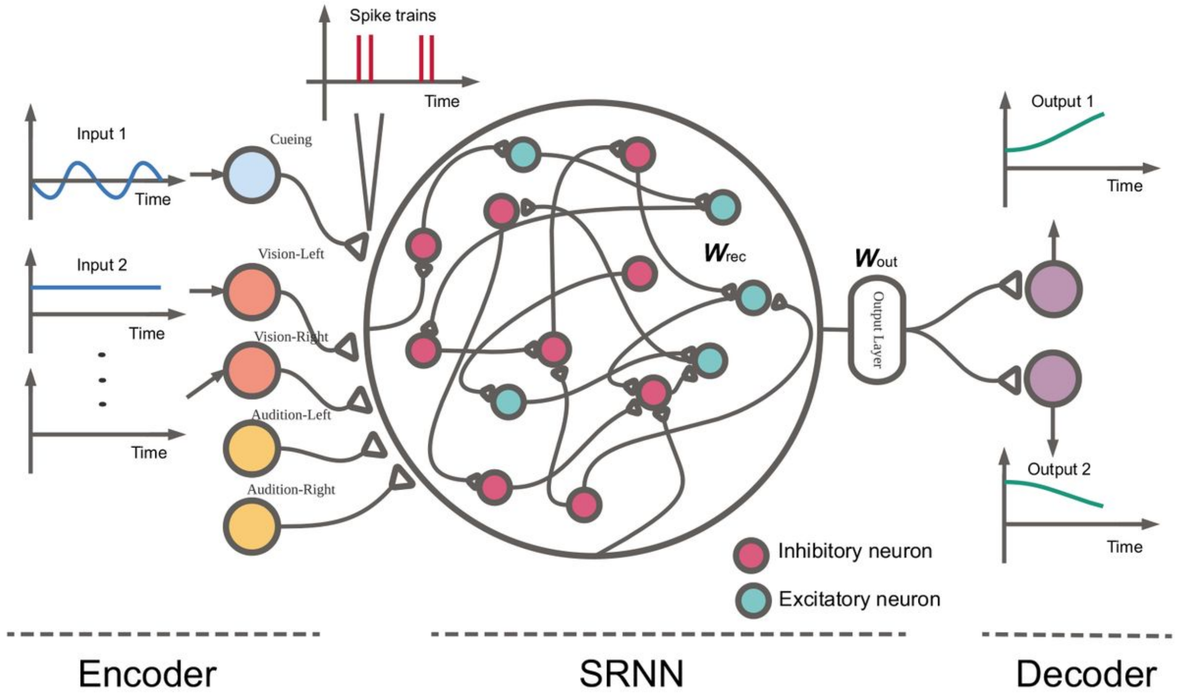


Neurons and nervous systems





Spiking neural networks



Natural and robotic motor control