What is Cognition?

- A cognitive process is a mental process, *e.g.*, sensing, language understanding, memory making and retrieval, understanding, planning, decision-making.
- Cognition is based on a collection of mental mechanisms.
- Cognitive Science and Artificial Intelligence (AI) differ in their focus and goals:
  - Cognitive Science seeks to understand the mechanisms underlying human cognition (must be consistent with human cognition and biology).
  - AI seeks mechanisms that can underlie any cognitive behavior (need not be consistent with biological cognition).

As such, AI is Cognitive Engineering.
Cognition as Mechanism

- Cognition was initially thought to be based on non-physical mechanisms, unlike the physical body (Dualism: “The Ghost in the Machine”).
- The countering view that cognition is based in physical processes (Monism / Materialism) underlies Cognitive Science and AI.
- In the popular mind, analogies for the mechanisms underlying cognition reflect the most complex / powerful systems known or constructed, *e.g.*, 
  
  **Antiquity:** Flowing water
  
  1850’s+: Electrical networks.
  
  1880’s+: (Mechanical) telephone networks.
  
  1950’s+: Electronic computers.
  
  1990’s+: The Internet.
Cognition as Neurons

- Neurons sensitive to total momentary sensed activity as well as average sensed firing rate over time.
- Cognition arises from the activities of larger and larger collections of neurons, culminating in whole brains.
Cognition as Brains

- Brain = group of neurons.
- Characteristics of a brain:
  - Large number of neurons ($10^4 - 10^{11}$)
  - No centralized control or synchronization
  - Composed of few neuron-types
  - Neurons are simple
  - Neurons are autonomous
  - Neurons sense and communicate locally

...Doesn’t this sound familiar? ...
EXAMPLE: Activity in Neural Collections

- Waves of electrical activity move in a regular fashion across neural structures like the cortex.
- If there is no central synchronization, how does this occur?
EXAMPLE: Activity in Neural Collections (Cont’d)

- **Entities:** Neurons

- **Enabling mechanisms:**
  - If no local activity, neurons are inactive.
  - If local activity crosses threshold, neuron becomes active.
  - Neural response decays over time (desensitization).
  - Once neuron becomes inactive, is inactive for a short period of time regardless of local activity (refractory period).

- **Example of:** Feedback (direct positive and indirect negative), Recruitment