CPEN 355 : Machine Learning

Chapter 1: What is Intelligence?

Souradeep Dutta
(pronounced as Show-Ro-Deep Duh-tah)

What is Intelligence?

- Hard to define, but we recognize it when we see it
- Humans, dogs intelligent; insects less so
- Core theme: survival via adaptation and action

Plants and Reactive Intelligence

- Plants sense light, temperature, pressure
- Exhibit reflexes (e.g. sunflowers tracking the sun)
- But lack planned movement or exploration

The Tunicate Example

- Mobile as juveniles; possess a nervous system
- Attach to rock once food is found
- Digest their own brain afterward
- Intelligence tied to *action*

Action as a Key Indicator

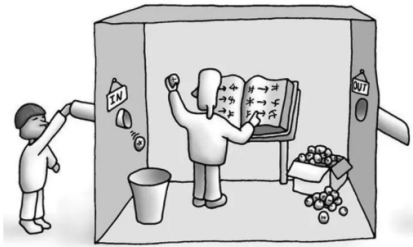
- Intelligence is not passive prediction
- Finding dropped keys requires movement
- Learning provides priors; action closes the loop

Are LLMs Intelligent?

- Short answer: no
- LLMs detect statistical patterns, not meaning
- No beliefs, intentions, or understanding

Chinese Room Argument

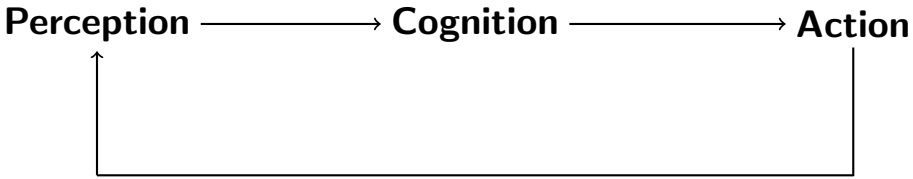
- Proposed by John Searle
- Rule-following can mimic understanding
- But rules $\neq$ comprehension



Searle's Chinese room argument

John Searle

Key Components of Intelligence



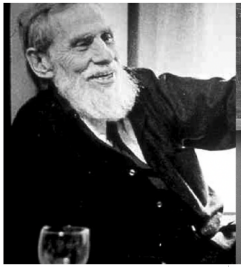
- Perception: sensing the environment
- Cognition: internal representations
- Action: affecting the world

Learning vs Cognition

- Learning: extracting priors from past data
- Cognition: handling novelty and decision-making
- Learning is a component, not the whole

Beginnings of Intelligence (1942–1950)

- McCulloch & Pitts: mechanical neuron
- Alan Turing: computation and intelligence
- Birth of neural network ideas



A LOGICAL CALCULUS OF THE IDEAS IMMANENT IN NERVOUS ACTIVITY*

WARREN S. MCCULLOCH AND WALTER PITTS
University of Illinois, College of Medicine,
Department of Psychiatry at the Illinois Neuropsychiatric Institute,
University of Chicago, Chicago, U.S.A.

Cybernetics

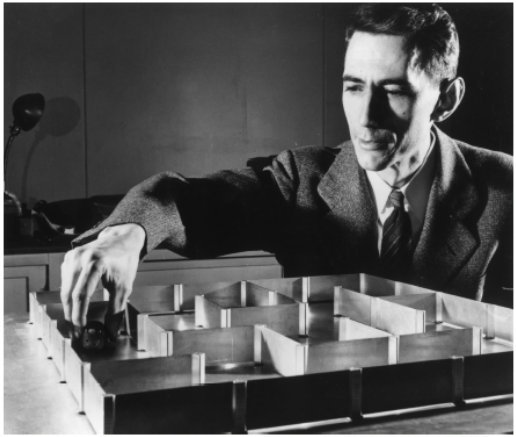
- Norbert Wiener at MIT
- Study of perception–cognition–action loop
- Control and communication in machines

Representation Learning

- Sensors and actions are continuous
- Cognition uses discrete symbols
- Representations bridge the two

Claude Shannon and Information Theory

- Compression, coding, decoding
- ML requires *forgetting* irrelevant details
- Overfitting = remembering the wrong things



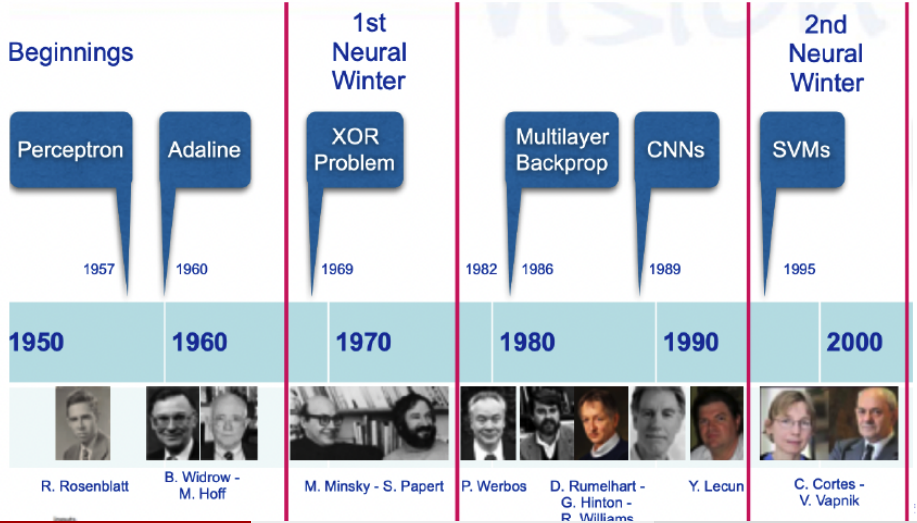
Intelligence Reloaded (1960–2000)

- Perceptron (Rosenblatt)
- AI winter after Minsky & Papert
- Backpropagation revival

CNNs, SVMs, and Applications

- CNNs inspired by neuroscience
- SVMs: strong theory, easy training
- ML adoption in industry

Historical Timeline



Intelligence Revolutions (2006–)

- More data + more compute
- GPUs enable large-scale training
- ImageNet breakthrough (2012)

Impact of Deep Learning

- Vision, language, speech, robotics
- Sciences and medicine
- Foundation of modern AI

Course Goals

- Use modern ML tools effectively
- Understand *why* they work
- Improve theory and practice

At a Glance

Instructor	Souradeep Dutta
TAs	Beidi Zhao; Anthony Cheng
Time	1:00 pm – 2:00 pm (Mon, Wed, Fri)
Location	Hector J. MacLeod Building, Floor 3, Room 3002
Piazza	https://piazza.com/ubc.ca/winterterm22026/cpen_v3552012025w2
Canvas	CPEN_V 355 201 2025W2 Machine Learning
Tutorial	2:00 pm – 3:00 pm (Mon), MCLD 3002
Office Hour	To be announced
Email	souradeep@ece.ubc.ca

Announcements

- **Jan. 5, 2025**: We do not have the tutorial for the 1st week.

Reminder

Please pay attention to announcements on Piazza and Canvas!

Pre-requisites

- Basic knowledge in linear algebra, probability, and calculus
- Proficiency in a programming language (preferably Python)
- Proficiency in a deep learning library (PyTorch, JAX, TensorFlow, etc.)
- Proficiency in LaTeX

Grading

- **40%** Assignments (4×, each 10%) Guideline & Policy
- **25%** In-class Quiz (1×) Guideline & Policy
- **35%** Project (1×) Guideline & Policy
- **3% Extra Credits** Participation Guideline & Policy

Important Notes (1/2)

1. All course-related questions should be handled via **Piazza**. Canvas is only used for submitting homework, assignments, and projects. Try to avoid sending emails directly as it may be buried in the inbox.
2. All homework, assignments, and projects must be done **individually**. A **20% (non-hourly) late penalty** applies unless special circumstances (e.g., illness). Any submission **later than 3 days after the deadline** will **not be evaluated**.

Important Notes (2/2)

3. You may use tools like ChatGPT for homework/assignments. If you use it, acknowledge it in your submitted materials and submit your prompts (e.g., screenshots) for investigation. Ideally, restrict usage to improving English writing rather than getting answers directly.
4. **UBC values academic integrity.** All students must understand the meaning and consequences of cheating, plagiarism, and other academic offences under the Code of Student Conduct and Discipline.