

Foundations of *Artificial* Intelligence (FAI)

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FAI or Φ

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Lecture | 02



What is Intelligence?





Intelligence is a suitcase word

We tend to use this one word to describe a whole bundle of abilities - learning, reasoning, creativity, problem-solving, and more.

Depending on the context, we might call very different things 'intelligent'.

A child solving a math problem.

A parrot mimicking speech.

A program that wins at Chess.

But are these all examples of the same kind of intelligence? Probably not.

Is Intelligence always related to Action?

View A: Intelligence enables **adaptive action** in the world

View B: Intelligence involves internal processes

- reasoning
- planning
- imagining

even if **no action** occurs



What Does It Mean to Be Intelligent?

Different disciplines offer different answers

Psychology: Mental abilities like reasoning, problem-solving, adaptation

- solving problems, learning quickly, adapting to new environments.

Neuroscience: Emergent behavior from neural networks in the brain

- how all these processes emerge from biological structures - particularly the brain

AI: Goal-directed, adaptive behavior by machines

- intelligence is often defined functionally: can the system achieve goals, learn from data, and adapt to change

Intelligence is a *suitcase* word

Marvin Lee Minsky



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Intelligence includes:

Reasoning

Learning

Memory

Planning

Perception

Social skills

Creativity

Adaptability

This ambiguity is why AI researchers - and psychologists too - often find the term frustrating.

Before you can model or measure intelligence, you have to unpack the suitcase and ask: which kind of intelligence are we talking about?"

Intelligence - Binary or a Continuum?



Myth: You're either intelligent or you're not.

Scientific View:

- Intelligence is a spectrum, not a switch
- Varies across individuals, contexts, and species



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The same idea applies in AI as a technology.

- A calculator performs specific logic — is that intelligent?
- What about a chess engine? Or ChatGPT?

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Intelligence - a Continuum

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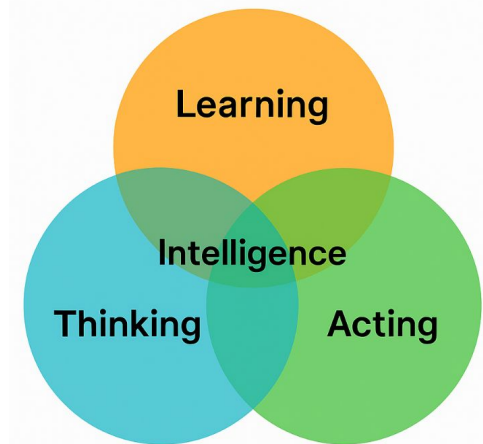
Intelligence as a gradient or a continuum

Reflex → Learned behavior → Reasoning human → (Superintelligent AI)

Components of Intelligence

- Learning
- Thinking
- Acting

Intelligence = when they intersect, and how much



Components of Intelligence



Learning is the process of acquiring new information or behavior through experience.

Thinking involves processing and manipulating what you already know planning, problem-solving, imagining alternatives. It's more than absorbing data — it's using it creatively or strategically.

Intelligence is the broader capacity that enables both learning and thinking, plus adapting to complex situations, by acting.

**A system can learn (like memorizing facts) without being especially intelligent.
Or it can think (daydream or simulate) without actively learning something new.**

Intelligence: Evolution's Hack



Intelligence is not perfection

It is an efficient shortcut evolution developed to help organisms survive and reproduce in complex, changing environments.

It trades optimality for speed, adaptability, and good-enough solutions.





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Not a grand plan → a product of *trial and error* over millions of years

From reflexes to reasoning → gradual layering of cognitive abilities

Survival-driven → perception, memory, and decision-making evolved to serve *immediate needs*

Bounded rationality → humans don't think optimally, but “fast enough” to act in time

Biological constraints → limited energy, limited brain size → creative workarounds

Parallel in AI → AI systems often use *heuristics* and approximations instead of brute-force “perfect”

Drivers of Intelligence's Evolution



Drivers of Intelligence's Evolution



Driver	How It Shapes Intelligence	Examples in Nature
Navigation	Requires spatial memory, environmental mapping, and prediction of routes.	Migratory birds, salmon, desert ants finding nest
Tool Use	Demands planning, problem-solving, and understanding cause-effect.	Chimpanzees fishing termites, crows bending wires
Social Behavior	Fosters communication, theory of mind, cooperation, and deception.	Dolphins coordinating hunts, primates grooming alliances



Thank you

