Introduction to Artificial Intelligence

- **Computer Science:**

  Methods for applying computers to problems

  Study of the fundamental limits of computation

- **Artificial Intelligence**

  Methods for applying computers to solve problems that require "intelligence" when people solve them

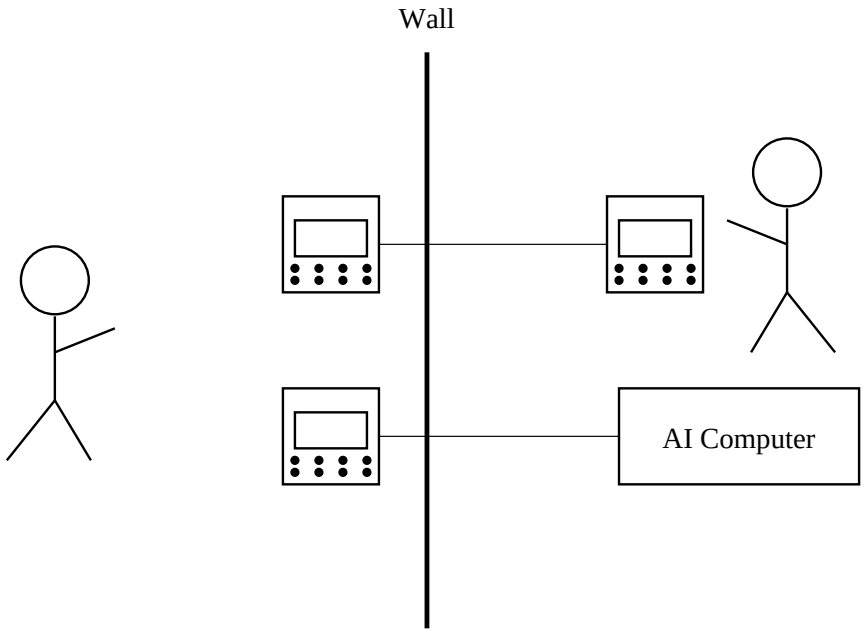
  Study of the fundamental limits of intelligence in computers

What is Intelligence?

	Like Humans	"Rationally"
Think	Cognitive Science	Laws of Thought
Act	Turing Test	Rational agents

Act Like Humans: The Turing Test

Can a computer fool a human interrogator for X minutes?



Abilities Required for Turing Test

- Natural language processing: Language understanding, language generation.
- Automated reasoning
- Machine learning
- Knowledge representation and storage
- Vision (for "total turing test")
- Robotics (for "total turing test")

Problem: Tends to focus on human-like errors, linguistic tricks, etc. Does not produce useful computer programs.

Think Like Humans: Cognitive Science

Goal: Develop precise theories of human thinking

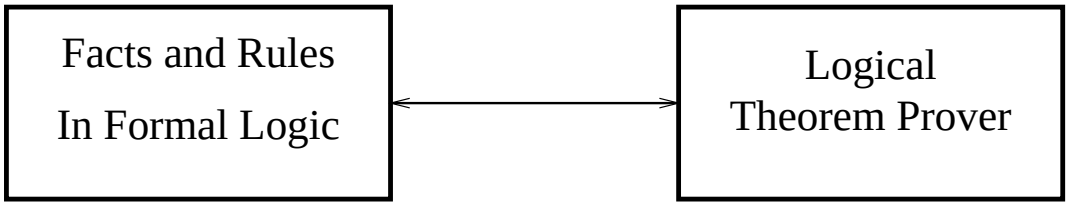
Cognitive Architecture (e.g, SOAR, ACTR)

- **Software Architecture for Modeling Human Performance**
- **Describe task, required knowledge, major subgoals**
- **Architecture follows human-like reasoning**
- **Testable predictions:**
  Time delays during problem solving, kinds of mistakes, eye movements, verbal protocol data, learning rates, strategy shifts over time, etc.

Problems: **Identifiability:** It may be impossible to identify the detailed structure of human problem solving using only externally-available data. "Optimal" or "Rational" performance is an excellent predictor of human problem solving in most routine tasks.

Thinking Rationally: The Logical Approach

Goal: Ensure that all actions performed by computer are justifiable ("rational")



Rational = Conclusions are provable from inputs and prior knowledge

Problems

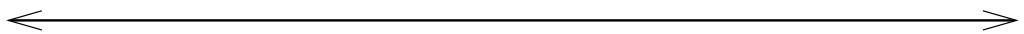
- Representation of informal knowledge is difficult
- How to define "provable" plausible reasoning
- Combinatorial explosion: Not enough time or space to prove desired conclusions. (Semi-decidable)

Acting Rationally: Rational Agents

Claim: "Rational" means more than just logically justified. It also means "doing the right thing"

Rational agents do the best they can given their resources

No thought — Careful, deliberate reasoning



Reflexes — Limited reasoning — Exhaustive reasoning

Adjust amount of reasoning according to the available resources and the importance of the result.

This is one of the things that makes AI hard

Summary

AI studies intelligent reasoning and behavior

- Reasoning, optimization, resource allocation (planning, scheduling, real-time problem solving, automated help desks, intelligent assistants, internet agents)
- Natural language processing (information retrieval, summarization, language understanding, language generation, automatic translation)
- Vision (image analysis, object recognition, scene understanding)
- Robotics (grasping, manipulation, locomotion, motion planning)

Daily experience with AI systems

- Word spotting for AT&T pay phones
- IBM "Via Voice", Dragon Systems "Naturally speaking"
- Airline gate and crew scheduling
- Automated steering, obstacle avoidance, crew scheduling
- World champions in checkers, chess, backgammon
- Microsoft Office assistant