Artificial Intelligence is actually one of the oldest fields of computer science.
It seeks to understand and build intelligent agents that can:

1. Perceive
2. Understand
3. Predict
4. Manipulate
5. Learn

These broad goals are shared with philosophy, psychology, neuroscience, etc.
BUT we build rational systems, where they seek to understand human ones.
Each specific goal, however, is shared with more computational disciplines:

1. Perception? Linguistics
2. Learning? Statistics
3. Understanding/Prediction? Mathematical Logic

The three eras of AI:

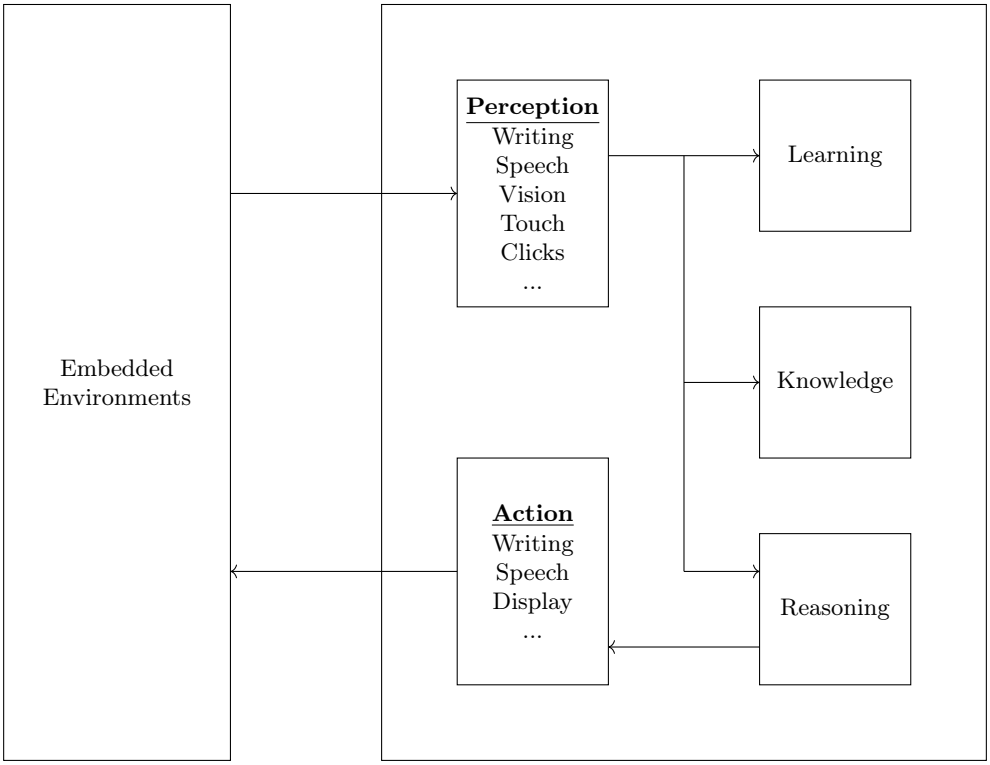
1. Knowledge Representation & Reasoning
   (a) (model): logic
   (b) CS-focused
2. Machine Learning
   (a) (model & functions): probability
   (b) Statistics and Math-focused
3. Neural Networks
   (a) (functions): neural networks
   (b) Engineering-focused

Our initial goals were proposed by Alan Turing; he thus developed **The Turing Test:**
≡ "can an AI convince a human it is human?" This requires:

1. natural language processing
2. knowledge representation
3. automated reasoning
4. machine learning

This avoids physical interaction, so robotics and vision are unneeded.
Since we tend to avoid monolithic approaches, this test is not applied nearly as often in the modern day.

Agents



How can we acquire knowledge?

1. from experts
2. by conversion from other forms of knowledge
3. from experience

How can we categorize knowledge?

1. Uncertain Knowledge (Opinion)
   (a) Belief Networks
   (b) Fuzzy Logic
2. Factual Knowledge (Facts)
   (a) Propositional Logic
   (b) First Order Logic (if A then B)

Why do we say A caused B?

1. Needed for explanation
2. Allows us to predict the future
3. Suggest ways to control future events
4. Moral responsibility
5. Legal liability

How can we formalize the reasoning process?

1. Deduction: What is implied by a knowledge base?
2. Belief Revision: What beliefs to prioritize?
3. Causality: What is the cause of an event?

Consider natural language processing:
It involves the following processes:

1. Understand Natural Language
2. Generate Natural Language

3. Text Summarization
4. Machine Translation
5. Speech Transcription

It has the following complications:

1. Syntactic Ambiguity: "They are cooking apples"
2. Semantic Ambiguity: "She ran to the bank"
3. Pragmatic Ambiguity: "Can you open the door?"

We use the following approaches:

1. Classical:
   (a) Provide the system with rich knowledge
   (b) Perform the above three types of analysis
   (c) Disambiguate using knowledge and reasoning
2. Modern:
   (a) Rely on corpus (collection of data)
   (b) Disambiguate using machine learning

But what is machine learning?
≡ Using experiences and observations to improve future actions
Characteristics:

1. What aspects of performance to be improved?
   We must determine and consider:
   (a) Irrelevant aspects of the world
   (b) How the world evolves
   (c) What are desirable/undesirable situations
2. What feedback is available?
   (a) Supervised: give observations and actions they should lead to
   (b) Unsupervised: give observations, machine finds patterns
   (c) Reinforcement: give positive/negative feedback on actions
3. How to represent output?
   (a) Logical Knowledge
   (b) Probabilistic Knowledge/Bayesian Networks
   (c) Neural Networks

In implementing AI, an important part is **planning**: ≡ finding a sequence of actions that will achieve a goal.

We must consider:

1. Input:
   (a) Actions (preconditions, effects)
   (b) Initial & Goal States
   (c) Knowledge of world (physics)
2. Output:
   (a) Conditional/Contingency Plan
   (b) Sensorless (Conformant) Approach
   (c) Hybrid

The largest application in the public conscience is **robotics**; Physical agents that perform tasks by manipulating the world. These are equipped with:

1. Effectors: legs, wheels, joints, grippers
2. Sensors: cameras, ultrasound, gyroscopes, accelerometers

Common categories:

1. Manipulators (robot arms): assembly lines, ISS
2. Mobile robots: unmanned probes/vehicles
3. Mobile robots with manipulators: humanoid