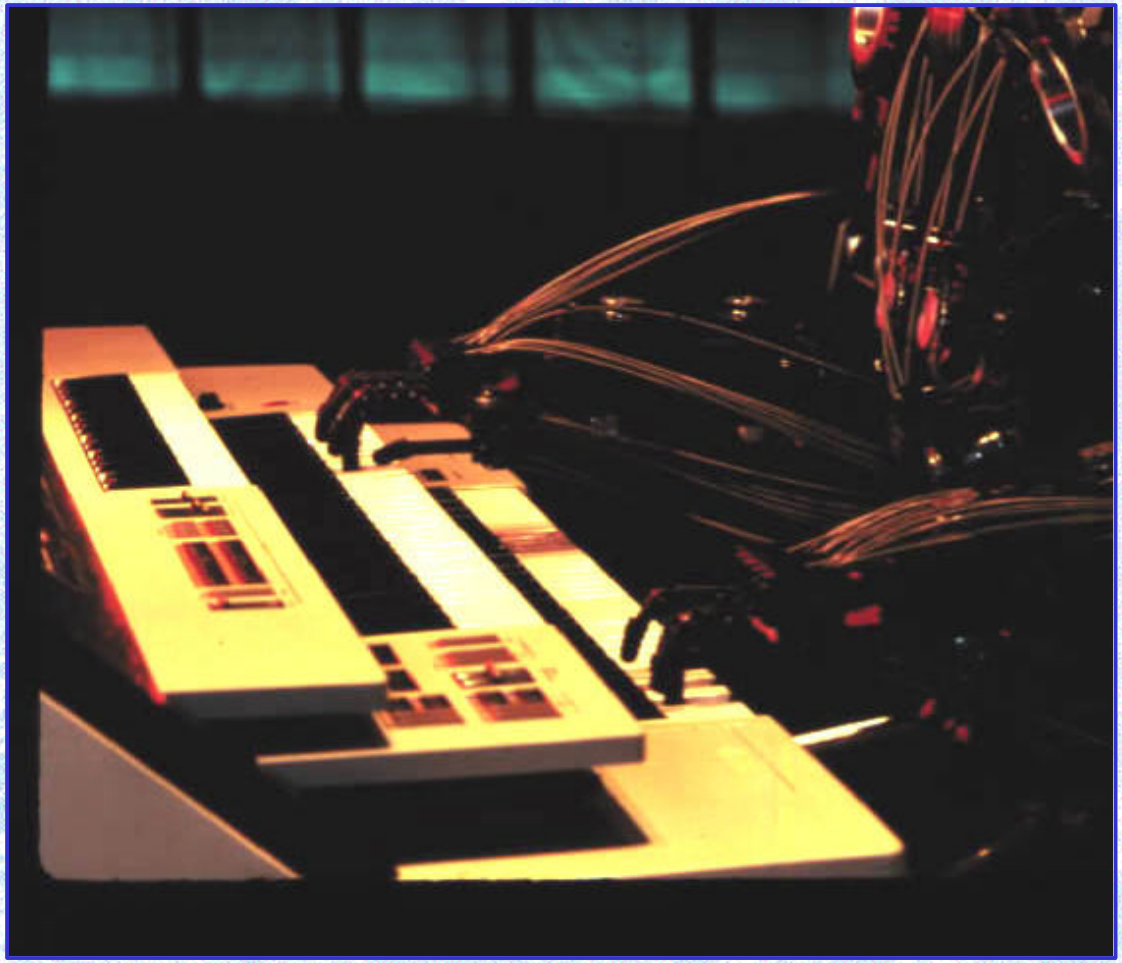
Chapter Thirteen



Is Artificial Intelligence Real?

After reading this chapter, you should be able to:

- Explain what artificial intelligence means
- Explain the two basic approaches of artificial intelligence research
- Describe several hard problems that artificial intelligence research has not yet been able to solve

After reading this chapter, you should be able to:

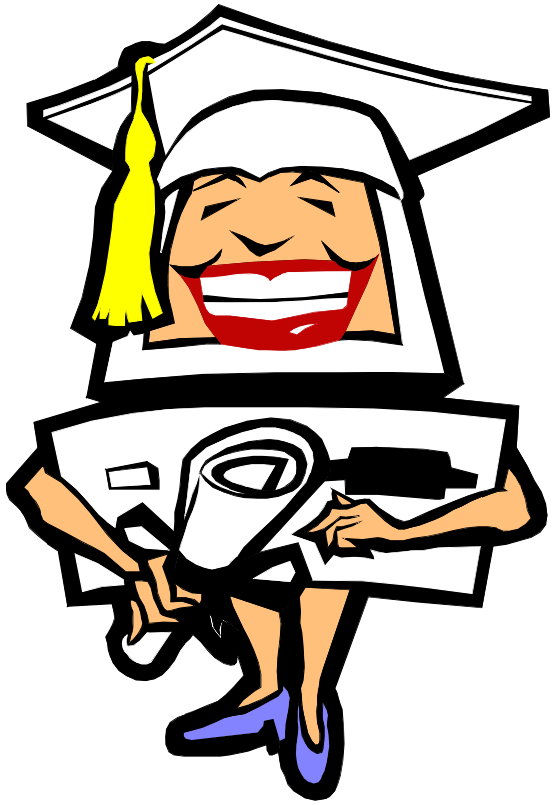
- Describe several practical applications of artificial intelligence
- Explain what robots are and give several examples illustrating what they can—and can't —do.
- Discuss the important social and political issues raised by artificial intelligence

Chapter Outline

- Thinking About Thinking Machines
- Natural-Language Communication
- Knowledge Bases and Expert Systems
- Pattern Recognition: Making Sense of the World
- The Robot Revolution
- AI Implications

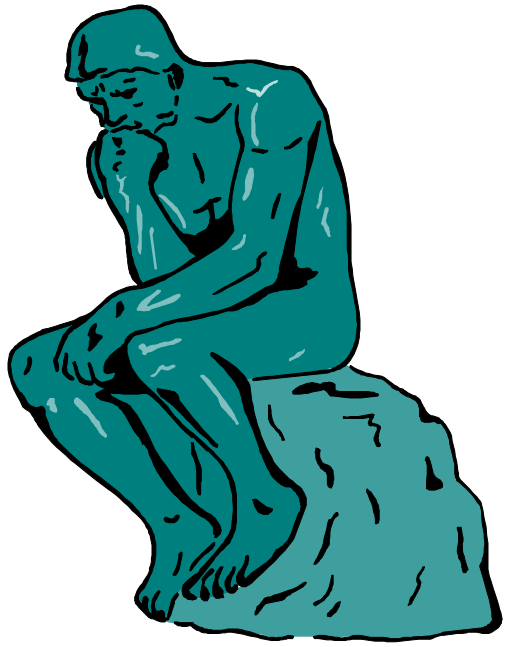
Thinking Machines

- Can machines think?
- To answer that question, we must explore:
  - Definitions of intelligence
  - The Turing test
  - What is artificial intelligence (AI)



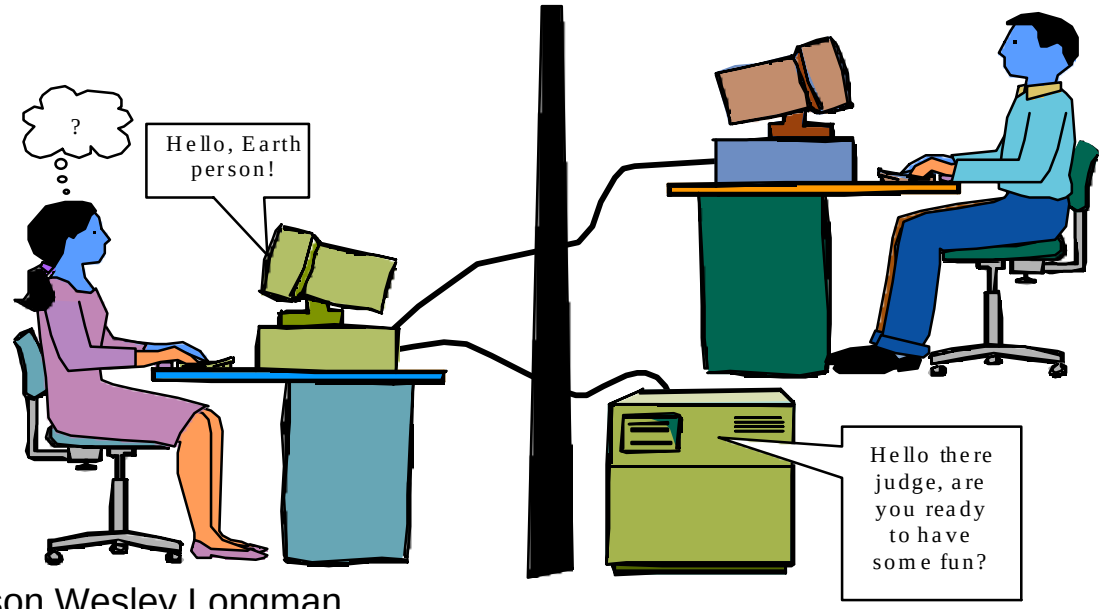
Definitions of Intelligence

- Some definitions of intelligence include:
  - Ability to learn from experience
  - Power of thought
  - Ability to reason
  - Ability to perceive relations
  - Power of insight
  - Ability to use tools
  - Intuition



The Turing Test

- In 1950, British mathematician Alan Turing proposed a test to determine if a machine had intelligence



What Is Artificial Intelligence?

- Artificial intelligence is the study of:
  - …*ideas which enable computers to do the things that make people intelligent.*
    Patrick Henry Winston
  - …*how to make computers do things at which, at the moment, people are better.*
    Elaine Rich
  - …*the computations that make it possible to perceive, reason, and act.*
    Patrick Henry Winston

Two Approaches to AI

- Simulate Human Mental Processes
- Design Nonhuman Mental Processes

Designing Intelligent Machines

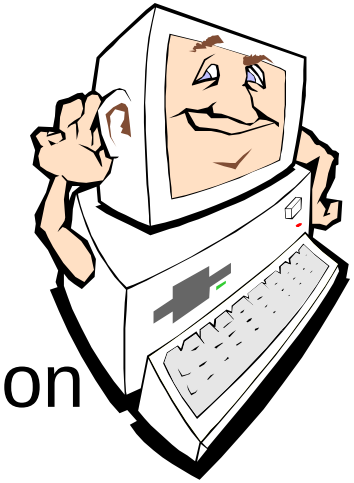
- Some branches of AI research include:
  - Games
  - Natural Languages
  - Knowledge Bases and Expert Systems
  - Pattern Recognition
  - Neural Networks
  - Robotics

Opening Games

- Simple games have limited domains. This allows AI researchers to develop strategies for:
  - Searching possible moves
  - Heuristics (“rules of thumb”)
  - Recognizing Patterns (new or old one?)
  - Machine Learning (machine becomes a better player over time)

Natural-Language Communication

- AI researchers would like to develop a machine that understands the words spoken by a person (natural language)
- Challenges to developing this kind of machine come from:
  - Machine Translation Traps
  - Conversation without Communication
  - Nonsense and Common Sense



Machine Translation Traps

- Required a “parsing program” to break down words from one language and convert them into another
- The meaning was lost in the translation.
- For example:
  - Out of sight, out of mind = *Invisible idiot*
  - The spirit is willing, but the flesh is weak = *The wine is agreeable, but the meat is rotten*

Conversation without Communication

- AI researchers attempted to “converse” with a machine using the software program ELIZA
- ELIZA had a limited natural language vocabulary
- In order to communicate with humans, ELIZA had to ask and be asked questions

Conversation without Communication

- However, ELIZA had no understanding of what was being communicated

Patient: I need some help, that much seems certain

ELIZA: WHAT WOULD IT MEAN TO YOU IF YOU GOT SOME HELP

Nonsense and Common Sense

- AI researchers attempted to learn more about natural languages by using the program RACTER to write a book
- However, despite a large and perfect English language vocabulary, RACTER's book was nonsense
- Machines are good at syntax but cannot compete with humans at semantics

Knowledge Bases and Expert Systems

- Machines are good at storing and retrieving facts and figures
- People are good at storing and manipulating knowledge
- Knowledge bases contain facts and a system of rules for determining the changing relationship between those facts

Knowledge Bases and Expert Systems

- Expert systems are software programs designed to replicate human decision-making processes

Examples of Expert Systems

- Medicine: medical facts and knowledge have been entered into an expert system to aid physicians in diagnosing their patients

Examples of Expert Systems

- Factories: expert systems are used to locate parts, tools, and techniques for the assembly of many kinds of products
- Financial: automation of banking functions and transactions is being done by many expert systems

Expert Systems in Perspective

- An expert system can:
  - Help train new employees
  - Reduce the number of human errors
  - Take care of routine tasks so workers can focus on more challenging jobs
  - Provide expertise when no experts are available

Expert Systems in Perspective

- An expert system can:
  - Preserve the knowledge of experts after those experts leave an organization
  - Combine the knowledge of several experts
  - Make knowledge available to more people

Pattern Recognition: Making Sense of the World

- Pattern recognition involves identifying recurring patterns in input data with the goal of understanding or categorizing that input
- Image Analysis: identifying objects and shapes

Pattern Recognition: Making Sense of the World

- Optical Character Recognition: identifying words and numbers

Pattern Recognition: Making Sense of the World

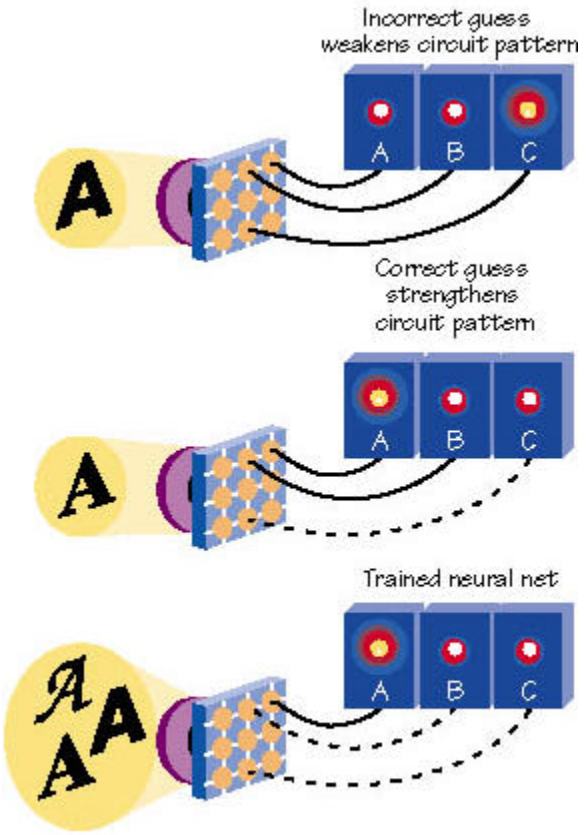
- Speech Recognition: Identifying spoken words
- Speech Synthesis: Generating synthetic speech

Neural Networks

- Neural networks are distributed, parallel computing systems based on the structure of the human brain
- A neural network consists of thousands of microprocessors called neurons
- A neural network learns by trial and error, just as the brain does

Neural Networks

- Concepts are represented as patterns of activity among neurons
- A neural net can still function if part of it is destroyed



The Robot Revolution

- The word robot comes from the Czech word for forced labor
- Today's robots combine many AI technologies, including:
  - Vision, hearing, pattern recognition, knowledge engineering, expert decision making, natural language understanding, and speech

The Robot Revolution

- While a computer performs mental tasks, a robot is a computer-controlled machine designed to do manual tasks

What Is a Robot?

- A robot differs from other computers in its input and output peripherals
- Robot input includes sensors (heat, light, motion)
- Robotic output is usually sent to joints, arms, or other moving parts

What Is a Robot?

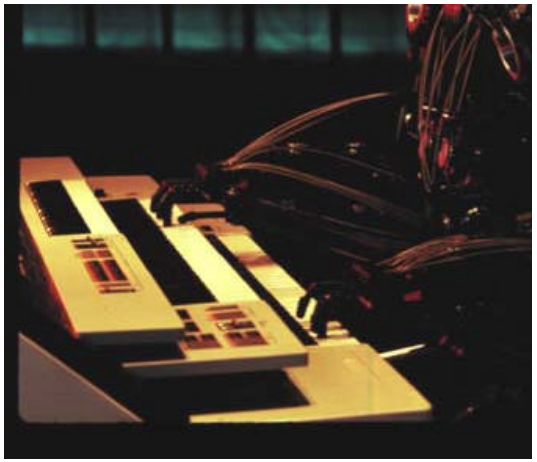
- These peripherals make robots ideally suited for:
  - Saving labor costs (robots can work 24 hours a day)
  - Improving the quality and productivity of repetitive jobs
  - Hazardous or uncomfortable jobs

Steel-Collar Workers

- Despite sophisticated input and output devices, robots still cannot compete with humans for jobs requiring exceptional perceptual or fine-motor skills
- But for people who earn their living doing manual labor, robots are a threat
- Displaced workers are not limited to factories

AI Implications

- “There are certain tasks which computers ought not [to] be made to do, independent of whether computers can be made to do them”



Joseph Weizenbaum

AI Implications

  - In the future, we are likely to see products with embedded AI
  - Some futurists predict that silicon-based intelligence will replace human intelligence
- Whether AI becomes embedded in products or evolves into a new form of intelligent life, what becomes of human values?