Questions at the heart of AI

• How intelligent will programs become?
• Can programs find their own shortcomings and modify their programs accordingly?
• Can programs break into the “for-humans-only” fields?
• Do we want them to?

The goals

Simulate human intelligence
  – Talk
  – Play games
  – See and understand
  – Walk
  – Compose music
  – Create new math theorems

A look back at the difference

• Computers are better at some things:
  – Calculate quickly and accurately
  – Remember things
  – Sort/search
  – Do things systematically

How do we bridge the difference – AI!
**Fuzzy Definitions**

- We use words that are hard to define, and will have definitions that differ slightly from their regular English definitions:
  - Knowledge
  - Learning/Teaching
  - Understanding
  - Intelligence
  - Mind

**Knowledge**

- Knowledge: Set of facts about something and its relationships to other things
- Chair:
  - Parts (leg, seat, …)
  - Position
  - Material
  - Age
  - Cost
  - How to move it
  - How to sit on it
  - How to turn it around

**Semantic Networks**

- Semantic networks: a way to represent knowledge (objects and relationships)
- The computer “understands” something when the object matches its description
- The computer “misunderstands” when an incorrect object matches its description

**Learning**

- Use reasoning to alter a knowledge base
  - Add or delete facts from knowledge representation, like a semantic net
  - Rote learning: “C1 is a chair, C2 is a chair”
  - Concept learning: “This thing that I sit on is a chair.”
  - Generalizing from examples can be deceiving
    “All tall candidates win the election.”
Reasoning

- Reasoning: Applying “rules” to objects in memory, resulting in building new links between objects already in memory.
- Example:
  “Jeff is Shannon’s brother.”
  “Sheila is Shannon’s sister.”
Rules about brothers and sisters lead to:
  “Sheila is Jeff’s sister.”
  “Jeff is Sheila’s brother.”

Games

- Trying to play human games with a computer is a long-standing area of study
  - Helps us take a closer look at human “intelligence”
  - Gives a standard framework for an intelligent task
  - Has quantifiable results (scores)
  - Is often considered “for-humans-only”
  - Is a lot of fun

Gaming trees

- Decision tree technology useful in game-playing
- Nodes are possible game states
- Arcs are moves
- Must search the tree to find a sequence of moves that leads to a winning board
- Trees too big to search completely – must use smarts…

Heuristics

- Heuristic: A rule of thumb capturing some human intuition
- Heuristics are useful in knowing which parts of the tree might never lead to a winning state and shouldn’t be searched, or in knowing which moves should be searched first because they are promising
- Example, in checkers:
  “Don’t move so that you back yourself into a corner.”
  “Getting a king is excellent.”
**Expert Systems**

- Human experts are valuable:
  - Doctors
  - Repairmen
  - Librarians
  - Etc…
- Simulating this expertise is lucrative!

**Expert Systems**

- People can usually describe their jobs fairly algorithmically in terms of if-then “rules”:
  - Dr. “If you are coughing and sneezing, you probably have a cold. If you have a cold and you are not allergic to it, I would give you cold medicine.”
  - Decision trees!!!

**Progress of AI**

- Games: Deep Blue defeated Kasparov to become the world-champion in chess (1997)
- Computer devises a proof of a theorem (the Robbins problem) that had eluded mathematicians for years. (1998)
- A computer composes a piece of music that fools an audience into believing it was written by Bach. (1996)

**Other areas**

- Automatic Programming: Having a computer write or modify its own programs, based on human descriptions
- Image understanding: recognizing handwriting, faces, …
- Natural Language understanding
- Learning: Finding the governing “rules” behind a set of examples
**Turing Test**

- Alan Turing devised a test of artificial intelligence:
  - Person facing 2 booths
  - In one, a human; in other, a computer
  - Can person tell which is in which booth?
  - Can interact through computers

Is this a good test of Intelligence?

**Philosophy**

- What are the “real” definitions of thought, mind, reasoning, understanding, etc…
- What does it mean to be human?
- What is our responsibility toward our technology?
- Can we simulate every bit of human thought?