Introduction to Artificial Intelligence (40-417)

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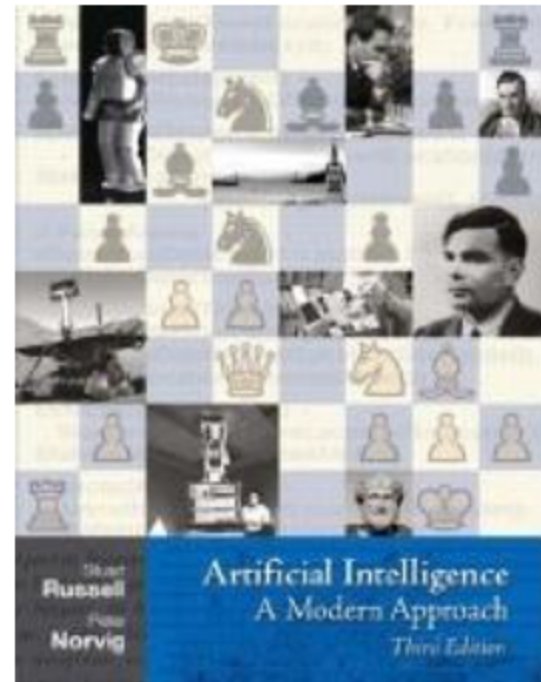
Course Page

- To be created
  - Announcements
  - Slides
  - Assignments

Textbooks

- S Russell and P Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, 3rd ed., 2010.

Evaluation

- Quizzes and Assignments (10%)

- Project (20%)

- Mid-Term Exam (35%)

- Final Exam (35%)

What is Artificial Intelligence (AI)?

Views of AI fall into four categories in Two dimensions:

- Thinking/Reasoning vs. behavior/action
- Success according to human standards vs. success according to an ideal concept of intelligence (rationality):

Act like humans	Act rationally
Think like humans	Think rationally

The textbook advocates "acting rationally"

Acting Humanly - Turing test

AI system

Control

Experimenter
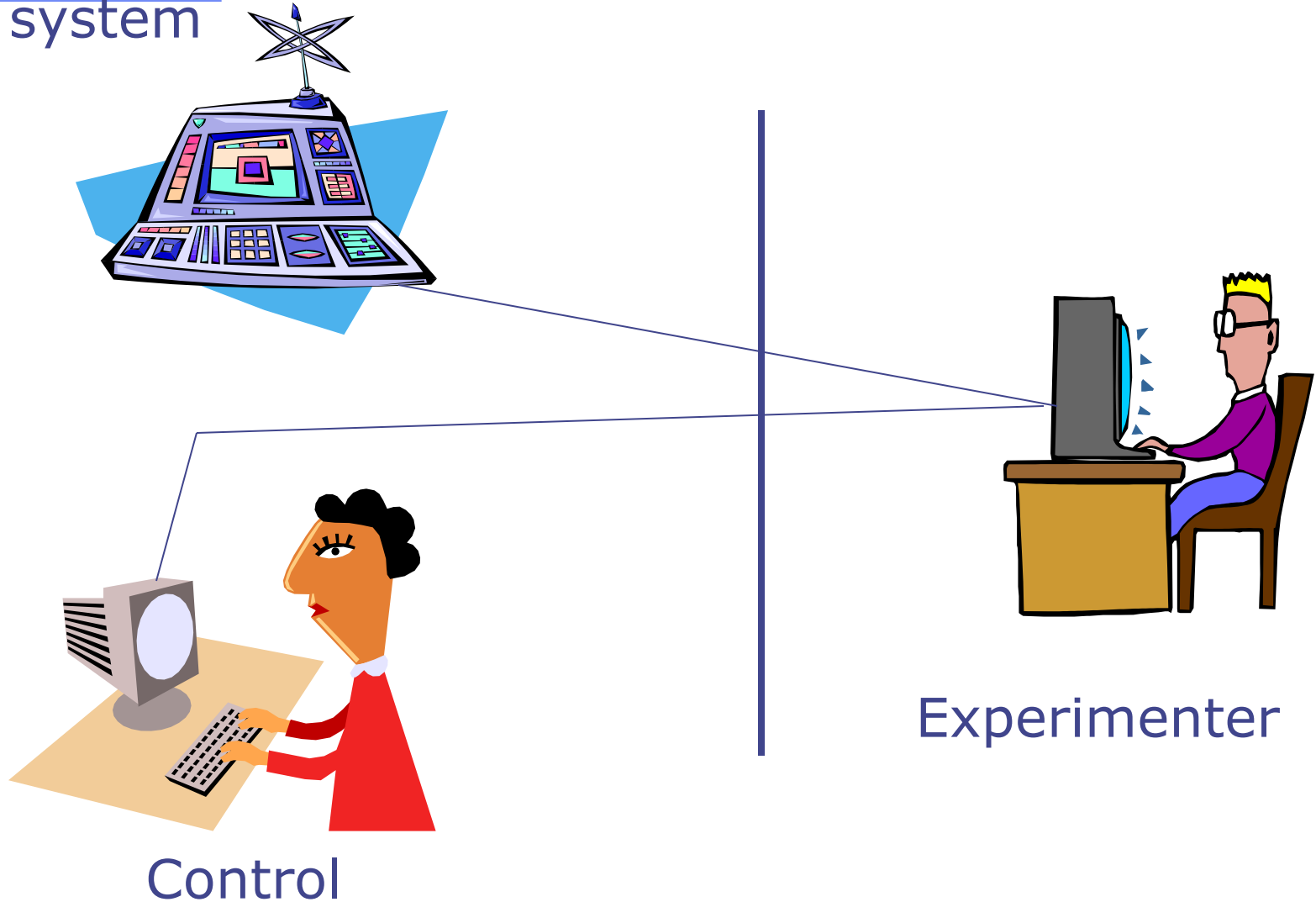
Acting Humanly - Turing test

- To act humanly a system needs
  - Natural language processing
  - Knowledge representation
  - Learning
  - Automated Reasoning
  - Vision and speech recognition (total Turing test)
  - Robotics (total Turing test)
- Problems
  - Not reproducible
  - Not constructive
  - Not amenable to mathematical analysis

Thinking Humanly – Cognitive Modeling

- ◆ Cognitive Science
  - ■ Scientific analysis of activities of the brain
- ◆ We need to get *inside* the actual workings of human minds
  - ■ Observing the electrical behavior of the brain
  - ■ Brain imaging
  - ■ Introspection: trying to catch our own thoughts as the go by
  - ■ psychological experiments: observing a person in action
- ◆ Cognitive Science and AI are now two separate fields

Thinking rationally: "laws of thought"

- The Greek philosopher Aristotle was one of the first to attempt to codify "right thinking,"
  - Socrates is a man; all men are mortal; therefore, Socrates is mortal.

- By 1965, programs existed that could, **in principle**, solve *any* solvable problem described in logical notation
- There are two main obstacles to this approach
  - First, it is not easy to take informal knowledge and state it in the formal terms
  - Even problems with just a few hundred facts can exhaust the computational resources of any computer

Acting rationally: The rational agent

- A **rational agent** is one that acts so as to achieve the best outcome or, when there is uncertainty, the best expected outcome.

- Two advantages over the other approaches
  - It is more general than the "laws of thought" approach
    - Inference is just one of several possible mechanisms for achieving rationality well defined
  - It is more scientific compared to approaches based on human behavior or human thought.
    - Standard of rationality is mathematically well defined

- Bounded rationality design best agent for given resources

- We will focus on rational agents in this course

Acting Rationally

- Rational behavior: doing the right thing
- "The right thing":
  - is **expected** to maximize goal achievement, **given the available information**
  - Limited resource, imperfect knowledge
- Doesn't necessarily (but often) involve thinking
- Doesn't necessarily have anything to do with how humans solve the same problem.

Rational agents

- An agent is an entity that perceives and acts
- The text book focuses on designing rational agents
  - An agent is a function from percept histories to actions:

$$f : P^* \rightarrow A$$

  - For any given class of environments and task, we seek the agent with the best performance.

The Origins of AI

1950 Alan Turing's paper, *Computing Machinery and Intelligence*, described what is now called "The Turing Test".

Turing predicted that in about fifty years "an average interrogator will not have more than a 70 percent chance of making the right identification after five minutes of questioning".

1957 Newell and Simon predicted that "Within ten years a computer will be the world's chess champion."
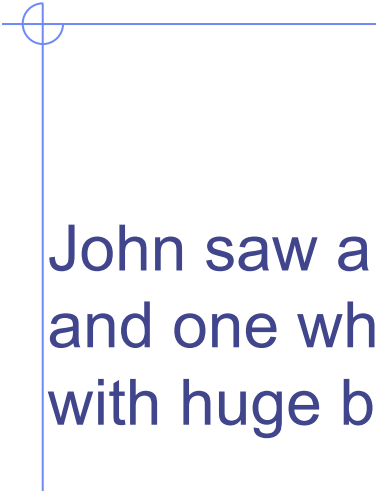
Newell and Simon Prediction

In 1997, Deep Blue beat Gary Kasparov.

But Chess is Easy

- The rules are simple enough to fit on one page

- The branching factor is only 35.

A Harder One

John saw a boy and a girl with a red wagon with one blue and one white wheel dragging on the ground under a tree with huge branches.

How Bad is the Ambiguity?

- Kim (1)
- Kim and Sue (1)
- Kim and Sue or Lee (2)
- Kim and Sue or Lee and Ann (5)
- Kim and Sue or Lee and Ann or Jon (14)
- Kim and Sue or Lee and Ann or Jon and Joe (42)
- Kim and Sue or Lee and Ann or Jon and Joe or Zak (132)
- Kim and Sue or Lee and Ann or Jon and Joe or Zak and Mel (469)
- Kim and Sue or Lee and Ann or Jon and Joe or Zak and Mel or Guy (1430)
- Kim and Sue or Lee and Ann or Jon and Joe or Zak and Mel or Guy and Jan (4862)