Introduction to Artificial Intelligence

الذكاء الصناعى والأنظمة الخبيرة

First Term 2022-2023

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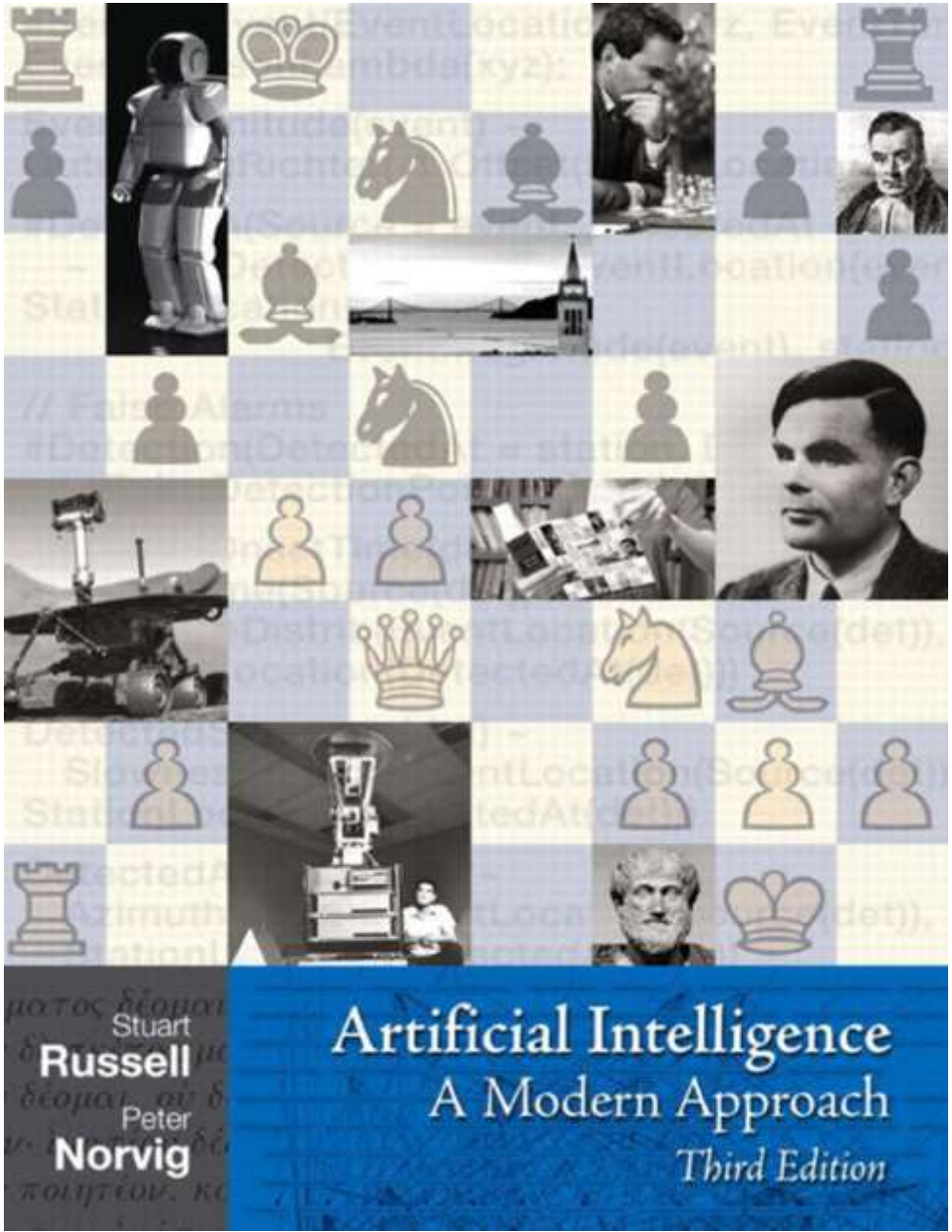
Course Info

- **Course Title: Artificial Intelligence and Expert Systems**
- **Course Code: CCE3219**
- **Grading:**
  - **Term work: 30 Points**
  - **Practical/Oral : 30 Points**
  - **Final Exam: 90 Points**
- **Lecture: 4 hours**
- **Section: 2 hours**
- **TA: Eng. Sondos**

Text Book


Stuart
Russell
Peter
Norvig
Artificial Intelligence
A Modern Approach
Third Edition

Lecture 1
Introduction To AI

What is AI?

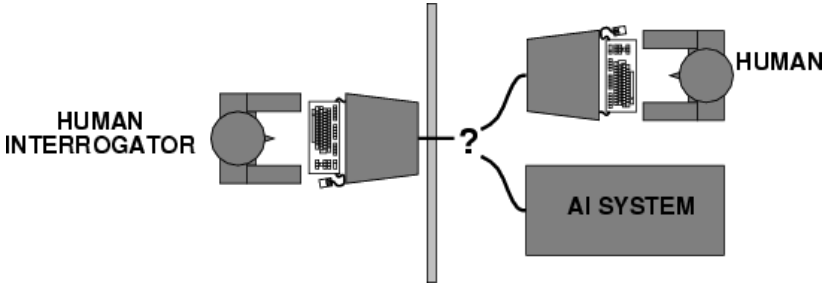
Thinking Humanly	**Thinking Rationally**
"The exciting new effort to make computers think . . . *machines with minds*, in the full and literal sense." (Haugeland, 1985) "[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning . . ." (Bellman, 1978)	"The study of mental faculties through the use of computational models." (Charniak and McDermott, 1985) "The study of the computations that make it possible to perceive, reason, and act." (Winston, 1992)
Acting Humanly	**Acting Rationally**
"The art of creating machines that perform functions that require intelligence when performed by people." (Kurzweil, 1990) "The study of how to make computers do things at which, at the moment, people are better." (Rich and Knight, 1991)	"Computational Intelligence is the study of the design of intelligent agents." (Poole *et al.*, 1998) "AI . . . is concerned with intelligent behavior in artifacts." (Nilsson, 1998)

Thinking humanly

- Cognitive science: the brain as an information processing machine
  - Requires scientific theories of how the brain works
- How to understand cognition as a computational process?
  - Introspection: try to think about how we think
  - Predict and test behavior of human subjects
  - Image the brain, examine neurological data
- The latter two methodologies are the domains of cognitive science and cognitive neuroscience

Acting humanly

- Turing (1950) "Computing machinery and intelligence"
- The Turing Test



- What capabilities would a computer need to have to pass the Turing Test?
  - Natural language processing
  - Knowledge representation
  - Automated reasoning
  - Machine learning
- Turing predicted that by the year 2000, machines would be able to fool 30% of human judges for five minutes

Turing Test: Criticism

- What are some potential problems with the Turing Test?
  - Some human behavior is not intelligent
  - Some intelligent behavior may not be human
  - Human observers may be easy to fool
  - Chinese room argument: one may simulate intelligence without having true intelligence (more of a philosophical objection)
- Is passing the Turing test a good scientific goal?
  - Not a good way to solve practical problems
  - Can create intelligent agents without trying to imitate humans

Thinking rationally

- Idealized or “right” way of thinking
- **Logic:** patterns of argument that always yield correct conclusions when supplied with correct premises
  - “Socrates is a man; all men are mortal; therefore Socrates is mortal.”
- Beginning with Aristotle, philosophers and mathematicians have attempted to formalize the rules of logical thought
- ***Logicist* approach to AI:** describe problem in formal logical notation and apply general deduction procedures to solve it
- Problems with the logicist approach
  - Computational complexity of finding the solution
  - Describing real-world problems and knowledge in logical notation

Acting rationally: Rational agent

- A rational agent is one that acts to achieve the best expected outcome
  - Goals are application-dependent and are expressed in terms of the **utility of outcomes**
  - Being rational means **maximizing your expected utility**
  - In practice, utility optimization is subject to the agent's computational constraints (*bounded rationality* or *bounded optimality*)
- This definition of rationality only concerns the decisions/actions that are made, not the cognitive process behind them

Acting rationally: Rational agent

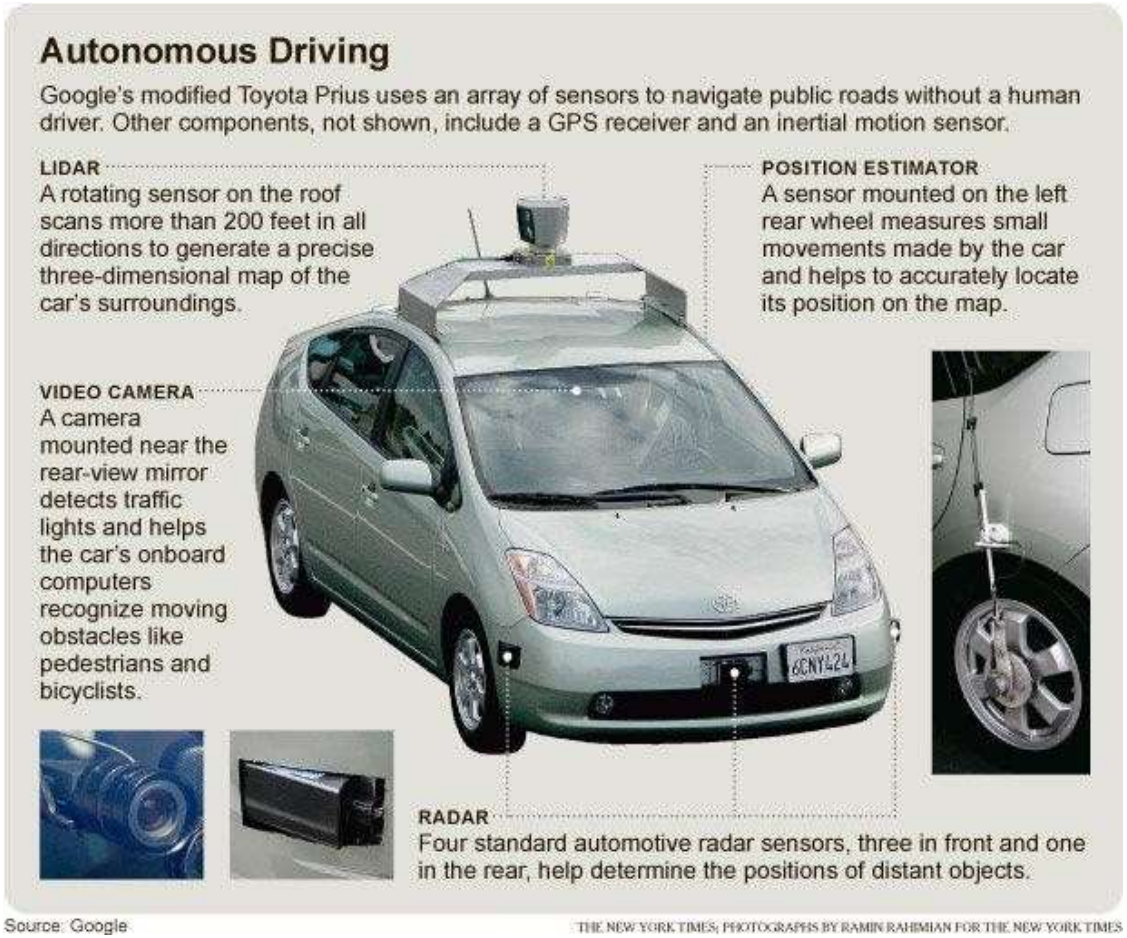
- Advantages of the “utility maximization” formulation
  - Generality: goes beyond explicit reasoning, and even human cognition altogether
  - Practicality: can be adapted to many real-world problems
  - Amenable to good scientific and engineering methodology
  - Avoids philosophy and psychology

What are some examples of AI today?

IBM Watson

- http://www.research.ibm.com/deepqa/
- NY Times article
- Trivia demo
- YouTube video
- IBM Watson wins on Jeopardy (February 2011)

Google self-driving cars



- [NY Times article]

Natural Language

- Speech technologies
  - Automatic speech recognition
    - Google voice search
  - Text-to-speech synthesis
  - Dialog systems
- Machine translation
  - translate.google.com
  - Comparison of several translation systems

Source	*The Original Text*	*Human Translation*	*Google Translate*
 French "Le Petit Prince" ("The Little Prince") By Antoine de Saint-Exupéry	Le premier soir je me suis donc endormi sur le sable à mille milles de toute terre habitée. J'étais bien plus isolé qu'un naufragé sur un radeau au milieu de l'océan. Alors vous imaginez ma surprise, au lever du jour, quand une drôle de petite voix m'a réveillé. Elle disait: -S'il vous plaît... dessine-moi un mouton!	On the first night, I fell asleep on the sand, a thousand miles from any human habitation. I was far more isolated than a shipwrecked sailor on a raft in the middle of the ocean. So you can imagine my surprise at sunrise when an odd little voice woke me up. It said: "Please ... draw me a sheep." - *Wordsworth Children's Classics, 1995*	The first night I went to sleep on the sand a thousand miles from any human habitation. I was more isolated than a shipwrecked sailor on a raft in the middle of the ocean. So imagine my surprise at daybreak, when a funny little voice woke me. She said: "If it pleases you ... draw me a sheep!"

Vision

- OCR, handwriting recognition
- Face detection/recognition: many consumer cameras, Apple iPhoto
- Visual search: Google Goggles

Math, games, puzzles

- In 1996, a computer program written by researchers at Argonne National Laboratory proved a mathematical conjecture (Robbins conjecture) unsolved for decades
  - NY Times story: “[The proof] would have been called creative if a human had thought of it”
- IBM’s Deep Blue defeated the reigning world chess champion Garry Kasparov in 1997
  - **1996: Kasparov Beats Deep Blue**
    “I could feel --- I could smell --- a new kind of intelligence across the table.”
  - **1997: Deep Blue Beats Kasparov**
    “Deep Blue hasn't proven anything.”

- In 2007, checkers was “solved” --- a computer system that never loses was developed
  - Science article

Logistics, scheduling, planning

- During the 1991 Gulf War, US forces deployed an AI logistics planning and scheduling program that involved up to 50,000 vehicles, cargo, and people
- NASA's Remote Agent software operated the Deep Space 1 spacecraft during two experiments in May 1999
- In 2004, NASA introduced the MAPGEN system to plan the daily operations for the Mars Exploration Rovers

Information agents

- Search engines
- Recommendation systems
- Spam filtering
- Automated helpdesks
- Medical diagnosis systems
- Fraud detection
- Automated trading

Robotics

- Mars rovers
- Autonomous vehicles
  - DARPA Grand Challenge
  - Google self-driving cars
- Autonomous helicopters
- Robot soccer
  - RoboCup
- Personal robotics
  - Humanoid robots
  - Personal assistants?

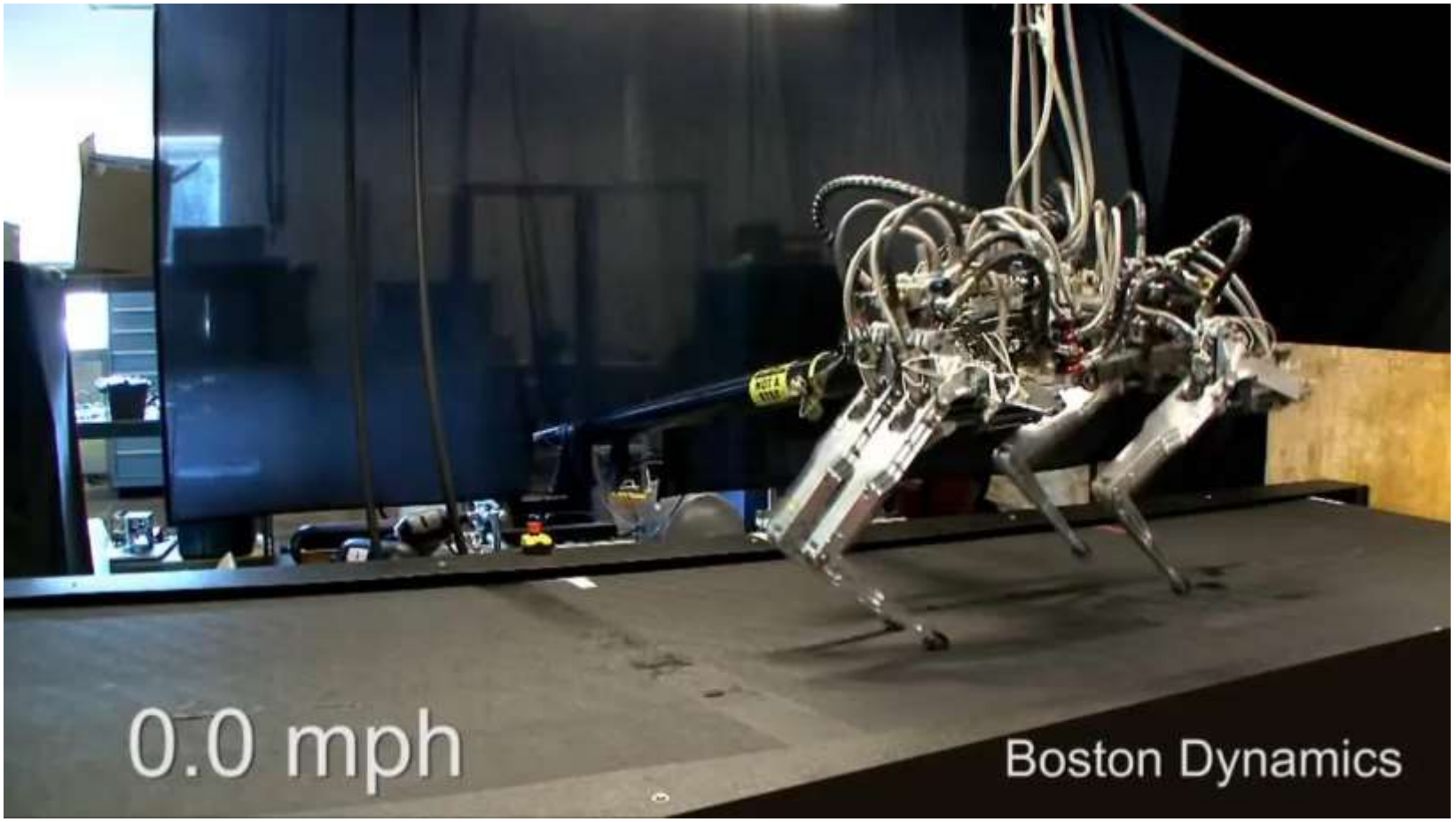
Towel-folding robot

"Cloth Grasp Point Detection based on Multiple-View Geometric Cues with Application to Robotic Towel Folding," ICRA 2010

Boston Dynamics Robots

Military Robots

Military Robots



Robot Chef