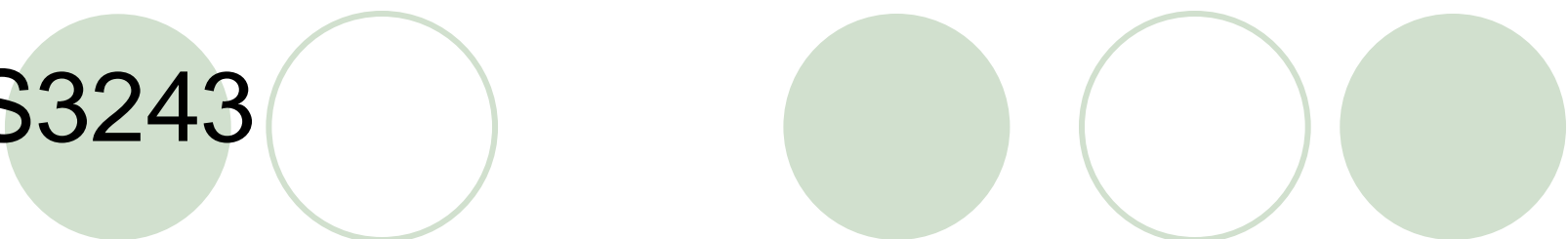


CS3243 FOUNDATIONS OF ARTIFICIAL INTELLIGENCE

AY2003/2004 Semester 2

Introduction: Chapter 1

CS3243



- Course home page:
<http://www.comp.nus.edu.sg/~cs3243>
- IVLE for homework submission and forum communication.
- Textbook: S. Russell and P. Norvig *Artificial Intelligence: A Modern Approach* Prentice Hall, 2003, **Second Edition**
- Lecturer: Min-Yen Kan (S15 05-05)
- Grading: Programming assignments (15%, 20%), Midterm test (25%), Final exam (40%)
- Class participation can only revise your grade upwards
- Lecture and tutorial attendance is mandatory
- Midterm test (in class, 1 hr) and final exam (2 hrs) are both closed book

Outline

- Course overview
- What is AI?
- A brief history
- The state of the art

Course overview



- Introduction and Agents (chapters 1, 2)
- Search (chapters 3, 4, 5, 6)
- Logic (chapters 7, 8, 9)
- Uncertainty (chapters 13, 14)
- Learning (chapters 18, 20)
- Optional Lectures:
 - Natural Language Processing (chapters 22, 23)
 - Planning and Robotics (chapters 11, 12, 25)
 - Machine Vision (chapter 24)

What is AI?

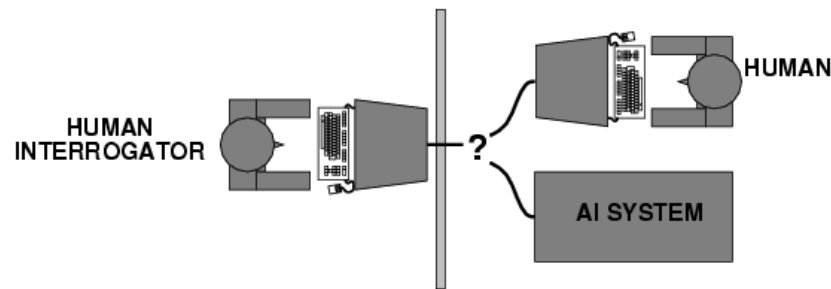
Views of AI fall into four categories:

Thinking humanly	Thinking rationally
Acting humanly	Acting rationally

The textbook advocates "acting rationally"

Acting humanly: Turing Test

- Turing (1950) "Computing machinery and intelligence":
- "Can machines think?" → "Can machines behave intelligently?"
- Operational test for intelligent behavior: the Imitation Game



- Predicted that by 2000, a machine might have a 30% chance of fooling a lay person for 5 minutes
- Anticipated all major arguments against AI in following 50 years
- Suggested major components of AI: knowledge, reasoning, language understanding, learning

Thinking humanly: cognitive modeling

- 1960s "cognitive revolution": information-processing psychology
- Requires scientific theories of internal activities of the brain
 - How to validate? Requires
 - 1) Predicting and testing behavior of human subjects (top-down)
 - or 2) Direct identification from neurological data (bottom-up)
- Both approaches (roughly, Cognitive Science and Cognitive Neuroscience) are now distinct from AI



Thinking rationally: "laws of thought"

- Aristotle: what are correct arguments/thought processes?
- Several Greek schools developed various forms of *logic: notation and rules of derivation* for thoughts; may or may not have proceeded to the idea of mechanization
- Direct line through mathematics and philosophy to modern AI
- Problems:
 1. Not all intelligent behavior is mediated by logical deliberation
 2. What is the purpose of thinking? What thoughts should I have?

Acting rationally: rational agent

- **Rational** behavior: doing the right thing
- The right thing: that which is expected to maximize goal achievement, given the available information
- Doesn't necessarily involve thinking – e.g., blinking reflex – but thinking should be in the service of rational action

Rational agents



- An **agent** is an entity that perceives and acts
- This course is about designing rational agents
- Abstractly, an agent is a function from percept histories to actions:

$$[f: \mathcal{P}^* \rightarrow \mathcal{A}]$$

- For any given class of environments and tasks, we seek the agent (or class of agents) with the best performance
- Caveat: computational limitations make perfect rationality unachievable
 - design best **program** for given machine resources

AI prehistory



- Philosophy Logic, methods of reasoning, mind as physical system foundations of learning, language, rationality
- Mathematics Formal representation and proof algorithms, computation, (un)decidability, (in)tractability, probability
- Economics utility, decision theory
- Neuroscience physical substrate for mental activity
- Psychology phenomena of perception and motor control, experimental techniques
- Computer engineering building fast computers
- Control theory design systems that maximize an objective function over time
- Linguistics knowledge representation, grammar

Abridged history of AI

- 1943 McCulloch & Pitts: Boolean circuit model of brain
- 1950 Turing's "Computing Machinery and Intelligence"
- 1956 Dartmouth meeting: "Artificial Intelligence" adopted
- 1952–69 Look, Ma, no hands!
- 1950s Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
- 1965 Robinson's complete algorithm for logical reasoning
- 1966–73 AI discovers computational complexity
Neural network research almost disappears
- 1969–79 Early development of knowledge-based systems
- 1980– AI becomes an industry
- 1986– Neural networks return to popularity
- 1987– AI becomes a science
- 1995– The emergence of intelligent agents

State of the art



- Deep Blue defeated the reigning world chess champion Garry Kasparov in 1997
- Proved a mathematical conjecture (Robbins conjecture) unsolved for decades
- No hands across America (driving autonomously 98% of the time from Pittsburgh to San Diego)
- 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 on-board autonomous planning program controlled the scheduling of operations for a spacecraft
- `Proverb` solves crossword puzzles better than most humans