Artificial Intelligence
Artificial Intelligence

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• Consultations: via email or after lecture.
• Course website:
  www.uet.vnu.edu.vn/~sonpb/AI
Readings

• Textbook:

• Reference books:
Course overview

• Problem Solving using search techniques
  – Blind search.
  – Informed search
  – Constraint satisfaction problem.
• Game Playing.
• Knowledge Representation:
  – Propositional logic
  – Predicate logic
  – Reasoning mechanisms
  – Probabilistic reasoning
• Prolog.
• Advanced Topics:
  – Machine Learning e.g. decision tree, neural network
  – Natural Language Processing
  – …
Assessment

• C: Class mark:
  – Assignments
  – Attendance and participation.
• E: Exam
• F: Final mark
  \[ F = C \times 40\% + E \times 60\% \]
Policy

• Encourage discussion but assignments must be your individual work
• Codes copied from books or other libraries but be explicitly acknowledged
• Sharing or copying codes is strictly prohibited.
AI Systems

- Thermostat
- Chess
- Your car
- Google
- Asimo
- Vacuum cleaner
What is AI?

• The exciting new effort to make computers think … machine with minds, in the full and literal sense.
• The study of mental faculties through the use of computational models
• The art of creating machines that perform functions that require intelligence when performed by people.
• AI … is concerned with intelligent behaviour in artifacts.
What is AI?

Views of AI fall into four categories:

- Rationality vs. human (humans are not perfect)
- Acting vs. thinking

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Thinking humanly: cognitive modeling

- Requires scientific theories of internal activities of the brain
  - Introspection
  - Psychological experiments
- -- 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
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
- Suggested major components of AI: knowledge, reasoning, language understanding, learning
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 out of all the thoughts that I could have?
Acting rationally

- **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
Short History of AI

The Thinking Machine
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
• 1950s  Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
• 1958  McCarthy invented LISP programming language.
• 1966—73  AI discovers computational complexity: scaling up prob. Neural network research almost disappears
• 1969—79  Early development of knowledge-based systems
• 1980--  AI becomes an industry
• 1986--  Neural networks return to popularity: back-propagation learning algorithm
• 1987--  AI becomes a science
• 1995--  The emergence of intelligent agents, statistical approaches
• 2000-  Where are we now?
State of the art

• Deep Blue defeated the reigning world chess champion Garry Kasparov in 1997.
• Deep Fritz defeated Kramnik in 2006.
• Watson defeated best human player in Jeopardy! In 2011.
• 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
AI Systems Video demos

- Watson is a Question answering (QA) computing system built by IBM. IBM describes it as "an application of advanced Natural Language Processing, Information Retrieval, Knowledge Representation and Reasoning, and Machine Learning technologies to the field of open domain question answering" which is "built on IBM's DeepQA technology for hypothesis generation, massive evidence gathering, analysis, and scoring."
- Google Self Driving Car
- Robocup
- VAV Virtual Assistant for Vietnamese - developed at FIT@UET