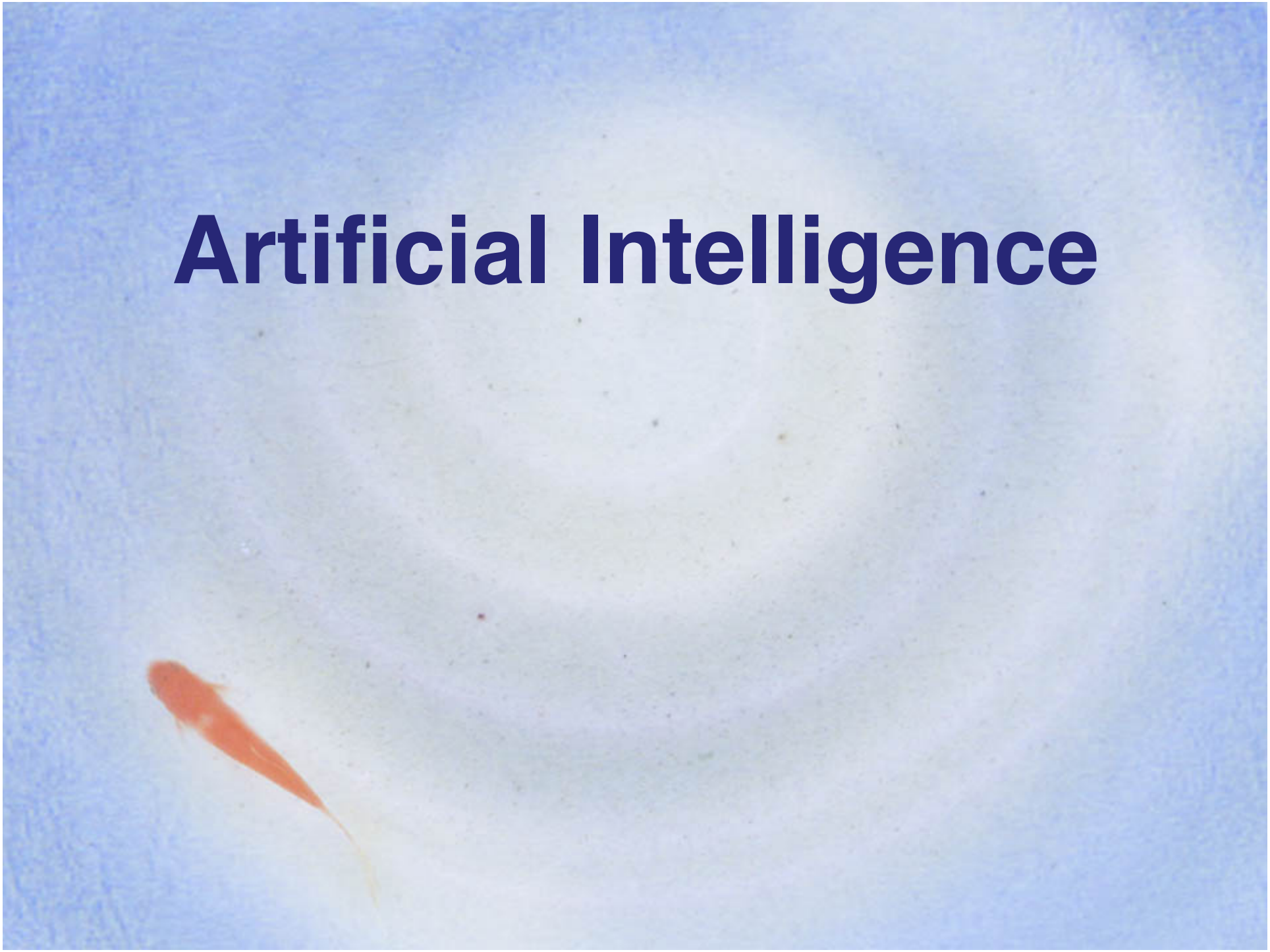
Artificial Intelligence



Artificial Intelligence

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

Readings

- Textbook:
  - S. Russel and P. Norvig: *Artificial Intelligence: A Modern Approach*. Prentice-Hall, Second edition.
- Reference books:
  - Ben Coppin: *Artificial Intelligence Illuminated*, Jones and Bartlett Publishers 2004.

AI Systems

- Thermostat
- Chess
- Autonomous car
- Google
- Asimo
- Vacuum cleaner

AI is everywhere

- Current trends:
  - IoT, Smart City
  - Industry 4.0
- Start-ups:
  - Bill Gates@Columbia University 2017: AI, Energy, Biotech

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?

- Artificial Intelligence is a science and a set of computational technologies that are inspired by—but typically operate quite differently from—the ways people use their nervous systems and bodies to sense, learn, reason, and take action.

What is AI?

Views of AI fall into four categories:

rationality vs. human (human are not perfect)

acting vs. thinking

Thinking humanly	Thinking rationally
Acting humanly	Acting rationally

Thinking humanly: cognitive modeling

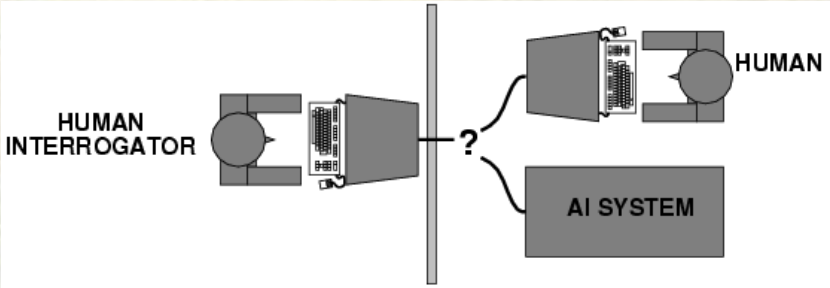
- Requires scientific theories of internal activities of the brain
  - Introspection
  - Psychological experiments
- -- How to validate? Requires

  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

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.
- Google DeepMind's AlphaGo defeated Lee Sedol in 2016.
- 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

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*40% + E*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.