Introduction to AI

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Course outline

Part I (FT)

- Fundamentals of search and planning in AI

- Resolution and unification and their use in automated reasoning

- Foundations of logic programming

- Rule-based systems for robotics

Part II (AR)

- Foundation of abductive logic programming with algorithms

- (Declarative) Answer Set Programming for real-world applications

- Satisfiability problem and algorithms for Sat-solving

Logistics

- one assessed coursework (pen and paper and Prolog)

- summer term exam (2/2 questions)

- Part I (FT)
  - Lectures + tutorials: Tuesdays 16:00-17:00 and Thursdays 9:00-11:00
  - Labs(mostly coursework Q&A): Tuesdays 17:00-18:00
  - **No** panopto recordings as they
    - hinder spontaneity (in both students and lecturers)
    - hinder interactions (amongst students and between lecturers and students
    - encourage rote learning
  - **Yes** Piazza
  - Slides complemented by reading material – integral part of course
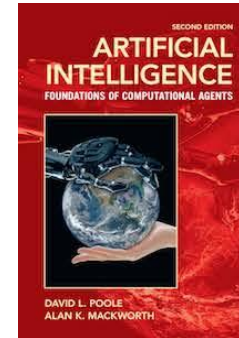
Reading material for the introductory lecture

Recommended reading:

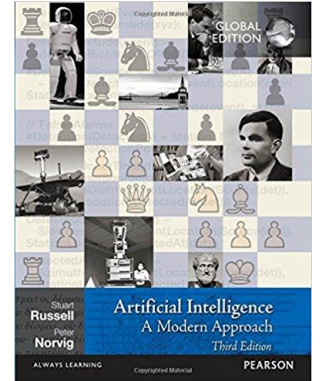Chapter 1
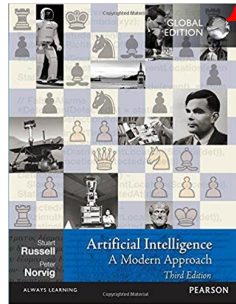
Additional reading:

Chapter 1

What is Artificial Intelligence?

Design and build systems that

	like humans	rationally
think	cognitive (neuro)science	logic
act	Turing test	agents

The Turing test

Answering questions correctly from standardized eighth-grade science tests is itself a test of machine intelligence.

BY CARISSA SCHOENICK, PETER CLARK, OYVIND TAFJORD, PETER TURNEY, AND OREN ETZIONI

Moving Beyond the Turing Test with the Allen AI Science Challenge

Assignment Project Exam Help

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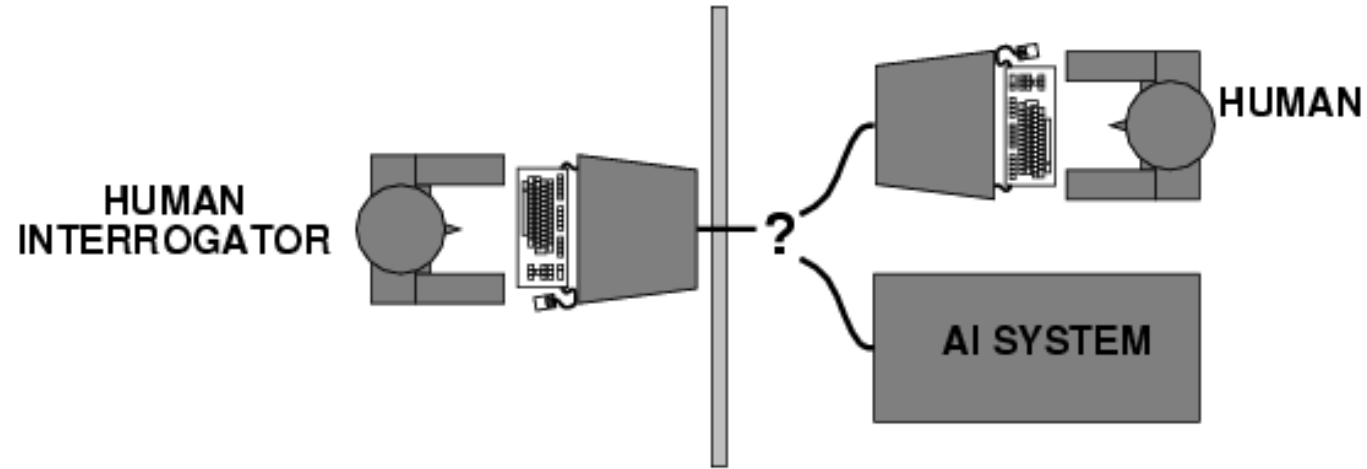
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captcha - Completely Automated Public Turing Test To Tell Computers and Humans Apart

6

Cognitive (neuro)science

scientific theories of internal activities of the brain

Predict and test behavior of human subjects

Link to neurological data

Logic - the study of *valid* arguments

1st meaning: valid chains of reasoning

- ✓ Every human is mortal, Socrates is human, therefore Socrates is mortal
- ✗ Every human is mortal, Socrates is human, therefore Socrates is blond
- ✓ No Martian is human, every human is mortal, therefore some mortal is not Martian
- ✓ Axioms of number theory hold, therefore √2 is irrational
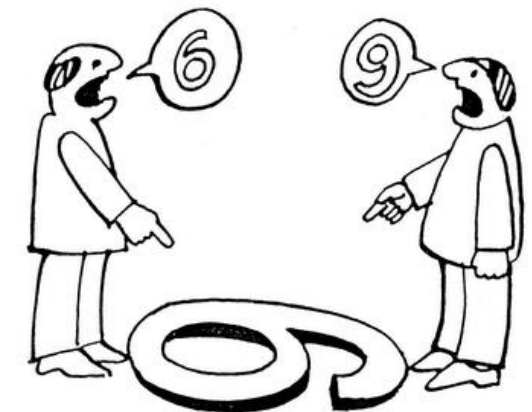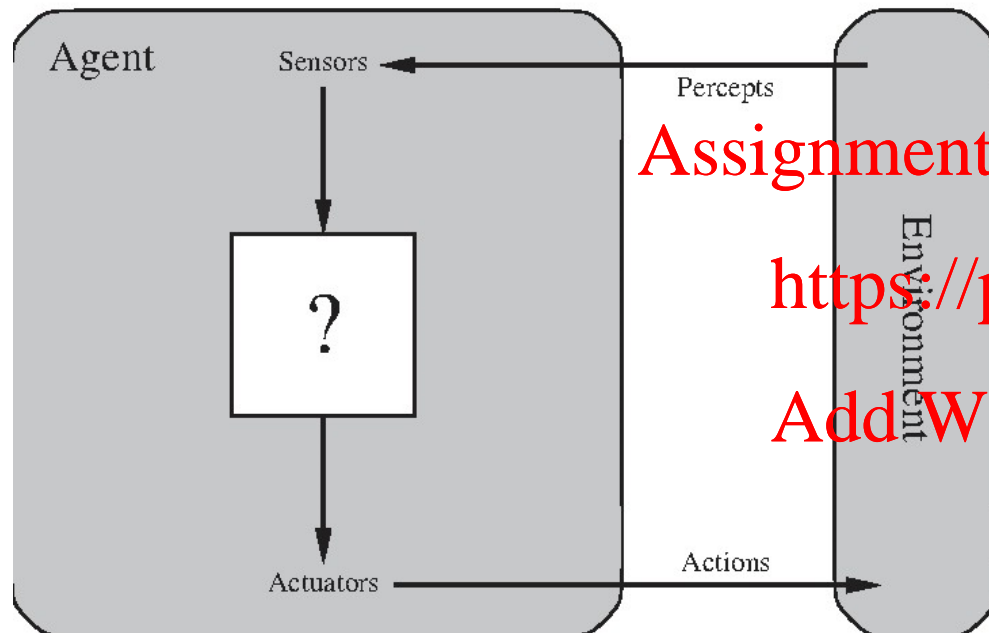
2nd meaning: valid disputes

There are two sides to every issue
(Protagoras 490 – 420 BC & Sophists 5th century BC)

Rational agents   (Doing the right thing)
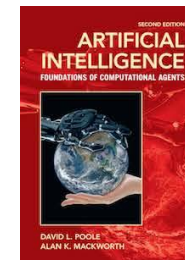

Agent

Sensors

Percepts

?

Actuators

Actions

Environment

offline | online

Prior Knowledge

Learner — KB → Inference Engine → Actions

Past Experiences/ Data

Goals/Preference   Abilities   Observations
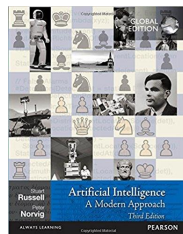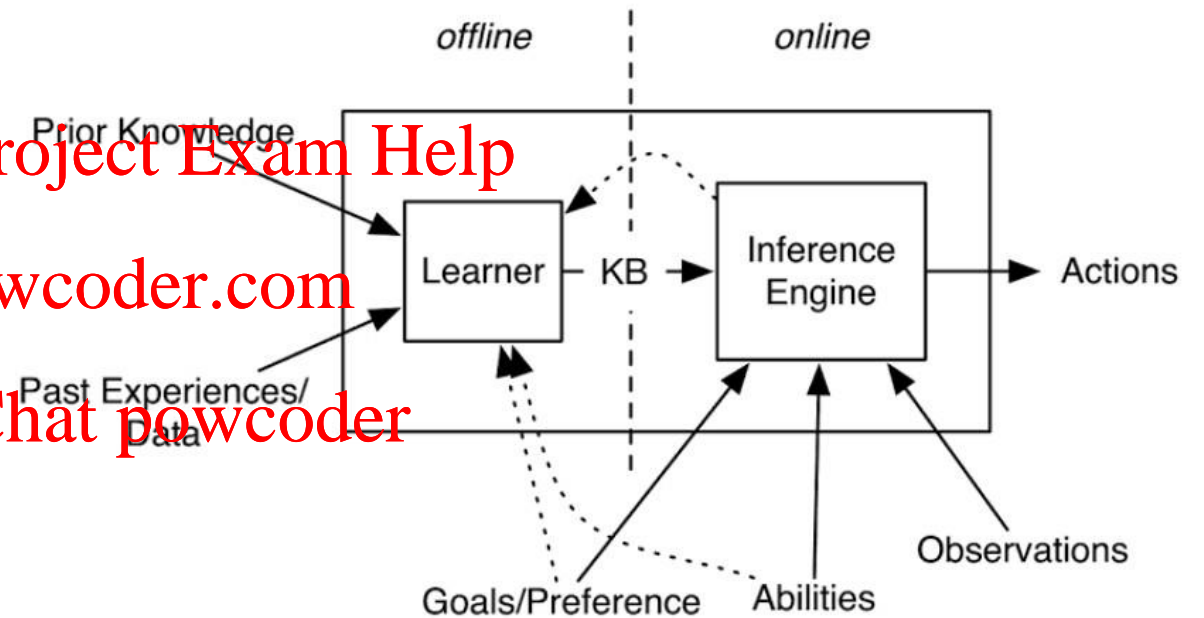
What is Artificial Intelligence?

"Intelligent" systems able to interact with /relate to humans
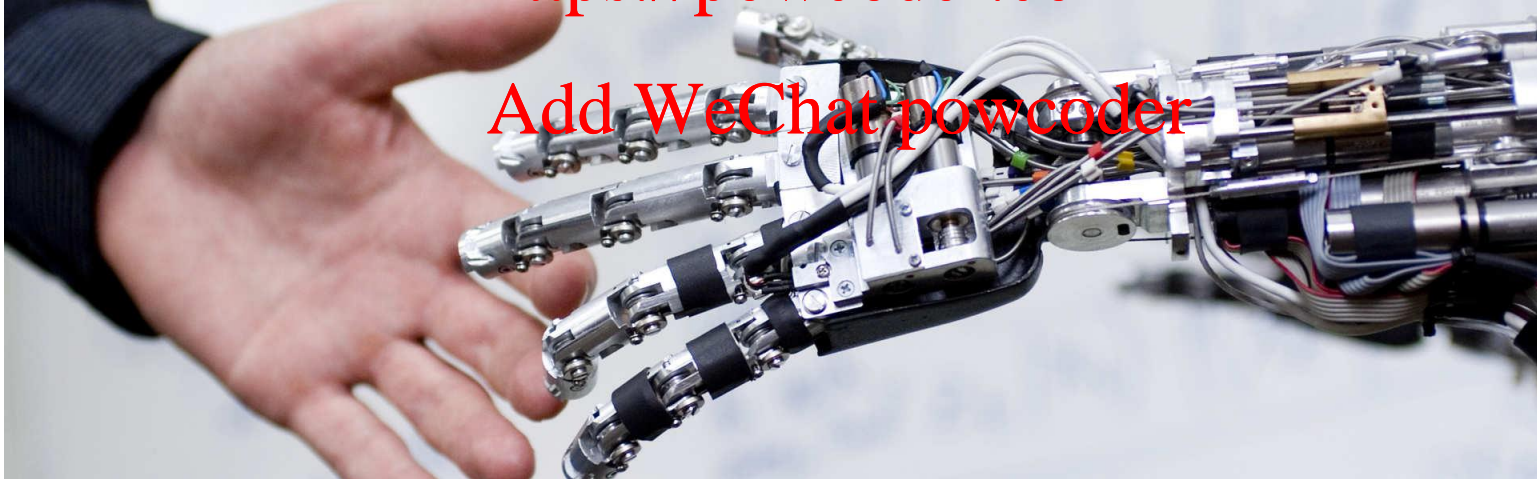
General Data Protection Regulation (GDPR)

"humanisation" of machine-generated decisions

What is Artificial Intelligence?

A collection/combination of methods & systems

- machine learning
- search
- planning
- knowledge representation
- reasoning
- constraint satisfaction
- natural language processing
- robotics and perception
- multiagent systems

27th International Joint Conference on AI
joint with the 23rd European Conference on AI

What is Artificial Intelligence?

- Automated reasoning and inference
- Case-based reasoning
- Cognitive aspects of AI
- Commonsense reasoning
- Constraint processing
- Heuristic search
- High-level computer vision
- Intelligent interfaces
- Intelligent robotics
- Knowledge representation
- Machine learning
- Multiagent systems
- Natural language processing
- Planning and theories of action
- Reasoning under uncertainty or imprecision

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Artificial Intelligence
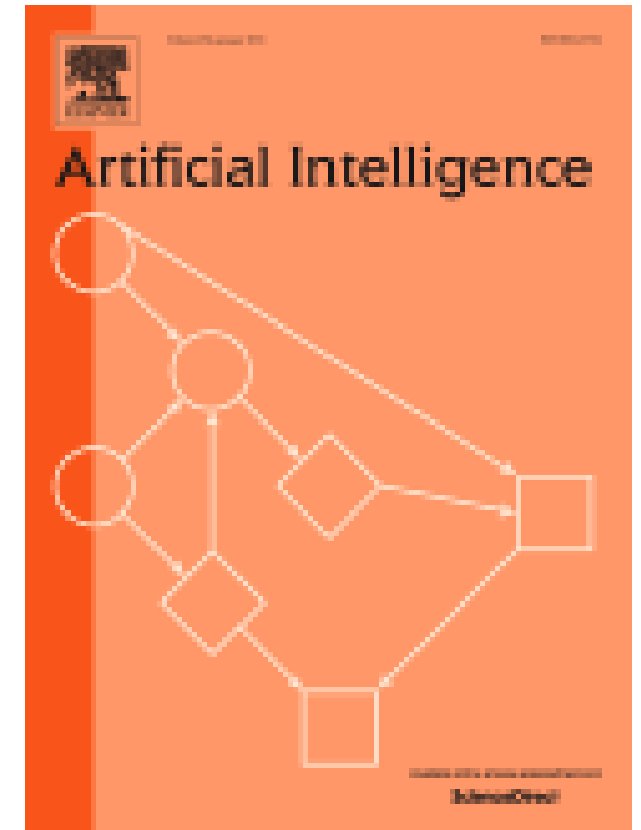
How did AI come about?

- "A logical calculus of the ideas immanent in nervous activity" McCulloch & Pitts **1943**:

  for any logical expression satisfying certain conditions, one can find a net behaving in the fashion it describes.

- "Computing Machinery and Intelligence" Turing **1950**:

  Can machines think?... I believe that at the end of the century the use of words and general educated opinion will have altered so much that one will be able to speak of machines thinking without expecting to be contradicted.

- Dartmouth summer research project on AI **1956**:

  how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves.

A partial abridged history of AI

- Newell and Simon (1956): discover proofs in propositional logic
- Wang (1960): prove every theorem in Principia Mathematica
- Samuel (1961): beat humans at checkers
- Minski (1952), Rosenblatt (1958): learning neural networks

- McCarthy, Hayes (1969): logical representations
- Minsky (1975): frames
- Expert systems (1970-80): DENDRAL (chemistry)+MYCIN (medicine)
- Logic-based reasoning (1970-80): Prolog
- Brookes (1987): Intelligence without representation
- Agents and multi-agent systems (1990-)

- NLP: STUDENT (Bobrow 1967), SHRDLU (Winograd 1972), CHAT-80 (Warren-Pereira 1982)...IBM Watson

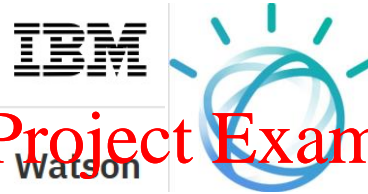- Semantic web (2001-)
- Deep neural networks (2006-)

What can AI do today?

Drive vehicles

Answer queries

Play (and win) games

Recognise faces

Recognise speech

vacuum clean

Translate across languages

Weak vs Strong AI

- Weak AI: technology leading to tools
  - Narrow focus
  - Specific domains

- Stong AI (Artificial General Intelligence):
  - general-purpose: consciousness? commonsense?
  - Ethics

Commonsense

Winograd "schema"

- The council refused demonstrators a permit as **they** feared violence
- The council refused demonstrators a permit a **they** advocated violence

- Easy for humans to map they to council and demonstrators respectively
- Grammar/statistical test will not help: commonsense is needed

Introduction - summary

AI

- What (several "definitions"/interpretations)

- What for (several uses/applications)