



Università di Parma

Dipartimento di Ingegneria e Architettura

Intelligenza Artificiale

A.A. 2023/2024

academic year: 2023-2024

Artificial Intelligence

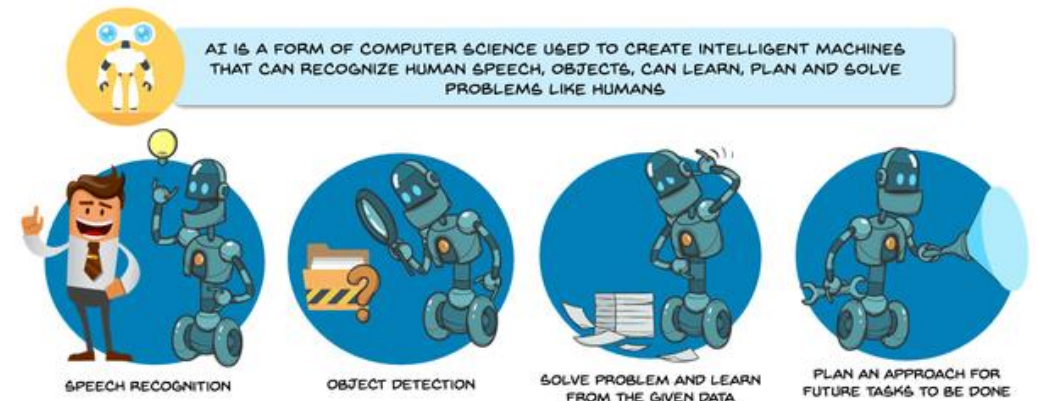
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Artificial Intelligence

The course aims to introduce

- the main techniques of Knowledge Representation
- the methodologies to formulate well-defined problems and solutions
- the management of (certain or uncertain) knowledge through logic and reasoning
- some aspects of Machine Learning and NLP





- ❑ Problem Formalization
 - And Solving Problems by Searching
- ❑ Notes of AI and Games
- ❑ Knowledge representation and Inference (reasoning)
 - First-Order Logic and inductive reasoning
 - Semantic network
 - Description logic
 - Knowledge Graph
- ❑ Uncertain Knowledge and Reasoning
 - Bayesian networks
 - Fuzzy logic
 - Decision Making Under Uncertainty
- ❑ Introduction on Reinforcement Learning
- ❑ Machine Learning
 - Learning from examples
 - Notes of NLP
- ❑ Deploying AI Applications
- ❑ XAI and ethical aspects

Artificial Intelligence



- ❑ Slides and teaching material :

<https://elly2023.dia.unipr.it/course/view.php?id=758>

- ❑ **Textbooks**

- Russell, Stuart J., and Peter Norvig. *Artificial intelligence: a modern approach*. Global Edition, 2021. (<http://aima.cs.berkeley.edu/>)
 - *Outdated versions are available on the internet*
- Chollet, F., et al. *Deep learning with Python*. New York: Manning, 2018.
[http://silverio.net.br/heitor/disciplinas/eeica/papers/Livros/\[Chollet\]-Deep_Learning_with_Python.pdf](http://silverio.net.br/heitor/disciplinas/eeica/papers/Livros/[Chollet]-Deep_Learning_with_Python.pdf)
- You can also take a look at the free online courses on the above topics offered at MIT
<https://ocw.mit.edu/index.htm>

Artificial Intelligence



The exam consists of

- A written test on the topics covered in class (*theory*)
 - *partial mid-course assessment*
 - *11 partial at the end of the course or during the first date of the exam- bonus*
 - *11 partial during the second/ third date of the exam - 0 bonus*
- A written report (and related oral presentation) on a supplementary work about some aspect of :
 - Knowledge and reasoning
 - Uncertain Knowledge
 - Learning knowledge by examples
 - XAI and ethical aspects of AI systems

Artificial Intelligence



Evaluation:

- The exam is passed if, in each of the two parts, the student reaches at least the sufficiency.
- The final mark is a weighted average trail score obtained in the written test (~70%) and the one obtained in the project work (~ 30%).
- Praise is given in case of achieving the highest score on all partials.

Related exams



- ❑ Nowadays, Python is the most popular language in AI
 - <http://tomamic.github.io/>
 - Python for data analysis NumPy, Pandas, PyPlotLib?

Machine learning

- ❑ The objective of this module is to provide students with the theoretical basis and practical knowledge of some relevant machine-learning and evolutionary computation algorithms, aimed at classifying data and data analytics methods. ...

Prof Cagnoni

Paradigmi e linguaggi per l'analisi dei dati

Prof. Tomaiuolo

AI : DEFINITIONS

Intelligence vs Artificial Intelligence



Problem (...mostly unresolved ...)

- Artificial Intelligence is a science :
 - that allows a machine to imitate a human also by modeling the biological and mental processes and behaviors?
 - which creates computational processes that obtain comparable or better results than those obtained by humans in activities considered typical of human intelligence?

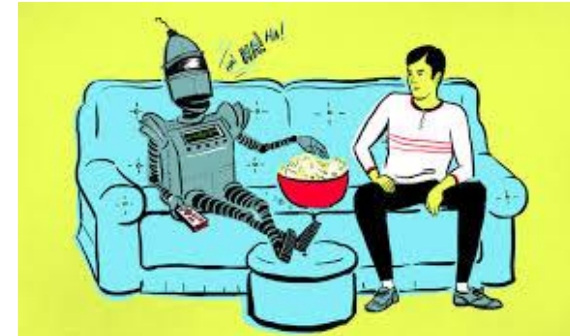
- In short:

performing the same actions

that a human being would

accomplish in the same context,

really puts the machine on the same level as the human being?



Artificial Intelligence

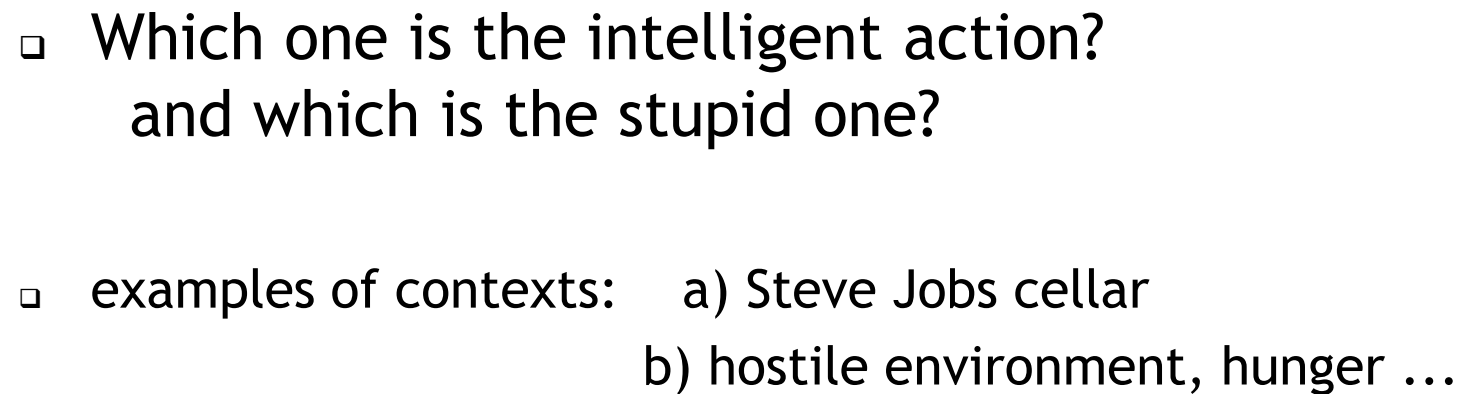


And again...

- Assuming that a machine can be considered intelligent according to one of the previous definitions

Intelligent = human?

- (that is, it does *exactly* the same thing a man would do, following the same processes to reach the decision)
- Imitating a stupid man is *Intelligence* even if Artificial?



Artificial Intelligence



And so....

Intelligent= rational?

- (that is, it does the right thing for the context in which it is at any moment)

Artificial Intelligence



Question :

The computer *can create* something that man would not be able to do?



<http://computationalcreativity.net/home/>

to model, simulate or replicate creativity to

- construct a program or computer capable of human-level creativity.

- better understand human creativity and to formulate an algorithmic perspective on creative behavior in humans.

- design programs that can enhance human creativity without necessarily being creative themselves.

<http://www.human-competitive.org/>

Human-Competitive Competition (HUMIES): prize awarded annually (in the evolutionary computing conference, GECCO) to the results of programs able to 'evolve' solutions that are at the level of the 'state of the art' .



Artificial Intelligence

from

<https://www.emailonacid.com/blog/article/industry-news/chatgpt-more-creative/>



Pure Imagination: Could ChatGPT Be More Creative Than You?

1. One of the most common definition: *Creativity is the ability to combine two or more seemingly disparate concepts to come up with a new idea or solution to a problem.*
2. *But originality could be defined as “undetected plagiarism”*

“For substantially, all ideas are secondhand, consciously and unconsciously drawn from a million outside sources, and daily use by the garnerer with a pride and satisfaction born of the superstition that he originated them.” ~ Mark Twain, Letter to Helen Keller, 1903

The way we are creative as humans isn't much different from how AI technology like ChatGPT works

Artificial Intelligence

from

<https://www.emailonacid.com/blog/article/industry-news/chatgpt-more-creative/>



- ❑ We learn things and have experiences, store them in our memories, and use them as fuel for creativity.
- ❑ Just like us, ChatGPT takes the data and information it has access to and uses that to answer questions or respond to prompts.
- ❑ Who are we to say that AI can't be creative if it's basically doing the same thing?

Artificial Intelligence



Kasey: Can you be creative?

ChatGPT: As an artificial intelligence language model, I am not capable of creativity in the same sense as humans are. However, I can generate unique and original text based on the patterns and information I have learned from my training data.

I can help you come up with creative ideas, suggest new ways of thinking, and provide you with inspiration for your projects or creative endeavors.

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- It's sort of funny how ChatGPT acts like a politician, dancing around questions like this:
- The response didn't indicate it was *not* creative, just that it's incapable of being creative "in the same sense as humans are."
- Instead, OpenAI wants you to view ChatGPT as a digital assistant that's ready to provide a helping hand when you hit a creative roadblock.
- So, in what ways can ChatGPT act creatively? (open-question)

Artificial Intelligence



From Wikipedia

- Generally we mean the ability of a computer to perform functions and reasoning typical of the human mind.
- In its purely IT aspects, it includes theories and techniques for the development of algorithms that allow machines (typically computers) to show an ability and/or intelligent activity, at least in specific domains.
- Currently one of the main problems is to give a formal definition of the synthetic (abstract) functions of reasoning, meta-reasoning and learning, typical of the human beings, to be able to build computational models which embody and implement them.

Artificial Intelligence



“[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+McDermott, 1985)
“The study of how to make computers do things at which, at the moment, people are better” (Rich+Knight, 1991)	“The branch of computer science that is concerned with the automation of intelligent behavior” (Luger+Stubblefield, 1993)

Thinking humanly	Thinking rationally
Acting humanly	Acting rationally

Thinking humanly: Cognitive Science



- ❑ 1960s «cognitive revolution»: information-processing psychologist replace prevailing orthodoxy of behaviorism
 - ❑ Requires scientific theories of internal activities of the brain
 - ❑ What level of abstraction? «knowledge» or «circuits»?
 - ❑ how to validate?
-
- ❑ Predicting and testing behaviour of human being?/Cognitive Science)
 - ❑ Or directly identification from neurological data (Cognitive Neuroscience)

Thinking rationally: Laws of thought



- ❑ ***Normative (prescriptive)*** rather than descriptive
- ❑ Aristotele: what are correct arguments/thought processed
- ❑ Greek logic: notation and rule of derivation for thought

- ❑ Problems:
- ❑ Not all intelligent behavior is mediated by logical deliberation
- ❑ What is the purpose of thinking?

Acting rationally



- ❑ ***Rational behavior: doing the right thing***
- ❑ Right thing: that which is expected to maximize goal achievement given the available information
- ❑ Doesn't necessarily involve thinking, but it should be in the service of rational action

Rational Agents



- An agent is an entity that perceives and act
- Abstractly, an agent is a function from percert histories to actions

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

- For any given class of environment an task we seek the agent with the best performance (that is the best program for given machine resources)

Rational Agents



- ❑ This general paradigm is so pervasive that we might call it the **standard model**.
- ❑ It prevails not only in AI, but also in:
 - ❑ control theory, where a controller minimizes a cost function;
 - ❑ in operations research, where a policy maximizes a sum of rewards;
 - ❑ in statistics, where a decision rule minimizes a loss function; and in economics, where a decision maker maximizes utility or some measure of social welfare.