Co-funded by the Erasmus+ Programme of the European Union

SOFIA UNIVERSITY "ST. KLIMENT OHRIDSKI" EST. 1888

ICT-TEX

ICT-TEX course on Digital skills

Topic 5: Introduction to Artificial Intelligence and Machine Learning

The course is developed under Erasmus+ Program Key Action 2:
Cooperation for innovation and the exchange of good practices Knowledge Alliance

ICT IN TEXTILE AND CLOTHING HIGHER EDUCATION AND BUSINESS

Project Nr. 612248-EPP-1-2019-1-BG-EPPKA2-KA

Co-funded by the
Erasmus+ Programme
of the European Union

SOFIA UNIVERSITY
"ST. KLIMENT OHRIDSKI
EST. 1888

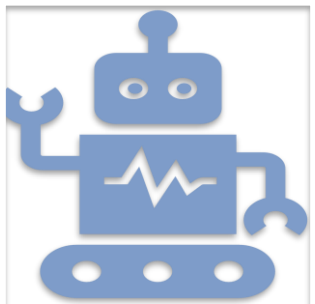
ICT-TEX

Contents

Outline

What is AI?

Where it can be applied?



How does it work?

Co-funded by the Erasmus+ Programme of the European Union

SOFIA UNIVERSITY "ST. KLIMENT OHRIDSKI" EST. 1888

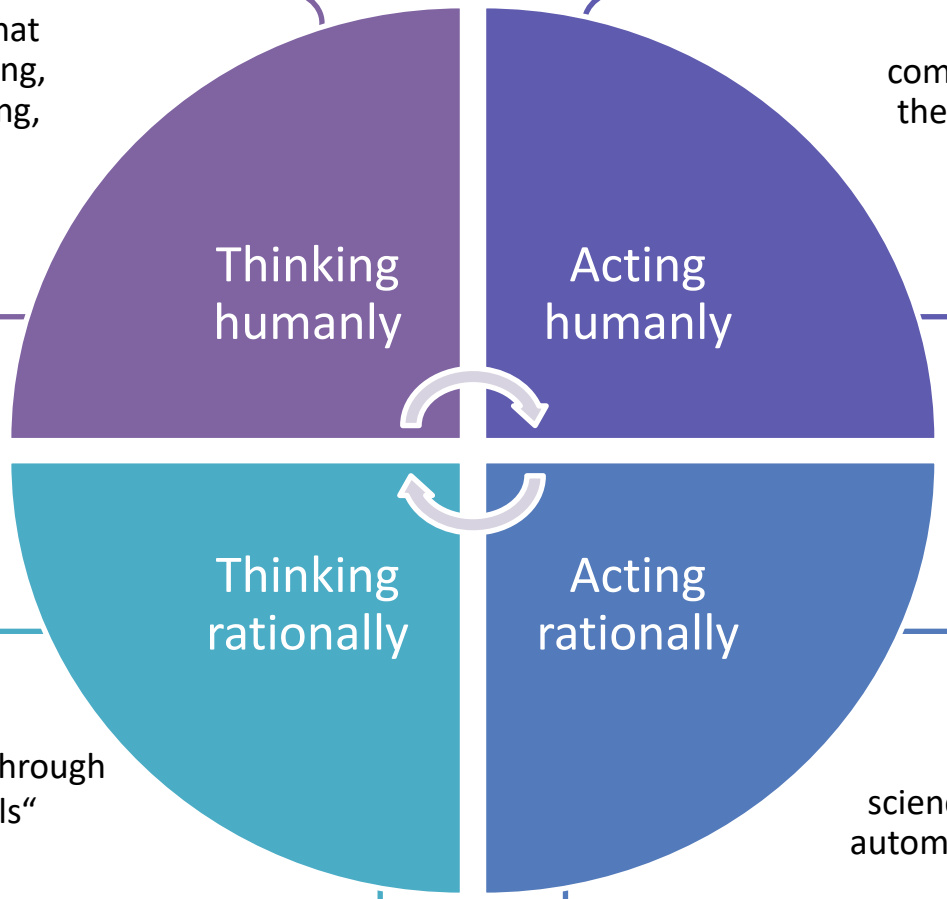
ICT-TEX

What is AI?

Strong AI

[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning …"
(Richard *Bellman* , *1978*))

"The study of how to make computers do things at which, at the moment, people are better"
(Rich+Knight, 1991)



"The study of mental faculties through the use of computational models"
(Charniak+McDermott, 1985)

"The branch of computer science that is concerned with the automation of intelligent behavior"
(Luger+Stubbleeld, 1993)

Weak AI

Strong AI

Strong AI refers to AI that exhibits human-level intelligence. So, it can understand, think, and act the same way a human might in any given situation. This is when a machine truly understands what is happening. There may even be emotions and creativity. For the most part, it is what we see in science fiction movies. This type of AI is also known as **Artificial General Intelligence (AGI)**. In theory, then, anything a human can do, a strong AI can do too.

Note that there are only a handful of companies that focus on this category, such as Google's DeepMind, the Human Brain Project and OpenAI.

Weak AI

Weak AI is both the most limited and the most common of the three types of AI. It's also known as narrow AI or **artificial narrow intelligence (ANI).** With this, a machine is pattern matching and usually focused on narrow tasks. The idea behind weak AI isn't to mimic or replicate human intelligence. Rather, it's to simulate human behavior.

Examples of this include Apple's Siri and Amazon's Alexa.

amazon alexa

Co-funded by the Erasmus+ Programme of the European Union

SOFIA UNIVERSITY "ST. KLIMENT OHRIDSKI" EST. 1888
ICT-TEX

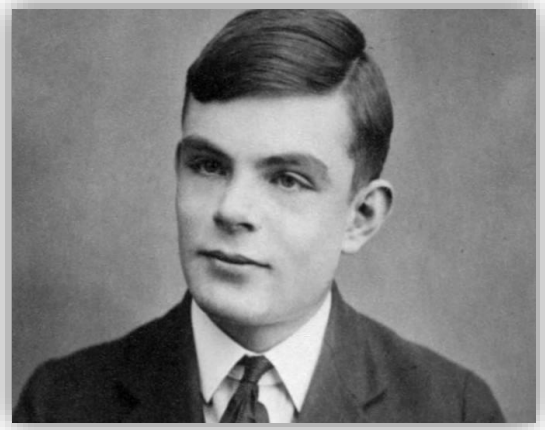
Super AI

Super AI is AI that surpasses human intelligence and ability. It's also known as **artificial superintelligence (ASI)** or superintelligence. It's the best at everything — maths, science, medicine, hobbies, you name it. Even the brightest human minds cannot come close to the abilities of super AI.

Of the types of AI, super AI is the one most people mean when they talk about ***robots taking over the world*****.**

Acting humanly: The Turing Test

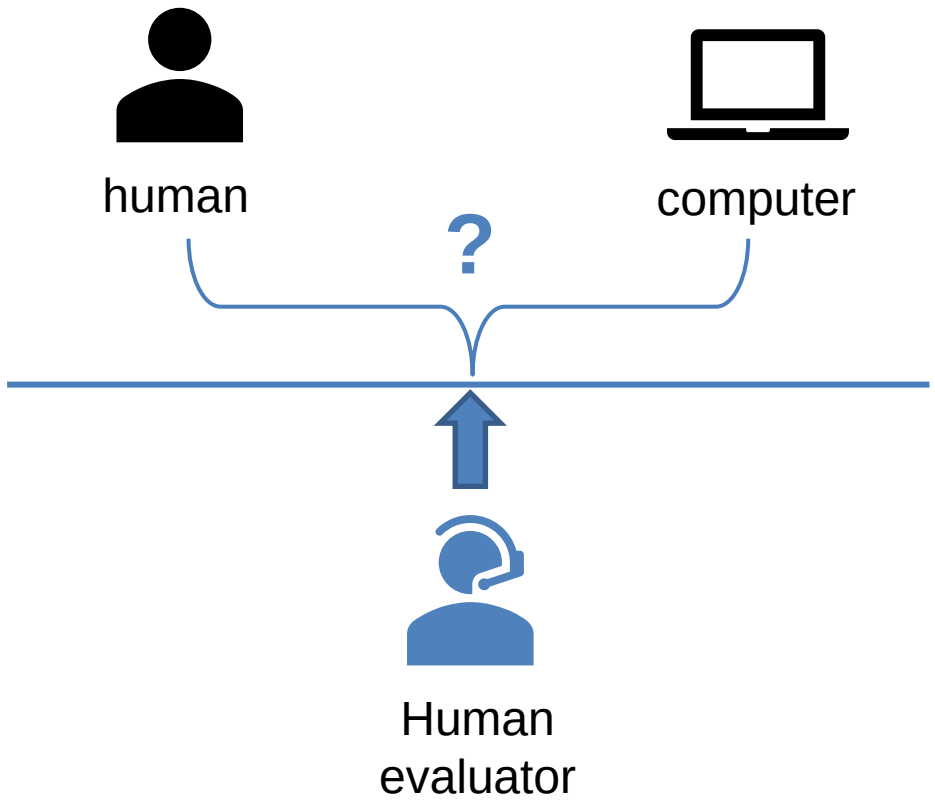
- The Turing Test, proposed by Alan Turing was designed to provide a satisfactory operational definition of intelligence. Turing defined intelligent behavior as the ability to achieve human-level performance in all cognitive tasks, sufficient to fool an interrogator. Roughly speaking, the test he proposed is that the computer should be interrogated by a human via a teletype, and passes the test if the interrogator cannot tell if there is a computer or a human at the other end.



Alan Turing (1912 – 1954)

Source: https://en.wikipedia.org/wiki/Alan_Turing#/media/File:Alan_Turing_Aged_16.jpg (Public domain)

Turing Test



- "Turing Test" is essentially a game with three players: two that are human and one that is a computer.
- The evaluator, a human, asks open-ended questions of the other two (one human, one computer) with the goal of determining which one is the human.
- If the evaluator cannot make a determination, then it is presumed that the computer is intelligent.

The Turing Test

- For now, programming a computer to pass the test provides plenty to work on. The computer would need to possess the following capabilities:
  - **natural language processing** to enable it to communicate successfully in English (or some other human language);
  - **knowledge representation** to store information provided before or during the interrogation;
  - **automated reasoning** to use the stored information to answer questions and to draw new conclusions;
  - **machine learning** to adapt to new circumstances and to detect and extrapolate patterns.

The Turing Test

- Turing's test deliberately avoided direct physical interaction between the interrogator and the computer, because physical simulation of a person is unnecessary for intelligence. However, the so-called total Turing Test includes a video signal so that the interrogator can test the subject's perceptual abilities, as well as the opportunity for the interrogator to pass physical objects "through the hatch." To pass the total Turing Test, the computer will need:
  - **computer vision** to perceive objects, and
  - **robotics** to move them about.

Thinking humanly: The cognitive modelling approach

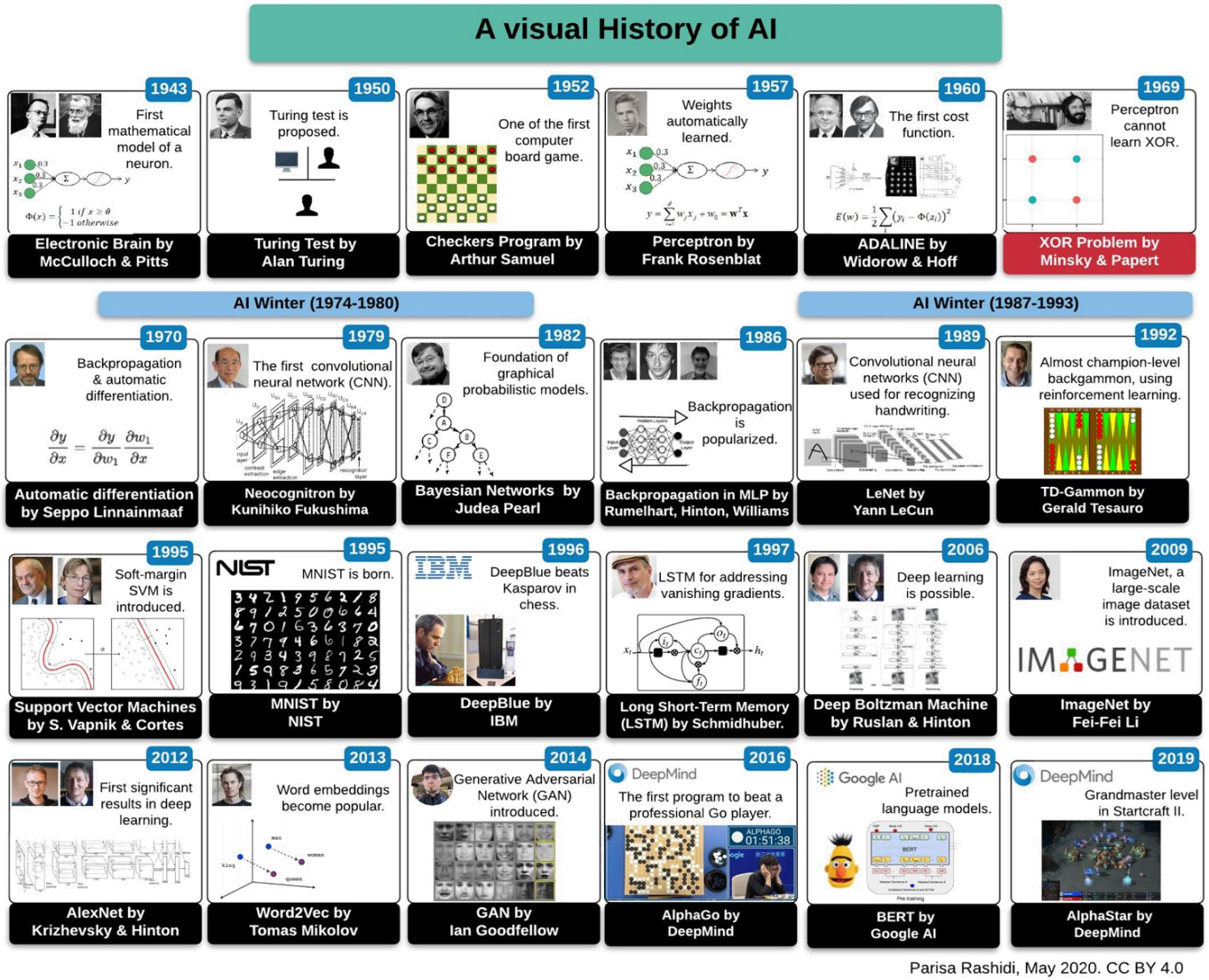
- Requires scientific theories of internal activities of the brain
- We need to get *inside* the actual workings of human minds.
- There are two ways to do this:
  - through introspection--trying to catch our own thoughts as they go by
  - through psychological experiments
- The interdisciplinary field of **cognitive science** brings together computer models from AI and experimental techniques from psychology to try to construct precise and testable theories of the workings of the human mind.

Thinking rationally: The laws of thought approach

- Normative (or prescriptive) rather than descriptive
- 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

Acting rationally

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



Source: https://twitter.com/Parisa__Rashidi/status/1264724313560592385/photo/1

Symbolic AI

- Rule-Based Systems

Connectionist AI

- Neural Networks

Evolutionary AI

- Genetic Algorithms

Molecular AI

- DNA Computing

Big Data

Capability to process massive amount of structured and unstructured data which can change constantly

Reasoning

Ability to reason (deductive or inductive) and to draw inferences based to the situation. Context driven awareness of the system

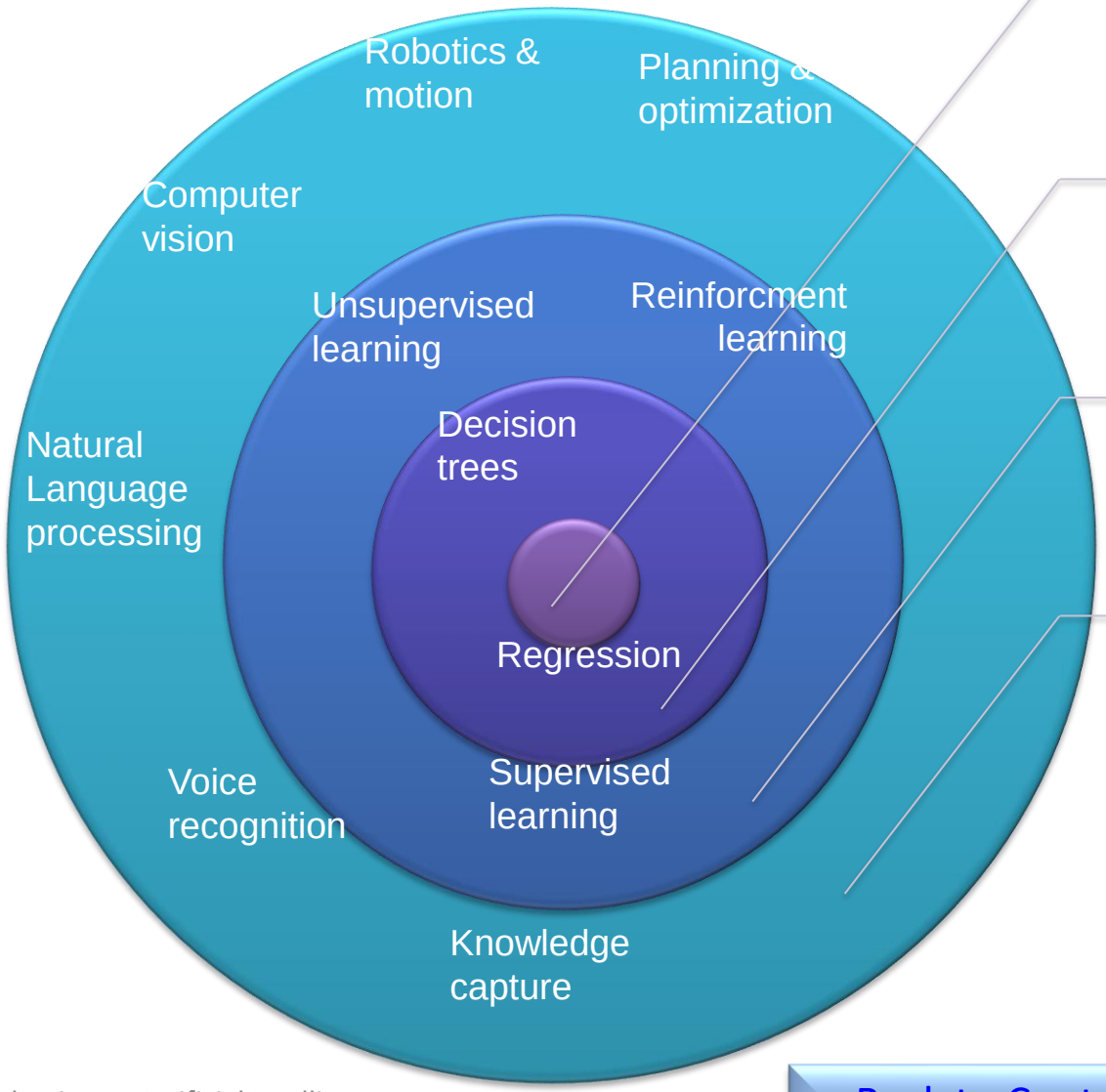
Learning

Ability to learn, based on historical patterns, expert input and feedback loop

Problem solving

Capability to analyze and solve complex problems to special purpose and general-purpose domain

Adopted version from the source: https://www2.deloitte.com/nl/nl/pages/data-analytics/articles/part-1-artificial-intelligence-defined.html



Technologies

- Technical enablement

Methods

- Ability to reason

Machine Learning

- Ability to learn

Artificial Intelligence

- Ability to sense, reason, engage and learn

Adopted version from the source: https://www2.deloitte.com/nl/nl/pages/data-analytics/articles/part-1-artificial-intelligence-defined.html

Essential techniques

Problem-solving

- Searching in the State Space
- Constraint Satisfaction Problem
- Genetic Algorithms

Knowledge, reasoning, and planning

- Knowledge Representation
- First Order Logic
- Planning

Uncertain knowledge and reasoning

- Probabilistic Reasoning
- Decision Support Systems

Machine Learning

- Unsupervised Learning
- Supervised Learning
- Reinforcement Learning

Communicating, perceiving, and acting

- Natural Language Processing
- Deep Learning
- Computer Vision
- Robotics

For the best experience with this topic, it is also recommended to go through the hands-on case studies, included in the "Additional resources" section in the course page on ICT-TEX platform.

References

- Stuart Russel & Peter Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, 2016, http://aima.cs.berkeley.edu/
- Taulli, Tom. *Artificial intelligence basics. A non-technical introduction*. Apress, 2019.
- Elements of AI: https://www.elementsofai.com/
- Types of AI: distinguishing between weak, strong, and super AI, https://www.thinkautomation.com/bots-and-ai/types-of-ai-distinguishing-between-weak-strong-and-super-ai/

- Illustrations: License: Free for https://pixabay.com/
  - commercial use; No attribution required

CONTACTS

Coordinator:
Technical University of Sofia

Project coordinator:
assoc. prof. Angel Terziev, PhD
aterziev@tu-sofia.bg

Web-site: ICT-TEX.eu

Author:
Assoc. Professor Svetla Boytcheva
Institute of Information and Communication Technologies,
Bulgarian Academy of Sciences

Co-funded by the
Erasmus+ Programme
of the European Union

KNOWLEDGE ALLIANCE
ICT-TEX
ICT IN TEXTILE AND CLOTHING
HIGHER EDUCATION AND BUSINESS