# ARTIFICIAL INTELLIGENCE

**EDITORS: Potes Barbas, Maria; Teles Vieira, Andreia**

**Koceski, S.; Koceska, N.; Potes Barbas, M.; Teles Vieira, A.; Marques, A.; Madeira, F.; Torres. A.; Ferreira, B.; Rodrigues, D.; Vinhal, G.; Elias, G.; Rendeiro, Costa, M.; (2024)**

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# Editor introduction

**Maria Potes Barbas**, Polo Literacia Digital e inclusão Social, CIAC, Instituto Politécnico de Santarém

Artificial Intelligence (AI) is a rapidly evolving field within computer science that aims to develop systems capable of performing tasks typically requiring human intelligence.

On that note, this handbook is divided into 5 parts. The first part in an Introduction to AI, some historical milestones, types of AI among other themes, the second part is the integration of Artificial Intelligence in Higher Education: an overview that includes the perspectives from the teacher's side and the student's side. The third part is focused on AI and Crypto for an Ethical, Decentralized Cyberspace. The fourth part is Introduction to AI from the eye of an academic professor, and last but not least we have the student's perspective on AI and it refers to a collaborative work with students of the Bachelor's Degree in Multimedia Production in Education and their vision on AI.

The main goal of this handbook is, to provide comprehensive and accessible information on Artificial Intelligence with a specific focus on educating students and academics. It is also a collaborative work between Portugal and North of Macedonia and their contributions to enhance Artificial Intelligence.

# 01. Introduction to AI

**Artur Marques** | Instituto Politécnico de Santarém Escola Superior de Gestão e Tecnologia de Santarém, Portugal.

## An Introduction to Artificial Intelligence

Artificial Intelligence (AI) is a rapidly evolving field within computer science that aims to develop systems capable of performing tasks typically requiring human intelligence.

Artificial Intelligence, a branch of Computer Science, is ubiquitous in modern technology. From web searches to generative systems and games, AI's presence is felt across various domains.

AI involves multiple definitions, complicating regulation and standardization. John McCarthy, in 1955, described AI as the development of machines that behave intelligently. Broadly, intelligence in AI can be summarized as the ability to perceive, analyze, and react appropriately.

## Historical Milestones

The Dartmouth Workshop

The Dartmouth College workshop in 1956 is often considered AI's birthplace. Organized by John McCarthy, Marvin Minsky, Nathaniel Rochester, and Claude Shannon, the workshop aimed to explore the potential for machines to simulate all aspects of learning and intelligence. Key participants included Ray Solomonoff, Oliver Selfridge, Trenchard More, Arthur Samuel, Allen Newell, and Herbert A. Simon.

## The Turing Test

Alan Turing proposed the Turing Test in 1950 to answer the question, "Can machines think?" The test involves a human interrogator interacting with a human and a machine via a text interface. If the interrogator cannot reliably distinguish the machine from the human, the machine is considered intelligent.

## Approaches to AI

Symbolists

Symbolists, like Marvin Minsky and John McCarthy, view intelligence as symbol manipulation. Their approach, known as Good Old-Fashioned AI (GOFAI), relies on logic and philosophy.

Connectionists

Connectionists, including Geoffrey Hinton, Yann LeCun, and Yoshua Bengio, draw inspiration from the structure and function of biological brains, employing artificial neural networks.

Evolutionaries

Inspired by biological evolution, researchers like John Holland use genetic algorithms to develop intelligent behavior.

Bayesians

Bayesians, such as Judea Pearl, use Bayesian statistics and probability to model and predict intelligent behavior.

Analogizers

Analogizers, represented by Douglas Hofstadter, focus on finding similarities between examples to develop intelligent systems.

## The Brain, Body, and Mind

Understanding AI involves parallels with human brain functions. The brain can be divided into the brainstem, midbrain, limbic system, and neocortex, each contributing to various levels of intelligence from basic survival to higher-level thoughts.

AI systems process data to derive information, cognition, knowledge, and ultimately intelligence. This involves extracting patterns, understanding, and making inferences.

## Types of AI

Narrow AI is problem-specific, utilizing techniques like logic-based AI, search algorithms, heuristics, knowledge representation, and genetic programming.

General AI encompasses broader capabilities, including machine vision, machine learning, natural language processing, and artificial creativity.

## Building Intelligent Agents

Human cognitive theories such as Dual-Process Theory and Multiple Intelligences Theory inform the development of AI. These theories highlight different types of intelligence and memory hierarchies.

AI agents aim for rational behavior, following rules and logical implications to achieve desirable outcomes.

The General Problem Solver, developed in 1959, was an early AI system using high-level representations of problems and logic-based methods. While successful in solving mathematical theorems, it struggled with real-world problems.

Artificial Intelligence continues to evolve, drawing from various interdisciplinary approaches to mimic and surpass human intelligence. Understanding its foundational concepts and historical context is essential for appreciating its potential and addressing its challenges.

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# 02. The Integration of Artificial Intelligence in Higher Education: An Overview

**Natasa Koceska, Saso Koceski, Maria Potes Barbas**

Faculty of Computer Science, Goce Delcev University, Stip, North Macedonia
Instituto Politécnico de Santarém Escola Superior de Educação de Santarém, Portugal.

The higher education sector has undergone a significant transformation over the last decade, largely driven by the influence of AI [1]. Furthermore, the immense potential of AI and especially generative AI, may help, if properly used, to completely transform various aspects of higher education systems, including admissions, administration, teaching methodologies, evaluation, assessment, library management, and training and placements. This will affect various stakeholders in the higher education starting from students and teachers, through universities management and administration up to policy makers.

## Role of AI in higher education – Teachers' perspective

Automating administrative tasks

Besides teaching and research, university teachers are performing myriads of routine administrative tasks such as preparation of assessment papers, performing the assessment, proctoring exams, detecting plagiarism and many more. All these activities and their quality is considered essential for the stakeholders in the education systems, but on the other side they are often perceived as tedious and time-consuming, requiring significant effort and manpower to complete effectively [2, 3].
In this context, recent advancements in AI offer an array of tools and systems that can be a valuable asset to handle these tasks, allowing university teachers to take on a supervisory role.

AI-powered systems can efficiently handle routine administrative tasks such as attendance tracking, grade recording, and schedule management, ensuring accuracy and saving time. For instance, automated attendance systems using facial recognition technology can quickly and accurately record student attendance, eliminating the need for manual roll calls [4].

For the purpose of various assessments university teachers are often constrained to prepare multiple sets of question papers. AI-powered software could eventually generate entire question banks based on specified criteria, with teachers only needing to validate the content. Additionally, machine learning can be used to adjust the difficulty level of questions for future exams based on students' performance [5, 6].

AI-driven assessment tools are revolutionizing how educators design and grade exams. Automated grading systems, such as Gradescope and Socrative, utilize machine learning algorithms to evaluate student responses with remarkable speed and accuracy. These systems can handle a variety of question formats, including multiple-choice, short answer, and even essay-type questions. By analyzing patterns in student responses, these tools can provide instant

feedback, helping students understand their mistakes and learn more effectively. Furthermore, AI can ensure consistency and objectivity in grading, reducing potential biases that may arise from human evaluators [7].

AI tools are also enhancing the quality of feedback provided to students. Platforms like Turnitin Feedback Studio and Edmentum offer detailed, personalized feedback on student submissions, identifying areas for improvement and suggesting specific actions to enhance their performance [8].

The advent of AI in proctoring has addressed many challenges associated with maintaining academic integrity during remote examinations. AI-powered proctoring tools, such as ProctorU and Examity [9], monitor students during exams using a combination of facial recognition, eye tracking, and behavioral analysis. These tools can detect suspicious activities, such as looking away from the screen, using unauthorized devices, or receiving external help, and alert human proctors to potential instances of academic dishonesty. By providing a secure and reliable examination environment, AI proctoring tools have made remote assessments more viable and trustworthy.

## Enhancing Communication and Coordination

AI can also enhance communication and coordination between teachers, students, and administrative staff. AI-powered chatbots and virtual assistants can handle common inquiries from students regarding course schedules, deadlines, and administrative procedures. These AI tools can provide instant responses, freeing up teachers' time and ensuring that students receive accurate information promptly. For example, a virtual assistant can automatically respond to frequently asked questions about assignment deadlines or exam dates, reducing the volume of emails teachers need to address [10].

Moreover, AI can facilitate better coordination of schedules and resources. University teachers often juggle multiple classes, meetings, and research commitments. AI-driven scheduling tools can optimize timetables, ensuring that there are no conflicts and that resources such as classrooms and equipment are efficiently allocated. This level of coordination helps teachers manage their time more effectively and focus on their core responsibilities.

## Streamlining Course Management

Course management involves a myriad of tasks, from creating syllabi to updating course materials and monitoring student progress. AI can significantly streamline these processes. For instance, AI can assist in syllabus creation by providing templates and suggesting content based on the course objectives and past syllabi. It can also help update course materials by automatically incorporating the latest research and developments in the field.

AI-powered learning management systems (LMS) can monitor student engagement and performance in real time. These systems can track which materials students are accessing and how much time they are spending on different activities, providing valuable insights into student behavior and engagement. Teachers can use this data to identify students who may be struggling and intervene early, offering additional support or adjusting the course content to better meet student needs [11].

## Improving Assessment and Feedback

Assessment and feedback are critical components of the educational process, but they can be time-consuming. AI can assist by providing more efficient and detailed assessments. For example, AI-driven assessment tools can analyze student writing for grammar, style, and coherence, offering instant feedback. While these tools do not replace the nuanced feedback that a human teacher can provide, they can handle preliminary evaluations, allowing teachers to focus on more complex aspects of student work [12].

Additionally, AI can track student performance over time, identifying patterns and trends that may not be immediately apparent. This longitudinal analysis can help teachers understand the effectiveness of their teaching methods and make data-driven adjustments to their courses. By providing detailed analytics on student performance, AI enables teachers to offer more targeted and effective feedback, enhancing the overall learning experience.

## Facilitating Research and Professional Development

Beyond administrative tasks, AI can support university teachers in their research and professional development. AI-powered research tools can automate literature reviews, identify relevant papers, and suggest potential research collaborators based on publication data and research interests. This can significantly speed up the research process and help teachers stay up-to-date with the latest developments in their field.

### Utilizing AI for Research Planning and Study Design

AI-powered experimental design tools leverage machine learning algorithms to optimize various parameters, significantly streamlining the experimental design process. This automation can help researchers save time and effort in designing studies, allowing them to focus more on data analysis and interpretation. Additionally, these AI tools can reduce human errors and lower research and development costs.

For effective use of AI tools in creating experimental design models, researchers must ensure that these models account for a wide range of variables and parameters. By inputting specific criteria, researchers can generate optimal designs that enhance the effectiveness of their studies.

### Utilizing AI Tools for Acquiring Research Knowledge and Conducting Literature Reviews

AI-powered research tools, such as Semantic Scholar, Enago Read, Connected Papers, Scite, EndNote, and Mendeley, can significantly enhance the efficiency of reading, annotating, and note-taking. These tools provide users with excerpts from literature sources, highlighting the most relevant information to help determine whether an article is worth reading [13].

These tools allow users to quickly locate pertinent information within research articles, identify key paragraphs for in-depth reading, and compile comprehensive notes on the subject matter.

For the most effective use of AI-powered tools in research, users should critically assess the AI-generated output and read the original texts rather than solely relying on AI

summaries. This approach ensures a deeper understanding and accuracy in interpreting the literature.

### Utilizing AI for Peer Review Assistance

The volume of submissions for peer review continues to grow, necessitating efficient screening and reviewing processes to save valuable working hours and enhance academic productivity. AI-powered peer review tools offer the potential for semi-automated systems where studies of potentially lower quality or controversial nature can be flagged, and reviewers can be matched based on their subject-matter expertise.

While AI cannot replace peer review entirely, AI tools play a crucial role in suggesting suitable journals for articles, conducting initial quality checks for submitted manuscripts, and identifying potential reviewers. Existing platforms like Publons, Review Wizard, and Manuscript Matcher, streamline the peer review workflow by automating routine tasks and facilitating better reviewer-article matches based on content relevance and expertise [14].

### AI for Academic Writing

In academic writing, synthesizing complex information from multiple sources and integrating original ideas is crucial. Effective note-taking systems that track source information and prevent plagiarism are essential for this process.

AI-powered tools, such as Grammarly, QuillBot and Copyscape, not only assist in organizing notes relevant to writing but also aid researchers in composing articles effectively. These tools can help researchers paraphrase sentences from their notes, which is particularly beneficial for scholars from non-English speaking backgrounds.

To maximize the effectiveness of AI tools in academic writing, researchers should not rely solely on AI for note-taking or writing tasks. Instead, they should ethically integrate AI-generated paraphrased content into their work by reformulating it rather than directly copying it. This approach promotes originality and ensures that the scholarly integrity of their writing is maintained [15].

Furthermore, AI can assist in professional development by recommending relevant courses, workshops, and conferences based on teachers' interests and career goals. Personalized learning platforms can provide tailored recommendations, helping teachers acquire new skills and knowledge that enhance their teaching and research capabilities.

## Role of AI in higher education – Students’ perspective

Immersive Learning Environments

AI is revolutionizing education by creating immersive and interactive learning environments. Artificial intelligence powers virtual reality (VR) and augmented reality (AR) technologies, allowing students to engage with educational content in previously unimaginable ways. From exploring historical landmarks in a virtual world to conducting virtual experiments in simulated

laboratories, these technologies enhance student engagement and deepen their understanding of complex concepts [16, 17].

Personalized Learning

AI enables the creation of personalized learning experiences by analyzing individual student data to customize educational content. Adaptive learning platforms like Coursera and EdX utilize AI algorithms to recommend courses based on a student's past performance and interests, enhancing engagement and learning efficiency [18].

Moreover, incorporating AI translators in digital classrooms enables automatic text and language translation, providing students with study materials in their native language. This approach effectively bridges language and communication gaps, enhancing accessibility and comprehension for all students.

Intelligent Tutoring Systems

Intelligent Tutoring Systems (ITS) offer personalized instruction and feedback, simulating one-on-one tutoring. For instance, Carnegie Learning's MATHia and IBM's Watson Tutor adapt to a student's learning pace and style, providing tailored guidance that improves understanding and retention of complex concepts [12].

Enhanced Collaboration and Immediate Feedback

AI-powered educational assistants, such as chatbots and virtual tutors, offer significant support to both students and teachers. Equipped with natural language processing capabilities, these AI tools can answer student questions, provide guidance on assignments, and facilitate peer-to-peer collaboration. These virtual assistants complement traditional teaching methods by offering personalized assistance around the clock, meeting the diverse needs of students and enhancing their learning experience.

Education for Students with Learning Disabilities

Students with learning disabilities often struggle with complex sentences and idioms in texts. In a typical classroom setting with a lot of students, it can be challenging for educators to tailor their teaching styles to meet the needs of each student, especially those with learning disabilities, and provide the necessary time, attention, and instructions [19].

AI holds significant potential to enhance the learning experience for students with disabilities. By simplifying complex texts into more understandable sentences, AI helps these students better comprehend and engage with the material. Additionally, adaptive learning systems, multimedia learning tools, and educational games can further enrich their learning experience, making education more accessible and effective for all students.

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# 03. AI and Crypto for an Ethical, Decentralized Cyberspace

**Dário Rodrigues** | Instituto Politécnico de Santarém Escola Superior de Gestão e Tecnologia de Santarém, Portugal.

## Artificial Intelligence and Digital Abundance

Artificial Intelligence (AI) excels at digital abundance by generating, analyzing, and distributing vast amounts of data quickly and efficiently. This capability allows AI to process large datasets, identify patterns, and develop new insights, solutions, or content at an unprecedented scale. Consequently, AI contributes to abundant digital resources, fostering innovations and advancements across various fields.

## Cryptography and Digital Scarcity

Cryptography, especially in blockchain technology, excels at digital scarcity by creating a limited, verifiable, and trustworthy set of data or assets. Blockchain technology ensures data security, immutability, and transparency through cryptographic methods. By automating trust and verifying transactions or records in a decentralized manner, blockchain prevents duplication and ensures authenticity. This trustworthiness is crucial for applications like cryptocurrencies, where the scarcity of tokens is essential to their value.

## Synthesis of Concepts

By combining these ideas, AI and blockchain complement each other.

> **AI** drives information's rapid creation and dissemination, contributing to abundant digital assets and insights.
>
> **Blockchain** ensures that within this abundance, there are elements of scarcity that can be trusted and verified, maintaining integrity and value.

Integrating AI's capacity for creating and handling abundant data with blockchain's ability to secure and authenticate data can lead to robust, balanced digital ecosystems. These ecosystems leverage both technologies' strengths to foster innovation while ensuring trust, reliability, and inclusion.

## Ethics on the Internet of Knowledge

The emergence of a blockchain-powered "Internet of Value" and an AI-powered "Internet of Knowledge" pave the way for a transformative ethical evolution. Integrating AI and blockchain unleashes data availability and reliability. Blockchain automates and distributes data's trustworthiness, while AI accelerates and distributes data-based computational reasoning.

Explainable Artificial Intelligence (XAI) can synergize with blockchain and other Decentralized Ledger Technologies (DLT). XAI refers to AI methods that provide clear, understandable insights into how they make decisions. Such interpretability and explainability are crucial for transparency. XAI involves designing AI algorithms, models, and data that are openly available for scrutiny to enable explanations of outputs or decisions. Measures for achieving a trustworthy AI include verified data sources, robust model development, data security, audits, transparency, and blockchain integration. This integration fosters trust and accountability, helps detect biases, and evaluates misuse risks, promoting transparency in AI's societal interactions.

## Ethical Impact of AI and Blockchain Integration

Integrating AI and blockchain holds significant potential for enhancing ethics in cyberspace. Key elements include:

- **Privacy:** AI systems handle vast amounts of personal data, raising concerns about data usage and potential surveillance. The principles of openness and transparency play a significant role in addressing these dilemmas, protecting privacy, and ensuring responsible data practices. Combining advanced cryptographic techniques like homomorphic encryption and zero-knowledge proofs (ZKP) with AI can balance personal privacy with proof of ownership, creating an environment ripe for ethical innovation.
- **Property Rights:** Blockchain's decentralized consensus mechanisms align with democratic principles to measure authority and credibility through popular validation. Blockchain's immutable data-stamped records ensure secure verification of transactions and data exchanges, decentralizing property rights' establishment and tracking and providing a foundation for trust in AI systems.
- **Content Precision:** Making AI's decision-making processes interpretable, explainable, and verifiable can help fight misinformation. Blockchain's immutable and transparent nature ensures the authenticity and accuracy of stored data, offering a reliable foundation for AI systems and mitigating the propagation of fake news and disinformation.
- **Access to Knowledge:** The centralization and opacity of AI algorithms raise concerns about unequal access to knowledge, which can worsen social imbalances and economic inequalities. Openness, transparency, and decentralization can be ethically paramount. Blockchain provides security, integrity, and traceability, while XAI promotes interpretability and explainability, enhancing access to trustworthy online resources.

## Integrating AI and Blockchain for an Inclusive Digital Future

A key outcome of integrating AI and blockchain is the promotion of inclusion. By decentralizing control and ensuring transparency, these technologies democratize access to information and digital resources, helping to bridge the digital divide and providing equitable opportunities for participation in the digital realm. Blockchain further enhances inclusion by validating identities

and securing transactions, enabling marginalized communities to benefit from technological advancements. Emphasizing digital decentralization, the synergy between AI and blockchain also enhances privacy, property rights, and content precision. A decentralized approach is crucial for defending openness and transparency, addressing data security challenges, and protecting the ethical use of distributed technologies. This digital strategy may unleash innovation and benefit community ecosystems, allowing individuals, organizations, and policymakers to shape a sustainable future where humanity can thrive trustfully, ethically, and inclusively.

## Blockchain and Artificial Intelligence (AI) in Arts and Entertainment

Integrating blockchain and artificial intelligence (AI) opens the door to a new era of innovation in the arts and entertainment sectors, empowering artists like never before. This integration revolutionizes copyright management, providing a secure and transparent platform for authors to register their works. A standout feature of blockchain is its self-executing smart contracts, which can ensure fair compensation and reduce the need for intermediaries. This innovation leads to decreased agency costs and a more equitable income distribution, better recognizing and valuing the artists' crucial role in the process.

Blockchain applications, mainly through non-fungible tokens (NFTs) and AI, are transformative in the arts and entertainment industries. NFTs provide artists with secure and transparent methods for registering and marketing their digital creations, completely revolutionizing the concept of ownership. On the other hand, AI can generate unique images and videos from textual descriptions, presenting a genuinely innovative and creative approach to digital art production. These AI-generated visuals redefine augmented reality experiences, leaving technology enthusiasts and policymakers in awe of their transformative potential.

Moreover, AI paves new creative paths by analyzing artistic styles and remixing them to produce unique works, expanding the boundaries of artistic expression. The creation of NFTs, representing exclusive ownership of digital or physical items, is poised to revolutionize the art market by enhancing the functionalities associated with digital ownership. Future entertainment possibilities include using NFTs to modify live events, allowing fans to influence aspects such as stadium lighting or choosing game highlights in real-time, thus enhancing their sports experience.

Blockchain and AI's Ethical Impact: More Cultural Diversity, Fairness, and Inclusion.

The integration of blockchain technology and the rapid advancement of AI in the arts and entertainment sectors offer not just technological advancements but significant ethical advantages. These technologies facilitate the creation of secure and immutable digital records, optimize copyright management, and promote fairness in income distribution. Smart contracts on blockchain networks can automate income (re)distribution, ensuring transparency and equity. Such evolution reduces artists' dependence on intermediaries and promotes a fairer compensation system, marking a significant step towards more inclusive support for artists.

Blockchain and AI-enabled digital decentralization can democratize access to platforms and computing resources, challenging the hegemony of large corporations over the distribution and monetization of artistic content. This shift promotes greater transparency in copyright management and equitable income distribution, influencing public policies to protect artists and

intellectual property. These technologies advocate for ethical reforms in the art and entertainment sectors by encouraging innovation and cultural diversity.

In summary, blockchain and AI's ethical and political implications in arts and entertainment emphasize transparency, equity, and support for cultural diversity. Developing policies promoting digital decentralization and fair income distribution will ensure these technological advancements benefit artists and other stakeholders.

# 04. AM's intro to AI

**Artur Marques** | Instituto Politécnico de Santarém Escola Superior de Gestão e Tecnologia de Santarém, Portugal

This compilation of 11 sets of slides that I (Artur Marques) contribute here, corresponds to an introduction of mine to Artificial Intelligence (AI). These contents should not be assumed to be correct in any situation, although any errors are not intentional.

This is a broad and superficial compilation that covers concepts, historical moments, problems and tools in logic, as well as different models for classification and regression in the area of Machine Learning (ML). The final chapter is a paper, which has already been published in other books, related to the generation of synthetic data and its pedagogical aspect, due to the observability and configurability of the datasets.

Most of the slide sets/chapters are conceptual but end with references to Python code (in public repositories) that enable readers to set the concepts into action, thus corresponding to theoretical-practical materials. Some of the code includes original, low-level implementations aimed at obtaining results that automatically include explanations of how they were obtained.

I hope these materials can be interesting and useful.

The chapters are available at
https://github.com/amsm/ia_pdfs
and are the following:

| Title | Content |
|---|---|
| 01 - AI, an introduction | About the evolution of the concept of Artificial Intelligence, different schools of thought, and tangents with other fields. |
| 02 - Propositional Logic, playing with it in Python | About problems in logic, such as satisfaction, consequence, and equivalence of expressions, including code for automatic verifications. |
| 03 - AI winters | A one-page segment to recall the consequences of unrealistic expectations. |
| 04 - Linear Regression | The concept of Linear Regression, related metrics, and examples of applications to classification and regression problems. |
| 05 - The roots of ML<br>The Perceptron | About the Perceptron, the root of all artificial neural networks. Includes procedural and object-oriented implementations. |
| 06 - Intro to ML | An introduction to Machine Learning (ML), mainly for supervised classification. |

| | |
|---|---|
| 07 - Playing with the Fashion-MNIST dataset | ML applications using models trained with the Fashion-MNIST dataset. |
| 08 - Confusion Matrix | A confusion matrix is a tool from which the most important performance measures of any model are derived: accuracy, precision, recall, f1-score. Includes code for the automatic generation of these matrices, including metrics with embedded automatic explanations. |
| 09 - KNN | A non-parametric algorithm, ideal for understanding the eventual need for data normalization and standardization. |
| 10 - Decision Trees | About Decision Trees, focusing on understanding the calculation of the Gini index, the measure that determines the splits of these structures. |
| 11 - AmWebTriangle<br>A toolkit for experimenting with ML | A copy of the article with the same title, employing several of the concepts and techniques studied in the previous chapters.<br>Available from:<br>https://aisel.aisnet.org/cgi/viewcontent.cgi?article=1050&context=capsi2022 |

# 05. Students' perspective on AI

**Multimedia Students Perspective about Artificial Intelligence |** This chapter was written as part of a course unit by students in the multimedia area. It is their perspective on the chosen topic: artificial intelligence. All the images in this chapter were created by the students.

## What is AI?

According to the European Parliament, artificial intelligence is the ability of a machine to replicate human-like abilities. This system has competencies such as reasoning/problem-solving, planning, communication, learning, and creativity.

Despite many thinking that AI emerged only a few years ago, the "Turing machine" was created in 1936, capable of performing intellectual processes. However, the term "artificial intelligence" was coined in 1956, at the Dartmouth Conference, and from there, it has been and continues to be in constant evolution. Just to give a brief idea of this, the first Chatbot (an AI used to communicate with people through text and/or voice) was invented in 1966.

AI began to be widely used in the 1980s/1990s, but it was only from the 2010s onwards that it became part of people's daily lives. In Portugal and around the world, it is already used in areas such as healthcare, transportation, entertainment, security, among others, because it can help identify diseases, monitor patients, drive more safely, avoid traffic jams, identify fraud, and various other aspects.

## Impact of AI

Benefits and Challenges of AI

Artificial intelligence also presents stronger elements than others in all fields. Here are just a few of these ideas:

> **Benefits** - In the field of healthcare, artificial intelligence can be a significant support in various ways, such as in complex and delicate surgeries that require greater precision. AI also increases productivity, thus achieving a company's goals in less time. Another aspect is education; this intelligence can produce the most suitable content and methods for each student, according to their topics and learning pace.
>
> **Challenges** - Unfortunately, this technology does not only have positive points but also entails some adversities. These challenges are not as simple as just high costs; they raise concerns related to ethics, explainability, security and privacy. AI also raises the issue of job displacement, where people's roles are taken over by robots. Additionally, if used by malicious individuals, it can lead to the creation of weapons that may cause harm to others.

## Fundamentals of AI

Artificial Intelligence (AI) is a field of computer science that aims to create systems capable of performing tasks that typically require human intelligence. To understand the fundamentals of AI, it's important to explore principles related to Machine Learning (ML).

Machine Learning is an area of AI that enables systems to learn and improve autonomously from experience through the use of mathematical processes on data. This helps a computer learn without being explicitly programmed for specific tasks. Instead, algorithms focus on identifying patterns in data to predict and make decisions based on these patterns. With more data and experience, the results of machine learning become more accurate, much like how humans improve with practice. Within machine learning, there are three distinct types:

Supervised Learning - In supervised learning, algorithms are trained using a specific set of data where each input example is associated with an expected output. The primary goal here is to learn the relationship between inputs and outputs so that the algorithm can predict and make accurate decisions with new data introduced. An example of this would be receiving an input, such as a photograph of a traffic sign, and the task is to predict the correct output or label — for example, which traffic sign is in the image (speed limit, STOP, etc.). In simpler cases, the responses have a yes/no format (these are called binary classification problems).

Unsupervised Learning - In unsupervised learning, unlike supervised learning, algorithms are trained using unspecified data groups. Here, the objective is to find patterns among the data without the need for specific outputs. This includes tasks such as clustering similar data or even reducing dimensionalities for data visualization.

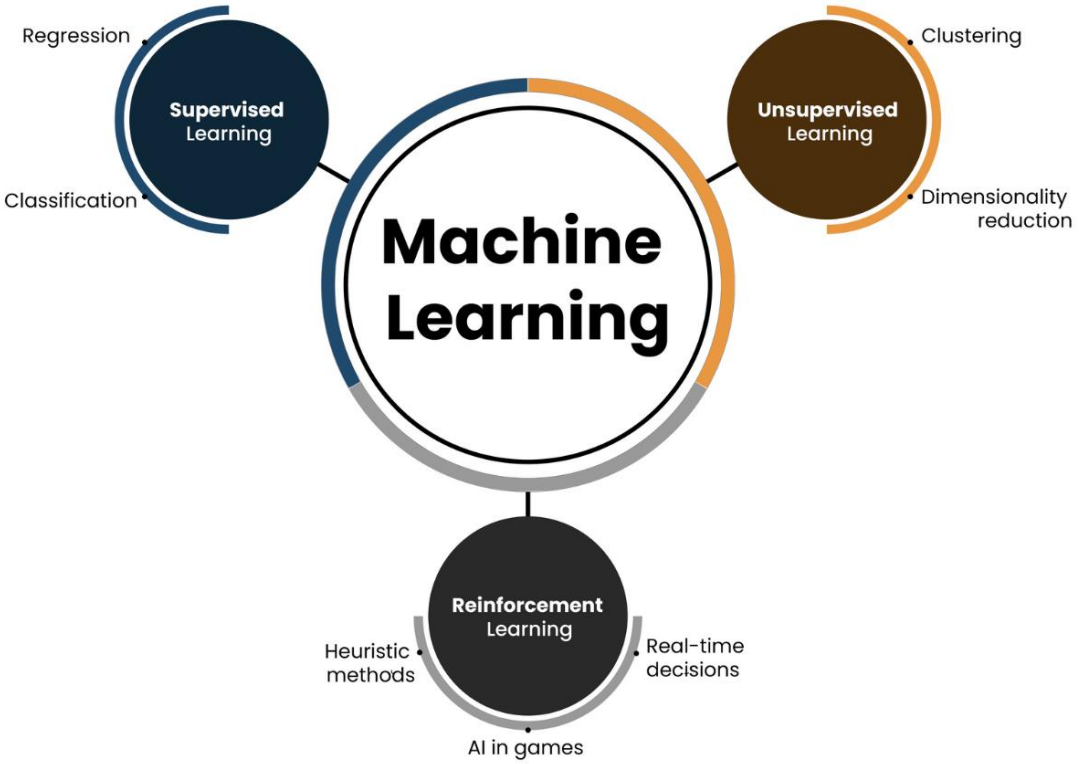


Fig. 1 Machine Learning (Students perspective)

Reinforcement Learning - In this learning method, algorithms learn through interaction with a dynamic environment. They receive feedback in the form of a reward or penalty, depending on how they interact with the environment. With this feedback, the system aims to improve its decision-making process to maximize the reward factor over time. This learning approach is commonly used in areas such as video games and robotics.

## Machine Learning Algorithms

There are different types of machine learning algorithms, each with their own characteristics and applications. Some of the main algorithms include:

**1. Linear Regression** - This algorithm is used in regression problems, where the goal is to predict a continuous value. It establishes a linear relationship between the independent variables and the dependent variable.

**2. Decision Trees** - This algorithm creates a decision tree where each node represents a question about the data attributes. Based on the answers, the algorithm decides which path to follow until reaching a conclusion.

**3. Neural Networks** - These algorithms are inspired by the functioning of the human brain. They have a structure of interconnected neurons capable of learning and recognizing complex patterns.

**4. Support Vector Machines** - This algorithm is used for classification and regression problems. It creates a hyperplane that separates the data into different categories.

**5. Clustering Algorithms** - These algorithms are used to group similar data into clusters, which can be useful for discovering patterns and segmenting customers, for example.

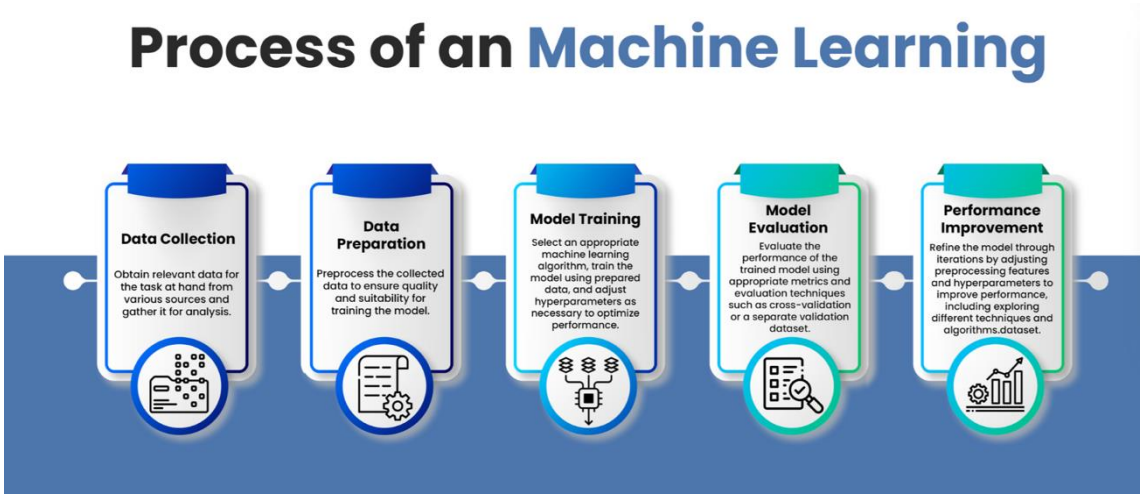


Fig. 2 Process of Machine Learning (Students perspective)

## Neural Networks

Neural Networks are architectures composed of nodes that operate very similarly to neurons in the human brain. By using algorithms, they can recognize hidden patterns and correlations in raw data, classify them by clustering, and continuously learn over time to improve.

A simple neural network includes an input layer, an output (or target) layer, and in between, a hidden layer. The layers are connected through nodes, and it's these connections that form a "network" – the neural network – of interconnected nodes.

## Types of neural networks

**1. Convolutional Neural Networks (CNNs)** - They contain five types of layers: input, convolution, pooling, fully connected, and output. Each layer has a specific purpose, such as summarizing, connecting, or activating. Convolutional neural networks have popularized image classification and object detection. However, CNNs have also been applied to other areas, such as natural language processing and prediction.

**2. Recurrent Neural Networks (RNNs)** - They use sequential information, such as data timestamped from a sensor device, or a spoken sentence composed of a sequence of terms. Unlike traditional neural networks, all inputs to a recurrent neural network are not independent of each other, and the output for each element depends on the computations of the preceding elements. RNNs are typically used in time series forecasting, sentiment analysis, and other text applications.

**3. Feedforward Neural Networks** - These are networks where each perceptron in a layer is connected to every other perceptron in the next layer. Information is transmitted from one layer to the subsequent one, and only in that direction. There are no feedback cycles.

**4. Autoencoder Neural Networks** - These are used to create abstractions called encoders, generated from a set of input data. Although like more traditional neural networks, encoders aim to model the inputs themselves, making them an unsupervised method. The premise of autoencoders is to desensitize the irrelevant and sensitize the relevant. As more layers are added, more abstractions are formulated in higher layers (closer to the point where a decoding layer is introduced). These abstractions can then be used by nonlinear classifiers.

## Deep Learning

Deep learning is a type of machine learning that uses artificial neural networks to enable digital systems to learn and make decisions based on unstructured data without labels. In general, machine learning prepares AI systems to learn from acquired experiences with data, recognize patterns, make recommendations, and adapt. With deep learning, instead of simply responding to sets of rules, digital systems create knowledge from examples and then use that knowledge to react, behave, and act like humans.

## Main Characteristics

Input Layer

An artificial neural network consists of various nodes that input data into it. These nodes comprise the input layer of the system.

Hidden Layer

The input layer processes and transmits data to farther layers in the neural network. The hidden layers process information at different levels, adapting behavior as they receive new information. Deep learning networks have hundreds of hidden layers that can be used to analyze a problem from various angles. For example, if given an image of an unknown animal that needs to be classified, you might compare it to animals you already know, or observe the shape of the eyes and ears, size, number of legs, and fur pattern, trying to identify patterns such as:

The animal has hooves, so it could be a cow or a horse.

The animal has cat-like eyes, so it might be some kind of wild cat.

The hidden layers in deep neural networks work in a similar way. If a deep learning algorithm is trying to classify an image of an animal, each of its hidden layers processes a different feature of the animal and tries to categorize it accurately.

Output Layer

The output layer consists of nodes that emit data. Deep learning models that generate "yes" or "no" responses have only two nodes in the output layer. Conversely, those that produce a broader range of responses have more nodes.

## Architectures of Deep Learning

**1. Convolutional Neural Networks (CNNs)** - Convolutional Neural Networks, or CNNs, are primarily designed to process grid-structured data, such as images. Inspired by the human visual system, CNNs consist of convolutional layers that automatically and adaptively learn spatial hierarchies of features from input images.

**2. Recurrent Neural Networks (RNNs)** - Recurrent Neural Networks, or RNNs, are adapted for sequential data processing such as time series, text, and speech. Unlike feedforward networks, RNNs have connections that loop back, allowing them to retain memory of previous inputs in the sequence.

**3. Transformers** - Transformers represent an innovative architecture introduced in the paper "Attention is All You Need". Unlike CNNs and RNNs, transformers rely solely on attention mechanisms, allowing them to efficiently capture long-range dependencies.

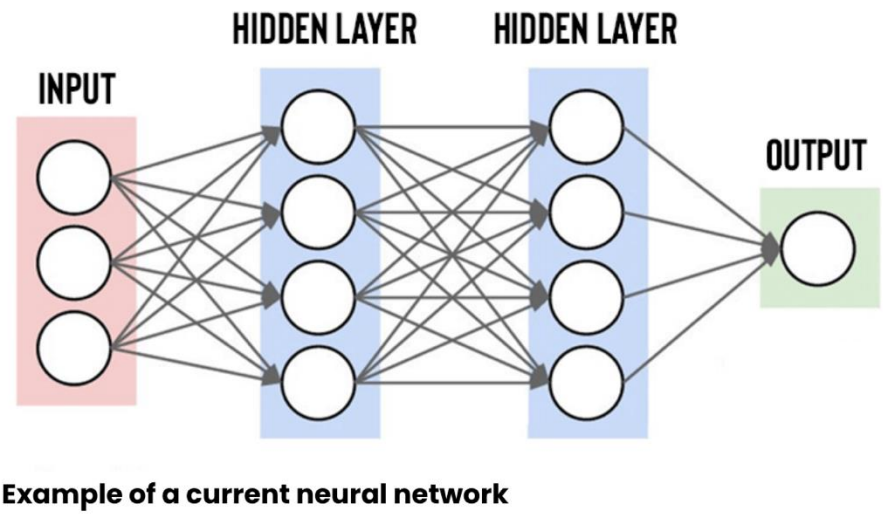


Fig. 3 Example of a current neural network (Students perspective)

## Generative AI

Generative AI is another area of artificial intelligence that involves the use of algorithms to create new content, such as text, images, music, and even programming code with characteristics and patterns similar to existing content. The way to produce new content involves training with a huge amount of information and not only that but also using different techniques that allow learning existing patterns.

**Some of these techniques used by generative AI include:**

**1. Generative Adversarial Networks (GANs)** - GANs are composite learning models consisting of two neural networks: a generator and a discriminator. During training, the generator creates data like real samples, while the discriminator distinguishes between real and fake data. This competition helps improve the efficiency of the models, with the generator learning to create more accurate data and the discriminator becoming more effective at detecting falsehoods.

**2. Transformer Models** - These models are an advanced architecture of neural networks whose main function is to process a sequence of data. These models are special because of their way of processing sequential information simultaneously. This process makes everything much more efficient than all other known traditional architectures.

**3. Autoencoders** - Autoencoders are a type of neural network architecture used in machine learning. Autoencoders consist of two processes: encoding and decoding. In the encoding process, the input data is converted into a compact format called "latent space". This term means that there is a much simpler and compact representation of the data, which facilitates processing and analysis by the neural network. After this process, we move to the decoder, where the attempt is made to reconstruct the original data.

This new way of producing content raises important ethical issues related to the use of these technologies, such as the authorship of content generated by AI, the biases present in the data used to train AI, which can lead to discriminatory results and decisions, and even the lack of transparency regarding AI algorithms, which makes it difficult to hold responsible parties

accountable for harmful decisions or actions. Who should be held accountable when errors or damages occur due to AI systems?

The future of generative AI is becoming increasingly real. What was once a mere speculation is now our reality. It is expected that AI will continue to advance, enabling the creation of various multimedia contents to improve further, as well as more realistic simulations and increasingly effective assistants. At the same time, it is also foreseen that these technologies will allow for the personalization and adaptation of content, leading to a better dynamic between humans and machines.

**In addition to the techniques mentioned above, there are other common approaches in generative AI, such as:**

**1. Latent Variable Models (LVM)** - This is a class of statistical models that deal with hidden variables inferred from observable variables. A common application of these models could be, for example, understanding how customer responses are related to factors such as "satisfaction," "product quality," among other factors.

**2. Recurrent Neural Networks (RNN)** - A Recurrent Neural Network (RNN) is a type of artificial neural network that deals with sequential data, maintaining a "memory" of the information processed previously. They receive input data sequentially, where the previous inputs influence not only the new input but also the output. These algorithms are widely used in various applications such as language translation, speech recognition, caption generation for images, and are often integrated into virtual assistant applications like Bixby, Siri, and Alexa.

**3. Long Short-Term Memory (LSTM)** - This neural network is a variation of recurrent neural networks (RNNs), capable of addressing the "vanishing gradient" problem. This challenge, in simple terms, occurs when the numbers that regulate how the neural network learns become so small that, as they pass through the various layers, they create difficulties for the network to learn effectively. This type of network was created to overcome this limitation and is used in tasks that require retaining information over a long period of time. A common use of an LSTM would be in automatic translation systems like Google Translate. When translating a sentence from English to Mandarin, LSTMs can understand the relationships between words in both languages. When a new sentence is presented, the LSTM is used to predict the sequence of words in the desired language. This allows for more accurate translation between different languages.

**4. Variational Autoencoders (VAEs)** - VAEs are neural networks used to learn compact representations of data. VAEs go through two processes: encoding and decoding. In the encoding phase, VAEs break down the input information into a more compact format. Then, in the decoding phase, VAEs reconstruct the original data from the compact format. The peculiarity of VAEs lies in how they model this compact format as a "probabilistic distribution." This term refers to a function that explains the chances of different outcomes occurring within a set of events or given data. In this way, they can generate new data, and this ability to generate new data makes VAEs widely used in content generation tasks, such as generating images, text, and music. A more concrete example of their use would be programs that generate images like DALL-E 2 and Midjourney.

## Ethics and Responsibility in AI

Bias and algorithmic justice

In the pursuit of a more ethical and responsible artificial intelligence, concepts of justice and bias likely receive the most attention. This is due to the existence of many AI systems in production but still lacking adequate regulatory frameworks. AI systems can exhibit unfair behaviors for various reasons, such as:

There may be cognitive biases affecting decisions made during the development of the system.

Biases reflect real social behaviors (before anything existed, artificial intelligence already existed).

Privacy and Data Security

The principle of Privacy and Security requires that the AI solution respects people's privacy, for example, the confidentiality of personal data, in accordance with the applicable laws in each jurisdiction, and is secure. In the case of data used to train the model, it must be protected against unauthorized access.

Privacy needs to be managed as a collective good and duty in the context of AI use, as the privacy of all individuals can be compromised even if most people have not consented to the processing of their personal data. The AI's ability to collect and process information and personal data makes data protection and privacy security essential. Therefore, artificial intelligence systems must be designed with user privacy and data treatment in mind, respecting ethics and applicable regulations always (General Data Protection Law).

AI deals with autonomous systems that may have access to sensitive information or control physical equipment. Developers must ensure that AI systems are secure and resistant to cyber-attacks, ensuring that they are not manipulated or hacked by third parties.

Social Impact and Regulation of AI

AI is exerting a transformative power in various aspects of society. Its influence spans from information technology and healthcare to retail and the arts, permeating our daily lives. In the United States alone, AI shows early adoption with a projected 100 million or more users in the first four years. Therefore, it is vital to assess the social impact of this technology, although it promises greater efficiency, productivity, and economic benefits, there are also concerns regarding the ethical use of AI-powered generative systems.

In just a few years since its introduction, Generative AI has transformed business operations and opened new paths for creativity, promising efficiency gains and market dynamics improvement.

As part of its digital strategy, the European Union (EU) aims to regulate artificial intelligence to ensure better conditions for the development and use of this innovative technology. AI can bring various benefits such as better healthcare, safer transportation, more efficient production, and cheaper energy.

In April 2021, the European Commission proposed the first EU regulatory framework for AI, suggesting that AI systems can be used in different sectors, but must be analyzed and classified according to the risk they pose to users.

European Union (EU) Artificial Intelligence (AI) Act

According to the Directorate-General for Communication of the European Parliament, represented by Spokesperson Jaume Duch Guillot, the priority is to ensure that AI systems used in the EU are safe, transparent, traceable, non-discriminatory, and environmentally respectful. The Parliament proposes human oversight of AI systems, rather than full automation, to prevent harmful outcomes. Additionally, it seeks to establish a uniform and neutral technological definition for AI, applicable to future systems. The new rules establish obligations for suppliers and users based on the level of AI risk, emphasizing the importance of assessing even minimal-risk systems.

Categories (prohibited systems, high-risk systems, and limited-risk systems)

AI systems of unacceptable risk are systems considered a threat to people and will be prohibited. These systems include:

Cognitive-behavioral manipulation of specific vulnerable individuals or groups: for example, voice-activated toys that encourage dangerous behavior in children.

Social scoring: ranking individuals based on behavior, socioeconomic status, personal characteristics.

Biometric identification and categorization of individuals.

Real-time and remote biometric identification systems, such as facial recognition.

Some exceptions may be allowed for law enforcement purposes.

AI systems that negatively affect safety or fundamental rights will be considered high-risk and will be divided into two categories.

**1 - AI systems used in products covered by EU product safety legislation, including toys, cars, and elevators.**

**2 - AI systems falling within specific areas that will need to be registered in a EU database:**

Management and operation of essential infrastructures;

Education and vocational training;

Employment, worker management, and access to self-employment;

Access to and enjoyment of essential private services and public services and benefits;

Law enforcement;

Migration, asylum, and border control management;

Assistance in legal interpretation and law enforcement;

All high-risk AI systems will be assessed both before they are placed on the market and throughout their lifecycle.

The use of data in AI

The amount of personal data collected by AI systems continues to increase, raising concerns about privacy and data protection. For example, various generative AI tools like ChatGPT, DALL-

E, or any other currently developed tool are often used for tasks such as writing emails, reports, and programming without the consent of individuals. Currently, companies lack standards for the use of AI tools by employees, even as security flaws and vulnerabilities in current AI tools emerge. To address these concerns, it is essential for organizations and companies developing or using AI technology to take proactive measures to protect data privacy. This includes implementing strong data security protocols, ensuring that data is used only for its intended purpose, and developing transparent systems that allow for explaining, inspecting, and reproducing decisions and data usage.

Transparency and Explainability

Generative artificial intelligence, such as ChatGPT, will not be classified as high-risk but will have to comply with transparency requirements and EU copyright legislation, meaning:

Disclose that the content was generated by AI;

Design the model to prevent it from generating illegal content;

Publish summaries of copyrighted data used for training.

General-purpose high-impact AI models that represent systemic risks, such as the most advanced AI model GPT-4, should undergo exhaustive assessments and report any serious incidents to the European Commission.

Content generated or modified using artificial intelligence, such as images, videos, and audio, needs to be properly labeled as "(generated by artificial intelligence)" so that users are aware of it when confronted with such content.

## Approaches and perspectives of AI

**1. Logic and Reasoning** - This approach is based on logical principles to represent knowledge and reason about it. It includes techniques such as propositional logic, first-order logic, and logic programming.

**2. Intelligent Agents** - These focus on building autonomous systems capable of perceiving their environment, making decisions, and taking actions to achieve their goals.

**3. Robotics** - AI in robotics focuses on the development of robotic systems capable of perceiving their environment, making decisions, and acting autonomously. This involves integrating techniques from computer vision, motion planning, and robot control.

**4. Case-Based Reasoning** - This perspective involves problem-solving by analyzing previous cases and adapting solutions to new problems based on similarities between them.

**5. Fuzzy Logic** - Fuzzy logic is an approach that deals with uncertainty and imprecision in data, allowing for the representation and reasoning about concepts that cannot be precisely defined.

**6. Artificial Neural Networks** - They are widely used in pattern recognition problems, natural language processing, and other machine learning tasks.

## Capabilities and principles

**1. Learning Capacity** - AI systems are designed to gather data and analyze large volumes of data, identifying patterns and making inferences from this information.

**2. Reasoning Capacity** - Artificial intelligence can reason, meaning it can make decisions based on available information.

**3. Pattern Recognition** - AI systems can identify patterns in data, images, language, and other types of information. This capability allows AI to be used in applications such as facial recognition.

**4. Interactions with Humans** - Using voice interfaces, chatbots, and other innovative technologies.

## Impacts of AI in different areas of life

**1.** Artificial intelligence has been the most significant technological advancement in recent decades and has seen rapid development.

Virtual assistants, such as Apple's Siri and Amazon's Alexa, are examples of AI applications that have revolutionized how we interact with technology. Beyond virtual assistants on mobile devices and smart speakers, AI has also been applied in other contexts, such as voice-based customer service systems and real-time simultaneous translation applications.

**2.** In the field of medicine, AI has shown great potential in improving medical diagnosis and clinical decision-making. That is, AI is used for early diagnosis of diseases like cancer. This AI-assisted diagnostic system can help doctors make more informed decisions and increase the accuracy and speed of diagnosis.

**3**. AI systems can analyze students' academic performance and learning patterns to identify areas of strength and weakness, allowing for personalized learning according to students' needs. For example, AI-based tutoring systems can provide instant feedback to students on their answers and suggest additional resources to reinforce their understanding in areas where they struggle the most.

**4.** AI-based recommendation systems analyze customers' purchasing and browsing habits to provide highly personalized product recommendations. For instance, when customers visit an online store, AI can show them products related to their interests.

**5.** AI systems can analyze real-time data from sensors and machines in the production unit to optimize scheduling and machine performance. For example, in the manufacturing industry, AI can predict the lifespan of machines and schedule preventive maintenance to avoid downtime.

## Presence of AI in everyday products and services

Today, there are several examples of Artificial Intelligence in everyday life, proving that technology is truly revolutionary and AI is much more accessible than it seems. We encounter it in our daily lives very easily, such as:

**1. Inventory control of products in companies** - There are different software programs to control a company's inventory through monitoring by intelligent sensors.

**2. Surveillance cameras** - Ultra-modern surveillance systems integrate artificial intelligence technology, which not only records daily activities for public security purposes but also has the capability to recognize profiles of wanted individuals.

**3. On TV** - Televisions nowadays are capable of speech recognition and natural language processing. It's also possible to use TVs essentially as home assistants, similar to Alexa.

**4. Facial recognition** - It's an incredible feature, utilized by various security, personalization, and convenience devices.

**5. Advertising on digital billboards** - Due to the digital platform, it's possible to create more attractive and compelling marketing campaigns.

**6. Smart homes** - Smart houses are becoming increasingly popular, especially outside of Portugal, thanks to the interconnection of devices such as air conditioners, heaters, lights, windows, among others, it's possible to control everything inside the house with voice commands.

## Use of AI in sectors in Portugal

**1. Health** - São João Hospital in Porto has implemented AI systems for the analysis of medical images, such as computerized tomography and magnetic resonance imaging, assisting radiologists in the early diagnosis of diseases such as cancer.

**2. Finance** - Although not publicly disclosed, individual banks utilizing AI for fraud detection are not explicitly mentioned. However, there is increasing talk of AI adoption in the Portuguese financial sector. It is likely that Banco BPI, a bank at the forefront of technological innovation, may already be or close to implementing AI to identify suspicious patterns and prevent fraud.

**3. Education** - The University of Lisbon has implemented an AI system that analyzes students' performance in online learning activities and provides personalized feedback to enhance learning.

**4. Industry** - Navigator Company, one of the largest paper companies in Portugal, has implemented AI systems in its factories to optimize the paper production process and reduce equipment maintenance costs.

**5. Marketing** - NOS, one of the largest telecommunications operators in Portugal, has implemented AI systems to analyze customer behavior and offer personalized telecommunications service offerings.

## Debates and discussions about the future of AI

Artificial intelligence faces several challenges in a new revolution, as there is currently no regulation in place. Although the European Union is taking initial steps, concerns remain regarding the correct use of data. However, it presents itself as a digital revolution that could be accelerated in Portugal to enhance productivity, ensure better wages, and prevent the

departure of qualified talent. Currently, AI is characterized by its usefulness and proper application, suggesting its implementation in modernizing services in public sectors. This includes customer service, process automation, data analysis for anomaly detection, improving the quality of services provided to citizens, and ensuring transparency and fairness in the use of public funds. Establishing good practices and standards for fair usage is also essential. Creating conditions in Portugal to provide quality solutions that guarantee increased productivity and the retention of critical mass is crucial. This helps retain skilled professionals seeking career challenges beyond Portugal's borders. The future of AI has arrived, and recognizing this reality means seizing the opportunity to leverage technology and improve productivity and quality of life in Portugal.

## Improvement of quality of life and social well-being

**1.** Early disease identification allows doctors to treat conditions sooner, which can result in better outcomes for the patient.

**2.** Facilitating collaboration among healthcare professionals: AI can be used to integrate and share health data among healthcare professionals in different locations.

**3.** Optimization of health data management: AI can help optimize health data management, making it more efficient and easily accessible. This allows healthcare professionals to make more informed and quicker decisions.

## Scientific and technological advancements

AI in improving diagnostics - Machine learning algorithms can analyze medical images, such as X-rays, magnetic resonance imaging, and computerized tomography scans, with unprecedented accuracy. AI in discovering new drugs - Algorithms can analyze vast databases of chemical compounds and simulate molecular interactions, accelerating the screening process for new drug candidates. AI in the advancement of medicinal cannabis - The collaboration between data science and medical cannabis opens doors to new hopes and treatment possibilities for patients worldwide.

## Benefits of AI

Artificial intelligence has the potential to bring many benefits to higher education, from personalized teaching to cost reduction. However, it also faces challenges and limitations, including ethical and legal aspects, technological dependence, and the need for teacher training. It is noted, however, that there are still concerns about the impact of AI on the future of work, education, and society itself. Themes related to artificial intelligence still evoke fear and curiosity even in those who deal with it daily. Therefore, it is expected that even schools, universities, and educational institutions will have doubts and bring questioning about these new roles of this technology.

Some people fear that the automation of routine tasks could lead to job losses in certain areas, while others see opportunities to create new professions and economic sectors based on AI,

including teachers and other education professionals themselves. Such doubts are legitimate, and that is precisely why governments, companies, and society as a whole should discuss these issues seriously and seek balanced solutions that maximize the benefits of AI for everyone.

## Challenges of AI

**1.** Artificial intelligence has the potential to significantly improve the quality of higher education, but it also presents a series of challenges and limitations, including concerns about technological dependence.

**2.** As institutions of higher education adopt artificial intelligence, they run the risk of becoming increasingly dependent on this technology, which can lead to significant challenges if the technology fails or becomes unavailable.

**3.** One of the main challenges of technological dependence is the vulnerability and failures of systems.

**4.** As artificial intelligence becomes more central to higher education, institutions run the risk of being impacted by system failures, including security issues, malfunctioning hardware and software, and service interruptions.

**5.** Another concern is that artificial intelligence may lead to increased standardization in higher education, which could undermine creativity and diversity in teaching and learning. Artificial intelligence can be programmed to provide standardized responses and follow predefined rules, which may limit teachers' ability to personalize learning to meet the individual needs of students.

**6.** Furthermore, technological dependence can lead to ethical and legal issues. For example, data generated using artificial intelligence in higher education may contain confidential student information, such as health information, academic history, and financial information, raising concerns about privacy and security.

**7.** Therefore, it is important for institutions of higher education to carefully address the implications of technological dependence and work to mitigate associated risks. This includes conducting regular audits of artificial intelligence systems, diversifying technology vendors, and promoting transparency in the collection and use of data.

## What to expect from the future

The future of Artificial Intelligence in higher education is full of promises. As technology continues to evolve, we can expect an even greater expansion of its applications and benefits in institutions of higher learning. AI is poised to play an increasingly significant role in improving the quality of education and transforming the student experience. One of the most notable future prospects is the continued growth of online and hybrid learning. AI will enable institutions to offer high-quality education to students worldwide, tailoring content and activities according to their individual needs. This flexibility promises to democratize access to higher education. AI will also have a significant impact on academic research and institutions' strategic decision-making. AI algorithms can analyze large datasets, identify emerging trends, and assist institutions in making informed decisions about program expansion, resource allocation, and

policy development. However, the growth of AI in higher education also brings with it ethical challenges and significant responsibilities. It is imperative that educational institutions address these issues seriously, developing clear ethical policies and ensuring proper oversight and auditing of AI systems.

## What is the role of AI in the education of higher education students?

The role of AI in shaping students' formation in higher education is extremely comprehensive. AI has the potential not only to optimize but also to personalize a student's educational experience. It offers numerous tools that lead to a more compatible and adaptable learning experience tailored to each individual student's needs, thus fostering a more inclusive and effective learning environment. The integration of AI into study programs helps empower students with various essential skills for the modern-day job market. In short, AI undoubtedly has the capacity to significantly transform how students learn in higher education and how they prepare for their careers in the future.

## The importance of technological infrastructure

Technological infrastructure has a significant impact on the issue of AI in higher education. A robust technological infrastructure provides the necessary foundation not only for the use but also for the efficient operation of AI applications themselves. This underscores that robust infrastructure, including hardware, software, and a reliable network, is essential to support the demands of AI tools in the classroom. These resources may not come cheap, but there is a need for such investment. When such robust infrastructure capable of supporting such AI tools is achieved, it ultimately facilitates their integration into a classroom while allowing students and teachers to fully enjoy the benefits these tools provide, thus enhancing their teaching process.

## Teachers of the future mastering AI in the classroom

With this reality increasingly present in our higher education classrooms, it raises a crucial need to train our teachers for this new reality. Their preparation is essential because only then can a teacher elevate their potential to educate. Thus, there is a need for adequate training so that teachers can understand how to integrate this new tool into their teaching methods. Reinforcing this idea is the new paradigm of education, where the internet has contributed significantly and is the primary source of information used by students today.

## "The use of AI in education can free teachers for the noblest tasks of their profession" (Figueiredo, 2024).”

In an interview with Diario de Noticias, Mário Figueiredo states that the use of AI in higher education will allow teachers to dedicate more time to guiding and providing personalized support to students. Regarding the preparation of teachers in the use of AI within classrooms, Mário Figueiredo also emphasizes: "For this, they also need to have literacy in these techniques" (Figueiredo, 2024, p. s.n). Here we can discuss the fact that teachers need to understand not

only the functioning of this tool in technical terms but also how they will effectively integrate it into their teaching. In conclusion, a teacher has a very challenging role, as we have seen, but it is important to remember that this role is not static; just like technology, the role of a teacher is dynamic, so they must stay updated with new technologies and educational practices.

## Monitoring and evaluating the impact of AI

Monitoring and evaluating the impact of AI in higher education should not be overlooked and forgotten; this step is so important because this is where the effectiveness of AI usage over time will be assessed. For there to be this monitoring and evaluation, it is necessary to collect and analyze data related to the performance of students who have benefited from the tools, the effectiveness of the tools themselves, and of course feedback from both teachers and students. Based on all this information, patterns can be identified, and with these patterns, whether positive or negative, adjustments can then be made to the way the tools are implemented to achieve certain desired results. It is still important to emphasize that continuous monitoring is essential to ensure that the initiatives of AI tools achieve their educational objectives.

## Conclusion

Concluding thus the handbook, here is highlighted the critical issue of Artificial Intelligence in our lives and daily routines, encompassing its creation, evolution, and even its presence in various sectors of society, including our main focus, higher education. Despite Artificial Intelligence bringing numerous benefits and improvements to the quality of our lives and advancing scientific fields, it also faces critical challenges that must be considered in its implementation. To fully leverage its benefits and mitigate its challenges, it is important to adopt an ethical and responsible approach to this issue. The future of AI is undoubtedly promising, but requires the collaboration of everyone cautiously and remembering to maintain continuous evaluation of its usage and its impacts so that in the end it can be ensured that it benefits all individuals.

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# Conclusion

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The rapid development of artificial intelligence (AI) and its widespread adoption in the recent years promises to transform a number of industries and radically change them. Therefore, many experts claim that these advancements are heralds of a new industrial revolution. While still evolving, this industrial revolution, will be fundamentally distinct from its predecessors as it prioritizes collaboration between humans and machines. Instead of seeing AI as a replacement for human jobs, the collaboration paradigm recognizes that AI and humans have complementary strengths. While AI excels at data processing and repetitive tasks, humans bring creativity, empathy, and nuanced understanding to the table. Together, they form a powerful partnership that can achieve remarkable results. The potential of AI to improve and expand human capacities is one of its most significant effects.

This potential of AI to transform the industries like healthcare, industry, marketing, environment, education as well as people's daily lives are described from both experts' and students' perspective in this handbook.

Large volumes of medical data can be processed by AI systems rapidly and correctly, allowing them to find patterns and insights that are not accessible to humans. This potential has significant ramifications for healthcare, where AI may help with illness diagnosis, treatment plan customization, and patient outcome prediction. AI-powered diagnostic systems, for instance, can analyze medical pictures with amazing accuracy, helping physicians identify diseases like cancer early and improve patient outcomes.

AI-powered personalized treatment plans take into account each patient's individual genetic composition, way of life, and past medical records to provide more specialized and efficient healthcare. Additionally, the incorporation of AI into telemedicine systems increases access to high-quality healthcare, especially in underprivileged and rural places.

AI is bringing about a new era of productivity and creativity in business and industry. Businesses are using AI to enhance customer service, streamline supply chains, and create new goods and services. Through deep insights into consumer behavior, AI-driven analytics provide organizations the ability to target marketing more precisely and create more individualized customer experiences. Automation driven by AI is also revolutionizing manufacturing processes, increasing productivity, cutting expenses, and eliminating human error. These developments not only promote economic expansion but also open up new avenues for skill development and employment creation.

The environmental sector can benefit greatly from AI technology as well. Artificial intelligence (AI) can analyze vast amounts of data from satellites, sensors, and other sources to monitor and forecast environmental changes, aiding in the fight against climate change. For instance, complex climate patterns can be simulated by AI algorithms, which helps scientists understand how many factors contribute to global warming and develop strategies to mitigate its effects. Artificial intelligence (AI) has the potential to enhance sustainable agriculture practices, reduce

waste through efficient recycling methods, and optimize energy use in smart grids by predicting weather patterns and optimizing resource utilization.

Higher education is about to undergo a revolution thanks to artificial intelligence (AI), which may improve student experiences and administrative effectiveness. AI-powered solutions provide individualized learning routes by adjusting the speed and material to each student's level of proficiency. Instant feedback is provided by intelligent tutoring technologies, which enhance conventional teaching techniques and provide pupils a more individualized educational experience.

AI may help expedite administrative processes like grading and admissions, which relieves professors of some of their duty and frees them up to concentrate more on teaching and research. By identifying students who are at danger of falling behind, predictive analytics can provide prompt interventions aimed at enhancing retention and success rates. AI can also help with better resource allocation, scheduling classes more efficiently, and managing campuses better.

However, the introduction of AI into society presents significant ethical and practical issues in addition to its many benefits. Data privacy is one of the main issues. Since AI systems need enormous volumes of data to work well, it is essential to put strong data protection mechanisms in place to preserve people's privacy. This entails creating thorough frameworks for data governance that guarantee accountability, openness, and adherence to regulatory requirements. We can assure the appropriate use of AI technologies and foster trust in them by addressing these concerns.

The possibility of prejudice in AI algorithms is another important concern. AI systems have the potential to unintentionally reinforce and magnify societal prejudices found in the data because they are trained on preexisting data. This may result in unjust and biased outcomes. Therefore, it is crucial to create and use fair AI algorithms that are routinely checked for bias and adjusted as needed in order to reduce this risk. In order to generate more egalitarian AI systems, research and development teams in AI should encourage diversity and inclusivity.

Another crucial factor to take into account is equity in access to AI technologies. Even if artificial intelligence (AI) has the potential to democratize access to services and information, it is crucial to guarantee that everyone, regardless of socioeconomic background, has access to these technologies. This entails making investments in digital infrastructure, offering chances for education and training, and tackling the digital gap that occurs both within and across nations. We can exploit AI's benefits for the greater good and make sure that no one is left behind by encouraging inclusive access to the technology.

When implementing AI systems, accountability and transparency are also essential. Making sure AI-driven judgments are intelligible and explicable to people is vital, especially in high-stakes domains like finance, criminal justice, and healthcare. Creating tools that let users know how judgments are made and offering channels for redress in the event that mistakes are made are both essential components of developing transparent AI systems. More measures to guarantee the ethical and responsible use of AI technologies include the establishment of regulatory frameworks and oversight organizations.

Adopting these values will enable us to use AI's potential to build a more inventive, egalitarian, and inclusive future for everybody. The prospects for future developments in AI are virtually limitless, and the journey toward complete integration of AI into society is only getting started.

We have the chance to significantly and meaningfully influence the direction AI takes as we forge ahead on this fascinating frontier, ultimately improving the lives and general well-being of people everywhere.

This handbook aims to make a modest yet significant contribution towards the global goal of integrating Artificial Intelligence (AI) into various sectors. It aims to give students, educators, researchers, and practitioners the information and resources they need to successfully use artificial intelligence (AI) by offering thorough insights and practical examples, deepening knowledge of AI, and fostering cross-disciplinary cooperation. Ultimately, this will help to progress AI technology globally.