TECHNICAL INFORMATION FOCUSED ON BUSINESS TRENDS AND THE CREATION OF NEW TECHNOLOGY - BASED COMPANIES

DEVELOPING NEW BUSINESS MODELS USING ARTIFICIAL INTELLIGENCE

IAPMEI

startup BOOST
Powered by CAPACITAR PARA EMPREENDER

TABLE OF CONTENTS

INTRODUCTORY NOTE

The Importance of Artificial Intelligence in New Business Models

Artificial Intelligence has evolved significantly over the years and has been strongly encouraged in the business world, in societies and organizations, looking at its possible and diverse applications.

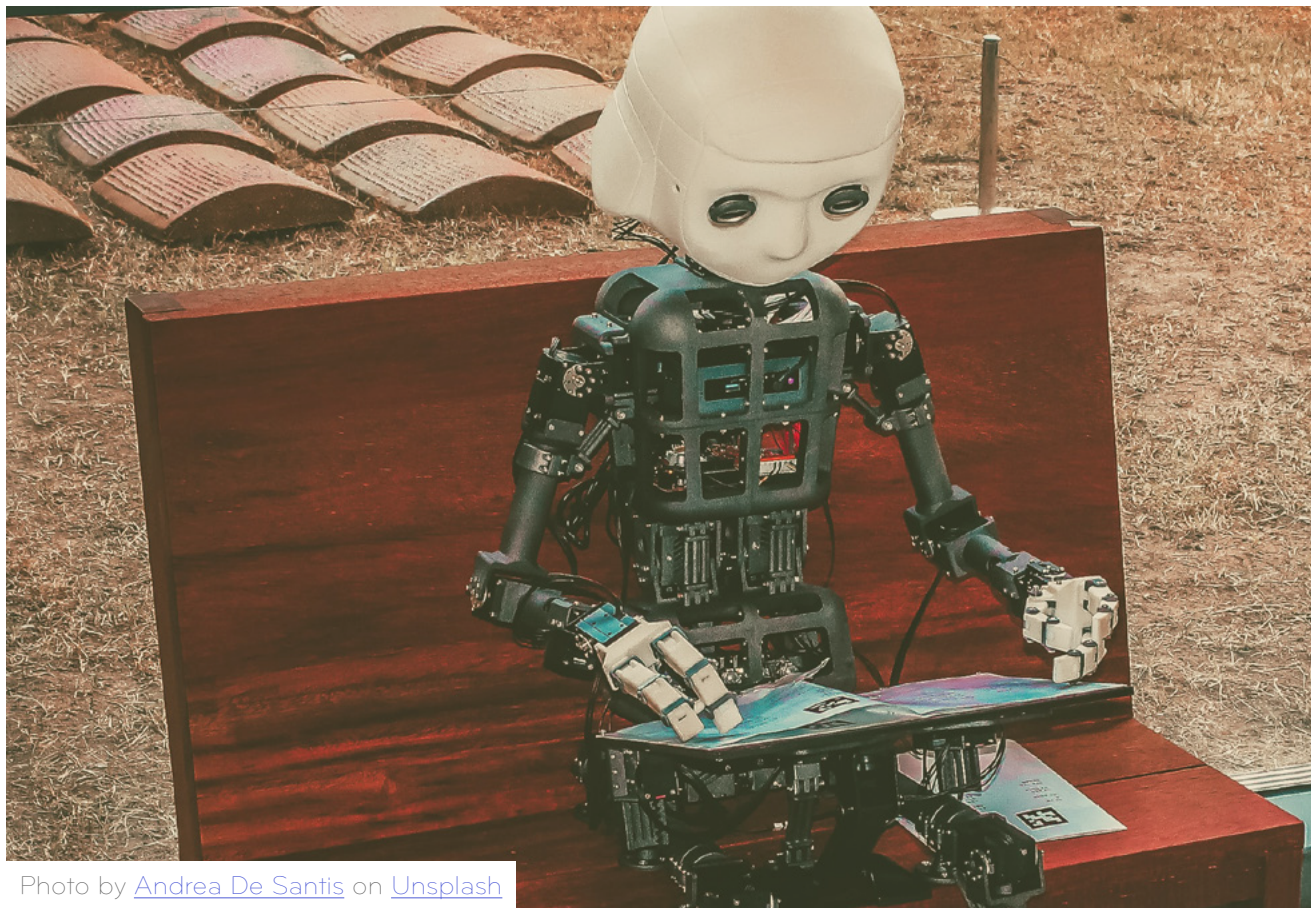


Photo by Andrea De Santis on Unsplash

AI Framework

Artificial Intelligence (AI) has been widely applied in several domains and has historically evolved with algorithms that are increasingly more capable, powerful and, on the other hand, faster as processing capabilities have increased.

Previously, AI-based **algorithms** were mostly used in academic research projects, where their applications were limited to proof-of-concept testing, with minimal advancement in what could be future large-scale applications. Recent **technical advancements**, the increase in the scientific community, and the exponential growth of resources committed to this subject have all contributed to AI-based algorithms becoming crucial and essential tools, facilitating operations that were previously considered to be **complex** (Collins et al., 2021).

This section is designed to provide a framework on the subject of Artificial Intelligence so that those who are unfamiliar with the field, particularly entrepreneurs, can have a solid base on the subject with references to relevant application cases.

Photo by Markus Spiske on unsplash.com

The impact of machines in the reshaping of business and society

AI enables machines to learn from past experiences and provides them with the ability to adapt to new and diverse information inputs, including the ability to execute tasks created by humans.

The use of AI-based systems in organizations has improved decision-making capability and has reduced operating costs associated with the same decision-making.

Not only has it enabled the reinvention of current business models, but it has also enabled organizations to focus heavily on digital innovation strategies of AI-based solutions (Duan et al., 2019).

Generally, AI is considered a very broad scientific area, which is allied to a major sub-area: **Machine Learning (ML)**. Because it is also considered a broad area, within ML technologies another major area can be specified: **Deep Learning (DL)**. There are algorithms and technologies that can be applied to machines in any of these areas and/or subareas. Machines, in turn, can be trained to perform certain jobs, as well as recognize patterns, execute tasks automatically, and make decisions, thanks to their ability to handle large amounts of data, resulting in a zero (or almost zero) interaction from humans. With this capability, society and organizations will be able to be more competitive in task performance, activity simplification, automation, and **process optimization**, enabling the development of new, more sustainable, current, and developed businesses.

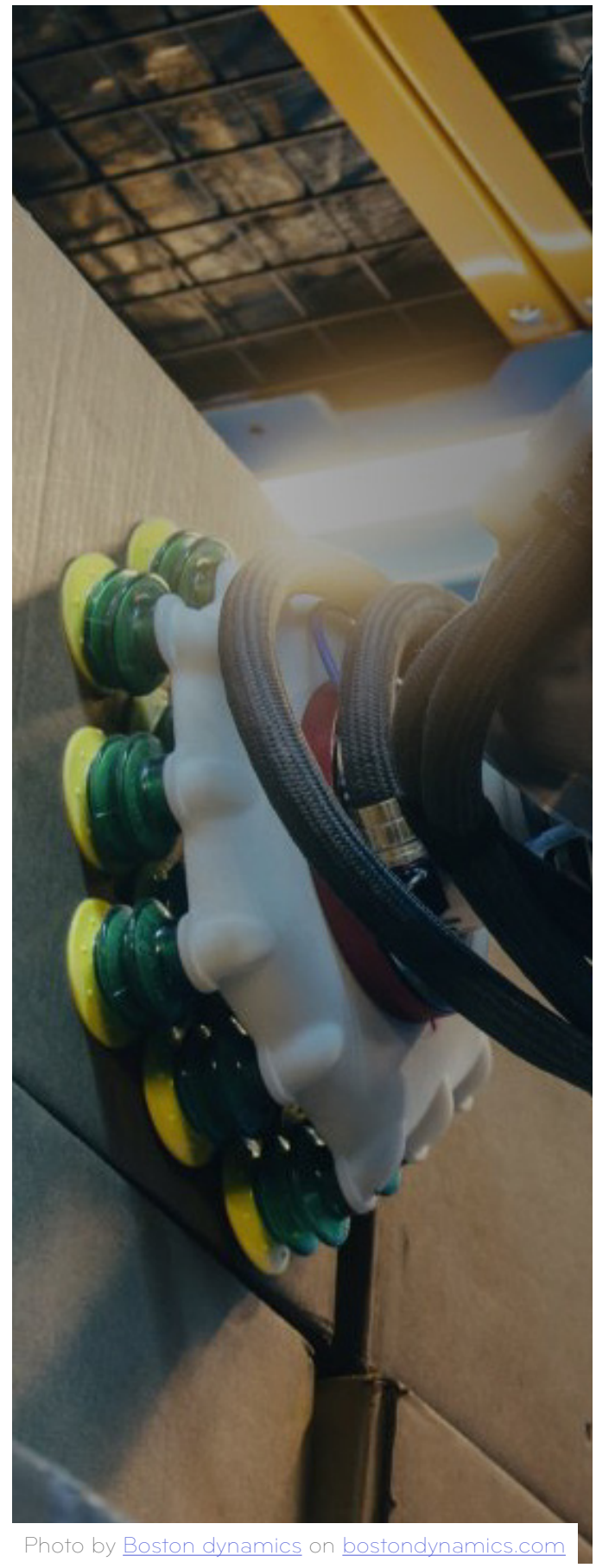


Photo by Boston dynamics on bostondynamics.com

The importance of AI

AI can be seen as the development of "**machines**" that can "**think**", **learn**, and **adapt**. Essentially, it can be said that any machine that implements an AI-based technology will tend to "replace" tasks that would supposedly be performed by a human resource. In other words, it is correct to say that any technique that enables a machine to **mimic human intelligence**, is an AI-based technique. However, AI and human thinking are very different because there are certain tasks that would be performed instantaneously by people, while machines can take hours (and some cases, days) to **perform the same tasks**.

However, AI and humans complement each other, since AI, and due to exponential technological advancement, is able to process huge amounts of quantitative information in a considerably smaller time window, while humans are much more intuitive and can make better decisions in an uncertain environment. Currently, AI can only follow through in limited scenarios of uncertainty and may have difficulty in scenarios with conflicting interpretations.

Through the **automation of information processing**, AI will enable the development of complex systems that, when applied in organizations and in society, allow to increase the performance, effectiveness and efficiency of internal information processing, where a human resource will hardly have the capacity due to its limitations to process that same information. In this sense, AI will continue to transform and have an innovative impact on society (including in terms of available job offers), processes, services, public and private organizations.

State-of-the-art

It was in the year 1943 that Warren McCulloch and Walter Pitts published an article where they referred for the first time to the term "**Artificial Neural Networks**" as an artificial representation and reasoning structure that, through a mathematical model, could perform a kind of "**mimic**" of our central nervous system. In 1950, Claude Shannon presented a machine capable of making chess moves, whose system was based on **simple calculations** of positions and movements (Figure 1).

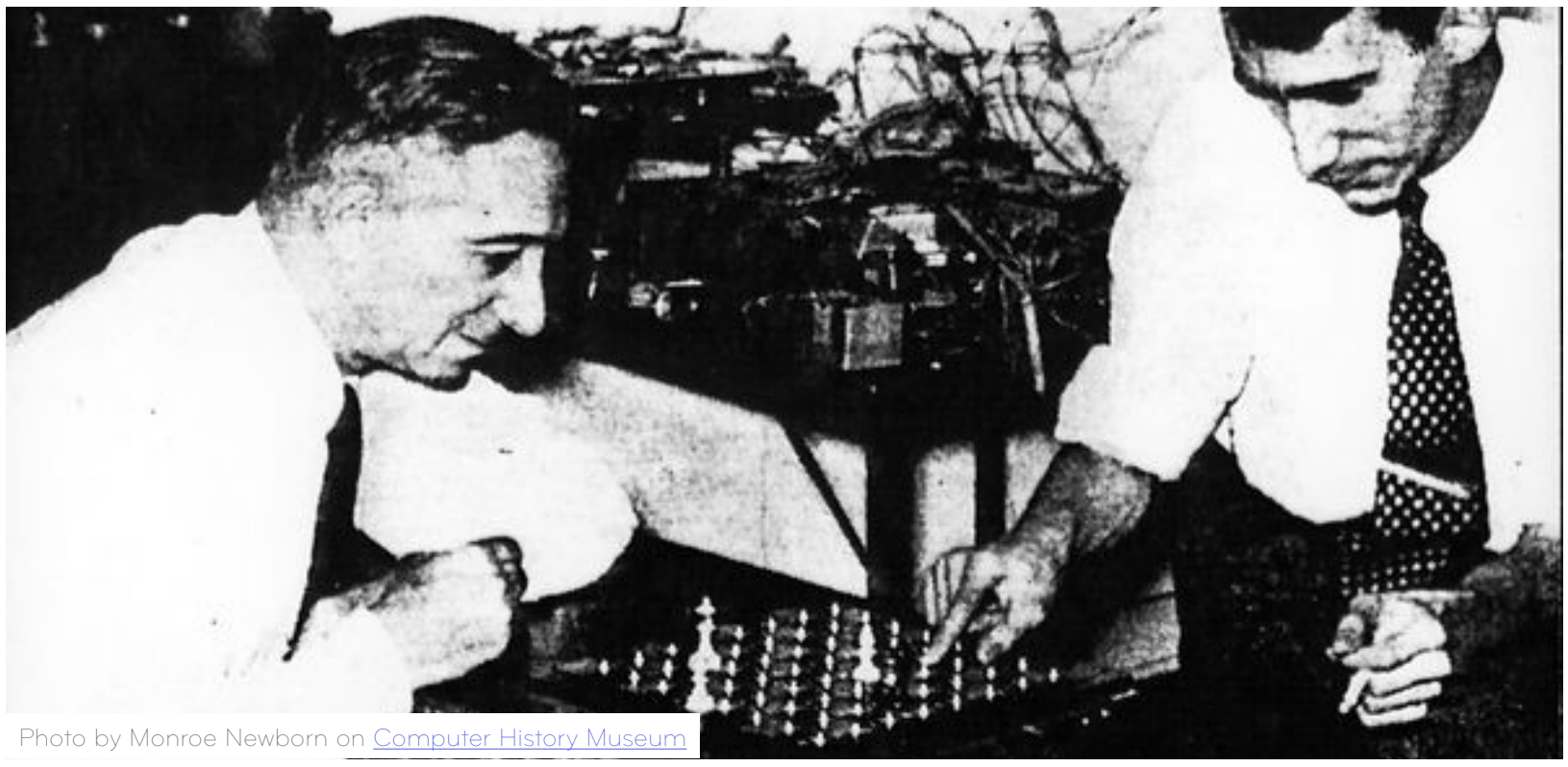


Photo by Monroe Newborn on Computer History Museum

Fig. 1. Claude Shannon, with his machine competing with chess champion Edward Lasker - MIT, United States of America (CHM, 2021)

Also in the 1950s, Alan Turing, considered the father of computer science (and by some, of Artificial Intelligence) developed one of the most acclaimed tests that put a given machine and a human being to the test, the Turing's Test (Laskowski, 2020), which consists in determining whether a machine has the ability to perform certain tasks by impersonating a human being in its entirety (Figure 2).

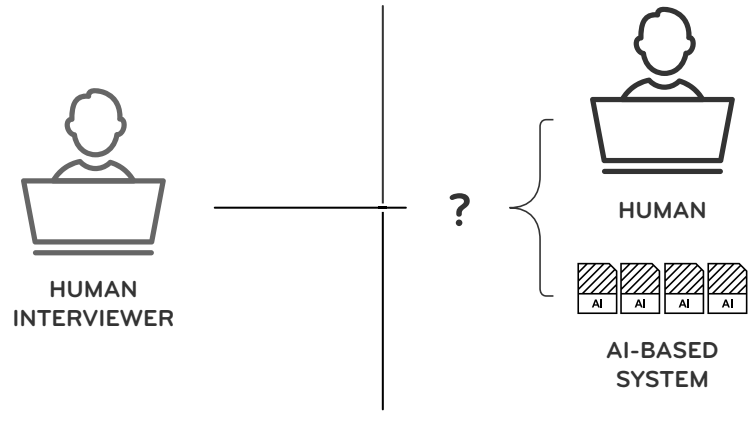


Fig. 2: An example of the Turing Test in action.

It was in 1955 that the term "Artificial Intelligence" (Eureka, 2019) was born, under the authorship of computer scientist John McCarthy, who defines it as "The science and engineering of making **intelligent machines**, especially **intelligent computer programs**. Figure 3 presents the most important milestones for Artificial Intelligence.

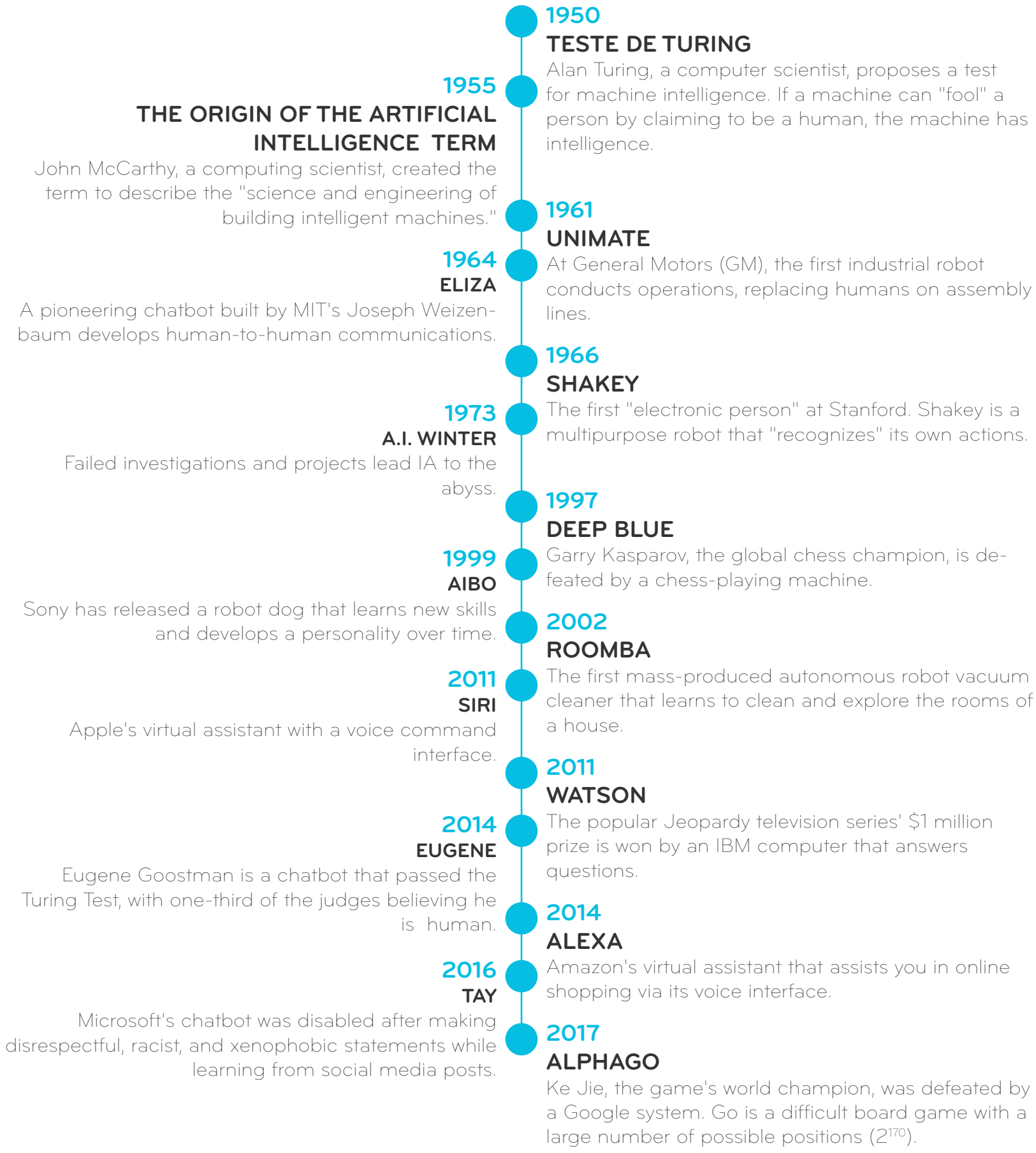


Fig. 3. The history of Artificial Intelligence.

Since 1955, Artificial Intelligence has gained popularity in the scientific communities, and nowadays it attracts the special attention of large organizations such as IBM, Google, Amazon, Microsoft, among others.

AI means the study of building machines with sense (perception), analysis or com-prehension, and human response.

AI gained popularity in the 1950s and, in recent years, has begun to be used for three reasons:

1. The availability of **big data**, i.e. the large amounts of data generated by e- commerce, social networks, and business;

2. Algorithms based on **machine learning** are optimized, making them more effective, efficient, and reliable;

3. **Cloud computing** and **high-performance computing systems** have become more affordable and powerful enough to handle more complex jobs.

AI is disrupting personal, social, and business life on a daily basis. It is used to create competitive, innovative and high- potential products, processes, and services (with general and even specific applicability, e.g. playing music, **playing chess**, painting, **driving autonomous vehicles**, etc.). AI is also widely used in industry, agriculture, logistics, healthcare, stock trading, **robotics**, **finance**, transportation, and education.

As previously said, AI refers to any and all algorhythms / technology / tools that replicate human behavior. Because AI is so vast, it was necessary to divide it into two sub- areas: *Machine Learning* (ML) (Simplilearn, 2018) and *Deep Learning* (DL) (Simplilearn, 2019 a), Figure 4.

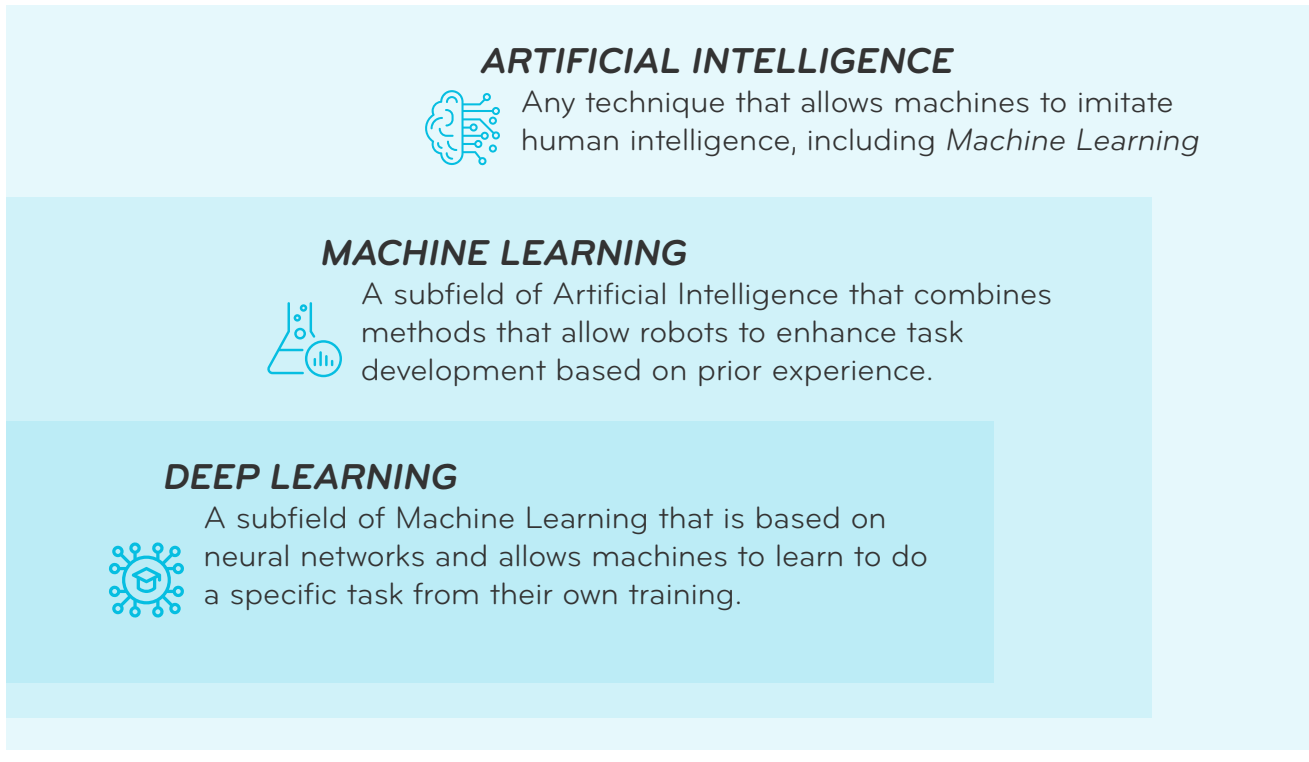


Fig. 4. Artificial Intelligence and its subfields: *Machine Learning* and *Deep Learning*.

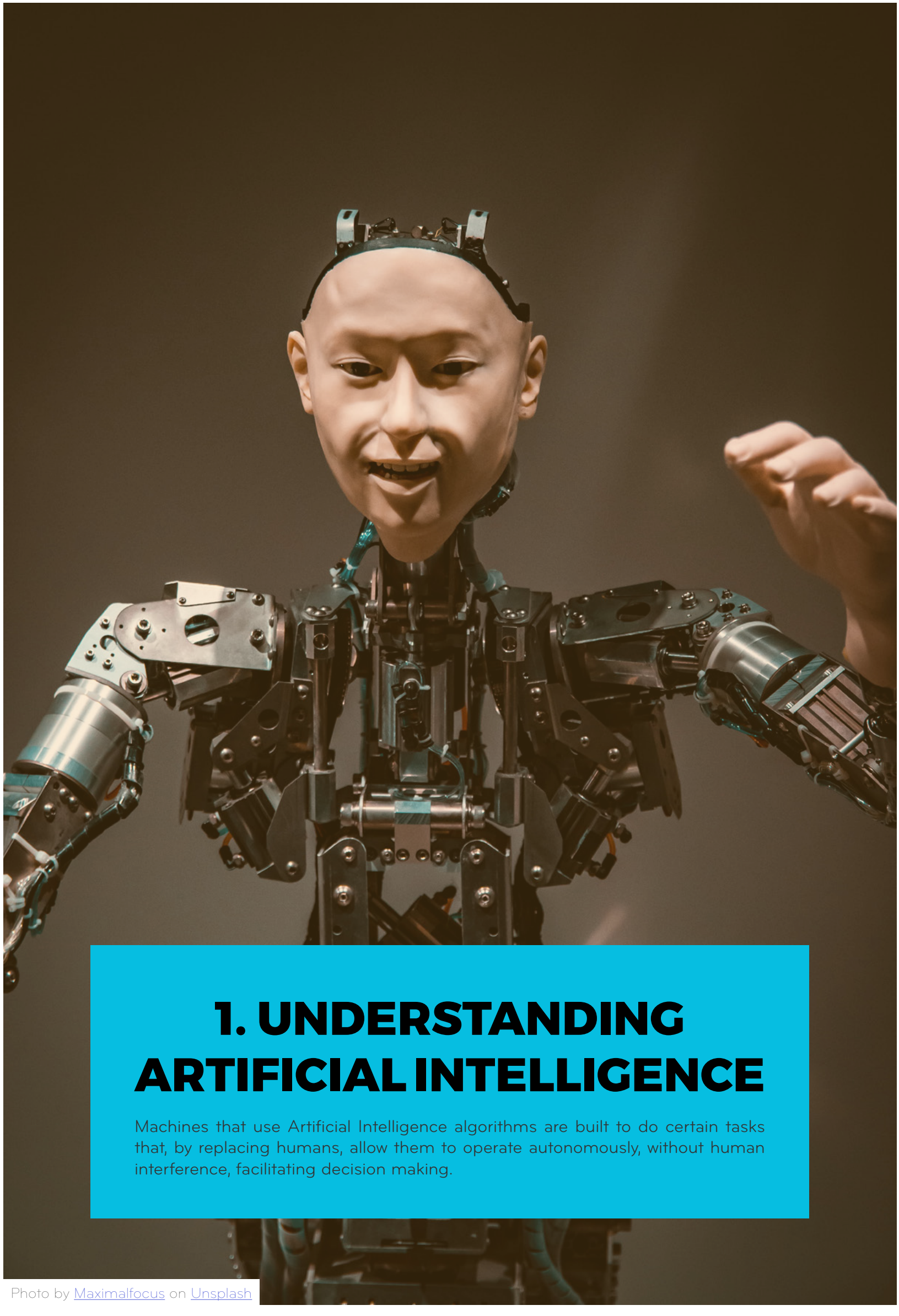
However, as the scientific community, the academy, and organizations began to invest more on new technologies in the AI area (and thus ML), the scientific community, the academy, and organizations began to bet more on these new methodologies supported by ML, allowing the emergence of new technologies / algorithms based on ML. However, as a result of this risky effort, new challenges emerged, resulting in more complex and demanding responsibilities.

Voice recognition, automatic text translation, fully autonomous driving, object identification in photos, and other activities are examples of tasks that, when performed by a human, are fairly simple, but when performed by a machine, are quite hard due to their complexity. Initially, machines were not used to conduct these tasks because the results were frequently not given in a timely manner due to a lack of computational resources.

Nowadays, these jobs are no longer "impractical" because of (mainly) the increase in machine processing capacity. These tasks gave rise to the most recent sub-area of AI known as **Deep Learning**, one of the most evolved technologies because it involves a whole concept of a high demand in terms of **computational efficiency** as well as its ability to **process a large volume of data**, whichwas inspired by two other scientific fields: *High Performance Computing* (HPC) (Google, 2020) and *Big Data* (Simplilearn, 2019 b).

Figure 4 depicts the integrated link between the AI scientific area and its subfields, ML and DL. This relationship also shows a ratio of **simplicity vs. complexity**, with DL-based algorithms/ technologies being far more complicated and demanding than **simpler algorithms** (easy tasks) that do not require ML-supported **algorithms** or even DL.

Keywords: Efficient Algorithms, Deep Learning, Operational Effectiveness and Efficiency, Complex Task Execution, Artificial Intelligence and Society and Organizations, Artificial Intelligence, Machine Learning, Process Simplification and Optimization, Decision Making.



1. UNDERSTANDING ARTIFICIAL INTELLIGENCE

Machines that use Artificial Intelligence algorithms are built to do certain tasks that, by replacing humans, allow them to operate autonomously, without human interference, facilitating decision making.

Photo by Maximalfocus on Unsplash

1.1. What is AI

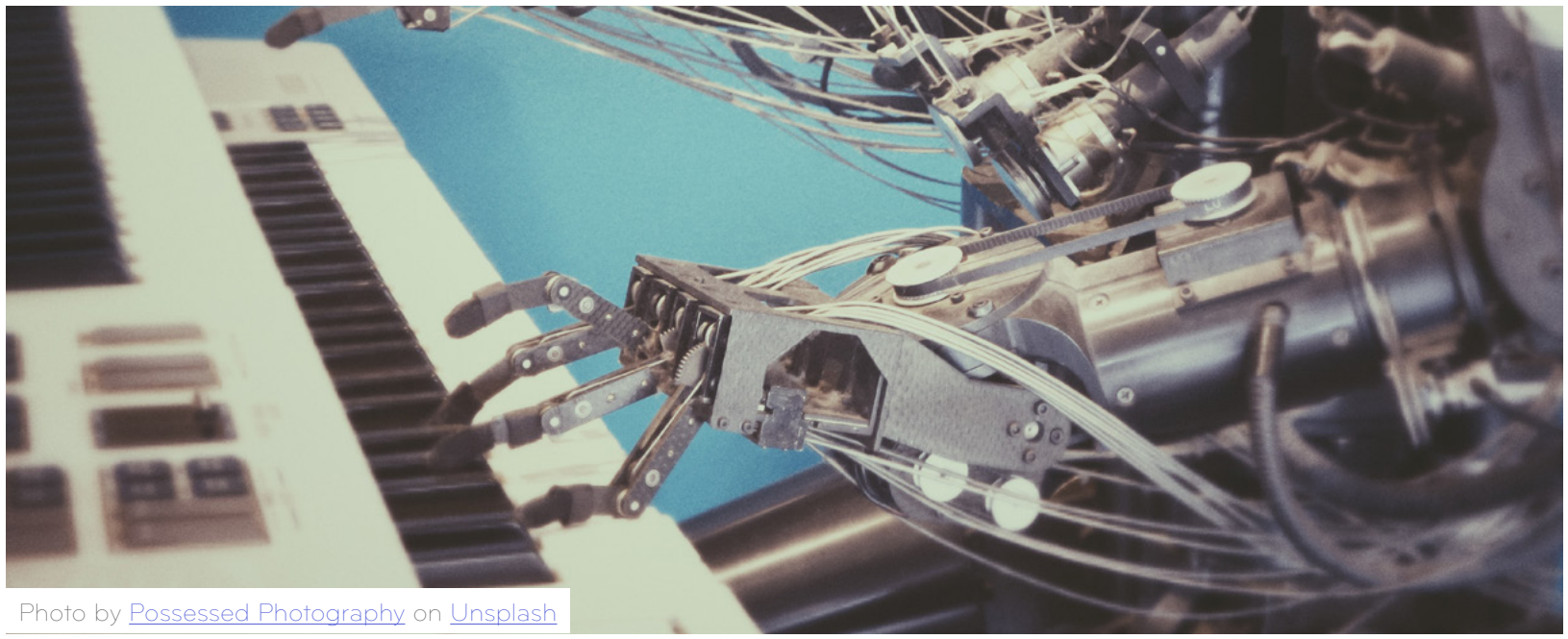


Photo by Possessed Photography on Unsplash

This section will define AI in a straightforward and clear manner. The reader will learn what AI is in a simple and natural approach, beginning with basic notions and progressing to more advanced concepts that are easy to understand for its application.

Artificial intelligence is the ability of machines to think like humans: to **learn**, **comprehend**, and **decide** (rationally) which paths to take in given situations. Computers required three fundamental pillars to progress from simple computing to the current one with Artificial Intelligence: Good data models for classification, processing, and analysis; Access to huge amounts of unprocessed information; Powerful computational resources at an affordable cost for effective and efficient processing.

In its "pure" form, AI can be used, for example, through the use of a Knowledge-Based System (KBS), which has a set of facts and rules (which are always assumed to be true) regarding a specific topic. These KBSs are "loaded" in a machine, and then a user asks questions about that topic, and the machine can "reply" based on the rules and facts that it has in its "knowledge" (e.g., what is the capital of Spain? Who was Portugal's first king? How many planets exist on our solar system?). It could also be applied to sensory systems that "guide" themselves based on rules and situations (for example, a robot that wants to get from point A to point B by performing "turn left/right," "go straight," "brake" movements, and so on). However, none of the above-mentioned systems are called "**machine learning**" systems, but rather "**intelligent systems**" because they show human-like behavior.

Machine Learning emerged from the need to catalog computers with the ability to "learn," allowing the development of algorithms capable of performing tasks that were "learned" (and not the result of KBS). For example, when a child is learning, the system absorbs, analyzes, and organizes input in order to understand and recognize what objects, people, patterns, and reactions of various kinds are.

Artificial Intelligence points to a future where platforms and systems will have enough intelligence to learn and execute **precise**, **accurate**, and **optimized** actions.

1.2. What is AI for

Nowadays, AI is present in intelligent and integrative systems in the form of **commercial products**, **processes**, or services, as well as in the defense and civil sectors of businesses and other organizations.

According to Forbes' article "**The Seven Patterns of Artificial Intelligence**", AI-based solutions can be used for pattern detection and recognition, autonomous and automated system development, event/goal-driven systems, predictive analytics, and human interaction systems, among other things (Figure 1.1).

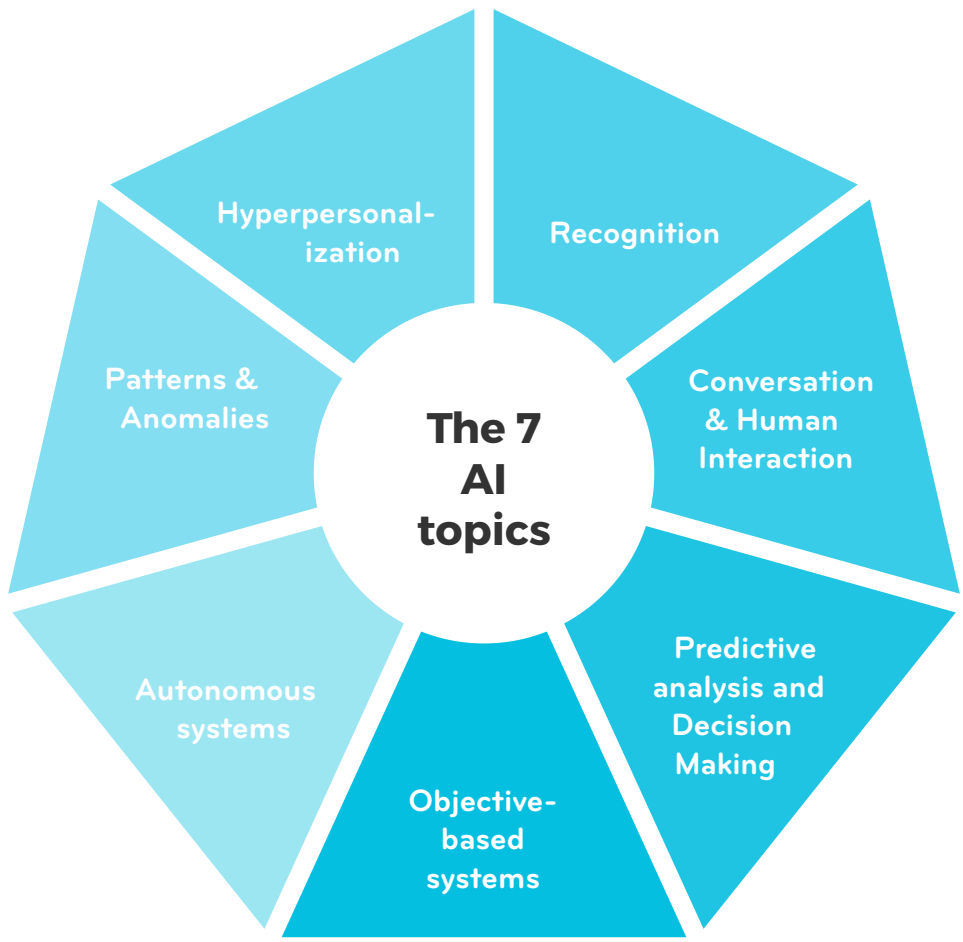


Fig. 1.1. The seven topics of Artificial Intelligence (Source: Forbes)

Intelligent machines are capable of recognizing images, audio, text processing and text translation, facial recognition, among other capabilities. However, in ***Machine Learning***, it is possible to create Artificial Neural Networks (ANNs) (Simplilearn, 2019 c), as well as intelligent assistants (Alexa, Siri, Cortana, Google Assistant) (respectively Alexa, 2016; Cortana, 2015; Google, 2018; Siri, 2017), which are vastly present in mobile devices. The focus of the market's products, services, and processes is the development of machines and platforms that learn from use and the demands of each market segment.

Because of the wide array of applications, artificial intelligence has a substantial impact on multiple sectors. It provides a performance capable of analyzing huge amounts of information in a matter of seconds and **making appropriate decisions** in the security domain. It has an impact on output, **quality**, **human resources**, and **sales** in the productive sector.

1.3. What are the components of AI

Table 1.1 presents the scheme of AI components and their interaction for developing **intelligent platforms and machines** in a pedagogical and simple way.

There are six major components that are required for AI to operate. While not all of them satisfy the traditional definition of AI, the **following are the key building blocks** of AI:

Table 1.1. Diagram of the AI Components.

1	2	3
IA APPLICATIONS Packaged applications that solve a business problem (virtual agents, financial planning)	**DATA PREPARATION AND CLEANING** Prepares the data for AI algorithms	**MODEL, BUILD, TRAIN AND RUN** A data science artist's studio for creating, training, and executing models (Machine Learning)
4	**5**	**6**
CONSUMER RESOURCES Speech, images and vision, used mainly in consumer use cases	**BODY LANGUAGE PROCESSING** The nervous system of business AI	**MANAGING THE LIFECYCLE OF AI MODELS** Understanding how they operate

1.4. *Machine Learning*, *Deep Learning* and Natural Language Processing

Because AI is such a broad scientific field, there are major subfields, the most prominent of which are as follows:

- ***Machine Learning***
  As the name implies, it is an area that includes the algorithms and technologies used in machines that were developed during design using "learning" approaches. Instead of setting rules for the machine to execute (with the desired result), it is possible that the machine will learn to "generate" these rules from the data, getting at the expected result automatically. Customized recommendations from platforms such as Netflix multimedia and Amazon Prime Video, for example, indicate titles (movies and/or TV series) based on the user's preferences, which can range from favourite movie genres, filmmakers, main actors, and other properties. As a user reads and consumes the content, the system can learn their preferences, resulting in a better user experience.

  There is a subfield of ML called *Reinforcement Learning* (RL) (Syllabus, 2018) which is related to a machine's ability to learn through a **cumulative reward system**, its behaviors will be evaluated, and the algorithm will be "rewarded" or "penalized" based on its classification. The machine learns whether it should conduct a specific set of activities or adjust its behavior in order to maximize the reward and minimize the penalty through this reward system.

  Figure 1.2 depicts a cyclical representation of an intelligent agent with a set of actions to perform when confronted with a specific environment. By repeating these behaviors in the environment, it will receive "rewards" or "penalties," which may cause the agent to learn and "adapt" its actions, eventually adopting an optimized set of actions that maximizes the reward after a few trials.

Fig. 1.2. Example of an RL-based system application (based on the game "Super Mario World")

- ***Deep Learning***
  A área do ***Deep Learning*** (DL) is a subfield of ***Machine Learning***. The main difference between the two fields is that DL is fully related with the use of (more complex) **Artificial Neural Networks**, which enable the execution of tasks that are also more complex. Because of their design, simple Artificial Neural Networks (found in ML) are no longer applicable to challenges such as computer vision. **Computational Vision** is one of the most exciting areas that DL is exploring (CV). CV is the scientific study of images and how machines "look" at images to perform tasks such as image classification, object identification, face recognition, and driving autonomous vehicles using real-time video, among many others. Because it requires a significant amount of computational effort, this field is now widely used, particularly in self-driving cars. (Figure 1.3).

Photo by Nvidia on Nvidia.com

Fig. 1.3. Autonomous car that uses computer vision to perform autonomous driving (NVIDIA Corporation, 2016).

Figure 1.3 shows an example of autonomous driving using DL-based algorithms. Tesla, a wellknown American automaker known for technological innovation in these areas, promotes **autonomous driving** as a feature on their cars. Tesla uses **computer vision technologies** that enable cars to drive in a way that completely reduces the intervention of a human driver by **identifying objects in real-time** (other vehicles, road markings, pedestrians, traffic signs, and so on). This is made possible by an **integrated camera system** (placed in their vehicles) that captures all information from the surrounding area, allowing the programmed algorithms to make **highly efficient and effective decisions**.

- **Natural Language Processing**
  This field, which is also part of the Machine Learning field, is in responsible for **Natural Language Processing** (NLP) (Edureka, 2018). This processing includes, among other things, voice recognition, text-to-speech and text-to-text conversion, text-to-speech translations, text characterization, and **sentiment analysis** via voice/text. **Machine Learning** techniques are used in this processing to find patterns in vast pure data sets and recognize natural language in a variety of ways. Thus, sentiment behavior analysis is one kind of NLP application, in which algorithms can search for patterns in sentences posted on social networks, for example, to identify how users feel about specific brands and products. Amazon, an American multinational technology business, provides an online store that, while selling its products, publishes a set of user evaluations showing their satisfaction with a certain product. Given that 88% of buyers trust reviews more than personal recommendations (Figure 1.4), the presentation of these reviews allows the buyer to feel more confident when making a purchase decision (Haque et al., 2018).

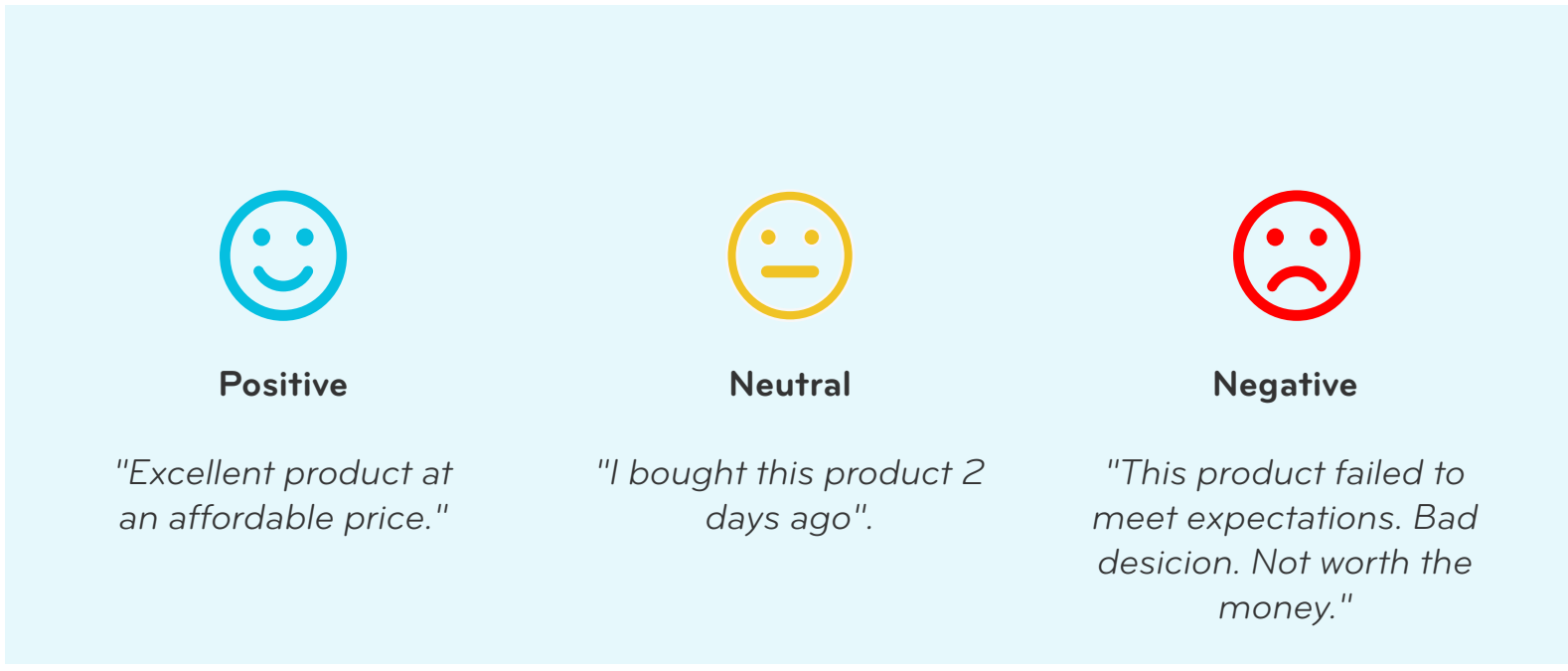


Fig. 1.4. Example of sentiment analysis of a product based on the content of the review.

In the example depicted in figure 1.4, it is possible to extract the "**feeling**" (or satisfaction) that a certain consumer has about a product and/or service using NLP-based algorithms. This might, for example, help vendors in improving their products based on the evaluations, filtering out only the "negative" ones so that they can understand the "pain" of their consumers in order to provide a better service. **Sentiment analysis** can also be used to exclude reviews that are considered invalid (for example, unfounded or poorly reasoned reviews) (Haque et al., 2018).

1.5. AI features for technology transfer

The type of the technology being transferred is a key factor impacting the process and outcome of **technology transfer**. The main properties of Artificial Intelligence technology allow one to move toward a framework that supports the **user's decision making** by maximizing their policy formulation on technology transfer.

AI has five characteristics: **complexity**, **location**, **uncertainty**, **capital intensity**, and **awareness**. Some of these features are, in theory, shared by other cutting-edge technologies, but they are unique to AI.

The **multidisciplinary nature** of AI technology contributes to its complexity. Certain AI subfields are locally constrained and require local innovative resources to develop on the fundamental concepts. The uncertainty in AI projects derives mostly from two factors: **the fast rate of development** and the challenges in quantifying the benefits of **transferring cognitive load** from human to machine.

Skilled human resources and **novel technologies** are necessary to build, operate, and use AI systems efficiently, meaning that these projects can be capital-intensive. Finally, because AI is new and not always totally transparent about itself, decision-maker awareness may be a significant issue to overcome in the growth of AI applications.

Photo by Maxim Tolchinskiy on Unsplash

1.6. Where can we find AI (types and sectors)

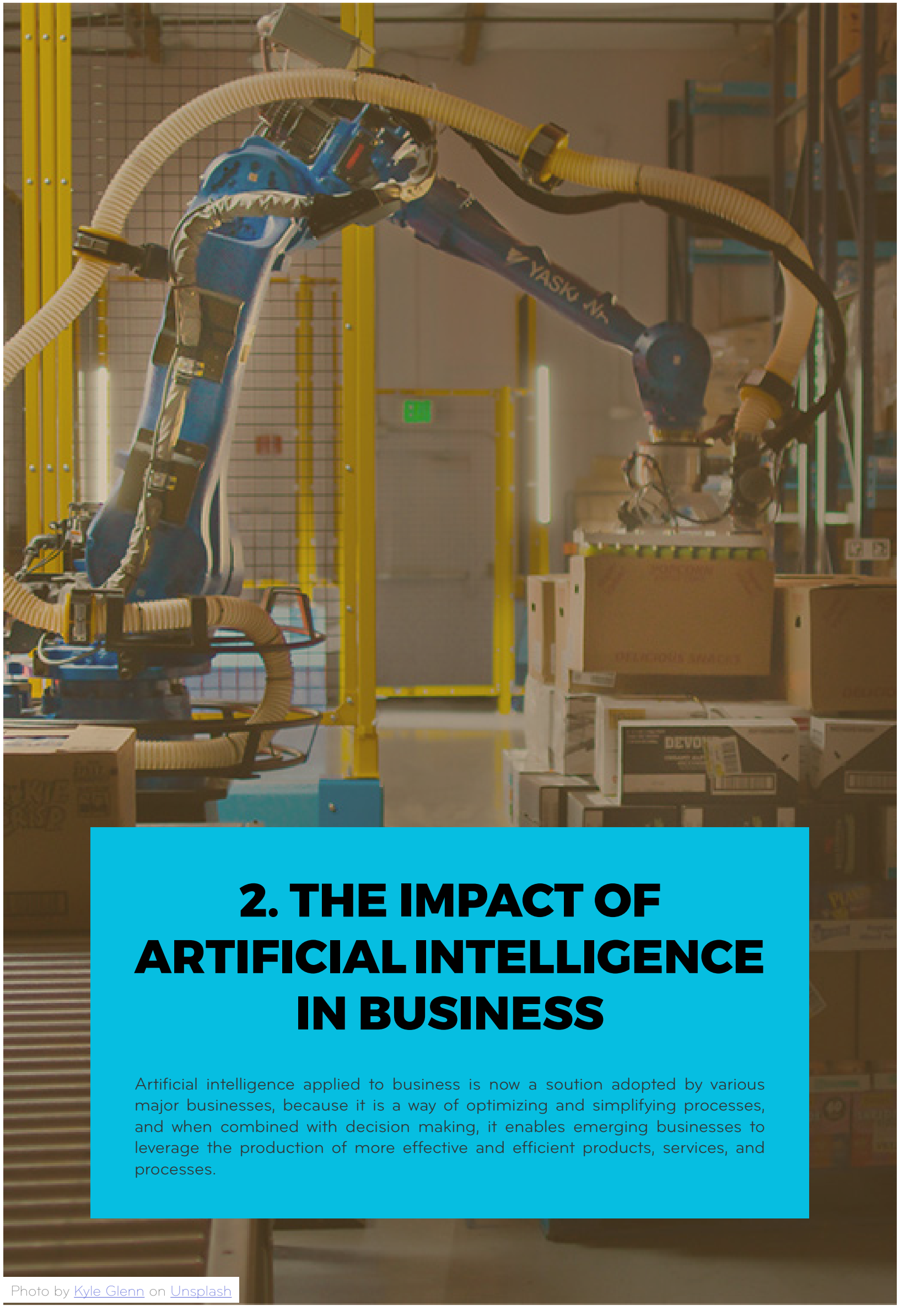
AI offers a wide range of applications in a variety of fields and industries. It can be applied to Climate Impact, for example, by using fleets of drones capable of planting a billion trees per year to mitigate deforestation, or by using unmanned underwater vehicles to detect leaks in oilfields, intelligent buildings designed to reduce energy consumption, and so on.

As **Personal and Virtual Assistants**, AI is used in the form of **interactive chatbots** that may recommend goods, restaurants, hotels, services, and shows based on our search history and emotional information for that day and location. In finance, AI can assist in the detection of fraud, the prediction of market patterns, and the recommendation of transactions to your clients.

In agriculture, through **Intelligent and Digital Platforms** that increase agricultural output, inform about negative environmental effects, and trigger **fully automated actions** using **predictive analysis**. It is useful in education to determine if a student is about to cancel his or her enrollment and to recommend new courses or to develop customized proposals to improve learning. AI helps the generation of sales projections and the selection of the most suited product to recommend to the customer in the commercial activity.

Companies like Amazon use algorithms to predict whether a book will be popular or not before it is published. In **Logistics and Transportation** field, its use can help to minimize collisions and traffic congestion, contributing to traffic flow optimization. Tesla has designed a system that, when its cars initially travel on a route, communicates information with other vehicles in order to send information to intelligent systems that can aid in decisionmaking.

In the field of health, there are chatbots that already ask for symptoms in order to formulate a clinical diagnosis, and data collecting allows pattern recognition algorithms that aid in the identification of genetic elements that make a person prone to illness development. As a result, there is a large field of industries and domains where AI is present and has a significant impact on the growth of society and, as a result, the success of companies.



2. THE IMPACT OF ARTIFICIAL INTELLIGENCE IN BUSINESS

Artificial intelligence applied to business is now a soution adopted by various major businesses, because it is a way of optimizing and simplifying processes, and when combined with decision making, it enables emerging businesses to leverage the production of more effective and efficient products, services, and processes.

Photo by Kyle Glenn on Unsplash

2.1. Being an entrepreneur and moving towards success in the AI era

AI is now widely used in companies as a tool to assist employees, and it is critical for business management, process automation, defining innovative strategies in the supply chain, market analysis, human resource performance analysis, commercial strategies tailored to each customer, behavior analysis, emotional analysis, and so on.

With AI's learning power, it is possible to adapt and adjust products, processes, and services with positive effects on a company's or other type of organization's bottom line. Artificial intelligence (AI) is already widely used in the financial, banking, insurance, education, healthcare, and other business areas.

It is important to identify the needs and **new business prospects**, as well as improvements that can be optimized using **AI algorithms**, in order to increase productivity and, as a result, billing and profit.

The main advantage of AI and its subfields is the ability to access a large amount of information that can be **analyzed**, **categorised**, and **correlated** to help in **decision making** in organizations in order to improve their performance and act in the improvement of productive quality. On the other hand, at the business level, processes can be triggered to predict customer interests and consumption. It is also possible to know which products and services are most in demand, as well as which or who are the best clients, in order to adapt marketing actions and provide unique products and services to current and future customers. Aside from being able to perform more efficiently and in repetitive tasks for employees, AI applications can also deliver **more creative and original work** from customers.

Today, many customer interactions are handled by algorithms including **AI for virtual assistants** that integrate **text**, **speech**, and **even image**, and that can solve and troubleshoot first and second line problems while minimizing human intervention in repetitive tasks.

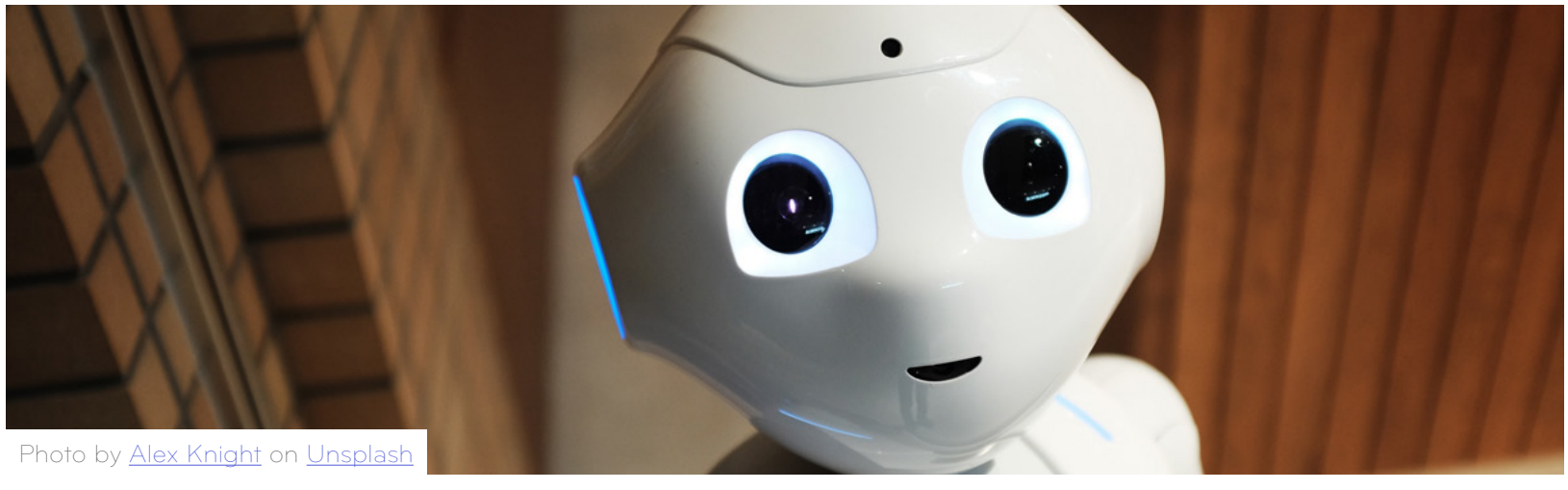


Photo by Alex Knight on Unsplash

Some examples illustrate how artificial intelligence (AI) can be used to improve business performance (Neurotech, 2021):

- **Insurance**
  the creation of an integrated digital platform that includes AI algorithms led to fewer claims due to the usage of a "information-rich" database, which resulted in better decision making. Adopting this platform brought in a 500% return on investment (ROI), a 20% reduction in claims, and a 5% reduction in annual costs.

- **Access to credit**
  with an unique AI-supported system, the customer evaluation for card issue was reduced from 25 to 3 minutes in organizations that had been stymied by long wait periods for cards and authorization for their issuance. On the other hand, even if a customer had a negative alert in accessing credit, this new mechanism allows the organization to analyze their effort capacity and offer credits immediately, increasing profits.

- **Shopping**
  as is usual in many online shopping platforms, the consumer gets notified of products that are likely to be of interest to them based on their profile and purchase history. Furthermore, when users enter the platform, they can be encouraged to visit the items of their choice in each of the sections, as well as with promotions that can **trigger the deal instantly**.

2.2. What are the best initiatives for the company to grow in the age of machine intelligence?

In a **production process**, whether as a **product**, **process** or **service**, it is important to identify what is to be developed and how it can be improved, with greater effectiveness and efficiency, to assess the need for the use of AI in its generality or sub-areas.

The identification of the company's areas and sectors is critical in the formulation of the **initial assessment plan** so that **the use of AI and its components** can be an important tool to consider in a company's area or sector for the development of initiatives that may impact the company's growth.

After identifying the area or sector that is intended to become more effective and efficient, it is important to clearly establish the production target and, in the value chain, evaluate which are the priorities for improvement and the challenges associated with each of these priorities. Priorities and challenges will allow for the quantification of the workforce associated with the projects to be developed, as well as the preparation of a plan that will allow for the **identification of the general goal** with its specific objectives in which AI algorithms can integrate **the transformation process** or even **innovation**.

There is no one-size-fits-all recipe; instead, perform a requirements analysis and then make a strategic decision based on well-defined planning, from the requirements and specifications to the development plan of the activities and even their demonstration of operation with the identification and evaluation of **key performance indicators (KPI)**.

It is always important for an entrepreneur who wants to use AI to consider what services are accessible and what the benefits for the customer are with the introduction of AI. This is critical in designing efforts that seek to address market demands and opportunities.

2.3. AI as a tool to support decision decision making and services for customers

Every marketing decision has several challenges, such as knowing and understanding customers' demands and aligning products and services to these expectations. Simultaneously, **knowing shifts in consumer** behavior is critical for making short, medium, and **long-term decisions**.

With the use of AI it is possible to have a better understanding of customers. Using an AI platform integrated with a decision support system will enable **real-time trend forecasting and analysis**.

Consider the following examples of how AI is being used to **improve customer service** as a source of inspiration for businesses (Salim, 2021).

One of the most common applications of AI in customer support is the **use of chatbots**. Chatbots enable companies to expand their first line of support: instead of having employees address particularly specialized requests, companies are turning to chatbots to answer customers' most common questions, reducing traffic to other support channels.

Customers prefer intuitive and immediate experiences and do not want to fill out forms to request basic information. Chatbots allow you to provide feedback to customers in real time and in a very simple way.

In employee assistance, various information is needed for task development. Chatbots can be used by the employee to interact on a question/answer basis rather than consulting a text interface, providing a lot more efficient system and a consultation style in a natural approach.

- Software such as the Drift (Drift, 2021) and Intercom (Intercom, 2018), include chatbots for a variety of topics, but other platforms provide the means to easily construct your own chatbot services customized to your business's needs. One example is CredAbility (CreadAbility, 2019), which has developed an application to create chatbots that serve as personal financial advisors to assist consumers in developing specific action plans to achieve goals such as raising their credit score (Figure 2.1).

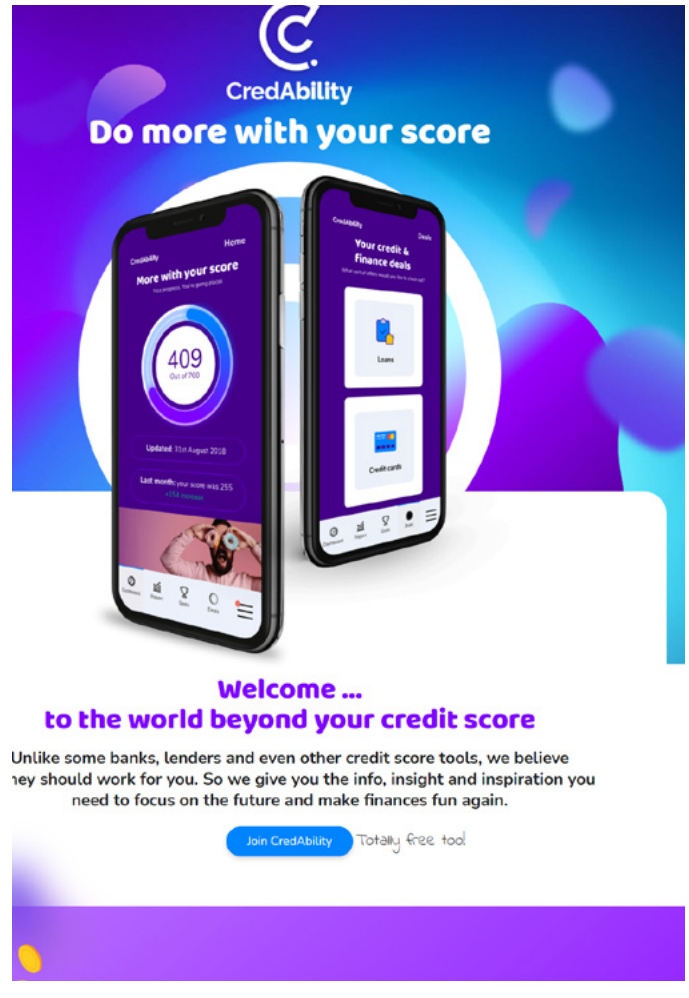


Fig. 2.1. CredAbility Platform. Source: (CredAbility, 2019)

2.4. Artificial Intelligence as an engine of constant innovation: new business models

Because everything is interconnected, businesses may now collect more data and thus innovate more effectively. As a result, we can expect a much-needed market evolution: **faster markets**, **easier operations**, **vibrant businesses**, **increased profits**, **informed consumers**, and **dynamic companies**.

Although enterprises in multiple industries and countries have different levels of AI adoption, it appears that the current approach to AI strategy is overly narrow, as enterprises have primarily adopted the use of AI to improve customer services, analyze data, predict performance, automate work efforts, business actions, and so on. The AI application and adoption trend has yet to effectively respond to the constantly developing intelligence capabilities. A lack of digital infrastructure may prevent data opportunities and innovations, and information must be shared between businesses in a controlled and corporate manner.

3. OPPORTUNITIES, SOLUTIONS AND BUSINESS TRENDS

When dealing with automated solutions that do not require human intervention, they raise operational security, information security, and other ethical concerns that could compromise their deployment. However, it is vital to give clear solutions to any potential problems that may arise.

Photo by Kyle Glenn on Unsplash

3.1. The importance of digital and information security

The increasing storage of data to "feed" AIsupported algorithms requires some prudence in terms of security. AI is now an area with essentially no regulations of engagement, and each government has issues in developing **security from algorithms** while taking **international laws** into account. Despite the fact that algorithms have no boundaries and **no worldwide regulations or regulatory agencies** are applied to algorithms, the source of the data exists, it is protected, and its usage is limited.

Even though some agreements have emerged regarding **cybercrime**, the interpretation of AI warfare remains outside of legally obligatory responsibilities. In the lack of an agreement on AI standards, business models and the company itself may be vulnerable.

For a more in-depth understanding of this subject, consult the e-book "Digital Security in New Businesses" (Santos and Sebastião, 2021).

3.2. Implementing AI implies ethical issues and lack of transparency

With the advancement of artificial intelligence, it is important to consider the ethical implications of the decisions that robots can make.

A typical illustration of a potential dilemma involves an autonomous vehicle that, on the brink of an accident, must choose between slamming into a wall and endangering the lives of its passengers or risking running over a group of pedestrians.

It is a difficult decision to make, due to the multiple circumstances. Perhaps the pedestrians are youngsters or elderly persons who outnumber the passengers in greater or lesser numbers. It is difficult to anticipate all possible outcomes in order to establish standards to follow and teach the AI to think ethically and morally.

The need to describe, inspect, and reproduce the mechanisms by which AI systems **make decisions** and learn to adapt to their surroundings is referred to as transparency.

There is a civil liability associated with the use of AI, which concerns **regulatory organizations**, society, and users. In this context, **transparency mechanisms** that allow algorithms and the results they generate to be reviewed are required.

If it is assumed that computers are in the process of obtaining emotional intelligence and that sensors used in the context of the *Internet of Things* (IoT) (Internet, 2018; Internet, 2020) it will amplify

the information base of this technology. This is a critical problem that must be debated by various stakeholders and with the active engagement of society.

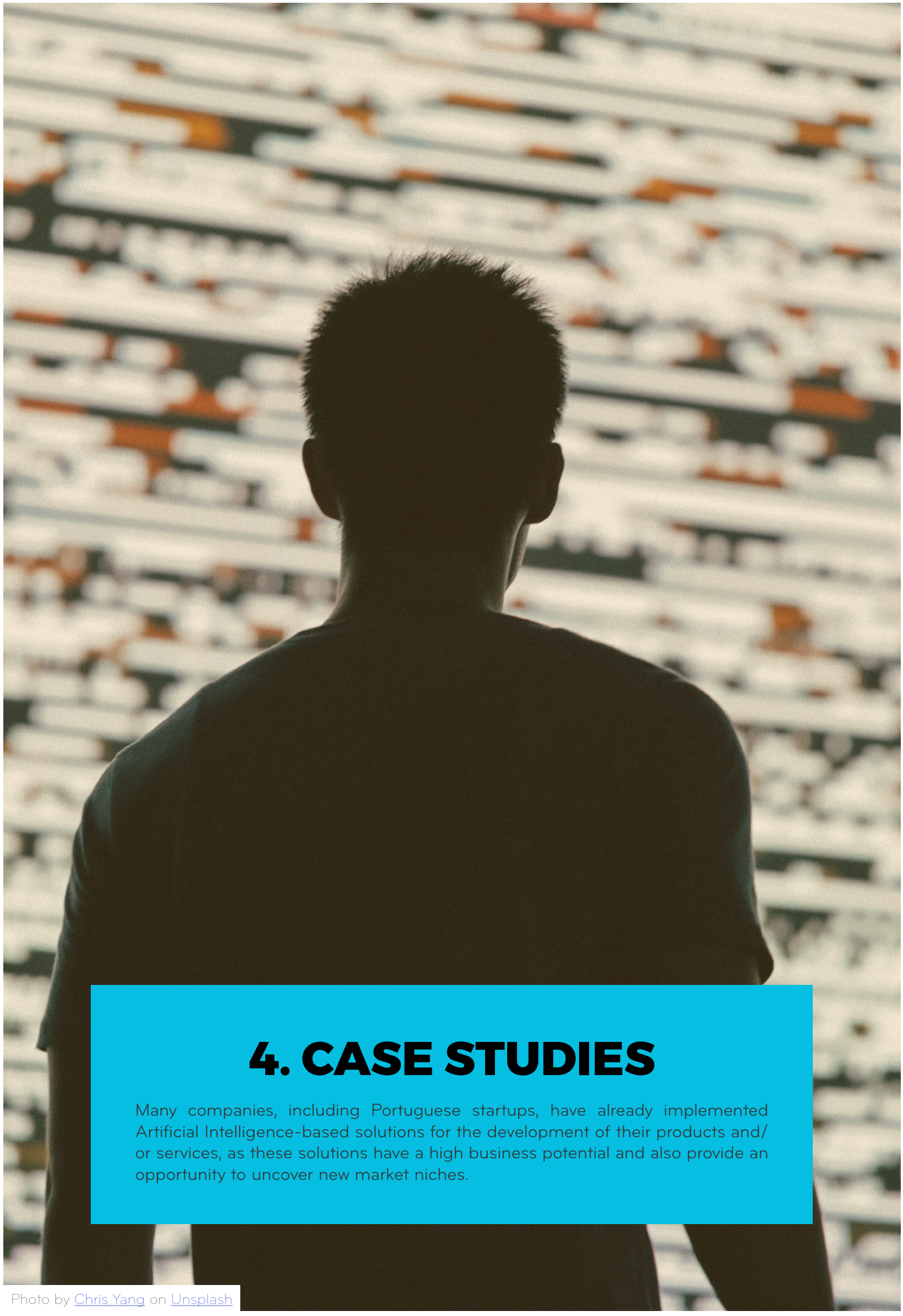
To apply AI in **decision making,** it is important understand the best approaches to solve problems, i.e., the ability to make decisions capable of delivering solutions of value to the customer while taking **ethical and deontological considerations** into account.

3.3. What are the business trends in AI

AI and ML have proven to be essential parts of business strategies, a trend that has intensified since the outbreak of the pandemic. To stay ahead of the competition in this industry, it is important to combine talent (data experts with specific financial experience), investment, and the most advanced technology solutions.

Explainable Artificial Intelligence (explainable AI, or xAI) (Explainable, 2021), is a major challenge that organizations must address if they are to take regulatory requirements into account. During 2020, new roles have emerged for **data science** professionals, and **data scientists** have already identified new ways of doing business, generating considerable value for companies.

Many organizations are already using NLP to extract value from **unstructured data**. Working with unstructured data is important and a trend to consider in the short and medium term.



4. CASE STUDIES

Many companies, including Portuguese startups, have already implemented Artificial Intelligence-based solutions for the development of their products and/or services, as these solutions have a high business potential and also provide an opportunity to uncover new market niches.

Photo by Chris Yang on Unsplash

4.1. Success

Several products and services are available around the world that leverage AI as the backbone for some **unique products**. The following examples are thought to be inspiring references for **prospective entrepreneurs**:

Feedzai

Uses AI to fight fraud and money laundering

Feedzai, a Portuguese business committed to ML-based solutions to make banking activities significantly safer, has developed anti-fraud software that allows for a set of autonomous analyses to detect and combat illegal behaviors. Feedzai is now worth $575 million, according to Forbes (D'Onfro, 2019).

DefinedCrowd

Recruits *freelancers* to train AI-based algorithms

DefinedCrowd, which is also a Portuguese company, works on the development and optimization of ML algorithms through **data collecting and processing** in order to build **intelligent systems**. According to Forbes, DefinedCrowd already has a market worth of 38.8 million dollars, ranking 46th among the most promising companies in the Artificial Intelligence universe (D'Onfro, 2019). DefinedCrowd built its first office at Startup Lisbon three months after it was founded. The company grew from three employees in the Portuguese capital to a global team of over 150. In 2016, this startup raised 1.1 million dollars in a seed investiment (ITFactory, 2020), with business investors like Sony, Amazon Alexa Fund, Portugal Ventures and Busy Angels. DefinedCrowd raised $11.8 million in a Series A investment (Reis, 2019) in July 2018 and recently raised $50.5 million in a Series B investment (ITFactory, 2020).

AssetFloow

Helps companies in optimizing space by extracting people routes and occupancy.

This Portuguese business monitors the flow of people in retail outlets using **ML-enabled algorithms** to analyze and improve the movement of people without the use of sensors or cameras, generating outcomes that are more than **90% accurate**. By analyzing consumer profiles and their trajectories, the system can make recommendations for organization and product arrangement to businesses, allowing them to increase sales. AssetFloow recently received an international prize of 20,000 euros (Salvador, 2020).

Skyverse

Uses AI algorithms to perform dronebased industrial inspections

This Portuguese startup implements **computer vision** mechanisms and algorithms based on **Deep Learning**, enabling inspections in the most diverse areas of industrial application, such as solar panels, wind towers and wind turbines, bridges, thermal and hydroelectric power plants, roads and railways. It provides **automatic detection** of failures, defects, and anomalies that may compromise the proper operation of infrastructures. These technologies allow for the optimization of current periodic inspection tasks in order to conduct **preventive and corrective maintenance operations**.

H&M

H&M uses AI to boost the efficiency of operations that were based on extracting information.

The company adopted an analysis of various critical points, such as:

1. Bad Product Cycle: By implementing AI, it is possible to **identify trends**, manage stock, and establish pricing to generate profit.
2. Supply for individual stores: With over 4,000 centersstores worldwide, the business used to deliver nearly identical stock to all of them. AI may be used to optimize the entire process of evaluating returns, receipts, and loyalty card data in order to personalize the inventory that goes to each store.
3. Automated warehouses: The company has automated warehouses where customers can acquire goods in just one day.
4. Customer experience: the company provides customized suggestions via algorithms, **integration of the physical and online shopping experience**, and **RFID technology** to have information about products and know where they can be found.
5. Customized fashion: in partnership with Google, an Android application analyzes customer behavior to create custom designs.

Governo do Reino Unido

AI is being used as a strategy to position the country in this technological field.

In addition to the government's AI approach, an AI-based algorithm was used to detect benefit fraud in the benefits program and identify the criminals responsible for such frauds.

When a claim is flagged as suspicious, a (human) investigator is deployed to determine whether or not the claim is fraudulent.

AI is used to evaluate social media profiles in order to detect anomalies in the information that users post on the networks. The algorithms discovered several suspicious situations, such as a person claiming unemployment benefits while attending a lavish party and posting images on social media. And yet another person who receives disability assistance and has uploaded images of himself participating in sports. Another common example is pretending to be single and uploading wedding photos. When inconsistencies are discovered, benefits are halted and an analysis at a higher level is conducted.

Rolls-Royce e Google

Work together to develop and transform smarter ships

Rolls-Royce and Google are collaborating to deploy powerful machine learning algorithms in ships to make them smarter, safer, and more efficient.

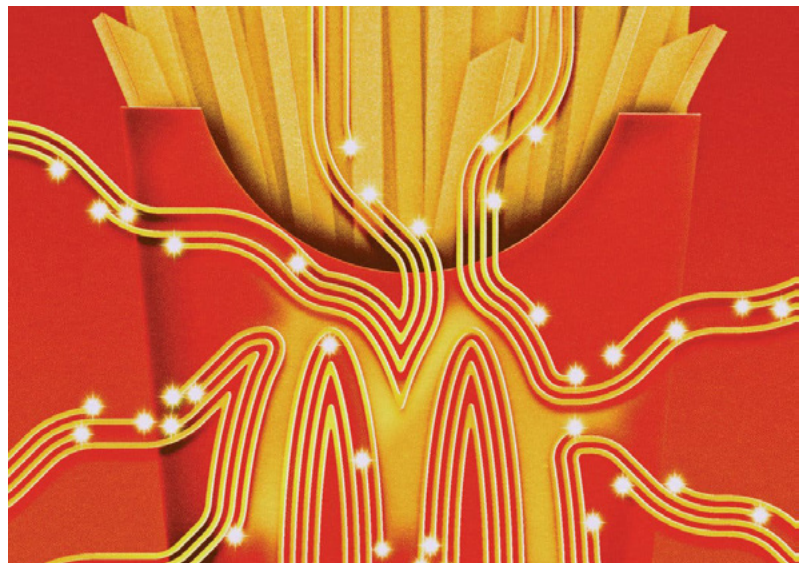
In a variety of applications, the project makes advantage of **Google's Cloud Machine Learning Engine**. The expectation is that we will progress to an autonomous vessel (similar to an autonomous automobile), but with higher complexity. AI replaces only one person in a car: the driver. There are more than 20 crew members on a cargo ship, for example, and algorithms are required to fulfill the jobs of the entire team.

Cameras and other **sensors** on board ships will generate a large quantity of data, which will be kept in the cloud and shared and uploaded to vessels located anywhere in the world, as well as the operations center.

Although Rolls-strategy Royce's for an autonomous vessel has been in the works since 2013, the company is still facing legal challenges.

McDonald's

Develops a data-driven culture



McDonald's has been relying on artificial intelligence (AI) to minimize costs and improve business efficiency since 2017. This company has a presence in 188 countries and serves over 69 million clients every day.

The company's Growth Plan is based on the use of AI algorithms to provide a more personalized and enhanced customer experience. The McDonald's app allows for ordering and payment, and it is possible to learn how frequently a consumer visits a chain location, what they buy, and whether or not they use the drive-through. This allows the brand to recommend other products, increasing sales. In Japan, sales have increased by 35%.

Data-driven digital menus: The company has launched new digital menus that update the options based on real-time data analysis. For example, on a cold but sunny day, the menu may highlight comfort items, while refreshing beverages may be highlighted on hot days. Such menus have increased sales in Canada by 3% to 3.5%.

Trend analysis: Using the data collected, McDonald's may acquire insight into the individual performance of each restaurant, as well as best practices that one location can share with another. The data is used to maintain a **consistent customer experience**.

Forbes has compiled a list of companies that have employed AI to achieve success (Forbes, 2019):

- **Alibaba**
  This Chinese company is the **world's largest e-commerce platform**, selling more than Amazon and eBay combined. Artificial intelligence is employed in the company's day-to-day operations to predict what customers wish to buy. Alibaba generates items for the site automatically using NLP.

  Furthermore, the Chinese corporation employs AI in its "City Brain" initiative, which intends to build **smart cities**. This project implements algorithms to help in traffic reduction and vehicle monitoring in the city.

- **Alphabet**
  Waymo, the autonomous technology branch of Google's subsidiary, seeks to minimize the frequency of incidents involving its vehicles. This is currently being done in California with selfdriving cabs. However, if the driver is not human, the company cannot charge fares.

  After acquiring DeepMind, Google signaled its commitment to Deep Learning. The system not only learnt to play 49 different Atari games, but it was also the first to defeat a professional player in the game. Another American company's innovation is Google Duplex, which uses NLP and a voice interface to make calls and **schedule appointments on the user's behalf**.

- **Amazon**
  Amazon's primary AI focus is its digital voice assistant Alexa, but it also uses this technology in other areas of the business. A excellent example of this is their creative method of sending things to people before they ever consider purchasing them. This is possible because they collect a large amount of data about their clients' purchasing behavior and can therefore forecast their aspirations.

  Amazon Go is a concept created by the company at a time when many physical establishments are struggling to thrive. The stores feature AI capable of checking out the products selected by the customer and **instantly charging** them via an app. Because there is no checkout, customers can bring their own bags to store their goods.

- **Apple**
  Apple, one of the world's largest technological companies, sells items such as iPhones, Apple Watches, software, and online services. Apple integrates AI into its main products, such as **FaceID** and the **intelligent assistant Siri**. The business is also expanding its services by recommending music in Apple Music, assisting in the search of a specific photo in iCloud, and driving to a specific location via Maps.

- **Baidu**
  Chinese Google uses AI in a number of different ways. They have the **Deep Voice** tool, which can clone someone's voice using Deep Learning by listening to 3.7 seconds of audio. The same technology is used by the company to ensure that selected books are read in the author's voice - completely automated and without the need for a recording studio.

- **Facebook**
  DeepText, a text recognition engine that automatically reads and interprets the emotional aspects of its members based on their posts on the social network, is used by Facebook on its platform. Additionally, the corporation uses AI to identify and eliminate posts considered inappropriate, such as pornography.

- **IBM**
  For many years, IBM has been at the edge of artificial intelligence. Deep Blue, the first computer to defeat a human chess world champion, is proof of this. The company has since produced several duels between men and machines.

  Project Debater is IBM's most recent accomplishment, in which a **cognitive computing** engine competed against two expert debaters and generated arguments identical to those used by people in conversations.

- **JD.com**
  The Chinese version of Amazon is relying on development to **fully automate the warehouse**. The warehouse is already automated, and products have begun to be delivered by drones in the last four years. JD.com is transforming business through the revolutions of AI, **big data**, and **robots**, while also laying the groundwork for the **4th industrial revolution**.

- **Microsoft**
  The company makes it clear that their AI focus is marketing-related. All of its products and services, including Cortana, Skype, Bing, and Office 365, make use of the technology.

  Moreover, Bill Gates' company is one of the largest AI-as-a-service (AIaaS) suppliers (in the world).

- **Tencent**
  In an effort to become "more respected," the social media company has recently incorporated AI into its operations. The social network's WeChat app boasts one billion members, but it has now moved into gaming, digital assistants, mobile payments, cloud storage, live streaming, sports, education, movies, and even **self-driving vehicles**.

  Tencent's slogan is "**AI in everything**", demonstrating the company's devotion to technology. Furthermore, it collects massive volumes of information and insights about its consumers with the goal of using the data for the company's profit.

4.2. Errors to avoid (situations that can lead to business failure)

Artificial intelligence helps in the automation of repetitive processes and tasks, thus enhancing productivity in an improved way. According to expert opinion, AI can provide several challenges to enterprises, like as:

Lack of Data Organization: When data is not properly structured and categorized, the AI application process is more likely to fail, meaning more efforts in structuring the data (which are obtained from various sources).

The quantity of data required to train the AI algorithms: In order to adopt AI-based solutions, a rather large data sample is required, as this sort of algorithm relies significantly on the requirement for training, which is dependent on the amount of data available for algorithm optimization.

Data integration: The integration of multiple data gathered from various sources is required for projects to be effective while using AI.

Static data: It is critical to guarantee that the data is dynamic and that the use of AI algorithms to improve real-time decisions makes sense.

Unstructured data: Examples of unstructured data include product images, audio files, social media posts, and email messages. It is critical that all of this information (data) be analyzed for use in projects involving the usage of AI algorithms.

Multidisciplinarity: When developing AI-related projects, it is important to assemble multidisciplinary teams that can contribute significantly with their skills and experience, from many viewpoints, and that can have the most value for the optimization of these algorithms.

Glossary

- **AI Model**

  A program or algorithm that uses a set of data to recognize patterns, draw conclusions, or make predictions.

- **Algorithm**

  Any program (usually software) that is designed to be implemented on machines to perform finite processes, to solve problems, following a defined set of operations.

- **Artificial Intelligence**

  Area that studies the development of digital solutions to be applied in machines to perform human activities in an autonomous way.

- **Big Data**

  Field of knowledge that studies how to handle, analyze, and obtain information about a large volume of data that cannot be analyzed by traditional analysis systems.

- **Business Model**

  Integrated view of the process of identifying and using resources, competencies, and partnerships to create and deliver value to its customers and shareholders.

- **Complexity**

  Evaluation of the structure / composition of a given algorithm, taking into account the need to use resources in order to obtain the expected performance.

- **Computational Power**

  Requirements and resources needed for an algorithm to perform a task or a set of tasks within its assumptions.

- **Computer Vision**

  Subfield of Artificial Intelligence that allows machines to understand the visual world.

- **Deep Learning**

  Subfield of Machine Learning that allows you to create knowledge representation models in a deeper way, where feature extraction is performed automatically.

- **Effectiveness**

  Ability to perform tasks in a competent way, to meet expected goals.

- **Efficiency**

  The ability to perform tasks with the least possible effort, time and/or other resources.

- **Machine**

  A computing platform, composed of various software and hardware components that allows the implementation of algorithms.

- **Machine Learning**

  Subfield of Artificial Intelligence that implements algorithms that perform tasks and autonomously learn information about data.

- **Mimic**

  Technique used by machines that implement Artificial Intelligence, performing human-like behaviors.

- **Neural Networks**

  A neural net is a network or circuit of neurons, or, more specifically, an artificial neural net composed of artificial neurons or nodes. This type of net can be used in predictive models, adaptive control, and applications that require training on a set of data.

- **Performance**

  A set of behavioral characteristics that evaluate the success of something.

- **Strategies**

  A plan, or a collection of actions and means for achieving a specific goal.

- **Task**

  Action or set of actions to be performed by a machine through one or several algorhithms.

References

Alexa, (2016), What Is Alexa? An Introduction to Amazon's Alexa Voice Service. https://www.youtube.com/watch?v=UOEIH2I9z7c (Accessed: October 2021).

Amit, R., & Zott, C. (2021). *Business model innovation strategy*. Hoboken, New Jersey: John Wiley & Sons.

Artificial Intelligence driven business models, Deloitte Netherlands. (2021). https://www2.deloitte.com/nl/nl/pages/innovatie/artikelen/artificial-intelligence-driven-business-models.html (Accessed: June 2021)

CHM. (2021). Shannon and Lasker at Shannon's chess machine | Mastering the Game | Computer History Museum. https://www.computerhistory.org/chess/stl-430b9bbe92716/ (Accessed: August 2021).

Collins, C., Dennehy, D., Conboy, K., & Mikalef, P. (2021). Artificial intelligence in information systems research: A systematic literature review and research agenda. International Journal of Information Management, 60, 102383. https://doi.org/10.1016/J.IJINFOMGT.2021.102383 (Accessed: August 2021).

Cortana, (2015), What is Cortana Feature in Windows 10 and how to use her? Windows 10 Features. https://www.youtube.com/watch?v=INTDOWHMbDQ (Accessed: October 2021).

CredAbility, (2019), New Fintech Challenger, CredAbility, Launches Innovative Financial Wellbeing Service with Low-Code Platform Leader OutSystems. https://ffnews.com/newsarticle/new-fintech-challenger-credability-launches-innovative-financial-wellbeing-service-with-low-code-platform-leader-outsystems/ (Accessed: October 2021).

Curso de IA desenvolvido pelo AUDAX para os quadros da Deloitte (2019).

Digital, O. (2019). 10 melhores exemplos de uso de Inteligência Artificial - Olhar Digital. https://olhardigital.com.br/2019/12/12/noticias/melhores-exemplos-de-uso-de-inteligencia-artificial/ (Accessed: August 2021)

Digital, W. (2020). Transformação Digital – O Guia Completo. https://www.waynext.com/waytrends/transformacao-digital-guia-completo/ (Accessed: August 2021)

Drift, (2021), How to Create A Chatbot. https://www.drift.com/learn/chatbot/how-to-create-a-chatbot/ (Accessed: October 2021).

Duan, Y., Edwards, J. S., & Dwivedi, Y. K. (2019). Artificial intelligence for decision making in the era of Big Data – evolution, challenges and research agenda. International Journal of Information Management, 48, 63–71. https://doi.org/10.1016/J.IJINFOMGT.2019.01.021 (Accessed: September 2021).

D'Onfro, J. (2019). AI 50: America's Most Promising Artificial Intelligence Companies. Forbes. https://www.forbes.com/sites/jilliandonfro/2019/09/17/ai-50-americas-most-promising-artificial-intelligence-companies/?sh=1455f434565c (Accessed: September 2021).

Edureka, (2018), Natural Language Processing In 10 Minutes: NLP Tutorial For Beginners, NLP Training. https://www.youtube.com/watch?v=5ctbvkAMQO4 (Accessed: September 2021).

Eureka (2019). Types of Artificial Intelligence, Artificial Intelligence Explained: What is AI, Eureka. https://www.youtube.com/watch?v=y5swZ2Q_IBw&t=241s (Accessed: September 2021).

Explainable AI, (2021), What Is Explainable AI – Importance of Explainable AI and The Principles, Artificial Intelligence Resources Hub. https://www.indianai.in/what-is-explainable-ai-importance-of-explainable-ai-and-the-principles/ (Accessed: October 2021).

Faggella, D. (2021). Comparing 5 AI Business Models – Part 1 – Transformation or Near-Term Value?. https://emerj.com/ai-executive-guides/ai-business-models-part-1/ (Accessed: June 2021).

Forbes, (2019), The 10 Best Examples Of How Companies Use Artificial Intelligence In Practice, https://www.forbes.com/sites/bernardmarr/2019/12/09/the-10-best-examples-of-how-companies-use-artificial-intelligence-in-practice/?sh=448a9d887978 (Accessed: October 2021).

Google, (2020), What is High Performance Computing?, Google Cloud Tech. https://www.youtube.com/watch?v=nIBu1EFYmBU (Accessed: September 2021).

Google assistant, (2018), What's the Google Assistant?. https://www.youtube.com/watch?v=naJ3S3jul1Q (Accessed: October 2021).

Hahn, C.; Traunecker, T. ; Niever, M.; & Basedow, G. M. (2020), *Exploring AI-Driven Business Models: Conceptualization and Expectations in the Machinery Industry*. IEEE.

Haque, T. U., Saber, N. N., & Shah, F. M. (2018). Sentiment analysis on large scale Amazon product reviews. 2018 IEEE International Conference on Innovative Research and Development, ICIRD 2018, 1–6. https://doi.org/10.1109/ICIRD.2018.8376299 (Accessed: August 2021).

https://www.the-itfactory.com/startup-knowledgebase/article/startup-funding-rounds/ (Accessed: September 2021).

Humanos na era das máquinas: a Inteligência Artificial no RH - TD | O ecossistema da Transformação Digital. (2018). https://transformacaodigital.com/recursos-humanos/humanos-na-era-das-maquinas-a-inteligencia-artificial-no-rh/ (Accessed: August 2021).

Inteligência Artificial como seletora de Modelos de Negócios. (2021). https://www.veradata.com.br/pt-br/blog/inteligencia-artificial-como-seletora-de-modelos-de-negocios (Accessed: June 2021).

Intercom, (2018), Intercom Custom Bots – introducing the next generation of bots. https://www.youtube.com/watch?v=hC7D_xZTFIQ&t=38s (Accessed: October 2021).

Internet of Things, (2018), Internet of Things (IoT): What is IoT, How it Works: IoT Explained, Edureka. https://www.youtube.com/watch?v=LIhmzVL5bm8 (Accessed: October 2021).

Internet of Things, (2020), Internet of Things (IoT) In 10 Minutes: What Is IoT And How It Works: Great Learning. https://www.youtube.com/watch?v=Fj02iTrWUx0 (Accessed: October 2021).

IT Factory., (2020), Rondas De Financiamento A Startups: Do Pre-Seed Ao IPO.

Laskowski, N. (2020). Will computers ever be smarter, Eye on Tech. https://www.youtube.com/watch?v=4VROUIAF2Do (Accessed: September 2021).

Lee, J.; Suh, T.; Roy, D.; Baucus, M. (2019). *Emerging Technology and Business Model Innovation: The Case of Artificial Intelligence*. Journal of Open Innovation Technology Market and Complexity.

McDonalds, (2018), How Does McDonalds Use Big Data?, Orcan Intelligence, https://medium.com/@Orcanintell/how-does-mcdonalds-use-big-data-439403bc3fee (Accessed: October 2021).

NeuroTech, (2021), Impacto da IA nos negócios da empresa. https://www.neurotech.com.br/impacto-da-ia-nos-negocios-da-empresa/ (Accessed: October 2021).

NVIDIA Corporation. (2016). DRIVE PX | NVIDIA DRIVE PX 2 utilizes deep learning to enabl... | Flickr. https://www.flickr.com/photos/nvidia/24074342082 (Accessed: September 2021).

Osterwalder, A., & Pigneur, Y. (2010). Business model generation. Hoboken, NJ: Wiley.

Pandya, J. (2019). How Artificial Intelligence Is Transforming Business Models. https://www.forbes.com/sites/cognitiveworld/2019/07/10/how-artificial-intelligence-is-transforming-business-models/?sh=670b79fe2648 (Accessed: June 2021).

Pauli, G. (2017). The Blue Economy 3.0: The Marriage of Science, Innovation and Entrepreneurship Creates a New Business Model That Transforms Society. Xlibris AU.

Pfau, W.; Rimpp, P. (2021). AI-Enhanced Business Models for Digital Entrepreneurship. Digital Entrepreneurship.

Reis T., (2019), Series A: saiba como funciona essa rodada de investimentos. https://www.suno.com.br/artigos/series-a/ (Accessed: September 2021).

Rolls Royce, (2021), Google AI to help drive Rolls Royce autonomous ship development. https://www.theengineer.co.uk/google-ai-rolls-royce-autonomous-ship/ (Accessed: October 2021).

Salim, S, (2021), 5 Ways to Use AI to Improve Your Customer Service Experience. https://www.outsystems.com/blog/posts/ai-customer-service/ (Accessed: October 2021).

Salvador, J. (2020). Plataforma analisa e otimiza percurso dos consumidores – Forbes Portugal. Forbes Portugal. https://www.forbespt.com/plataforma-analisa-e-otimiza-percurso-dos-consumidores/ (Accessed: September 2021).

Santos, V. (2018). Inteligência Artificial: como estruturar modelos de negócios para isso? - FM2S. https://www.fm2s.com.br/inteligencia-artificial-modelos-negocios/ (Accessed: August 2021).

Santos e Sebastião, (2021), Segurança Digital nos Novos Negócios, e-book, IAPMEI, 2021.

Shane, J. (2019). *You Look Like a Thing and I Love You: How Artificial Intelligence Works and Why It's Making the World a Weirder Place*. New York: Voracious.

Simplilearn, (2018), Machine Learning Basics: What Is Machine Learning? Introduction To Machine Learning, Simplilearn. https://www.youtube.com/watch?v=ukzFI9rgwfU (Accessed: September 2021).

Simplilearn, (2019 a), Deep Learning in 5 minutes: What Is Deep Learning? Deep Learning Explained Simply, Simplilearn. https://www.youtube.com/watch?v=6M5VXKLf4D4 (Accessed: September 2021).

Simplilearn, (2019 b), Big Data In 5 Minutes: What Is Big Data? Introduction To Big Data: Big Data Explained, Simplilearn. https://www.youtube.com/watch?v=bAyrObI7TYE (Accessed: September 2021).

Simplilearn, (2019 b), Neural Network In 5 Minutes: What Is A Neural Network? How Neural Networks Work, Simplilearn. https://www.youtube.com/watch?v=bfmFfD2RIcg (Accessed: September 2021).

Siri, (2017), This Is The Algorithm That Lets Siri Understand Your Questions. https://www.youtube.com/watch?v=uE_WJTnqUwA (Accessed: October 2021).

Soltanifar, M., Hughes, M., Göcke, L. (2021) *Digital Entrepreneurship - Impact on Business and Society, Springer*.

Syllabus, (2018), Reinforcement Learning Series Intro - Syllabus Overview. https://www.youtube.com/watch?v=nyjbcRQ-uQ8 (Accessed: October 2021).

Terdiman, D. (2018). How AI is helping Amazon become a trillion-dollar company. https://www.fastcompany.com/90246028/how-ai-is-helping-amazon-become-a-trillion-dollar-company (Accessed: August 2021).

The Machine Learning Primer. (2021). https://www.sas.com/en/whitepapers/machine-learning-primer-108796.html?utm_source=google&utm_medium=cpc&utm_campaign=ana-gen-emea_52484&gclid=EAIaIQobChMIxpPKI8uV8QIViZeyCh0O1Q4QEAAYASAAEgIR3PD_BwE (Accessed: August 2021).

Photos

Figures

Tables

AUTHORS
António Raimundo and
Pedro Sebastião

PROMOTING ENTITY
IAPMEI, Agência para a Competitividade e Inovação, I.P.
Departamento de Empreendedorismo e Financiamento
Departamento de Valorização e Capacitação Empresarial

COORDINATION & REVISION
AUDAX – Centro de Inovação e Empreendedorismo do ISCTE-IUL
Sérgio Moro

GRAPHIC DESIGN
I AM - The Creative House

DATE OF ISSUE
October 2021

PRODUCTION

ISBN: 978-972-8191-64-1

Co-financed by

COMPETE 2020

PORTUGAL 2020

UNIÃO EUROPEIA

Fundo Social Europeu