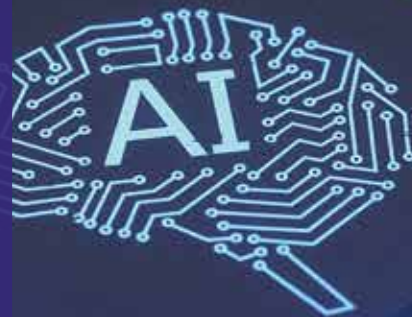


Les Cahiers du Digital

#6

On the Way to Augmented Intelligence

Reflections on the forms
of AI at the service of
businesses and the
changes they induce for
the manager



The aim of the *Les Cahiers du Digital* collection is to enrich the teaching provided at HEC Liège thanks to the contribution of experts who possess proven field knowledge on key topics related to digital transformation.

The handbooks are written in a clear and accessible style, in order to allow our students to correctly grasp the major challenges of digital transformation and to arouse their curiosity, so that they wish to explore the topic further, including through their theses.

TABLE OF CONTENTS

The Authors	5
Foreword	7
Chapter 1 - Artificial Intelligence: Its Possibilities, Its Limitations and How to Use It in Business	11
Introduction	11
The Role of the Algorithm	12
The Evolution of Artificial Intelligence	14
The Different Artificial Intelligence Systems	15
The Branches of Artificial Intelligence	16
Conclusion	19
Chapter 2 - Managing AI-Induced Change	23
Artificial Intelligence is on the rise! For managers, Emotional Intelligence and creativity will make the difference	23
As a manager or project leader, am I concerned ? And what about my team?	24
Learning to collaborate and cooperate is a necessity	25
Bringing AI into your company or organization is like climbing mount everest	26
I'm starting the AI journey and going step by step	27
Confidence and motivation are built on small successes	30
There will be failures in the implementation of AI	31
Success is a sequential process	32
Conclusion: the intelligence of the project manager who leverages AI and their team is an augmented intelligence	33
Chapter 3 - Apprehending the Future with Natural Language Processing	37
Introduction	37
Natural Language Processing	38
Anomaly detection system	40
Trend detection & monitoring	42
Conclusion	44

Et si le risque était de ne pas s'épauler des technologies IA ?



Dans un contexte économique toujours plus compétitif et très variable, les dirigeants d'entreprise sont amenés à identifier les enjeux des technologies numériques telles que l'Intelligence Artificielle (IA) et utiliser ce levier pour faire face aux changements.

Pour rester compétitives, les entreprises n'ont d'autre choix que de réduire leurs coûts, proposer de nouveaux services ou produits mais aussi attirer et garder des talents. L'IA est sans aucun doute un outil essentiel pour répondre à ces défis.

Contrairement à ce que l'on peut croire, les grandes entreprises ne sont pas les seules concernées par cette technologie. L'IA s'adresse également aux petites et moyennes entreprises, de tous les secteurs d'activité tels que l'industrie, la santé ou l'énergie mais aussi l'art, l'agriculture ou encore le notariat.

D'après l'étude de Mc Kinsey Capturing the true value of Industry 4.0, « Dans un large éventail de secteurs, il n'est pas rare de constater des réductions de 30 à 50 % des temps d'arrêt des machines, des améliorations de 15 à 30 % de la productivité du travail et des prévisions plus précises de 85 % ».



Il est vrai que cette technologie amène son lot de questions et d'appréhensions. Comme pour tout projet innovant, l'entreprise doit prendre des risques et investir. Il est donc impératif de mesurer ce risque. C'est pourquoi au sein de DigitalWallonia4.ai (programme d'accélération de l'adoption de l'IA dans le cadre de la stratégie Digital Wallonia), l'Agence du Numérique a mis en place deux dispositifs d'accompagnement et de financement.

80%
des entreprises
lauréates sont
des PME

160+
Projets IA
financés



Start.

Start IA vise à faire émerger des opportunités liées à la donnée, à l'IA et à vos activités, grâce à des experts qualifiés et dans le but d'assurer la réussite de futurs projets digitaux innovants.

-  Maximum 5000€ dont 70% subsidiés
-  Mission de 40h étalée sur 3 mois

Tremplin.

Tremplin IA permet de développer un Proof of Concept (PoC) en collaboration avec le prestataire de votre choix. L'objectif est de tester la faisabilité d'un projet.

-  70% de subvention du montant de la valeur du projet, jusqu'à 28.000€
-  Mission de 6 mois

« Une chose est sûre : nous souhaitons intégrer cette technologie par petites touches afin d'améliorer notre compétitivité et aussi conserver l'intelligence au sein de l'entreprise et la maîtriser. »

Témoignage de Yannick ANDRE-MASSE,
Product Manager chez Bea Sensors



digital
wallonia
4.ai



Plus d'informations sur digitalwallonia.be/ia

The Authors

Maxime Deuse & Florine Xhrouet

Holder of a Master's degree in management engineering from HEC Liège that followed a Bachelor's degree in civil engineering from the University of Liège, Maxime is an entrepreneur with a passion for digital innovation. He is especially interested and develops knowledge in the digitalization of companies and AI. During his studies, he launched a first project with his twin brother Julien: a web platform that quickly became a precursor of Webtoon in Europe. They caught the eye of a major Silicon Valley entrepreneur who made them an offer they couldn't refuse. In 2016, they decided to found Deuse, a computer engineering company. They increased the number of collaborations, including with large companies such as Fluxys, Elia and Bridgestone. Since then, the team has grown to about thirty people. The company specializes in the development of custom digital tools: mobile applications, web platforms and interfaces, management software, digital businesses and other custom developments.

Holder of a Master's degree in information and communication from the University of Liège, Florine joined the Deuse team in 2019 to take care of the company's communication. She is in charge, among other things, of popularizing the IT development sector in order to make it accessible to everyone. It is in this context that she participated in the writing of this article, by vulgarizing some concepts of AI.

Christian du Jardin

Christian du Jardin is a management engineer, graduated from the Solvay Brussels School of Economics and Management. After a fruitful career in marketing, sales, communication and strategy with renowned companies such as Unilever, Pepsico (abroad) and bpost, he created in 2014 his consulting company Kera Way Consulting which accompanies businesses and start-ups on transformation journeys. Passionate about people, he then trained in various tools and techniques aimed at unleashing the potential of leaders and teams. Convinced of the impact of AI on the lives of companies and managers, and aware of the fears that can arise from a technology that is often misunderstood, he wrote the book *Manager 3.0 – sept principes pour gérer le changement induit par l'intelligence artificielle* in 2020. His credo is that to succeed in digital transformation, managers must develop their skills in creativity and emotional intelligence. He offers high level coaching to CEO's, managers and teams who wish to transcend change and succeed in digital transformation. Christian du Jardin is currently Head of purposeful strategy at Gondola, a B2B platform that connects major players (CEO's, C-Levels) from the world of retail, manufacturers and brands in Belgium. In addition, he is the founder, with his wife Pascale Debliquy, of the Centre Psyché in Waterloo, a multidisciplinary and paramedical center whose vocation is the therapeutic care of people and managers in stress, burn-out and life transition situations.

Judicaël Poumay

Passionate about science and technology, Judicaël Poumay is a PhD student specializing in Natural Language Processing, a sub-field of artificial intelligence that aims to analyze textual data and that recently gave birth to ChatGPT. Judicaël's research is based on large-scale data analysis in order to understand the weak signals and emerging trends that are developing in our ever-changing world.

Foreword

Nicolas Neysen

It always takes a long time for technologies to gain actual momentum. This is a paradoxical observation if we refer to the saying that, in this field, "everything evolves very quickly". Artificial intelligence (AI), as an emblematic example, was born in 1956, with the idea that the machine would sooner or later surpass the capabilities of human beings. Over the decades, AI has raised as many hopes as fantasies linked to transhumanism. But in the face of repeated failures and few convincing results, AI experienced long periods of stagnation during which research funding was frozen. They were called the "AI winters".

This boom-and-bust history has led Gartner to model this evolution and even transpose it to other technologies. This reputable firm publishes each year an updated list of so-called "emerging and inherently disruptive" technologies, accompanied by a graph placing them along a curve, strongly ascending at its beginning, which then crashes to reach the "trough of disillusionment," before slowly recovering, though never reaching its previous peak, known as the "peak of inflated expectations." By 2022, technologies such as NFT's and the metaverse were getting dangerously close to this peak. Whatever the technology, the reasons for this collapse are always the same. The companies that design or support these embryonic technologies are struggling to demonstrate their benefits through convincing use cases. As a result, users are limited to early adopters, investors turn away from the technology in question, and the interest of the entire community wanes.

For the past decade or so, AI has been back in the spotlight. Instead of fantasizing about it, serious researchers and entrepreneurs have focused on its real potential: creating algorithms that provide effective solutions to real-world problems. In every industry, from

manufacturing to healthcare or agriculture, AI has demonstrated that it can add value. Technology, like great inventions, is proving to be useful for increasing human potential, but without threatening it. We are very far from the idea of a creature capable of replacing human intelligence.

Despite this, some people do not hesitate to raise the specter of a dangerous AI, acting in complete autonomy. This is the case of Elon Musk. In 2019, the billionaire declared that AI will eventually consider humans as "slow and stupid" beings, before overtaking them. For anyone who understands how AI is built and operates, the very idea of a robot with consciousness and the ability to make judgments is preposterous. AI will remain a tool programmed by humans to serve them, and if it does harm them, it will only be because they consciously choose to do so. Even the most striking advances, such as ChatGPT¹ for example, should not distract us from what AI is, a lifeless tool designed to make our lives easier. This is reminiscent of a line from Robbin Williams in *Good Will Hunting*: "You're talking without having a clue what you're talking about. If I tell you to tell me about Michelangelo, you'll throw me a digest of all the books on the subject, but I bet you can't describe the smell inside the Sistine Chapel."

¹ ChatGPT is a conversational robot developed by the company OpenAI, founded in 2015 by Elon Musk, whose test version was opened to the general public on November 30, 2022, attracting over 1 million users in 5 days.



Artificial Intelligence: Its Possibilities, Its Limitations and How to Use It in Business

CHAPTER 1

Chapter 1 - Artificial Intelligence: Its Possibilities, Its Limitations and How to Use It in Business

Maxime Deuse & Florine Xhrouet

Introduction

We frequently hear about Artificial Intelligence (AI) in many fields. But do we really know what it is?

Artificial intelligence refers to the ability of a computer or machine to perform tasks that normally require human-like intelligence, such as understanding language, recognizing patterns, learning and solving problems.

AI is used in many different ways today and the list is constantly growing as new applications are developed.

Here are some examples of use:

- Personal assistants: virtual assistants, such as Apple's Siri or Amazon's Alexa, use natural language processing¹ to understand and respond to voice commands.

Their comprehension capacity seems close to that of a human being, but have you ever been frustrated because you had to repeat your request several times or change the wording of your sentence because your virtual assistant does not understand it? For example, if you ask it to "launch the vacuum cleaner", Google Home will not be able to answer your request because the verb "to launch" is not adequate. A human, however, would understand the request even if you don't use the right verb.

- Customer service: many companies are using AI-powered ChatBots to handle customer requests and provide information, freeing up customer service agents for more complex tasks.

This application of AI is effective when customers have a relatively simple, frequently asked question. If the question is more complex,

they will certainly need to communicate with a person at some point. This allows companies to filter requests but not to answer them 100%.

- Fraud Detection: Financial institutions use machine learning algorithms² to analyze financial transaction patterns and identify potential fraudulent activity.

- Medical diagnosis: AI algorithms can be trained on large datasets of medical records and images to help doctors identify diseases and make more accurate diagnoses.

- Autonomous vehicles: self-driving cars and drones use AI to navigate and make decisions in real time. AI can be used to detect pedestrians or cars that are out of place on the road. The car will then automatically brake or move away from them.

- Supply Chain Management: AI can be used to optimize the flow of goods and materials through a supply chain, helping companies become more efficient and reduce costs.

- Social media moderation: AI algorithms can be used to help identify and remove inappropriate content from social media platforms.

A Racist AI?

Developed by Microsoft in 2016, an AI named Tay made inappropriate comments on Twitter. Indeed, some users wanted to test the limits of this ChatBot which was supposed to interact with American teenagers in order to study the

¹ We will develop this technique in the section "The Branches of AI".

² We will develop this technique in the section "The Branches of AI".

understanding of language³. They succeeded in making it repeat racist statements. The AI also answered a set of questions and, among other things, denied the Holocaust. The AI learns with the data it has at its disposal and that is provided to it for training, in this case publicly accessible data but also the numerous tweets sent by the platform's users. In Tay's example, the information provided at the beginning for training was partially racist, and this is why it made such comments later. Tay was supposed to learn and improve as it went along, but with the many slip-ups, Microsoft apologized and deactivated it after only 8 hours of existence.

These are just a few examples, but AI is also being applied in many other areas, both in the professional and private spheres.

As you can see, AI is everywhere and is even present in this chapter. Indeed, part of this introduction – the italicized part – was written by a recently released AI writing program, ChatGPT⁴. The company OpenAI released its new program in November 2022. It can answer questions, start a conversation, admit mistakes, or reject inappropriate requests⁵.

The results published by Internet users could be confused with human intelligence, but one must remain careful because the program is not infallible. In fact, before the first use, this warning message pops up: "While we have safeguards in place, the system may occasionally generate incorrect or misleading information and produce offensive or biased content. It is not intended to give advice". The developers are aware of the limitations of their

³ Tual, M. (2016). *A peine lancée, une intelligence artificielle de Microsoft dérape sur Twitter*. Le Monde.fr. https://www.lemonde.fr/pixels/article/2016/03/24/a-peine-lancee-une-intelligence-artificielle-de-microsoft-derape-sur-twitter_4889661_4408996.html

⁴ <https://chat.openai.com/chat>. Quotations translated from French by the editor.

⁵ Open AI (2022). *ChatGPT : Optimizing Language Models for Dialogue*. <https://openai.com/blog/chatgpt/>

program, which is not yet the final version. They have offered a first free version to receive feedback from users and determine what improvements they can make to the program.

Despite the advances of the last few years, one must be careful with the term "intelligence" because a machine equipped with AI, even if it is capable of performing incredible tasks, is not intelligent in the sense that we understand it. Indeed, it is a very good tool, it can be more efficient than the human being to carry out certain specific tasks, but it does not supplant them.

The goal of this chapter is to explain what AI is, to decipher it in order to understand what it can do and present, using examples, how it can help companies. We also want to demystify AI a little because, as we said earlier, it is far from having the same capabilities as human beings and is not close to surpassing them, contrary to what is sometimes implied.

“

Despite the advances of the last few years, one must be careful with the term "intelligence" because a machine equipped with AI, even if it is capable of performing incredible tasks, is not intelligent in the sense that we understand it.

”

The Role of the Algorithm

In the collective imagination, AI is often associated with the use of robotics in the manufacturing industry, among others, but it is much more than that. We will go deeper into the subject to understand all the ins and outs of this technological revolution, which is not new, as we will see in the next section.

We are confronted with AI on a daily basis. Here are some other examples that attest to its omnipresence:

- Suggestions appear in your search engine as you start typing;
- The navigation system in your car searches for the best possible route based on traffic;
- Your smartphone unlocks when it recognizes your face;
- You can ask your virtual assistant to turn on the heating;
- You receive an advertisement for a product that you wanted to buy;
- After several viewings, Netflix suggests movies or series that you might like, with a compatibility rate ;
- The same goes for YouTube or Spotify: after listening to a few songs, these platforms propose you new ones that you should like;
- The Shazam application finds the title and performer of the song that you are hearing;
- etc.

In these examples, we find computer systems that allow to sort and process information and that work thanks to algorithms. The algorithm is a very important concept in AI. It is a set of

instructions, of operations to follow in order to solve a problem or accomplish a task.

To put it simply, we can compare an algorithm to a cooking recipe. You have ingredients and by following precise instructions, you reach an outcome, for example, a chocolate cake. For the algorithm, it is the same, you replace the ingredients by a set of data, then carry out the instructions, i.e. the steps of the recipe that represent the operations composing the algorithm. Finally, you obtain a result.

Let's complete this example to understand a little better what an AI algorithm can do: if you ask a program without AI to find pictures of the HEC Liège building, the program will search its database (the ingredients of the recipe) and show you the pictures associated to this building. However, it may not show you all the pictures because some of them may not be labeled "HEC Liège building" and therefore without AI, the algorithm will not recognize the building on these pictures. If only one element is missing, the recipe will not give the desired result – in this case, seeing all the images of the HEC Liège building.

Conversely, with AI, the program will be able to show all images, even those without the label "HEC Liege building". To achieve this, the program first needs to see a series of pictures of the building in order to train itself to recognize it. It will visualize the elements that do not change and those that can vary. This

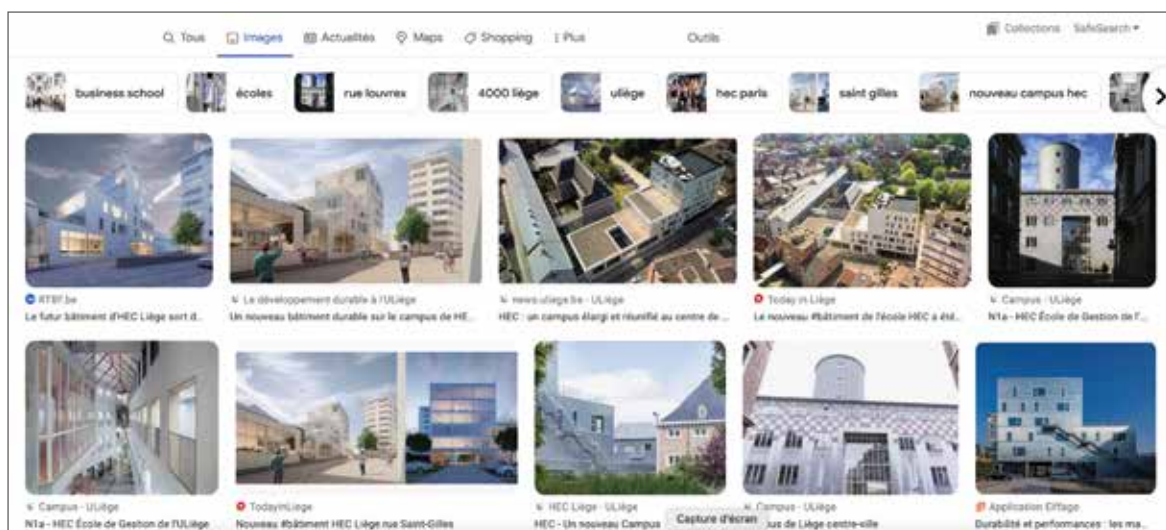


Figure 1: With AI, the program will be able to show all images, even those without the label "HEC Liege building".

training allows it to answer your request by showing you *all* the pictures of the HEC Liège building that the program has in its database. This image recognition is one of the many tasks that AI can perform.

To better understand this concept, it is interesting to trace the key moments of its development. AI appeared in the 1950s and has been evolving a great deal since then.

The Evolution of Artificial Intelligence

The world has become familiar with AI since the first half of the 20th century thanks to science fiction, notably with the humanoid robot in the film *Metropolis* by Fritz Lang released in 1927⁶. Then, scientists and mathematicians took up the concept.

In 1950, Alan Turing, the inventor of the computer, wrote an article entitled "Computing machinery and intelligence⁷" in which he explains how to build intelligent machines. He assumes that human beings use reason and available information to make decisions and solve problems, and he suggests that machines could do the same. He also explains how to test them to see if they come close to human intelligence through what is called the "Turing Test". This test consists in a program having a written conversation with a human interrogator for five minutes. The interrogator must then assume whether they were talking to a machine or a human. If the machine deceives the interrogator 30% of the time, then it has passed the test⁸.

The term "Artificial Intelligence" was first used in 1956. It was coined for a conference held at Dartmouth College by scientists John McCarthy and Marvin Minsky during which Allen Newell, Cliff Shaw and Herbert Simon presented their

6 https://www.allocine.fr/film/fichefilm_gen_cfilm=240.html

7 Anyoha, R. (2020, April 23). *The History of Artificial Intelligence*. Science in the News. <https://sitn.hms.harvard.edu/flash/2017/history-artificial-intelligence/>

8 Russel S. & Norvig P. (2009). *Artificial Intelligence: A Modern Approach (Third Edition)*, Malaisie, Pearson, Global Edition. p. 1021.

program "The Logic Theorist", designed to mimic the problem-solving abilities of a human. It is considered the first AI program.

From that year on, AI flourished for some time, thanks in particular to the evolution of computer science and various forms of financing. For example, in 1965, Joseph Weizenbaum created the program ELIZA, the first to pass the Turing test, at least for a few minutes. It is a program that replaces the psychotherapist during interviews with patients.

Expectations were very high, but the technology could not yet fully meet them. Data storage and processing were still a problem. Hans Moravec, McCarthy's doctoral student at the time, said that "computers were still millions of times too weak to exhibit intelligence⁹". Funding then dropped and research came to a standstill for a decade. This crisis is called the AI winter.

AI-related finance and research began to rise again in the 1980s. It was during this period, in particular, that John Hopfield and David Rumelhart popularized Deep Learning techniques¹⁰, which allow computers to learn from experience, and that Edward Feigenbaum developed expert systems that allow a machine to make decisions like a human expert. The program would ask an expert how to react to given situations in a specific field and when the answers were assimilated, non-experts could then be advised by this program. The systems were widely used in industry and finance, for example, to detect credit card fraud.

Later, in 1997, the machine beat the human being for the first time: Deep Blue, a chess computer program, beat the reigning world champion, Gary Kasparov. This was an important date that marked a considerable advance towards an intelligent decision-making program. It must be acknowledged that Deep Blue had a considerable advantage: it had in its memory thousands of games of the best players in the world. Its processor allowed it to find the best strategy for each move. In the same year, another big step was taken, this

9 AICorespot Editorial Team. (2021, August 6). *The history of Artificial Intelligence*. AICorespot. <https://aicorespot.io/the-history-of-artificial-intelligence/>

10 We will develop this technique in the section "The Branches of AI".



Deep Blue had a considerable advantage: it had in its memory thousands of games of the best players in the world.

time in the interpretation of spoken language: the voice recognition software, developed by Dragon Systems, was installed on Windows.

Since then, the storage capacity and accumulation of data as well as the computing power of computers have continued to increase. All these technical improvements allow the development and increase in performance of algorithms. This is how in 2015, Google's AI

“

Since then, the storage capacity and accumulation of data as well as the computing power of computers have continued to increase. All these technical improvements allow the development and increase in performance of algorithms.

”

AlphaGo beat Fan Hui, the European champion of the Go game¹¹, and in 2017, the program even managed to beat the world champion, Ke Jie¹². The psychological benefits are worth noting, the machine is not likely to lose focus, or to be under pressure, unlike human beings.

The Different Artificial Intelligence Systems

The different AI systems are classified according to their functionality. There are four of them.

Reactive machines

In this category of AI, we find machines that operate according to the current situation, with the current data that they receive. They interact

¹¹ Tual, M., & Larousserie, D. (2016, January 27). *Fan Hui, champion européen de go : " L'ordinateur joue comme un humain "*. Le Monde.fr. https://www.lemonde.fr/pixels/article/2016/01/27/fan-hui-champion-europeen-de-go-je-suis-le-premier-joueur-pro-a-perdre-contre-une-machine_4854891_4408996.html

¹² Le Monde avec AFP. (2017, May 25). *L'intelligence artificielle AlphaGo bat une nouvelle fois le champion du monde de go*. Le Monde.fr. https://www.lemonde.fr/pixels/article/2017/05/25/l-intelligence-artificielle-alpha-go-bat-une-nouvelle-fois-le-champion-du-monde-de-go_5133716_4408996.html

with their environment and can only perform a limited number of predefined tasks. They are not able to make inferences based on their data or past experiences to determine their future actions. Among the reactive AI, there is the chess program Deep Blue that defeated Garry Kasparov, the reigning world champion, in 1997, or the robotic arms in a factory that are programmed to react in presence of a specific object in front of them on a conveyor belt and, for example, to move this object to a designated spot.

Limited memory

This AI is able to make decisions based on data stored in its memory, which is ephemeral, hence its name. By storing past experiences, it is able to evaluate future actions. The perfect example is the self-driving car. It uses information gathered in the past to act immediately. Thanks to sensors, it can identify pedestrians crossing the road, but also traffic lights, road works, damage in the road, traffic, etc. All this data is used to make decisions and adjust its speed and trajectory if necessary.

The "theory of mind"

As its name suggests, this AI is interested in emotional intelligence to understand human thoughts. This type of AI is more advanced than the two previous ones, it is not yet fully developed but research is being conducted to reach this goal. This AI could play an important role in psychology. If we manage to develop machines with this AI, they will be different from the machines created until now. They will be able to perform the same tasks as the first two types of AI, but they will also be able to understand human emotions and adapt their behavior accordingly.

Self-aware

This type of AI corresponds to Super Artificial Intelligence, in which machines would have their own consciousness. This would be an extension of the "theory of mind", in which machines could understand human emotions, but would also be able to feel them and predict the emotions of those around it. Again, this is pure science fiction and we are very far from reaching such a level. This remains a

hypothesis and nothing allows us to claim that such a level is really possible.

The Branches of Artificial Intelligence

AI can be used to solve all kinds of problems through different techniques. Here are some of them.

Machine Learning

Machine Learning allows machines to make decisions based on data rather than programming them to perform a specific task. Machine Learning algorithms or programs learn as they encounter new data, allowing them to improve. For example, it is possible to predict which player will receive the ball next during a soccer game. To do this, the algorithm that has been trained – by analyzing a very large number of games – relies on real-time data such as the identity of the player who has the ball at that moment and the positions of other players, to predict who will receive the ball.

Machine Learning includes 3 categories:

1. *Supervised learning:*

This learning is said to be supervised because it is considered to be guided by a "teacher", i.e. a set of data whose role is to train the machine or the model. Once trained, the machine can then make decisions or predictions when it receives new data.

2. *Unsupervised learning:*

Here, the model learns through observation. It finds structures and relationships in the data it receives by creating groupings. However, it is not able to name these groupings. For example, it will separate skirts and dresses but it will be unable to say that they are skirts and dresses.

3. *Reinforcement learning:*

This category has the ability to interact with the environment and find the best result. The model is rewarded for a correct answer and penalized for an incorrect answer. It then trains on the

reward points it has earned. It will be able to start predicting new data when it is trained.

Deep Learning

Deep Learning is an advanced area of Machine Learning, it learns from experience and can solve even more complex problems. It mimics the way a human brain works, i.e. it uses the concept of artificial neural networks that work like the neurons in our brain. It can process much larger data in order to find information and/or a solution.

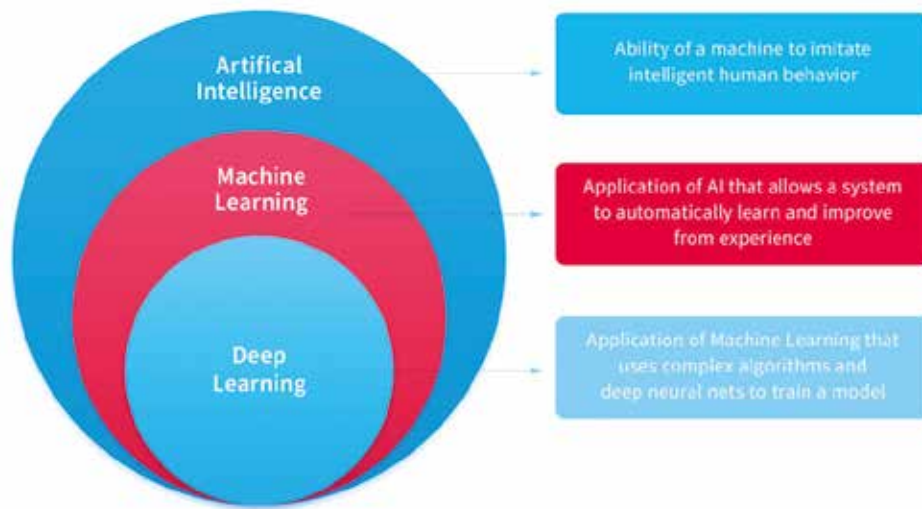


Figure 2: Deep Learning is an advanced area of Machine Learning.

Here is an example to distinguish between Machine Learning and Deep Learning:

Let's say we want to develop a system that recognizes dogs in an image. If we use Machine Learning, we will define the characteristics of a dog such as ears, muzzle, paws, etc. The system will then be able to identify these features on its own in the images. With Deep Learning, we don't need to define the features, the system will find them automatically thanks to neural networks.

We find Deep Learning, among other uses, behind the face verification algorithm on Facebook, DeepFace. Machine Learning is not enough because an image contains a lot of data. Amazon, Netflix and many other sites will use Deep Learning to understand the behavior of their customers and offer them what best suits them. Deep Learning algorithms can also

be used to analyze images and videos, which is useful in security and surveillance.

Natural Language Processing

Language is one of the abilities that most differentiates human beings from other species and it is on this ability that Alan Turing based his test to know if a machine is close to human intelligence. NLP is a technique that allows machines to understand voice or textual data and to answer it as a human being would.

Human language is very complicated and to help machines understand it, several techniques decompose textual or voice data. We will not go into details because the last chapter of this Cahier du Digital is dedicated to NLP.

Understanding language can be difficult at times because of different accents, variations in intonation, pronunciation, grammatical errors,

“

NLP is a technique that allows machines to understand voice or textual data and to answer it as a human being would.

”

etc., which can explain some mistakes or the fact that Siri or any voice-controlled machine sometimes asks us to repeat our request. ChatBots on websites, for example, use NLP to identify your problem and/or answer your questions. If they don't know how to answer, they will usually try to identify your problem as best they can and direct you to the right person.

NLP is also useful in spam detection. It allows you to analyze emails and identify undesirable ones. It happens, however, that some legitimate mails are sent in your spam box by mistake. Indeed, the tool does not always detect correctly the elements usually attributed to spam.

In the field of computer development a tool called GitHub Copilot can help with writing code. It will complete the developer's code based on what they write. The tool works with all languages, and even though it can't write a complete function, it is a time saver.

It is also thanks to NLP that the ChatGPT program can answer our questions and conduct a written conversation. Sometimes it doesn't understand what we write, in which case it asks for clarification. Automatic translators such as DeepL or Google Translate also work with NLP. But beware, not all these programs are infallible and errors are possible.

Computer vision

Computer vision allows a machine to analyze and interpret the visual world such as images and videos in order to, among other things, extract information and make decisions based on immediate observations.

This technique is useful for many sectors such as business, transportation, healthcare, etc. The growth of applications using computer vision is due, among other things, to the flood of visual information coming from our smartphones, increasingly strong security systems, traffic cameras, etc. Computer vision can be used for a wide range of applications, such as the following.

- Autonomous vehicles are the most telling example. Computer vision allows cars to

perceive and understand their environment in order to drive on the road.

- Face and object detection and recognition as well as image classification are often used. As mentioned earlier, your smartphone can unlock itself by recognizing your face. It can also sort your photos according to the people who appear in them.
- The Google Lens application gives you information related to the object that it identifies in the image you are showing it. If you take a picture of the Atomium, the application will reveal relevant information about this monument.
- Medical image analysis: computer vision allows the identification of anomalies or the diagnosis of diseases by analyzing, for example, X-rays.
- This vision is also used in sports: the VAR in soccer (video-assisted refereeing) makes it possible to reconstitute an image thanks to 4 cameras. Without AI, a high number of cameras would be needed around the field to have a 360° view.
- Since November 2022, the Ghent entity of Ikea has been using autonomous drones to search for requested products and carry out inventories overnight by moving through the aisles and scanning barcodes¹³. This technique facilitates the work of the teams and saves them time. It can also be applied to surveillance and security to identify suspicious activity.
- At the industrial level, computer vision can be useful for predictive maintenance. Indeed, it can detect damage or defects on machines and thus prevent a possible breakdown.
- Computer vision can also analyze and sort products. For example, if a producer of apples and pears needs to sort them

¹³ Van der Ven, M. (2022, November 29). *Les employés d'IKEA Gand assistés désormais par des drones autonomes*. Levif.be. <https://datanews.levif.be/ict/actualite/les-employes-d-ikea-gand-assistes-desormais-par-des-drones-autonomes/article-news-1610417.html>



Ikea has been using autonomous drones to search for requested products and carry out inventories overnight by moving through the aisles and scanning barcodes.

according to their appearance, it can be done by a machine using computer vision.

Robotics

Robotics is one of the most popular branches of AI and focuses on the various applications of industrial and humanoid robots. Industrial robots are widely used in factories and play an essential role in production, be it in assembling parts, packaging or sorting as explained in the example of the fruit producer above.

Robots can also be found in customer service in the hotel or retail sectors, for example. These robots use several techniques, including natural language processing and computer vision, to interact with customers and their environment like humans. They adapt and improve their behavior as they interact through Machine Learning. They are used to inform customers and improve the shopping experience.

Conclusion

Artificial intelligence has evolved enormously since its appearance and is increasingly present in our daily lives, whether in our private

or professional lives. We sometimes don't even realize that we are dealing with AI anymore because it has become part of our habits.

The different branches of AI such as Machine Learning, Deep Learning, natural language processing, computer vision as well as robotics offer many opportunities that can be adapted according to the sector of activity of the company. This is particularly the case for autonomous drones that use computer vision, they can be used to carry out an inventory as well as to monitor an operating site.

It is a remarkable tool that allows, among other things, to save time by completing tasks faster than staff, for example by keeping a steady pace over a period, obviously longer. It allows to optimize and automate some processes, but AI cannot replace the human for everything. It remains a tool among others.

Therefore, one should not opt for artificial intelligence at any price because it is "trendy". To use it, one must have identified a tangible need and have verified that AI is the best way to meet this need.

The first step is to identify the problems and then to think about the solution, which tool can best answer these issues, with or without AI.

For example, wanting to analyze production data when you don't have much of it is possible, but without opting for AI and Deep Learning methods.

Finally, you have to take into account the financial and environmental cost¹⁴ of implementing an AI-enabled tool and calculate, in the long term, whether it is a really advantageous solution.

To summarize, let's remember that AI is a great tool but one should not expect more from it than it can provide, and must above all avoid seeing this tool as a solution capable of replacing human intelligence.

Sources for the figures

Figure 1 : Google Image search for "bâtiment de HEC Liège"

Figure 2: Piluta, R. (2023, 7 avril). *Deep Learning vs Machine Learning or How AI Benefits Business*. NIX United. <https://nix-united.com/blog/artificial-intelligence-vs-machine-learning-vs-deep-learning-explaining-the-difference/>

¹⁴ On this topic, see the 4th and 5th issues of *Les Cahiers du Digital*



Managing AI-Induced Change

CHAPTER 2

Chapter 2 - Managing AI-Induced Change

Christian du Jardin

Artificial Intelligence is on the rise! For managers, Emotional Intelligence and creativity will make the difference

Let's quote the numbers from the excellent Harvard Business Review (HBR) article "How artificial intelligence will redefine management"¹. This analysis, which repeats the key messages of the 2015 study by Accenture The impact of cognitive computing in management², was the trigger for my reflection on the effects of AI on the lives of tomorrow's managers. These figures are both reassuring and challenging (see figures 1 and 2 below).

The 1,770 middle and senior managers surveyed estimated that administration, coordination and control tasks take up an average of 53% of their time. However, these are the activities that are likely to be carried out with greater speed, precision and efficiency by our allies the robots in a near future. As a result, 25% to 50% of management tasks will eventually be threatened. Or, to put it more positively, 25% to 50% of managers' valuable time will soon be freed up for other activities. Another good piece of news is that 86% of the surveyed managers look positively on the help that AI will soon provide.

In this study, managers were then asked to state the skills they felt they needed to develop to maintain success over time. Not too surprisingly,

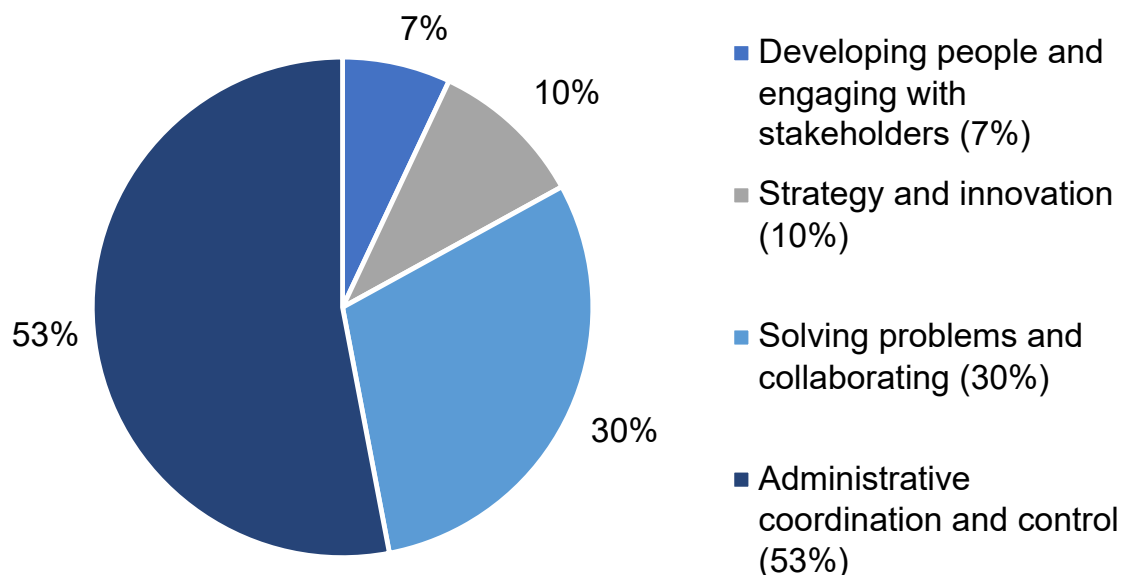


Figure 1: Time managers spend on different categories of tasks (source: Accenture).

¹ Kolbjørnsrud, V., Amico, R. Thomas, R. J. (Novembre 2016). *Harvard Business Review*, "How artificial intelligence will redefine management".

² Accenture Institute for High Performance and Accenture Strategy (2015). *The impact of cognitive computing in management*.

the top three responses were: 1) technical and digital knowledge, 2) information technology, and 3) data analysis and interpretation.

More worrying than this observation of a need to step up the technical aspects, the study mentions that emotional intelligence skills — such as the ability to cooperate and network, people development and coaching — seem to be considered important by only 21% of respondents. And yet, this is where the challenge lies! Because, as the authors' analysis confirms, the key skills to be developed to succeed as manager in the world of tomorrow are creativity, collaboration, empathy and judgment.



Figure 2: Percentages of respondents who included this skill to be developed in their top three.

As a manager or project leader, am I concerned? And what about my team?

Obviously, strong rise in awareness is needed. Because we must realize that it is not only the repetitive jobs in the manufacturing and service industries that will be affected by the rise of AI, but all jobs. Whether you are a human resources director, a sales manager, a specialized doctor, a certified public accountant, an insurance broker, a lawyer, a small business owner, a university professor, a biotech researcher or practice any other profession, your job and that of your team will be reinvented in whole or in part in the next five to fifteen years. Be aware of this, all studies confirm it!

There are three possible approaches to the impact on employment:

1. The substitution logic, in which a job will be totally automated and therefore disappear;
2. The rationalizing logic, in which the work will be led by algorithms that will indicate to a human being the technical gestures to be performed (for example through a virtual reality headset, or through scripts for salespeople in business-to-business solutions);
3. The enabling logic, in which the human beings will be helped, and thus augmented, by AI in their analysis and decision-making capacity.

According to the experts in the Accenture study, all jobs will be affected. Whether a job is substituted or augmented will not be determined by technology alone. The company's vision and strategy will make the difference. They can be short-termist in search of savings, or on the contrary, visionary, aiming at creating well-being and value for all stakeholders: customers, employees, shareholders, society and the planet.

Now that the diagnosis has been made on the possible impacts of digital transformation and the rise of AI on tomorrow's activities in general, and for your company or organization in particular, the critical move would be to ignore it! Don't hesitate to get on the train of change with the early adopters: you will be in the 16%

of informed people who will have foreseen the innovation before the others³. These actors will have understood how the world works and will not hesitate to leave their comfort zone to welcome innovation. The future will belong to them much more surely than to the latecomers. Get on the road to join them!

Learning to collaborate and cooperate is a necessity

Robots are here. They are here to stay and they will be able to do many things, often better than human beings. In fact, they will be able to do anything that involves repetitive, data-driven tasks. What requires complex social interaction and disruptive creativity, however, will remain a human prerogative.

“

Robots will be able to do many things, often better than human beings. What requires complex social interaction and disruptive creativity, however, will remain a human prerogative.

”

Indeed, this social and emotional intelligence is what humans being have but robots do not, it is unique to our species, which allows us to function with others and to manage change, with all the hopes and fears that come with it. This inspired and sometimes artistic creativity brings us truly original solutions. This high intelligence allows us to picture ourselves in the future and create the founding and unifying myths for our future.

Therefore, in order to optimize available resources, gain efficiency and potentially

reduce costs, smart professionals will be led to collaborate (from the Latin co-laborare) with robots, i.e. to divide and distribute work optimally between humans and machines: this will bring them greater productivity, fewer errors, and more time that can be devoted to other value-creating activities.

At the same time, it will be important for them to cooperate (from the Latin co-operare) even better with their alter egos, which means working together, creatively, with a common goal, with a strong emotional bond. Communication skills, active listening, empathy, inspired innovation — which are unique to humans — will be the best assets to go through this transition to the world of tomorrow in the best way.

As in martial arts, let's use the opponent's energy! The technological current is too strong to be resisted: everything seems to indicate that one should take advantage of it optimally and consciously. In the world of business and organizations, the professional who will have adapted and succeeded in collaborating effectively with robots, while cooperating naturally with their alter egos in this new world reshaped by technological evolution, is called **Manager 3.0**.

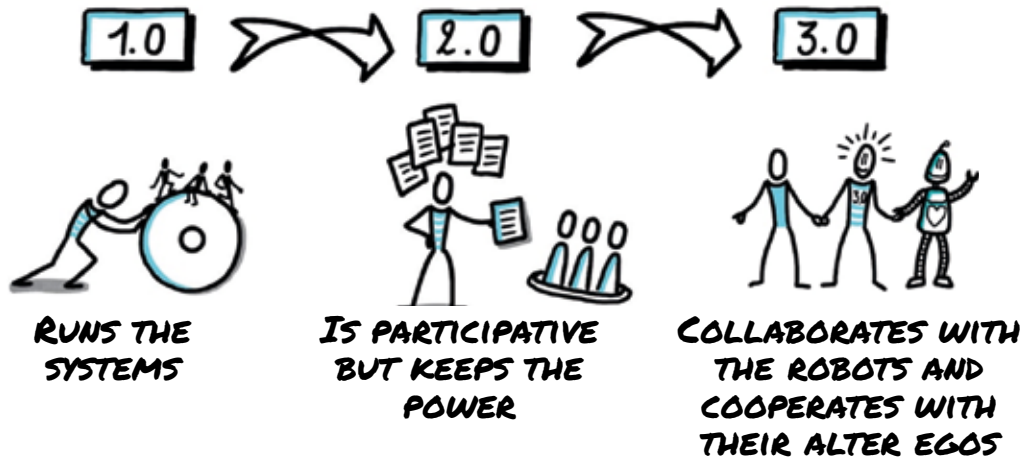
Manager 1.0 lived during the time of the second industrial revolution. They were running a system. Their mode of operation was command and control: "I tell you what to do!" Information was a source of power to them, they kept it jealously. Competition in the market and in the company was part of the hard rules of the game.

Manager 2.0 appeared in the early 2000s. They are participative but keep the power. Information is accessible on a need-to-know basis: "I give you what you need to know." Cooperation is encouraged as long as it does not slow down the speed of execution.

As for **Manager 3.0**, their intelligence is enhanced by their ability to collaborate with the robots and to cooperate with their alter egos. Everyone plays their own part. They have worked on their self-knowledge and have freed their organization from limiting constraints. Information is available everywhere and all the

³ Sinek, S. (2009). *Start with the WHY*, Penguin Editions 2009.

MANAGER 3.0



time. Creativity and challenging the status quo are part of their daily life. They are a visionary, they give direction. They are a resources provider for their teams. The difference that makes the difference is their ability to question themselves and to continuously develop their emotional intelligence in order to cooperate with their alter egos and embrace the wind of change.

Bringing AI into your company or organization is like climbing Mount Everest

The summit is high, it culminates at 8,848 meters. Its ascent is dangerous. Since the first victory of Edmund Hillary with his Sherpa Tensing Norgay on May 29, 1953, the mountain has claimed many victims.

The Mount Everest metaphor is powerful because it illustrates both losing strategies, whether it's the feat of climbing this mythical mountain or the digital transformation of your business with AI.

1. The first of these strategies is the one that makes you stay at the bottom of the mountain, in your comfort zone. You look at the top: it's high, it's cold, you decide not to move. There is then no chance that you will ever reach your goal. If you are paralyzed by the prospect of exploring AI to develop your

business, it is likely that you will not succeed in your digital transformation.

2. The second failure strategy has you putting on your sneakers and running straight for the peak at 8,848 meters. In this case, you've left your comfort zone, but you'll fail irreparably in the danger zone. You won't reach the summit either.

By trying to put AI everywhere and without any real preparation, you risk leading your business or organization to disaster and it could be costly.

Fortunately, between the comfort zone and the danger zone, there is an extraordinary space called the zone of boldness! As you can see, in order to arrive and navigate in this zone, you must have left your comfort zone, without however falling into the danger zone.

Characteristics of an action in the bold zone:

1. There are risks but I have identified them and assessed them well — **anticipation**.
2. I have trained — **preparation**.
3. I don't go alone, I take my colleagues with me — **cooperation**.
4. I am helped by guides (Sherpas for Mount Everest, expert technology facilitators for digital transformation) — **specialization**.
5. I am indeed on my way to the top — **action**.



The Mount Everest metaphor is powerful because it illustrates both losing strategies, whether it's the feat of climbing this mythical mountain or the digital transformation of your business with AI.

Just as climbing Everest always begins with setting up in base camp at 5,270 meters, the first step in a digital transformation journey will be to set up base camp and check:

1. that I am fit and know what I want to do;
2. that I have my equipment, that I know it and that I have tested it;
3. that I am not alone and that my companions want to climb the same mountain;
4. that I have the right Sherpas and carriers with me.

Then, the wisdom of a well thought out ascent will be to organize it in a certain number of carefully thought-through progressive stages which correspond, for Mount Everest, to camps 1 to 4 that follow the base camp. Thus, when the journey begins, the intermediate goals are accessible, and the first days of the ascent are an opportunity to test one's physical level, one's equipment, one's companions, one's guides. The difficult conditions of the mountain are tamed little by little. The necessary adjustments are made, in a continuous learning process. You gain confidence. We go up from one camp to the next, and finally, at camp 4, if the fitness and the motivation are still present and if the weather conditions are favorable, we will be able to climb to the summit. This is a critical moment, many lack foresight and patience on

this last journey and get injured or even lose their lives.

The project manager in charge of the transformation will not confuse speed with haste. They will confidently enter their zone of boldness and be clear-sighted so as not to fall into the danger zone.

I'm starting the AI journey and going step by step

According to Fidaa Chaar, "implementing AI is a strategic decision. So it should first be a top-down decision. But a top-down decision not about the business case, but about the intention of the company. You then need to gather the right use cases and ideas using a bottom up approach⁴".

Implementing AI in your organization will require very specific actions and skills that are associated with any digital transformation.

Capgemini⁵ has structured this preparation process into a few key steps and best practices:

⁴ Chaar, F., Global Head of Client Services (Société Générale), cité par Capgemini https://www.capgemini.com/gb-en/wp-content/uploads/sites/3/2017/09/dti-ai-report_final1-1.pdf

⁵ Digital Transformation Institute (Juin 2017). *State of AI survey, 993 companies implementing AI.*



Implementing AI in your organization will require very specific actions and skills that are associated with any digital transformation.



1. Check the quality of your data and don't take cybersecurity lightly;
2. Discover and develop in-house AI skills and talents;
3. Identify the person who will be responsible for the customer/user experience, the CXO (Chief eXperience Officer), who is present in more and more organizations;
4. Ensure the support and confidence of the teams that will have to implement the solution;
5. Have the right technology facilitators to support you.

Let's go back to the steps of the Mount Everest climbing metaphor: once the decision to travel has been made, it is important to set up the base camp and define the plan for the ascent as well as the different steps that will mark out the climb to the summit.

For the digital transformation adventure with AI, the following major steps are to be expected.

Base Camp: Preparing for the journey to AI

The project leader:

- will verify data quality and will not take cybersecurity lightly;
- will surround themselves with internal AI expertise;

- will identify the person in charge of the customer/user experience;
- will ensure the support and confidence of the teams;
- will seek outside advice and expertise if necessary.

Camp 1: The AI discovery camp

Choose a pilot concept among opportunities that are fairly easy to implement and likely to bring visible and tangible results in a relatively short term. This limits the risks in case of failure and gives a solid and objective business case in case of success. You will remain in a limited and protected environment but it is important stay on the ground, in connection with the real life of the company and its employees. The goal of this first ascent to camp 1 is to gain expertise and confidence in the direction taken with AI within the team, the equipment and the guides. This first experience should also reassure the teams in the broadest sense about the impact of AI on the organization in general and jobs in particular. The results and the confidence gained will make them want to continue the journey. Success will keep you motivated and convince any skeptics to change their perspective.

To choose the right pilot, don't play the rebellious project leader who only listens to themselves. The Low Hanging Fruits⁶ (the first accessible successes) have been identified industry by industry and are well documented by technology facilitators, who effectively use them to get their clients started. Examples of projects with low to moderate complexity and high potential benefits that will carry the label of "must do cases" include:

- personalized customer service by virtual assistants;
- prediction models of customer loyalty;
- self-learning document search or archiving programs;

⁶ Capgemini (2017). *Turning AI into concrete value: the successful implementers' toolkit*. https://www.capgemini.com/gb-en/wp-content/uploads/sites/3/2017/09/dti-ai-report_final1-1.pdf

- detection of anomalies in production or internal control processes with triggering of maintenance or correcting actions;
- demand and inventory management;
- supply chain optimization.

Focus on these challenges, or the ones that are best suited for you, and put AI to work in your business processes to measure the impact in terms of financial return, competitive advantage, or customer satisfaction.



This first experience should also reassure the teams in the broadest sense about the impact of AI on the organization in general and jobs in particular. The results and the confidence gained will make them want to continue the journey.



Despite his passion for technological innovations such as the Alexa assistant, drone deliveries with Prime Air or the Amazon Go convenience stores, which are checkout-less, Jeff Bezos, CEO of Amazon, concedes that for his company, the biggest investment in the development of machine learning algorithms concerns processes that are not directly visible to the customer, such as demand forecasting, product recommendations, website and screen organization, fraud detection... In other words, everything that concerns the core business and daily operations of this online retail giant.

Camp 2: The camp of the step up

At this stage, the pilot concept is expanded and deployed in the company to be tested on a large scale. It is taken out of its protected environment and exposed to the greatest

number of people. The speed and ease of its adoption in the organization are measured. The solution can be improved with feedback from teams, customers and the market. At this stage, one also thinks about the governance to choose and to prioritize the AI projects that will follow. The key criteria will be, not surprisingly:

- the strategic alignment with the mission and vision of the company or organization;
- the complexity of the implementation, the expected return on investment;
- the available skills and resources.

At this stage, one will seek to develop the organization's AI systems management skills in order to create a sustainable strategic advantage.

Camp 3: The camp of continuous transformation

Once AI is introduced in multiple places in the organization, remain attentive and be creatively challenged by any new opportunities that arise. Nurture an internal culture of AI adoption whenever possible, if justified by the vision. According to McKinsey, who has extensively studied the processes and rates of AI adoption in companies⁷, early adopters quickly explore different technologies and multiple applications of AI. The best of them even become serial adopters, energized by the spectacular results of some AI systems. This acceleration is often made possible because the barrier of end-user adoption has been cleared, while it still holds back the most hesitant competitors.

Camp 4: The mastery camp

At this stage, AI is part of the DNA of the company and the organization. It has become a key element of the promise made to external or internal customers. It feeds the difference that makes the difference. It has gone from being a factor of optimization of existing processes to a facilitator and promoter of innovation.

⁷ McKinsey Global Institute (2017). *Artificial Intelligence The next digital frontier ?* <https://www.mckinsey.com/~media/McKinsey/Industries/Advanced%20Electronics/Our%20Insights/How%20artificial%20intelligence%20can%20deliver%20real%20value%20to%20companies/MGI-Artificial-Intelligence-Discussion-paper.ashx>

- It optimizes the customer experience in stores, making them a place of entertainment. A facial recognition program identifies them at the entrance and captures their current state of mind. The suggestions and promotions offered throughout the "shopping moment" are perfectly personalized.
- It allows users of cosmetic products to test them virtually in front of their smartphone and, through the analysis of their voice-produced comments, to vary the colors and contrasts proposed, as well as the prices.
- It optimizes energy consumption and air quality in the company's offices by anticipating their occupancy, modeled thanks to the employees' schedules and the sensors present in their mobility solutions.
- It produces innovative orthopedic prostheses if this is your core business for significantly improved patient comfort, and within much shorter manufacturing delays than competitors.
- It organizes the delivery crew's hyper-reactivity thanks to the geotracking of customers waiting for a package. They will be able to install complex equipment in record time thanks to augmented reality that helps them in real time.
- It anticipates traffic conditions several days in advance and offers subscribers the best mobility solution in real time.

This world may not please everyone. It leaves less and less room for spontaneity and the unexpected. An ethical AI is a transparent AI that must allow each of us to be free to vote with our feet and with our smartphone. We like to receive multiple recommendations from our online stores suggesting personal development books. But we also really like to walk in the second-hand bookstore we entered incognito: there, maybe, on the table next to the entrance, a book will be waiting for us that no AI would have had the idea to suggest to us and that will nevertheless give us a wild pleasure.

Confidence and motivation are built on small successes

To achieve success, focus on the objective must be accompanied by confidence and motivation. It is confidence that allows us to move forward with serenity and avoid getting sidetracked at every pitfall or changing our priorities at every complication. It occurs at three levels: oneself, one's collaborators, and the chosen direction. It is built day after day and is not immutable: external or internal factors can affect it. Motivation is the energy to move forward.

This was confirmed by the ambitious work of two Harvard researchers, Teresa Amabile and Steven J. Kramer⁸, who observed for four months the daily state of mind of 238 people involved in 26 different projects in seven companies — generating 12,000 calendar data that were then analyzed in their model. The projects were mainly about the design and development of new products, services or IT solutions. The number one factor of confidence and motivation identified with all the people tracked in the study was the ability to measure progress on meaningful tasks.

Thus, a day that builds confidence and motivation will be characterized by the following factors:

1. My actions have meaning and find their purpose in the great common project;
2. I have the resources to move forward;
3. I measure real progress, however small, every day;
4. I am happy with myself and I am acknowledged by my hierarchy for this progress.

Conversely, a bad day, which will undermine confidence and motivation if these circumstances tend to be repeated, will be characterized by the following factors:

⁸ Amabile, T. & Kramer, S.J. (2015). *Inner Work Life: Understanding the Subtext of Business Performance*. Harvard Business Review. <https://hbr.org/2007/05/inner-work-life-understanding-the-subtext-of-business-performance>

1. I don't understand the meaning of what I do;
2. I don't have the resources to do what I need to do well;
3. I don't see myself moving forward. Or, even worse, I feel myself moving backwards;
4. I am not proud of myself or I am satisfied but not acknowledged for my efforts.

The project leader can choose to be a catalyst of confidence and motivation, or an inhibitor of these energies, those that lead to performance and satisfaction.

The project leader who manages the changes brought about by AI has a vested interest in sharing the vision, as well as acknowledging each step taken in the right direction, while ensuring that the right resources are there to enable the advancement of a realistic program, day after day. Failure can be given meaning when it is seen as a learning experience, allowing one to move forward thanks to the lessons learned. Adopting the philosophy of Tal Ben-Shahar, professor of psychology at Harvard⁹, the enlightened project leader accepts setbacks as part of the learning process.

“

Failure can be given meaning when it is seen as a learning experience, allowing one to move forward thanks to the lessons learned

”

Focused on their ascent and confident in the road ahead, they are also patient and humble. Like an archer, they know that the arrow must be given time to reach its target. This is why they never rush or panic.

⁹ Ben-Shahar, T. (2011). *L'apprentissage de l'imperfection*, Éd. Pocket.

There will be failures in the implementation of AI

The introduction of AI is an innovation in itself, of great complexity as we talk about the fourth industrial revolution. The implementation of such an important innovation is a change process that must be managed as such. Not surprisingly, the challenges linked to this digital transformation are comparable to those encountered in any major change program: the lack of appropriate skills and talents as well as the insecurity created by the unknown. In addition, there are other issues specific to the introduction of AI, such as data quality and cybersecurity, or the possible doubt about its added value for the organization.

In their report “Make AI pervasive¹⁰”, Mindtree consultants have surveyed 650 IT leaders and provided an uncompromising picture of the situation:

- 26% of the surveyed business leaders say that they understand AI technology but do not have a good grasp of how to deploy it to create value;
- Among those who have implemented it, less than a third (31%) say that they are already seeing benefits from their AI efforts;
- 47% of respondents concede that they will need to train their staff in order to move forward with AI systems;
- 51% of these people realize that they don't fully understand the infrastructure and data strategy implications of implementing AI.

In his newsletter to shareholders in April 2017, Jeff Bezos raised awareness on the complexity and ambiguity of the environment: the companies that will remain leaders in the world of tomorrow, he said, will have fast decision-making processes (he talks about “high-velocity decisions”), with the ability to pick strong options based on only 70% of the available information. “If you wait until you have

¹⁰ Mindtree (2019). *Make AI Pervasive to Deliver Personalized Sales Assortment Recommendations*. <https://www.mindtree.com/about/resources/make-ai-pervasive-deliver-personalized-sales-assortment-recommendations>

the 90%, in most cases, you will probably be slow. And it's more costly to be slow than to be fast with a risk of error, as long as you're careful and responsive to correct what needs to be when necessary." According to Bezos, it's better to be wrong and correct mistakes than to be slow.

Another argument to encourage you to take action is to realize that everything is an experiment and to convince yourself that today's failures are the foundations for tomorrow's successes. Didn't Edison find 10,000 ways not to make a filament lamp work before he had the stroke of genius that made him part of history?

The implementation of AI is therefore an ambitious project. It should be treated as such, with seriousness and agility. We will carefully avoid the "white elephant" type of working group that works underwater for months with high consumption of resources before coming out. As soon as we have a minimum viable process¹¹ or, even better, a minimum lovable process, we will confront it with the reality of the market, the clients and the organization. Feedback will emerge on the relevance of the initiative and, following the philosophy of design thinking¹², a first evaluation of its

capacity to create a strong emotional benefit for the customer can be made.

Learning again and again what AI can bring to the "differentiating" value proposition is the project leader's winning attitude in this innovation process.

Success is a sequential process

A success builds on the previous success. I would even say: a success is built on the previous experience, whether it was positive or negative. It is certain that each action taken moves us forward, like the pieces of a domino that cascade one on top of the other, as long as a certain logic has directed their placement. Various physics experiments have shown that a tipping domino can generate an energetic force that can in turn tip another domino with a mass equal to 150% of its own. This is a scenario of geometric mathematical progression. Thus, it is demonstrated that physically, the twentieth domino set in motion by a six gram sugar cube could weigh up to thirteen kilos. We reach a ton with 31 dominoes!



To achieve extraordinary results with your AI projects, all you need to do is make this progression, let each success build on the previous one, let each experience be a learning experience.

¹¹ Ries E. (2011). *The lean startup*, Éditions Crown Business.

¹² *Design thinking* is a methodology for innovation developed by the d.School of Stanford University.

To achieve extraordinary results with your AI projects, all you need to do is make this progression, let each success build on the previous one, let each experience be a learning experience. The rules are: don't lose focus, don't try to tackle too many things at once and keep the pace. It takes discipline and preparation and above all, daring, at a given moment, to topple the first carefully chosen piece of the domino game, the game of setting up AI in your organization. Like pieces of increasing size that tip over one after the other, success will call for success. The key is in the timing and patience that the sequential side of things imposes. If you go too fast, if you aim too high, too far... the game stops, like dominoes.

Before running with AI, the project leader will learn to walk with it. They will know how to resist rushing. They are aware that by going too fast, they could injure themselves, risk damaging their team or their company. Walking with awareness prepares you for efficient and effective running. It involves the whole body, requires posture work and promotes deep breathing and brain oxygenation. The first kilometers with AI will be inspired by it. They will hasten slowly, conscious of the journey. They will avoid doing several things at the same time. They will use sticks, as in Nordic walking, to move smoothly from walking to running. And above all, as in walking or running, they will take a direction that will please them and make sense to them.

Conclusion: the intelligence of the project manager who leverages AI and their team is an augmented intelligence

AI is rapidly gaining momentum. In the short term, it will have a significant impact on the lives of companies, organizations and the professions. It requires the development of new skills. It will create new jobs. Some will be able to transcend these upheavals, others will not. Transcending an event means finding oneself higher and stronger after having gone through it.

The professional who will have adapted and will be comfortable in the world of AI is the one who will have understood the full potential of this technology, who will have managed to go creatively with the flow of change and who will have developed their emotional intelligence.

They collaborate with the robots. They have learned to speak their language made of abstruse acronyms. They are impressed by the power and speed of the algorithms that drive them and aware of their limits. They thought about the best way to distribute the tasks between them, themselves and their teams. They implemented this new way of working with the full cooperation of their alter egos. With all of them — robots and human beings — they are now able to achieve things that were not imagined, or even imaginable, a short time ago.

This informed individual has discovered how to listen to their emotions and those of their collaborators, and how to tame and respect them, as they are the infallible clues to their needs. Inspired, inspiring and listening to others, they have a clear view of the path to successful digital transformation. They have developed the emotional intelligence and creativity that are unique to human beings and that will be needed tomorrow more than ever to achieve long-term success. They have proceeded step by step, listening to the fears and difficulties encountered by the teams who are led against their will into a change that is too often unwanted, because it is misunderstood and worrisome. Aware of the ethical and societal challenges brought by AI, they are also the guardian of a trustworthy AI.

The changes that we are going through will be among the strongest experienced by humanity until now. This is due to the acceleration of the environment in which we live. Let's dive into in the ambitious, creative, inclusive and benevolent implementation of AI. In doing so, we will have an augmented intelligence of AI and our new emotional skills.



Apprehending the Future with Natural Language Processing



CHAPTER 3

Chapter 3 - Apprehending the Future with Natural Language Processing

Judicaël Poumay

Introduction

In the machine learning community, we like to say that making predictions is difficult, especially about the future. Jokes aside, being prepared for the future is essential for managers to evaluate risks, detect problems before they arise or prepare for new opportunities. This requires them to be aware of the business environment by analyzing various sources of information.

Fortunately, in today's world, information has become ubiquitous. Millions of news articles, blog posts, images, videos, and more are published daily¹. However, the issue often is not to find the data but to find what data is relevant. This overabundance of information makes it difficult to understand the business

environment clearly. Moreover, the speed at which data is generated is expected to grow exponentially, especially with the advent of the Internet of Things (IoT).

Artificial Intelligence's (AI) strength precisely comes from its ability to navigate a high number of data points for us. This can help decision-makers by simplifying our complex world and reducing it into the insights that matter. These AI systems can be used for many applications, which can be broadly classified as predictions, information reduction, and agent-based learning.

Prediction tasks include regressions and classifications. Regression is the task of trying to predict a value for a given input, such as the expected future price of a stock given some known information. Classification is the

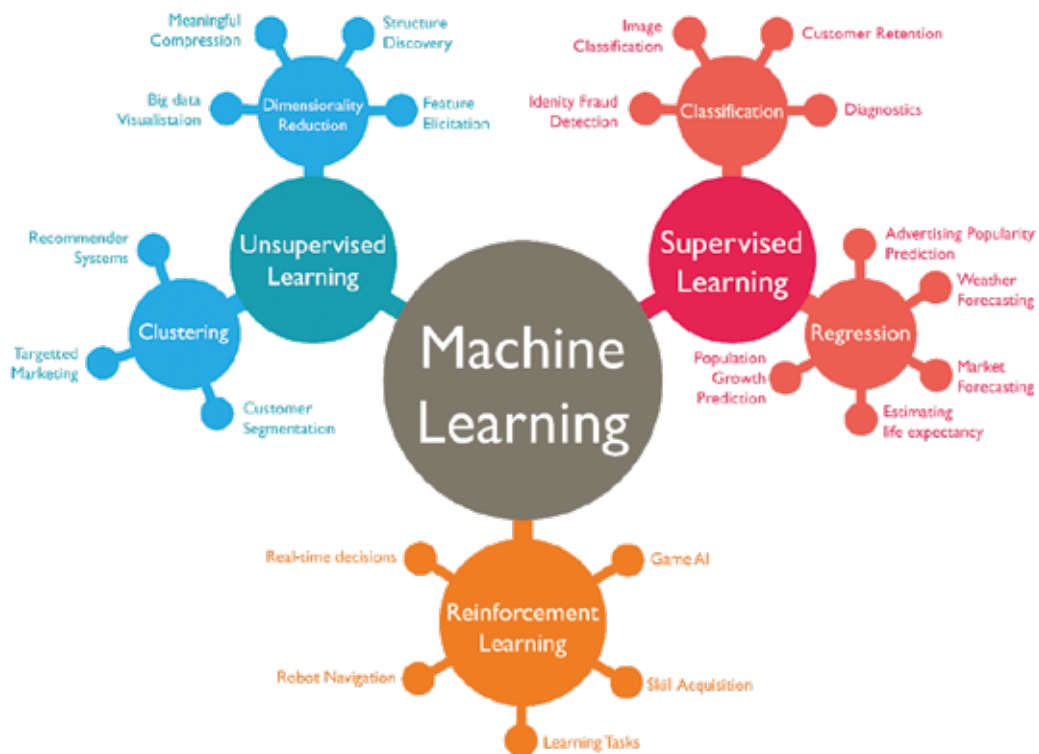


Figure 1: Mapping the concepts behind Machine Learning (ML).

¹ Bulao, J. (2023, 7 février). *How Much Data Is Created Every Day in 2023 ?* Techjury. <https://techjury.net/blog/how-much-data-is-created-every-day/>

task of assigning a class to an input, such as determining whether a customer is eligible for a loan.

Information reduction includes tasks such as clustering, information extraction, compression, summarization, trend extraction or anomaly detection. These tasks aim to take a large amount of unstructured input data and extract what matters, or to find mathematical representations that simplify the information.

Agent-based learning tasks involve creating agents or bots that can interact with an environment and learn how to behave to achieve a specific goal. Self-driving cars and trading bots in the stock market are examples of agent-based systems.

When we study AI for text analysis, we call this Natural Language Processing (NLP). As such, it is also tightly tied to linguistics. NLP aims to understand the inner workings behind languages to support language-related tasks such as translations, text-to-speech, speech recognition, opinion mining², and many more.

In this chapter, we will describe the field of NLP and discuss two of its applications which can directly affect businesses: anomaly detection, and trend detection & monitoring. We argue that by leveraging the power of texts, managers can be better prepared for the future in a world in constant evolution.

Natural Language Processing

History

Some argue that NLP started in 1954 with the Georgetown experiment. This experiment consisted in translating 60 Russian sentences into English and was somewhat of a success. In 1960, SHRDLU was the first language-controlled program, allowing simple conversations with its user in a world of blocks. All these advances seemed to show that AI and NLP would become very important in the coming decades.

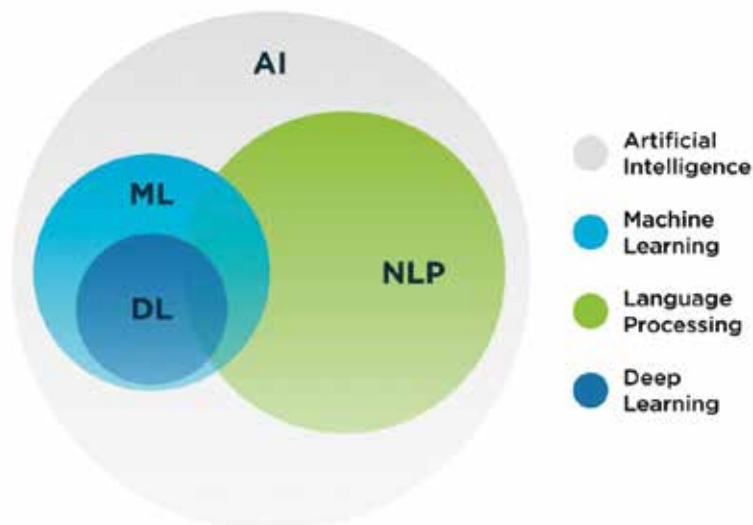


Figure 2: The subsets of AI.

² With the explosion of the Internet and social networks, it has become necessary to analyze millions of posts, tweets or opinions in order to know what Internet users think. Opinion mining allows to automatically analyze all these textual data and to bring out the different opinions expressed on a specific subject such as a brand, a news or a product. (Source : Zarour, A. (2020, September 18). *Qu'est-ce que l'Opinion Mining (ou Sentiment Analysis)* ? Inbenta. <https://www.inbenta.com/fr/blog/quest-ce-que-lopinion-mining-ou-sentiment-analysis/>. Translated from French by the editor.)

However, this early success was misleading. Scientists of the time quickly realized how difficult the task really was. Not just automatic translation but everything else that AI and NLP were supposed to solve. This was the beginning of the AI winter. An era during which the evolution of much of AI was slowed and under-financed. This is a long and complex

period in which AI attracted a bad reputation in the industry and academia³.

Over decades of research, AI and NLP gained in maturity. But it was only in the 2010s that they regained their reputation. In 2011, Watson (an IBM AI system) won Jeopardy, a TV show, by defeating the best human players. Apple, Google, and Amazon soon followed with the creation of their virtual assistants, such as Alexa and Siri. Automated translation became actually useful, and many other problems were solved. Since then, AI has been on the rise, and so has NLP.

Tasks

Whenever we are trying to systematically and automatically extract or manipulate information from text through a computer, we are doing NLP. This goes from simple tasks such as Part-Of-Speech tagging (POS), where the goal is to assign a label to each word of a text, such as “verb”, “adjective”, or “pronoun”, or Named

or subjectivity score to texts such as product reviews to understand the feelings and reactions of people, or automatic summarization, which is the task of automatically summarizing a long text into a few lines. These tasks are more complex as they rely on simpler tasks such as POS tagging and NER. These are only a few of the many tasks that can be carried out by NLP⁴.

Tools

A few tools are fundamental in NLP. These include language models, word embeddings and topic models. Language models are large neural networks trained in an unsupervised manner on large corpora⁵. They are trained to predict missing words in sentences accurately. By doing so, they learn how to generate text and how words interact with each other. Such models are the backbone of modern NLP as they contain prior knowledge about languages that can be easily reused in most downstream tasks in the form of word embeddings.

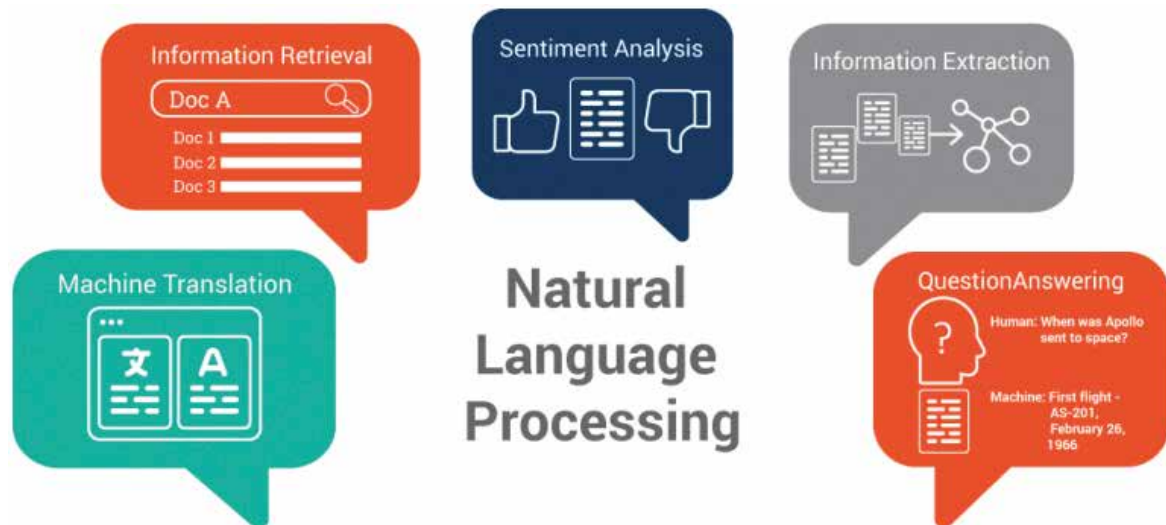


Figure 3: NLP applications.

Entity Recognition (NER), where the goal is to find words or sequences of words that refer to entities such as people, objects, products and other concepts in a text.

There are also more complex tasks such as Sentiment Analysis which assigns a polarity

Word embeddings are a fascinating piece of technology that translates words into a mathematical space, such that the semantic relationship between words is encoded as an

³ To learn more on this topic: <https://thethoughtprocess.xyz/language/en/science-en/computer-science/2020/05/15/artificial-intelligence-history/>

⁴ <http://nlpprogress.com/>

⁵ Lutkevich, B. (2020, March 2). *Language modeling*. Enterprise AI. <https://www.techtarget.com/searchenterpriseai/definition/language-modeling>

algebraic relationship in a latent space⁶. This allows us to perform mathematical operations on words, which is essential for computers to manipulate those words. For example, using such vector representations of words, the following is true: KING-MAN+WOMAN = QUEEN.

Finally, topic modelling is another flagship tool of NLP. These models are capable of extracting topics from a corpus of documents⁷. In other words, given a set of text, we are able to extract groups of words that tend to co-occur, which defines themes that run in the documents. Over time these models have become more complex by introducing the extraction of topics and sub-topics or the extraction of events as topics localized in time.

Anomaly detection system

One way to use AI to prepare for the future is through anomaly detection systems. Learning to detect anomalies quickly can help companies prevent problems such as mechanical failures in heavy machinery or take on new opportunities that might arise unexpectedly in a market.

What are anomalies?

Anomalies are defined as surprising occurrences that are outside the realm of what we expect. For example, a faulty robot in an assembly line or a sudden surge in demand.

These anomalies are often hard to detect until they evolve into something bigger. This can lead to a large impact on the bottom lines or a missed opportunity. Nonetheless, if they are dealt with quickly, their consequences can be mitigated or taken advantage of.

“

Learning to detect anomalies quickly can help companies prevent problems or take on new opportunities.

”

We can classify anomalies into three types⁸. Point anomalies are singular occurrences that lie outside the realm of what is expected. This can manifest as a sudden large transaction of money in a bank account or an unexpected war that impacts supply chains. Conversely, collective anomalies are a collection of occurrences whose distribution is distinct from the rest of the data. These are often the results of multiple point anomalies that come from the same source. For example, if one has bought machines for their factory from various brands, but all the machines from one brand have a similar problem.

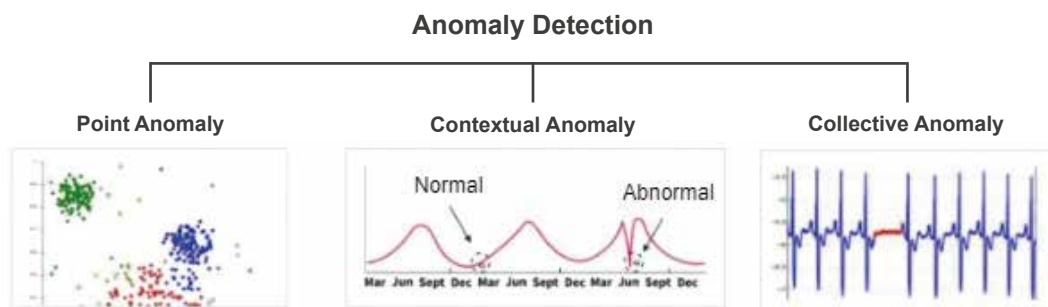


Figure 4: The 3 types of anomalies.

⁶ Poumay, J. (2021, May 24). *Embeddings : matching words with numbers*. <https://thethoughtprocess.xyz/language/en/science-en/computer-science/2020/06/19/embeddings-matching-words-with-numbers/>

⁷ Pascual, F. (2019, September 26). *Topic Modeling : An Introduction*. MonkeyLearn Blog. <https://monkeylearn.com/blog/introduction-to-topic-modeling/>

⁸ Ahmed, M., Mahmood A. N., Hu, J. (2016) "A survey of network anomaly detection techniques." *Journal of Network and Computer Applications* 60: pp. 19-31.

Finally, anomalies can be contextual, meaning they are only anomalous with respect to some context. It might be normal for your computer's processor to run at 75°C, but only when it is doing some work. While 75°C is a normal temperature, this temperature is anomalous if your computer is idle.

a signal. Detecting anomalies is like finding a needle in a haystack; except the needle might cost you millions of dollars if you don't find it.

Hence, to find anomalies, we have to define what is "normal" and detect data points that are outside this defined "normal". However, a system's normal behavior is not always

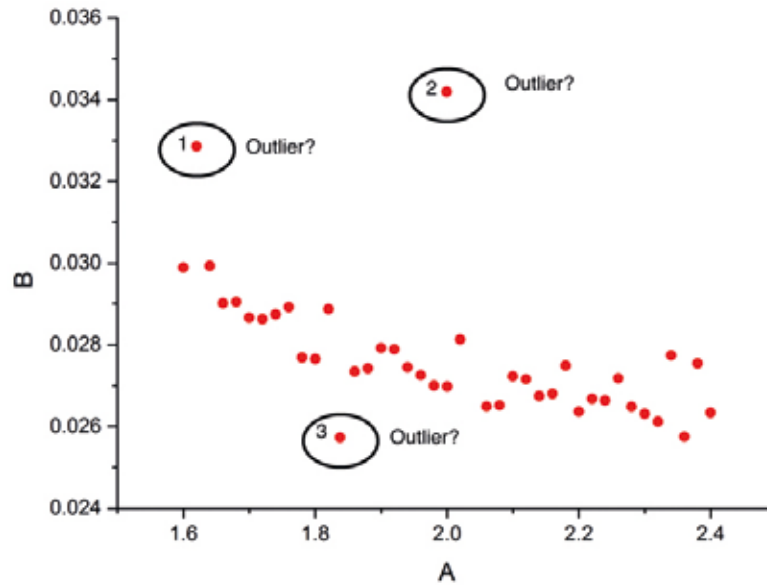


Figure 5: The identification of point anomalies requires a survey of outliers.

Each type of anomaly requires a different approach when attempting to detect them. Point anomalies are the simplest ones as they are single points clearly lying outside the normal distribution. On the other hand, collective anomalies exist as their own separate distribution which must be modelled first to understand their cause. Finally, contextual anomalies require a more complex model since, by definition, their anomalous behavior is contextual to the environment they exist in. Therefore, deciding which variable might be relevant to detect contextual anomalies can be an arduous task.

Challenges in anomaly detection

Anomalies are outliers. In most statistical analyses, outliers are seen as noise that needs to be removed as we assume such data points are the result of human or measurement errors. Hence, the biggest challenge when looking for anomalies is that we have to look inside the noise to find data points that are outliers but which do not come from the inherent noise in

easily definable or clear-cut. Moreover, what is considered normal behavior can evolve over time as people, technology, and economic landscapes change.

Anomalies arising from malicious activities often take advantage of this. Attackers will often try to hide their anomalous activities by behaving in such a way to make them look "normal". For example, splitting what would be a large and suspicious money transaction into many smaller ones.

Finally, the significance of the drift from the expected range differs from domain to domain. In the medical context, a slight fluctuation in body temperature can be anomalous, whereas a similar degree of change in the temperature of heavy machinery might be normal. The significance of this drift might also change with technology. For example, small anomalies in railway manufacturing quality can be deadly for high-speed trains while simply uncomfortable for traditional trains.

Applications of anomaly detection

Anomaly detection systems monitor an environment and learn the normal range and relationships between observed variables. Hence, when something out of the ordinary happens, the system should be able to notice the anomalous pattern and signal the user. This requires a system able to constantly monitor the environment and learn any change in what is considered normal.

In the petroleum industry, anomaly detection can be extremely useful. Heavy machinery such as turbomachines are expensive and vital for the proper functioning of the operations. Hence, such machines are monitored by hundreds of sensors measuring vibrations, temperature, pressure, etc. In this context, anomaly detection systems can prevent mechanical failures by monitoring anomalous readings in these sensors⁹. When an anomaly is found early, the related issue can often be fixed faster and in a cheaper manner.

Fraud detection is another flagship application of anomaly detection¹⁰. These include credit card fraud, healthcare fraud, insurance fraud and money laundering. Such activities have been estimated to cost more than \$400 billion in the US alone. By carefully monitoring financial transactions, fraudulent operations can be detected as they often have an anomalous signature. However, criminals always learn to find new ways to trick the system and go undetected. This results in an arms race between them and the engineers developing the anomaly detection system.

In the context of NLP, anomaly detection is used to detect abnormal patterns in text. Tools such as word embeddings can be particularly useful as they provide a mathematical representation of text. Hence, we can model how normal text should look in a latent space and compare potentially anomalous text to this learned normal. We can use this to detect spam or find

9 Martí, L., Sanchez-Pi, N., Molina, J.M., Bicharra Garcia, A.C. (2022). "Anomaly detection based on sensor data in petroleum industry applications." *Sensors* 15, no. 2 : 2774-2797.

10 Hilal, W., Gadsden, S.A., & Yawney, J. (2022). Financial Fraud: A Review of Anomaly Detection Techniques and Recent Advances. *Expert Syst. Appl.*, 193, 116429.

unusual complaints from customers and act on those before they become problematic. In one article¹¹, the authors analyzed customer reviews to detect unusual but significant customer complaints. In another¹², the authors learned to detect spam reviews in the e-commerce context.

Trend detection & monitoring

Trend detection is another way of using AI systems to prepare for the future. Detecting and monitoring trends can help companies understand where they should invest their time and money. Careful monitoring of trends helps them understand when to enter or exit a market to maximize their bottom line.

What are trends?

Trends are topics that currently draw the attention of a community. For example, we can cite crypto money and AI as current trends. Being aware of trends is essential for businesses. They inform managers on where to focus their resources for research and development.

Trends can be in various states over time. Trends first emerge and are picked up by early adopters such as technology enthusiasts. As they grow in importance, they pick up more and more popular support. Finally, a trend can decline and may be replaced by the next best thing.

In practice, emerging trends may hibernate for a long time or go through many declines before becoming popular. This was the case for the field of AI as we know it today. Current methods based on artificial neural networks were discovered long ago in the 50s. However, the field went through two so-called "AI winters"

11 Seo, S., Seo, D., Jang, M., Jeong, J., & Kang, P. (2020). *Unusual customer response identification and visualization based on text mining and anomaly detection*. *Expert Systems With Applications*, 144, [113111]. <https://doi.org/10.1016/j.eswa.2019.113111>

12 Xie, S., Wang G., Lin, S., Yu, P.S (2012). "Review spam detection via temporal pattern discovery." In *Proceedings of the 18th ACM SIGKDD international conference on Knowledge discovery and data mining*, pp. 823-831.

in the 70s and 90s. It was only in 2012 that the field finally took off properly, thanks to the explosion of data availability and hardware improvements¹³.

and opinion mining techniques. With such techniques, we can study how people discuss these trends on social media to understand how to better react to them.

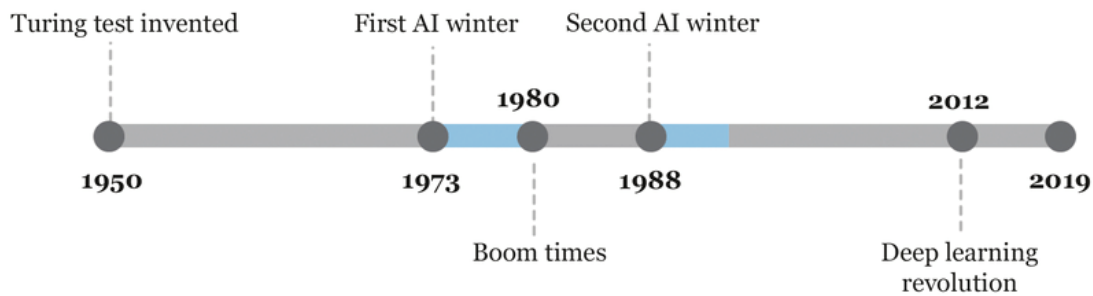


Figure 6: Timeline of AI winters.

Challenges of trend detection & monitoring

Detecting trends is not an easy feat, it requires text mining methods to study thousands or millions of documents. Techniques such as topic modelling are commonly used to extract topics from text which can then be tracked over time to understand their developments.

Emerging trends are particularly difficult to detect and track due to their elusive nature¹⁴. As they emerge, trends provide a little footprint of their existence. Thus, we require models that are capable of detecting the slightest novelty. Moreover, the growth of emerging trends is not inevitable as they may die young, and this evolution is often unpredictable (remember Blu-ray?). Similarly, well-established trends may eventually die off. Nonetheless, when and how fast this decline will occur is also difficult to assess.

Finally, not all trends are created equal. Evaluating how a trend is perceived is also important. Is it overall positive? Negative? Controversial? And why? These questions can be partially answered using sentiment analysis

Applications of trend detection & monitoring

In the scientific realm, trend detection & monitoring can be used to discover current and developing trends in a particular domain¹⁵. This can be done through the analysis of thousands of scientific articles. Such methods can be helpful for scientists to find out the state of a field, get ideas or be part of the first ones to explore new problems. Businesses can also take advantage of this to be better prepared for new technologies that may arise from research.

From a marketing perspective, trends can be helpful in understanding what people are paying attention to. What is trendy tends to sell; therefore, it is important to keep an eye on how the business environment is changing. By studying social media using trend detection and monitoring tools, marketers can target specific customers. Moreover, marketers can also study how people's emotions change over time about a particular product or brand¹⁶.

In the financial market, trend analysis can be used to predict the values of stocks. For example, people have been analyzing tweets

13 Poumay, J. (2020, août 20). *Artificial Intelligence History*. <https://thethoughtprocess.xyz/language/en/science-en/computer-science/2020/05/15/artificial-intelligence-history/>

14 Kim, J., Lee, C. (2017). "Novelty-focused weak signal detection in futuristic data: Assessing the rarity and paradigm unrelatedness of signals." *Technological Forecasting and Social Change* 120 : pp. 59-76.

15 Le, M., Ho, T.B., & Nakamori, Y. (2005). Detecting Emerging Trends from Scientific Corpora. *International Journal of Knowledge and Systems Sciences* 2, no. 2: 53-59.

16 Esiyok, C., & Albayrak, S. (2015). Twitter Sentiment Tracking for Predicting Marketing Trends. *Smart Information Systems*, pp. 47-74. Springer, Cham.

from celebrities such as Elon Musk to invest in cryptocurrency and other assets¹⁷.

“

Trend detection and monitoring methods can be helpful for scientists to find out the state of a field, get ideas or be part of the first ones to explore new problems. Businesses can also take advantage of this to be better prepared for new technologies that may arise from research.

”

Conclusion

AI systems cannot predict the future. However, they can help us be better prepared by giving us a better understanding of the present and the past. In particular, NLP models can help by providing tools to analyze large quantities of texts. From this, we can discover trends, understand their evolution, or detect anomalous events before they become problematic. As the production of information keeps increasing exponentially, these AI systems will be more and more necessary to keep a competitive edge.

Sources for the figures

Figure 1 : Mayo, M. *Which Data Science / Machine Learning methods and algorithms did you use in 2018/2019 for a real-world application?*. KDnuggets. <https://www.kdnuggets.com/2019/04/poll-data-science-machine-learning-methods-algorithms-use-2018-2019.html>

Figure 2 : 7wData. (2021). *Natural Language Processing: Taking Your Business to the Next Level*. 7wData. <https://7wdata.be/article-general/natural-language-processing-taking-your-business-to-the-next-level/>

Figure 3 : Roy, D. S. (2021, 14 décembre). *A light introduction and roadmap to Natural Language Processing*. Medium. <https://medium.com/unknownimous/an-introduction-and-roadmap-to-natural-language-processing-8956874b330d>

Figure 4 : Alihodžić, S. (2023). *Mystery of Predictions in Anomaly Detection*. E&P Research. <https://research.einar.partners/mystery-of-predictions-in-anomaly-detection/>

Figure 5 : Fernández-Godino, M. G., Diggs, A., Park, C., Kim, N., & Haftka, R. T. (2016). *Anomaly Detection Using Groups of Simulations*. Aerospace Research Central. <https://doi.org/10.2514/6.2016-1195>

Figure 6 : Schuchmann, S. (2019). *Analyzing the Prospect of an Approaching AI Winter*. ResearchGate. <https://doi.org/10.13140/RG.2.2.10932.91524>

¹⁷ Lennart, A. (2021). How Elon Musk's Twitter Activity Moves Cryptocurrency Markets. *Social Science Research Network*. <https://doi.org/10.2139/ssrn.3778844>

On the Way to Augmented Intelligence

Les Cahiers du Digital - N°6

Digital Lab - HEC Liège Management School - Liège Université

Authors: Maxime Deuse et Florine Xhrouet, Christian du Jardin, Judicaël Poumay

Date of online publication: April 2023

Coordination : Nicolas Neysen

Communication & Design: Roxanne Thonnard

Image credits: Cover: ©Shuo/Adobe Stock, p.15: ©Garry Kasparov, p.19: ©IKEA, p.27: ©Somnath Ghosh/Unsplash, p.32: ©fran_kie/Adobe Stock.

The Digital Lab would like to give special thanks to Ethias, Micropole, KPMG and Partenamut, its partners in projects related to AI.

This publication is free of charge and may not be sold or used for commercial purposes. This *Cahier du Digital* is a publication of the HEC Digital Lab. You are free to reproduce, distribute and communicate this creation to the public in respect of the moral rights of the authors, provided that you cite your sources and do not make commercial use of it.

With the support of:



Micropole, accélérateur de la transformation des entreprises par la Data.

Du conseil à la mise en œuvre opérationnelle, Micropole accompagne les entreprises dans leur stratégie Data, et les transformations organisationnelles, humaines et technologiques associées.



Repensez votre organisation et gagnez en pilotage, productivité et compétitivité.



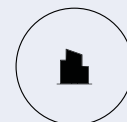
Valorisez et exploitez au mieux vos données en toute sécurité.



Augmentez la croissance et la transformation de votre entreprise.



1200
collaborateurs



14
agences



6
pays

France - Suisse - Belgique - Luxembourg - Espagne - Chine

CONTACT

www.digitallab.be

hecdigitallab@uliege.be