Machine Learning and the 4th Industrial Revolution
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Introduction

It is a huge privilege to be among you today and talk to you about a topic very close to my heart. My name is Loubna Bouarfa, and I am a machine learning engineer by training. I am the founder of OKRA.ai, a company that equips pharma with its own unique artificial intelligence brains. What we actually do at OKRA.ai is being part of the AI revolution for the healthcare system. We live in very interesting times, witnessing the beginning of the 4IR. As it unravels, the history of humanity is being rewritten while we go about our daily affairs, unable to suspect the watershed moment humanity is going through. We'll spend the next hour together and I'll do my best to explain to you what the origin of 4IR is, how machines think and support us in our everyday life, and how the symbiotic relationship between intelligent machines and humans is the key to overcome global issues affecting our planet.

Chapter 1 - Why do we care? Why should you care?

Timeline

We are at a new inflection point, and like every transition, it is marked by big changes and a need that had to be met.

Hunter-gatherers

12.000 years ago, the earth had just undergone a major climate change, and the ice age was coming to an end as a result, a less harsh, more stable climate settled in, which helped plants and animals multiply. 4 million humans shared the planet, our ancestors the hunter-gather homosapiens, pursuing their survival in symbiotic harmony with nature. The invention of fire and the settlement known as a village were fundamental to build the society of today.

Agrarian era

About 10.000 years ago, one area, in particular, set the place for the next evolution that forever changes humans' relationship with nature. The fertile crescent in the new east, where wild edible wheat and plants grew. Here the agrarian society prospered establishing a form of social organization that was characterised by the ownership of land, which was passed down through generations. As the agrarian society was born from the need of settlement and societal structure the industrial revolutions also came from a need: the need to speed the production for a population growing exponentially.

The first industrial revolution

1760 - The first industrial revolution started with the invention of the steam engine we started using water and steam power to mechanize production.

The second industrial revolution

Between 1870 and 1914, the second industrial revolution saw the widespread adoption of technological systems such as the telegraph, the development of sewage systems and the use of electric power to create mass production. It is during this time that an embryonic hierarchical leadership model is developed; humanity divided work into specialities.

The third industrial revolution

The third industrial revolution - the digital revolution - began in the late 1900s and is characterized by the spread of electronics and information technology. The technology has not been used only to automate production but also to expand the possibilities for people to have leisure, travel and improve the quality of life.

The fourth industrial revolution

Far from the rule-based approach, the fourth industrial revolution is characterised by the symbiotic relationship between humans and machines to solve big problems that our world is facing from climate change, healthcare, and inequality.

Global threats

These previous industrial revolutions and the growth of the population impacted the world heavily in terms of exploitation of resources. The last few years, saw the world emerging to a new inflection point in the history of humanity. In a time when the pandemic outbreak causes tremendous loss of human life and froze the economy and the travel industry. AI systems helped monitor and reduce the spread of the disease. We saw governments across the world using automatic tracking and tracing to manage the interaction with positive coronavirus patients. The threat of an incoming geopolitical war and the reality of climate change will inevitably put at risk life as we know it. AI can propose unconventional methods to save energy as well as generate sustainable energy.

World population

The world population is expected to increase by 2 billion persons in the next 30 years, from 7.7 billion currently to 9.7 billion in 2050. This rapid increase in population brought with it a growth of production and acceleration of consumption. Over the course of the 21st century, world population growth will slow down significantly, coming close to its peak at 10.9 billion by 2100. This means that the focus of the new industrial revolutions will shift and the evolution of the human race is not based anymore on **how to accelerate the production for a growing population but on how to change our way of production to protect the planet and to live in harmony with nature** in a way similar to our hunter-gatherer ancestor but in a modern world that is not only run by human intelligence but also Artificial intelligence.

AI solutions and the planet

The new industrial revolution needs to bring a symbiotic relationship between humans and the planet, to solve big problems that are facing our world from climate change, healthcare, and inequality in the world. Humans and machines need two work hand in hand in the new era. What is this technology that allows us to make a transition from a volume-driven economy to an outcome-driven economy that brings harmony with nature similar to the hunter-gatherer age? The technology that we are talking about today is AI, this technology allows the development of intelligent machines that mimic human intelligence without its biological limitations. This is why I believe AI will lead to a more equitable digital economy and society, not a more discriminatory one. AI processes increase efficiency and effectiveness and aim for outcomes by overcoming errors and biases inherent in human decision-making. The shift to renewable energy and finding ways to monitor energy consumption and save energy cannot wait any longer. This new revolution promises a more conscious use of resources in a mentality that combines profit outcomes and respect for nature. We are going to explore together also how this amazing new technology will make us switch from a sick care-oriented healthcare system to a wealth-care-focused not on curing each sick organ but the specific unique person as a whole. The focus on the specific individual will be reflected also in other aspects of our life such as the individualised educational programmes aimed to teach the best skills to each unique child.

Chapter 2 - Generalization: Can machines think?

Can machines think?

Let's look at how it all started. The science of AI started initially in developing intelligent computer programs for the primary task to understand human intelligence, but AI developed further to achieve results at high speed without the need to confine itself to methods that are biologically observable. Alan Turing[1] is the first one to ask the question "Can machines think" in his seminal work, "Computing Machinery and Intelligence",1950 - To answer that question he offers a test, now famously known as the "Turing Test",

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[1] A. M. Turing (1950) Computing Machinery and Intelligence. Mind 49: 433-460.
https://redirect.cs.umbc.edu/courses/471/papers/turing.pdf

where a human interrogator would try to distinguish between a computer and human text response. Turing thought a computer program would have "intelligence" if it could trick an interrogator into believing it is human. Today's AI doesn't need to pass the "Turing Test"[2] to be relevant to solve today's problems. This is no longer relevant, as machines have developed and already beat humans in certain tasks.

An example from the healthcare industry

An example from healthcare is in radiology: detecting tumours: Deep learning algorithm (DL) outperformed physicians in classification and nodule detection for malignant pulmonary nodules on chest radiography.[3] DL for assessing mammographic breast density – comparable with experienced mammographers.[4] Machines are taking roles different from humans in the 4th industrial revolution, where machines are good at high computing, high granular tasks, and goal-oriented tasks, humans are using their intuition and emotional intelligence to drive outcomes for the future.

Moore's Law is dead

In 1965, Gordon Moore posited that roughly every two years, the number of transistors on microchips will double. Moore's Law, by the strictest definition of doubling chip densities every two years, isn't happening anymore. CPU performance improvements have now slowed to roughly 30% annually, so technically speaking, Moore's Law is dead[5]. Even though Moore's Law is dead, there are other aspects of the performance development of machines that have not been taken into consideration until now. Machines today have a different kind of intelligence more similar in many ways to human intelligence. Today and thanks to the high computing power and Moore's law, we can build machines that can go beyond rules and learn from observations, that no longer need humans to design the rules.

Robot creating poem

In 1984 When the book "The Policeman's Beard Is Half-Constructed" by "Racter"- a collection of surrealistic poetry and prose - was published, no one could really imagine that Racter was not a real poet - not a human one at least. Racter (short for raconteur) was an algorithm, it could just create sentences randomly but grammatically correct and coherent, but it was for the human developers behind Racter to choose the most relevant sentences and compile the book for publication. Some human intervention was still needed in the process then but not today. Today - Probabilistic self-learning AI - like Verse by Verse: An experimental AI-powered programme can help you compose poetry inspired by classic American poets at real-time speed receiving only a few inputs and delivering an amazing poem - outcome.

Can AI learn from observation?

Pattern recognition

To understand where the 4IR is taking us with self-learning AI, we need to understand the intrinsic power of this technology that is about to change our world I want to start at the beginning. I'm sure that, throughout the 100,000-odd years of our species' existence, our ancestors looked up to nature and wondered if what they see is real if it is only made up in their heads or if there is more. Let's begin with a question: As humans, do we see the world patterns created by the laws of nature, or by us? How do we convert a set of observations into concepts in our brain? How do we learn from examples? And how does knowledge grow from the experience?

Elephant

I went on a safari in Kenya, and I had an experience where I saw something I can describe as a red animal with a massive body, large ears, a long trunk, it was about 300 meters away. I come to believe that in reality, there's a red elephant 300 meters away. We drove away, and I kept looking at the elephant, he got smaller and smaller, until I couldn't see it anymore, but is it still the case that in reality, there was an elephant that was far away? could I be wrong? Could I be misinterpreting the nature of my perceptions?

Recognition and categorisation

The tree can be recognized from its leaves, the daughter in the habits of her mother. We thereby consciously

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[2] https://www.d.umn.edu/~tcolburn/cs1581/lectures/chapter07/intelligence/index.html
[3] Nam JG, et al. Radiology. 2017;284(2):574–582
[4] Lehman CD, et al. Radiology. 2019;293(1):38–46
[5]https://d2axcg2cspgbkk.cloudfront.net/wp-content/uploads/Breaking-Analysis_-Moores-Law-is-Accelerating-and-AI-is-Ready-to-Explode.jpg

make observations on animals, trees, people's habits, pieces of art, and metaphors in literature. When observing, we encounter a new member of a class, we recognize it and can assign the class name while classifying the observation.

The miracle of generalization

The miraculous ability to judge the similarity between objects is named generalization. Human beings are pattern recognisers, not just because of this ability, but especially because we are aware of it. The name of the class is not just the name of a set of observed objects. In fact, it refers to something deeper. It refers to a possibly infinite set of seen or unseen objects in the universe that we may or may not encounter. Generalisation is a remarkable feature of the human brain. Generalisation is the cornerstone of human intelligence. Pattern recognition underpins the capability to generalise and thus serves as a key feature of human intelligence. The skill of generalization makes us conscious beings. It constitutes the basis of any science, of any religion, of any story that has been ever told, every village or city that has been created, and every tree that has been planted. The question is how we do this? How do we come from observation to generalization? And from generalization to action?

From human to machine

Is generalization a skill that only humans do? Or can it be transferred to machines? Generalisation is a trait we humans gave to machines. The self-learning machines. Can we conclude that a machine can generalize/learn from observations as humans do? AI systems constantly learn from the data we feed them. They are able to organise the learning into patterns, similarly to us. Machine recognition mimics the human ability to recognize a specific object by using suitable sensors, and algorithms to find and measure the relevant features in the data given. This is followed by the application of statistics on a training set with examples. With fully automated systems, in order to obtain new insights and discoveries then we have to be ready to be open for new sensors and different algorithms.

Chapter 3 - The pair matching (Pythagoras)

How do we build intuition into AI

Next to learning from observation, another key philosophical development leading to the creation of thinking machines; regards the famous mathematician and philosopher Pythagoras. To develop self-learning machine learning - we had to mathematically disobey Pythagoras. Yes, you read it correctly. Believe it or not, Pythagoras was not right about everything. To build machines that can self-learn we had to disobey the triangular inequality; in order to be able to do pair matching. To be able to match similar objects mathematically we had to disobey the famous premise that "the shortest distance between two points is a straight line." Pythagoras was a spiritual leader. If you wanted to join the Pythagoreans, you had to swear an oath to their holy triangle.[6] Pythagoras was obsessed with triangular theorems. There is documented evidence of students visiting Pythagoras' room and finding tables and walls covered in equations and charts of triangles.[7]

Euclidean and non-Euclidean metrics

Non-Euclidean metrics, the ones respecting Pythagoras' triangle inequality, are not the only distance metrics that can be used to train machine learning algorithms. We will demonstrate why we disobey Pythagoras' theorem when it comes to the automation of human decision-making. In machine learning, we solve many automation problems through pair matching from A to B. To train machine learning algorithms in this relevant task, distance metrics are used to measure the distances between two points in our feature space and hence automate the recognition of objects. We have Euclidean metric algorithms, which are very strict and refer to triangle equality. Finally, we have the non-Euclidean, non-metric algorithms, which basically violate the triangle inequality. So now the question is: what distance metrics are best for a real-world situation? Should we use metric or non-metric approaches to train our algorithms?

Pythagoras got it wrong

A paper that I like very much published its results in 2014.[8] In this paper, the authors claimed that in machine

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[6] https://listverse.com/2017/04/26/10-strange-facts-about-pythagoras-mathematician-and-cult-leader/

[7] https://www.theonion.com/new-evidence-reveals-pythagoras-wrote-dozens-of-unhinge-1819655096

[8] Walter J. Scheirer, Michael J. Wilber, Michael Eckmann, Terrance E. Boult (2014) Good Recognition is Non-Metric, Pattern Recognition 2014, Volume 47, Issue 8, August 2014, Pages 2721-2731

learning, good recognition is non-metric. Now, let's use an example to illustrate the Pythagoras theorem. Imagine that we need to train a machine learning algorithm to determine how likely the picture on the left is the same person as the one on the right. If we apply the triangle inequality to this example, the distance between the two pictures on the right is actually smaller than the distance between each one of them with the photo on the left. In this example, we are using non-Euclidean metrics which respect Pythagoras' triangle inequality. At first sight, we can already conclude that the triangle inequality does not stand in this example. Pythagoras, in this case, got it wrong.

Recognition through non-metric approach

Every moment we live is never equal to any moment in the past. There are always differences. Every street, every tree, and every person we meet is different from all the streets, trees, the persons we have ever seen before. How do we know that the new place where we find ourselves is a street? How do we know that the person standing in front of us is a person? Even if she is your mother, and you have lived with her all your life, the ability to recognize her is miraculous. To obtain good recognition, we need to use non-metric approaches. Therefore, good recognition doesn't satisfy the triangle inequality. In the real world, the shortest distance between two points is not a straight line. It turns out that the science of learning is improved with a non-metric approach; initial confusion creates better eventual clarity.

Chapter 4 - The fast-thinking brain

The enormous power of the unconscious brain

Another characteristic our machines inherited from us is the power of the unconscious brain. Numerous processes occur automatically in our brain, without the involvement of our consciousness, to prevent the mind from being overloaded by simple routine tasks such as eating and biking, freeing up mental capacity to concentrate on other pursuits. This unconscious activity plays a central role in recognising objects in the real world and is fundamental to our species' survival and thriving. We give AI technology the ability to "think" and calculate based on pattern recognition in nanoseconds.AI functions using probabilistic thinking, calculating in the split of a second with an accuracy of 90% the possible outcomes in any given situation.

Chess game

If I showed you this chess layout of an actual chess game for 5 seconds, could you reproduce it? Studies show that most chess novices can recreate 25% of it, but chess masters do it with 95% accuracy. The masters don't have a photographic memory - they simply use their knowledge and intuition, based on patterns they have seen over years of practice!

Robot playing chess

Machines can now play strategic games too. How do they learn so well they can beat the human that created them? AlphaGo is a computer program that plays the board game Go, developed by DeepMind Technologies. Subsequent versions were completely self-taught without learning from human games and could play additional games, including chess and shogi. The last version, MuZero, learns without being taught the rules.

Fast or slow thinking

Interestingly, when it comes to complex decisions like buying a house or marrying someone, while many believe careful thought with a pros and cons list is best, one study actually found that participants made better choices when they went with their snap intuitive decision. Those who trusted their gut were more satisfied with their decisions in the long run than those who thought through the process carefully. However, when making simple purchases like what TV to buy or toothpaste to buy - where variables are not as complex - the study found intentional thought and research to be helpful. This is proven with AI algorithms, when we have a subset of relevant features, the algorithms can get much better accuracy. Therefore, applying feature selection is a key process in AI development. AI is built for fast thinking, for unconscious thinking, not all the variables are available, but the key variables are enough to recognize and predict.

Can you identify the sound of your own voice?

Think you can identify the sound of your own voice? Surprisingly, after listening to a recording of many voices in succession, including their own, 75% of participants in a study made a mistake in recognizing their own voice. But the most fascinating part is that their skin conductance was also measured, and these levels went much higher when their own voice came on - even though they didn't consciously recognize their voice,

suggesting they had ignored their intuition which knew the correct answer first.

Duality of empathy

When we are in a learning or training mode (extracting knowledge) our brains are in slow thinking mode and we are using our cortex which is responsible for conscious thoughts to solve the problem. Once we master the skill, and we become experts in the matter, our brains are activated in the basal ganglia, which is linked to habit formation, automatic behaviours and it is the same that controls feelings. Recognising emotions for example a sad person involves fast thinking; understanding the emotion of sadness is an immediate brain response. And this fast thinking is where intuition lies. So, is following your intuition always the route to go when considering emotions? Not always in cases of empathy, it turns out. A study involving over 900 participants found that when it came to accurately interpreting and understanding the feelings of others, systematic thinking or carefully analysing the information available before making a decision was more successful than going with what feels right. For example, we could recognise a happy person at first but then realise that it was only nervous laughter. Not only did we not resolve the tension between logic and intuition, but we also ensured the machines that will change our world inherited the dilemma as well!

Robot and emotions

Recent works aim to design algorithms for classifying emotional states from different input modalities, such as facial expression, body language, voice, thermal facial images and physiological signals. The most advanced robots can recognise emotional states and be active support in the first critical phase of welcoming a patient in the ER.

Chapter 5 - Philosophical developments leading to ML

The dilemma between intuition and logic

We were given two systems of thinking - conscious and unconscious- - logical and intuitive- - slow thinking and fast thinking. Let's now revisit the origins of the dilemma between intuition and logic from a philosophical perspective. This tale of the dichotomy separated the two most famous schools of thought in the history of philosophy. Why will we need instead to put our intuition back in the centre of the 4th industrial revolution? Now we have the technology that can build fast thinking and intuition into machines, into organisations, and into businesses. We do not need to choose anymore.

Plato

Plato, the father of intuitive, automated, subconscious thinking suggested we all carry in us imprints of the Ideas, which are the things we see around us in their pure form, untouched by the contingencies of space and time. That we are born carrying inside us for example the knowledge of what a table is, carrying the image of the Idea of the table as a concept. This is what makes us able to recognise an object when we see it in real life as such and furthermore place it in its relations with the other objects in the world. All knowledge is a priori given to humans and by living in the world and thinking about the world and its objects it just resurfaces.

Aristotle

His student Aristotle did not agree and suggested as the foundation of our thinking Logic, which is the ability to observe things and deduce conclusions based on the rational exploration of phenomena. Aristotle cemented his place in history as the father of Reason and the western world, from its theology to its science fully embraced the idea that this is how human cognition works, based on reason and epagogic thinking. What else is science other than the ability to deduct conclusions based on the observation of phenomena, conclusions that can be repeated if the same conditions in which they were observed are replicated? Science is the triumph of epagogic thinking.

Kierkegaard

Another philosopher, the Danish philosopher of the 19th century, Søren Kierkegaard, tried in his work "Either/or" to answer the question asked by Aristotle, "How should we live?" The dualism between intuition and logic can be compared with the concept of aesthetic life and ethical life that mark human existence according to Kierkegaard. The aesthetic life is personal and subjective, it is where each person extracts pleasure. The ethical realm is a conscious choice, the choice to choose. This is where the values and identity of an individual are judged by the objective world. Here each person can choose either to remain oblivious

to the world or to be involved.[9]

AI: A combination of both approaches - The era of and/both

For the first time in history, we don't have to prioritise one side at the expense of the other; The era of either/or is over and we are entering the era of the "and/both" How can both approaches be combined in order to obtain the maximum outcome? AI combines both sides of the medal, both approaches, it learns automatically from observations, but it needs an a priori knowledge which is given by the algorithm, the data we decide to feed into it and the features we decide to take into consideration. It is the irony of the circles of history that a product of hard science, AI technology is bringing back to the fore the intuitive thinking -combined with the logical thinking- that our brains carry and that for a long time we neglected. Wonder what Plato and Aristotle would say if they encountered AI technology now!

The balance in a corporate setting

With AI it is now possible to combine insights with intuition even within a business context. Intuitions can be used to develop a theory. This theory can then be put to the test with various data sets and deep-learning algorithms which will give insights and lead to the optimal decision. When companies undergo digital transformation, collective intelligence becomes one of the key assets. To manage this resource successfully requires a high degree of intuition and understanding of the 'mental general sentiment' to respond to potential risks and prize successes.

How do we work at OKRA.ai - Pyramid

Another way to integrate both intuition and logic is to implement human-like intuition in AI. AI systems capable to apply human intuition have been one of the most difficult challenges in the field. Most life science companies today rely on either single human intelligence or collective human intelligence to drive decisions. Let me tell you how we work at my company OKRA.ai: We help life science companies to take a step further and enable Human-Machine Intelligence within their organisations. At OKRA.ai we understand that every Pharma company is unique. We augment decision-making, using historic business decisions, past successes and failures across the enterprise, to create learnings and actionable suggestions from data, so you can be sure of every business decision you make in the future. We work at the forefront of innovation, creating world-leading AI systems, where every prediction and suggestion is explained, ensuring optimal Human-Machine Intelligence is achieved.

Chapter 6 - A tour of the new reality - The symbiotic relationship between machine and human is at the centre of everyday life

The future under the 4IR: Algorithms in our day-to-day life

The great philosophers of antiquity would not be the only ones that would be bewildered if offered a tour of the future under the 4IR. Even we, humans of our times, cannot imagine the sheer scale of change that is in store for the near future. It's still the dawn of the 4IR and we now have algorithms involved in every part of our existence. We swipe right to find our match in love, following the predictions of a data-driven app. The products we buy increasingly come from suggestions tailored to our unique buying preferences. The food delivery systems can help us understand which restaurant should be in which area. AI is playing a pivotal role in every moment that makes us human data-driven systems are already co-existing with us in our everyday life.

Child and robot

Robots have managed to diagnose mental health conditions in children more accurately than any adults the children came in contact with. Children apparently spoke more freely and openly to robots, which were able to then more correctly spot depression, anxiety and other issues in the young ones. Now, this is a taboo-shattering moment for humanity: because it's ok to have the internet connecting you to your loved ones across the globe at the push of a button. But to have robots do better than trained professionals in connecting with our very children is another level. Under the 4IR, what we will experience is a symbiotic relationship between man and machine. And if we so far have shaped the machines in our image, soon the dialogue will

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[9] What can then save the person from this dilemma? According to Kierkegaard, only faith can but ultimately each person should "discover a second face hidden behind the one you see" in themself first, and then in others. https://en.wikipedia.org/wiki/Either/Or#cite_note-4

continue the other way around. It's a matter of time before the machines shape us back.

AI and agricultural sector

If a farmer is having a problem with one of his plants and he doesn't know what to do with it, he can simply take his mobile take a picture and upload it to an app and the system will provide him with the solution around the clock and with no human interaction. These everyday life tasks are of great use in the bigger picture: Traditional Industries and food agriculture companies can help to reduce the use of pesticides insecticides by really targeting specific amounts of insecticides and pesticides on specific plants or weeds in the fields. With precision farming, we really ensure the minimum use of fertilizers and maximum output by analysing the ground and air quality.

Self-driving cars

What about self-driving cars? Are these a reality yet? AI can already automatically detect the occupancy status of a parking spot, identifying whether it is free or occupied. Companies like Google's Waymo have already created fully autonomous cars prototypes, but those cars are not yet available for everyday drivers to purchase. These cars have been tested in limited areas but still, present some security problems. Deep learning research has made them more reliable. This type of car operates itself using sensors and cameras without any human assistance. Techniques developed for intelligent cars are not going to be wasted - they are already used for traffic management (data collection through cameras) and help us understand the traffic situation on the main highways making transport systems more effective and more efficient.

The future of communications

Meeting online services like zoom are giving the possibility to users to include interpreters in their meetings or webinars. This allows the host to designate participants as interpreters during a Zoom session. Soon this feature will be implemented with AI - when you are going to use zoom in one of your meetings you will be able to speak with people that do not speak the same language and read captions of what they are saying in your own language. The language will be translated simultaneously while the person speaks without the need for interpreters. This new AI feature in communications tools will not only have a big impact at B2B level but at global level as well: minimising language barriers is fundamental to further international cooperation - critical in the global collaboration to achieve 2030 goals.

The good and the bad

If robots can substitute us in the delicate task of understanding our children, you might wonder, what is then left for us? These moments will eventually reshape what it means to be human. If you are a pessimist, you will foresee an inevitable total dominion of machines, serving non-human-centric goals. Humanity will descend into chaos, meeting its end by its very creation. If you are an optimist, you are envisaging a world where automation has freed humans from laborious, boring, repetitive work, turning the earth into a paradise of intellectuals and benefactors, dedicated to the improvement of humanity and the world. That sounds ideal, but I am more of a pragmatist. I strongly believe that like with every symbiotic relationship, we have a big part to play in directing the course of things. It is up to us to find the strength and inspiration to guide the technology we created in our image to express the better part of our nature: collaboration, respect for others and the planet, creation of value, beauty and improving quality of life. AI will help solve problems like eradicating cancer for example, but also create other issues, like the rise of populism, bringing a whole new different way of thinking to the table, it will result to be humanity's most invaluable assistant. What AI definitely won't achieve is to resolve once and for all the age-old dilemma for humans: are we inherently good or are we evil and self-serving? Like every other tool we have invented, AI will put our character to the test.

Chapter 7 - Digital and virtual worlds: blurring territories

Children and technology

One of the most striking results of the symbiotic relationship between man and machine is going to be the blurring of the lines that separate what we consider really different realms today: physical, tangible reality as we understand it will get increasingly fused with what we now know as the digital, virtual world. Generations living on this planet at the moment, still carry memories of an analogue world, made up fully of what our two hands can grasp and what is the sum of our senses. Soon, children coming after us will have no such recollection. The lines separating the physical, biological world and the virtual or digital world do not exist anymore. Machines are helping us, and we are helping the machines. AI is us and we are AI. The two come closer together with each passing year and it is predicted that very soon the biological and the technological

will merge into an unbreakable union, creating new forms of life and reconfiguring the terms of our existence and the world around us.

Avatar and 3D-printed heart

We will be at equal familiarity with our physical body as with our avatar who will participate in the countless groups and activities of the metaverse. For our children, the virtual world will no longer feel like a fake alternative to the real one, the one perceived as materialised. Integrating virtual and physical reality will continue as the technology will further develop, adding to the blurring of what is real and what is fake until the two become one. One day, a 3D printer will print out your new heart for you, saving your life and extending it for years to come, while your surgeon will move a robot from another part of the planet to make sure that this heart is securely placed in your body, with a precision few humans could achieve.

Robot creating art

You will go to an art gallery with the family on Sunday and there will be no distinction between a painting made by a human and an artwork made by a machine. Actually, some might be created as a collaboration between humans & non-humans. The robotic arm mimics the artist's gestures through a computer camera creating synchronicity of movements between humans and machines. "We are living in a time of unprecedented complexity; our senses are currently whip-driven by a feverish new pace of technological change. The activities that mark us as human, though, don't begin, exist in, or end by such a calculus." said Adrienne Rich. And I believe it is true, as the machines shape us again, it remains to see who we are going to become as a species. In the same way, some art cannot be seen unless we become machines ourselves - with augmented reality, we will be able to see an exposition in real life even if the room in front of us appears completely empty.

AI music

Did you know that it is also possible to create entire album music with AI and no knowledge of musing creation? There is a natural feedback loop between the person and AI. The artist provides some directions such as beats per minute, tones, instrumentation, up and down moments etc and the AI system provides the creative outputs within the bounds of those directions (iterative creative process).

Chapter 8 - Machine learning and the 4th Industrial Revolution: Why is AI hailed as an unprecedented revolution (practical examples from business and healthcare)

Global crisis

We have seen how AI is present in our world and helps us solve everyday problems. With the world becoming more and more connected at a global level, my problems are also yours and the way around and we all have to face bigger problems. Our generation has been tested by facing a cluster of crises in a short amount of time. Financial insecurity for larger parts of the population, geopolitical redrawing of borders through competition of superpowers and wars, the pandemic and of course lurking at the backdrop of all those already tough enough issues, climate change with the imminent threat of destroying nature or irreversibly compromising the quality of our natural resources. Adding to the constant uncertainty is the development of these exciting new technologies we've been talking about, which for all their promise and potential could easily take a dark turn.

AI as the radical solution?

Without a doubt, AI comes at a time where radical, brave solutions are necessary if we are to save our planet and survive as a species and correct the many mistakes we have made that originally brought us to the crunch point we find ourselves in today. It is predicted that technology will play the role of the catalyst in moving us away from the abyss and solving those pressing issues that threaten to annihilate humanity. Let's just examine some examples of how this will become possible.

AI in business

AI can predict with formidable accuracy business outcomes years in advance. This means a radical rethinking of how business is designed, managed and evaluated. If we know years in advance which outcome will be the successful one, uncertainty will cease to be a deciding factor in business decisions. The chase just for profit to the detriment of quality and efficacy of deliverable business outcomes will no longer be an option for

businesses. Whoever delivers the best outcome will naturally receive the monetary reward, too, thanks to the prevalence of the prediction model the algorithms will introduce. This is a radical shift that will change the nature of the economic system, liberating human endeavours from the relentless quest to just make more money. Serving other causes will become possible and prioritising goals that will improve the lives of many and promote the common good, not just on the basis of romantic idealism, but because those will be the most sound and profitable business goals to pursue as well.[10]

AI and the future of productivity

AI will significantly improve human capital by offering novel ways of teaching and training the workforce. Some consider that in reality, technological progress has a much greater impact on productivity than shown by many estimates, as a result of mismeasurement. The OECD expects that through the detection of patterns in enormous volumes of data, AI will significantly improve decision-making, cut costs and optimise the use of production factors and consumption of resources in every sector of the economy.[11] Overall, it seems likely that, while AI has significant potential to boost productivity, the final effects will depend on the rate of AI diffusion across the economy and on investment in new technologies and relevant skills in the workforce.

AI in healthcare

The number of people with chronic diseases is getting higher and higher every year. This is unacceptable at a moment in history in which the possibility for innovation in the healthcare sector is endless. How can we foresee chronic diseases in advance and have a better chance to cure them on time? We need to screen the population - for example, to diagnose diabetes tests always exist. What are the difficulties that we are currently facing to organise these periodical screenings? To screen this huge number of people the waiting time is very long to get an appointment and there is a big strain on the facilities, the human resources are quite limited, and there is a huge cost and a burden on the economy. This is where artificial intelligence has a major impact on decreasing the difficulties and complications that we face with diabetes. The patient gets diagnosed and screened without the intervention of a human being you will have screening stations it can be in a mall it can be anywhere and people will just check in voluntarily and an automated camera will take a picture of the fundus of the eye and the AI algorithm will diagnose at the initial stage whether or not there is a complication in the retina. Then, the AI system will refer the patient to a physician for the best treatment. This will decrease the time of the clinic visit by 80 per cent and decrease the number of staff and human resources needed. Once the screening is done it will be easier to provide treatments fast before they go into complications.

AI to achieve the strategic goal of sustainability

AI is the missing piece in the puzzle to save the planet. It is the key to achieve the strategic goal of sustainability in alignment with vision 2030. To provide water and food while preserving the environment will be challenging. Urban areas represent 70 per cent of global emissions, the organisation and design of new sustainable cities are crucial to lower greenhouse gas emissions.[12] Balancing industrial and economic growth along with protecting the planet is crucial for our future. AI can unlock the potential to achieve that goal: cloud seeding, smart irrigation, remote sensing and satellite images enable us to save billions of cubic meters of water. AI promotes a smart and effective decision-making ecosystem and creates sustainable energy. The implementation of sustainability solutions and Cutting Edge Technologies and AI applications lower the effort required to preserve and protect the environment and mitigate the impact of climate change and reach Net

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[10] According to the McKinsey Global Institute around 70 % of companies would adopt at least one type of AI technology by 2030. It's expected that AI may deliver an additional economic output of around US$13 trillion by 2030, increasing global GDP by about 1.2 % annually.
This will mainly come from the substitution of labour by automation and increased innovation in products and services.
[11] OECD, Artificial Intelligence, Machine Learning and Big Data in Finance - Opportunities, Challenges and Implications for Policy Makers, https://www.oecd.org/finance/financial-markets/Artificial-intelligence-machine-learning-big-data-in-finance.pdf
[12] How will the cities of the future be like?
It is a societal imperative to develop a new model for cities supported by AI, a data-driven simulation-based process that gives suggestions on how to build new sustainable cities.
Collecting data insights is fundamental to understand human dynamics in the city and plan the interventions that can improve that performance.
A new governance is also important: a new creative public policy with new technologies that can create a community that's in harmony with the nature and becomes like a natural ecosystem.

Zero carbon by 2060.

AI and education

What else is there to address when we think about the future if not the education of the young generation? You? Artificial intelligence (AI) systems offer effective solutions in the field of education: online learning and teaching, personalizing learning, automating instructors' routine tasks, and powering adaptive assessments. For students the possibilities are endless, as we have seen during the lockdown - AI allowed millions of students to continue studying from their own homes. Personalization of education is a great plus: personalised approaches based on every student's own needs, unique experiences and preferences. AI-powered solutions can analyse students' previous learning histories, identify weaknesses and offer courses best suited for them. AI tutors and chatbots are a perfect solution in these scenarios. An AI-powered chatbot can answer student questions at a response rate of 2.7 seconds. Universal 24/7 access to learning: Students from all over the world, in rural areas and developing countries, can gain access to high-quality education without incurring travelling and living expenses.

Chapter 9 - Closing the circle of history by revisiting human societies' values of the past

The enormous shift

We just looked at some examples of how AI will radically transform every part of our everyday lives. It is not an exaggeration to say that a new chapter in human history is opened. Thanks to the seismic shift of values and the abandonment of profit as the sole motivation, with the dominance of probabilistic thinking and machines tons of data in nanoseconds to deliver credible suggestions, we will see the fusion of reason with intuition. Machines, a product of rational scientific thinking, will have created a world where numerous agents functioning with probabilistic thinking, which is data-driven systems, will outnumber humans on the planet. The irony is that the fusion of reason and intuition, the fusion of digital and physical worlds, and the honouring of our farmer genes in parallel with the adventurous, altruistic rise of the hunter-gatherer societies' values, will create a more just, fair world. Hunter-gatherer values will re-emerge as a society will move to more knowledge and skills-based distribution of labour, redefining the meaning of wealth beyond money and material assets, including other values and concerns in what gives life meaning and makes individuals a success. Humans and machines in their dialectic relationship will have reshaped morals, everyday life and what it means to be human. This shift is what needs to happen in order for humans to be able to collaborate with each other empowered by AI technology and focus all the effort not on making profits but to unlock new possibilities and potential to solve global issues and make this planet our planet a better world for everyone.

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Images and videos

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