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Artificial Intelligence or Augmented Intelligence? Impact on our lives, rights and ethics

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Abstract

Artificial Intelligence (AI) is a highly topical issue that opens up opportunities still largely unexplored, but also many economic, ethical and social issues. Questions about AI are many. What does AI include? What are the technologies that support it? What are the applications that are already possible today future? These are the questions we seek to address in the present paper by exploring the main academic sources and reference. Thus, through this research we would like to guide the reader to understand the phenomenon, with an indication of its areas applicability, future developments and questions in the economic, social and ethical sphere that it raises. The manuscript provides a global view of the issue from an international point of view.

Keywords: Artificial Intelligence; economic; social; ethics.

1. Introduction

Artificial Intelligence (AI) is one of the most promising technologies of our times. AI will reshape our lives. But it is first necessary to understand what is meant by "*Artificial Intelligence*", from a theoretical and technical point of view. In this way it will possible to understand the opportunities and also the limits of AI, as well as the most immediate areas of application and effective [1]. The premise is that the definition of AI continues to change. At one time, AI was what allowed a robot to win a game of chess. Today, it is also able to solve different problems and to carry out

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much more complex reasoning and actions. There is no univocal and shared definition of the term "*Artificial Intelligence*" because it is a concept that it includes a very large number of related topics to different disciplines, from neurology to computer science, from neurobiology to neurophysiology (and in general all disciplines that study the human brain) to math and so on. Proper implementation of AI involves several challenges that need to be faced in order to integrate AI in a profitable way [2]. First of all, the ***ethical problem***, which is the basis of every other reflection in this field. The *anthropocentric principle* must be strongly affirmed, according to which AI must always be placed at the service of people and not vice versa. The second challenge is the ***technological*** one: AI is not still able to reproduce the complex functioning of the human mind, but only some of its limited abilities. Another fundamental aspect concerns the ***skills*** that need to be developed in the age of AI. The fourth challenge is the one related to the ***data*** on which the algorithms are based. It is necessary that the data be good quality, as free as possible from bias (prejudices) due to errors in their generation. The last challenge is the ***legal*** one. In this regard, for example, in the context of AI it is necessary to reconcile the principle of transparency and the protection of personal data with the right to privacy [3]. In other words, AI is at the same time a technological and social innovation that can radically transform our world. Therefore, it is necessary to accompany it carefully, governing it respecting people's rights. AI can benefit society as a whole, in all sectors, and in life daily and in people's work [4]. Thus, the aim of this study is to contribute to the understanding of developments on AI from a technological, economic and ethical point of view. Thus, this manuscript analyses global trends on AI in Section 2; in Section 3 an overview of AI and ethics is provided; while in Section 4 global challenges for our future is analyzed. Finally, the main conclusions of the study are summarized in Section 5.

Nomenclature

AI	Artificial Intelligence
AAAI	Association for the Advancement of Artificial Intelligence
AIxAI	Italian Association for Artificial Intelligence
DESI	Digital Economy and Society Index
ECCAI	European Association for Artificial Intelligence
GDP	Gross Domestic Product
I-DESI	International Digital Economy and Society Index
SDGs	Sustainable Development Goals

2. Global trends on AI

Before describing the state of the art and the future prospects of AI in our society it may be useful to analyze what is happening in the field of digital transformation. In this context it is interesting to note that the Digital Economy and Society Index (DESI) monitors Europe's overall digital performance and tracks the progress of EU countries in digital competitiveness. According to **DESI 2020**, the most significant progression is noted in Ireland, followed by the Netherlands, Malta and Spain. Finland and Sweden are amongst the leaders in overall performance in digital, but in terms of progression over the last five years they are just slightly above average, together with Belgium and Germany. Italy is in third last place among the 28 EU member states, with a score of 43.6 (compared to the EU figure of 52.6). It is important to underline that the largest EU economies in terms of GDP are not among the digital frontrunners and this impacts on the overall performance of the single market. In fact, from a world point of view, the International Digital Economy and Society Index (**I-DESI 2020**), highlights that EU countries outperform their global counterparts in terms of digital skills, from basic to advanced, but are constantly lagging behind in the digitization of public services [5]. However, the EU average is still below major advanced economies such as USA, Australia, Japan, Canada, South Korea and China. They are today the main protagonists at an international level. China intends to become the first developer of AI tools by 2030 [6]. In the US, the government invests mainly in research for military defense, letting large companies (such as Google, Facebook, Microsoft, Amazon) drive the search basic and applied. European States have activated individual national plans, such as the United Kingdom, France, Finland, Sweden and Germany. Surely, beyond the specific policies of each country, there is no doubt that the development of AI has become a central theme

for all industrialized countries and emerging economies over the last few years. In terms of investments, however, the effort currently being put in place by the United States and China to acquire dominance in the AI sector is far greater than that of other countries [7]. Alongside China and the USA, industrialized countries such as Japan (as early as 2015), South Korea (2016), Canada (2017) and emerging economies such as India (in 2018) have adopted national plans in AI theme. The proliferation of national plans has not escaped the EU institutions, which have decided to strengthen coordination between Member States under the "*Digitising European Industry*" program. Unlike other technologies of the past, AI has a strong interconnection between three components: research and technology transfer, production and its adoption [8]. In this context, there are various associations worldwide that promote the dissemination and activities on AI (i.e. AixIA; AAAI; ECCAI). To understand the evolution of world research on AI we conducted an analysis on scientific databases. In particular, the analysis was conducted using the SCOPUS database that is among the largest curated abstract and citation databases of peer-reviewed literature – scientific journals, books and conference proceedings. The search strategy was conducted considering the following string (TITLE (artificial AND intelligence) OR TITLE (augmented AND intelligence)) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (SUBJAREA , "COMP")). In other words, to assess the volume of scientific production, all the articles in the category "*Computer Science"* with the word *"Artificial Intelligence*" or *"Augmented Intelligence"* in the title were extracted from Scopus and analized. Furthermore, only article published on international journals were considered. Data is updated to June 2021. Results shows that since the 1960s we have been witnessing a growing interest in intelligence issues artificial as highlighted Figure 1 (on the left). As this is an obvious result, it is interesting to note that almost 60% of production is concentrated from 2018 to today. In this scenario, United States is the first country for number of published documents, followed by China, United Kingdom and India Figure 1 (on the right).

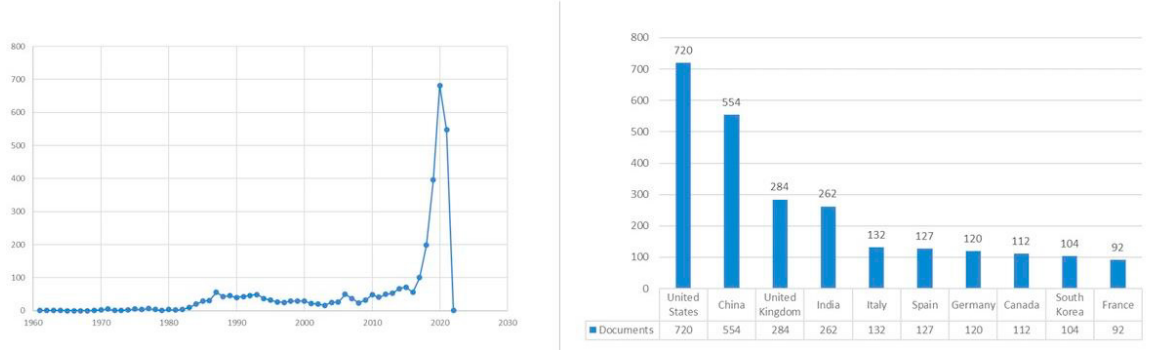

Fig. 1. Documents by year (on the left); Documents by country/territory (on the right) (source Scopus update June, 2021)

From an academic point of view it is interesting to note the main sources where articles on AI are published. Figure 2 shows that the journal in the first position is IEEE Access, a multidisciplinary, open access journal of the IEEE (Impact Factor 2020: 3.367).

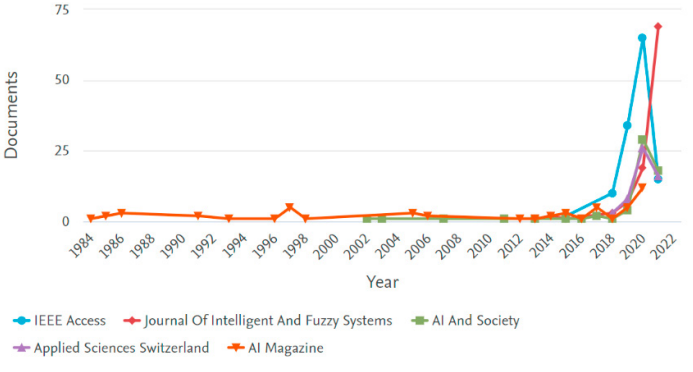

Fig. 2. Documents by journal (source Scopus update June, 2021).

Artificial intelligence has impacts on all productive, social and economic sectors. However, according to several authors, some sectors are currently having greater impacts such as the medical, manufacturing and financial sectors [9], [10], [11], [12]. Thus, we have carried out further investigations on Scopus as shown in Table 1.

Table 1. Documents by sectors.

Investigation on Scopus	String	N° of documents
1th investigation on Scopus	(TITLE (artificial AND intelligence) OR TITLE (augmented AND intelligence)) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (SUBJAREA , "COMP"))	**3.233**
2nd investigation on Scopus *(Medical and health sector)*	(TITLE (artificial AND intelligence) OR TITLE (augmented AND intelligence) AND TITLE-ABS-KEY (medical) OR TITLE-ABS-KEY (health)) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (SUBJAREA , "COMP"))	**268**
3rd investigation on Scopus *(Manufacturing sector)*	(TITLE (artificial AND intelligence) OR TITLE (augmented AND intelligence) AND TITLE-ABS-KEY (manufacturing)) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (SUBJAREA , "COMP"))	**105**
4th investigation on Scopus *(Finance sector)*	(TITLE (artificial AND intelligence) OR TITLE (augmented AND intelligence) AND TITLE-ABS-KEY (finance)) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (SUBJAREA , "COMP"))	**26**

Finally, it is interesting to note that most of the publications (as expected) belong to US authors and to medical sector as shown in Figure 3. In the following sections an analysis of the main documents belonging to each sector is reported.

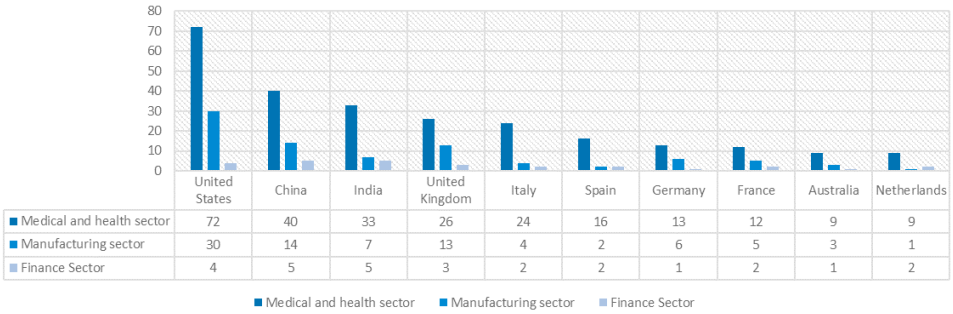

Fig. 3. Distribution of documents by country/territory and sector.

2.1 Medical and health sector

In the **medical and health sector** the application potential is wide, thanks to everything that can be done with big data analysis and the clinical history of patients by applying the machine learning: from improvements in the diagnostic phase to possibility to administer personalized care based on the individual's genetics. The potential of artificial intelligence is also relevant for the prediction and prevention of diseases or *epidemics* on a large scale as well described by several authors [13], [14], [15]. Innovation and digitalization, in particular solutions based on artificial intelligence and robotics, deeply affect the structure of the medical act of care and the functioning of the healthcare facility by questioning organizational culture and leadership. This generates a tension between medicine and treatment, innovation, optimization and quality that the manager has to manage [16]. The ethics of technologies accompanies this process, orienting it towards the quality of care and the promotion of the centrality of the person. Research on scopus revealed that most of the papers have been published in the past 3 years including the unfinished 2021: 2021 (77 documents; 28,7%); 2020 (99 documents; 33,6%); 2019 (30 documents; 11,2%). In this cluster the documents strongly cited by the scientific community are by Lu et al. [17]; Patel et al. [18]; Pan [19]; Bennett and Hauser [20]; Shah et al. [21]. A detail is reported in Table 2.

Table 2. Main publications belonging to the sector “Medical and health”

Authors	References	Title	Year	Journal	N° of citations
Lu, H., Li, Y., Chen, M., Kim, H., Serikawa, S.	[17]	Brain Intelligence: Go beyond Artificial Intelligence	2018	Mobile Networks and Applications	386
Patel, V.L., Shortliffe, E.H., Stefanelli, M., (...), Bellazzi, R., Abu-Hanna, A.	[18]	The coming of age of artificial intelligence in medicine	2009	Artificial Intelligence in Medicine	204
Pan, Y.	[19]	Heading toward Artificial Intelligence 2.0	2016	Engineering	143
Bennett, C.C., Hauser, K.	[20]	Artificial intelligence framework for simulating clinical decision-making: A Markov decision process approach	2013	Artificial Intelligence in Medicine	142
Shah, P., Kendall, F., Khozin, S., (...), Ringel, M., Schork, N.	[21]	Artificial intelligence and machine learning in clinical development: a translational perspective	2019	npj Digital Medicine	77

While, Figure 4 shows the main keywords cloud belonging to the sector “Medical and health”.

Fig. 4. Keywords cloud belonging to the sector “Medical and health”.

Research pointed out that AI is already able to make diagnosis and prognosis quickly and reliably. However, digital medicine should not replace traditional medicine, but support it, thanks to new communication channels and new technologies.

2.2 Manufacturing sector

One of the best known applications of artificial intelligence in the **manufacturing sector** is that of autonomous cars: second the financial giant BlackRock in 2025 98% of vehicles will be connected and in 2035 75% will be self-driving. Research on Scopus revealed that most of the papers have been published in the past 3 years including the unfinished 2021: 2021 (12 documents; 11,4%); 2020 (23 documents; 21,9%); 2019 (10 documents; 9,5%). In this cluster the documents strongly cited by the scientific community are by Dwivedi et al. [22]; Renzi et al. [23]; Leo Kumar [24]; O'Leary et al.[25]; Kusiak [26]. A detail is reported in Table 3.

Table 3. Main publications belonging to the sector “Manufacturing”.

Authors	References	Title	Year	Journal	N° of citations
Dwivedi, Y.K., Hughes, L., Ismagilova, E., (...), Walton, P., Williams, M.D.	[22]	Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy	2021	International Journal of Information Management	147
Renzi, C., Leali, F., Cavazzuti, M., Andrisano, A.O.	[23]	A review on artificial intelligence applications to the optimal design of dedicated and reconfigurable manufacturing systems	2014	International Journal of Advanced Manufacturing Technology	76
Leo Kumar, S.P.	[24]	State of The Art-Intense Review on Artificial Intelligence Systems Application in Process Planning and Manufacturing	2017	Engineering Applications of Artificial Intelligence	67
O'Leary, D.E., Kuokka, D., Plant, R.	[25]	Artificial Intelligence and Virtual Organizations	1997	Communications of the ACM	63
Kusiak, Andrew	[26]	Artificial intelligence and operations research in flexible manufacturing systems	1987	INFOR: Information Systems and Operational Research	63

While, Figure 5 shows the main keywords cloud belonging to the sector “Manufacturing”.

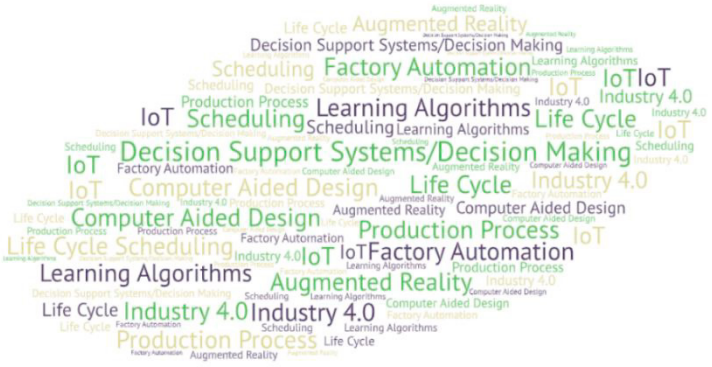

Fig. 5. Keywords cloud belonging to the sector “Manufacturing”.

In the manufacturing sector, research showed that for companies, AI represents enormous potential in terms of reducing operating costs and improving productivity and quality. Major companies use AI in all operations related to production and in the management of predictive maintenance.

2.3 Finance sector

Or in the **finance sector** AI is redefining the type of financial services offered. Research on scopus revealed that most of the papers have been published in the past 3 years including the unfinished 2021: 2021 (77 documents; 28,7%); 2020 (99 documents; 33,6%); 2019 (30 documents; 11,2%). In this cluster the documents strongly cited by the scientific community are by Bahrammirzaee [27]; Gunning and Aha [28]; Belanche et al.[29]; Gunning et al. [30]. A detail is reported in Table 4.

Table 4. Main publications belonging to the sector “Finance”.

Authors	References	Title	Year	Journal	N° of citations
Bahrammirzaee, A.	[27]	A comparative survey of artificial intelligence applications in finance: Artificial neural networks, expert system and hybrid intelligent systems	2010	Neural Computing and Applications	221
Gunning, D., Aha, D.W.	[28]	DARPA's explainable artificial intelligence program	2019	AI Magazine	106
Belanche, D., Casaló, L.V., Flavián, C.	[29]	Artificial Intelligence in FinTech: understanding robo-advisors adoption among customers	2019	Industrial Management and Data Systems	44
Gunning, D., Stefik, M., Choi, J., (...),	[30]	XAI-Explainable artificial intelligence	2019	Science Robotics	41

While, Figure 6 shows the main keywords cloud belonging to the sector “Finance”.

Fig. 6. Keywords cloud belonging to the sector “Finance”.

Applied to the finance sector, the research showed that AI is able to give us very useful services (i.e. accurate market predictions or bionic counseling) that have changed the way we interact with banks and manage our capital. It is one of the most pervasive technologies and which has given rise to concrete innovations perceived by many.

3. AI and ethics: a delicate and crucial relationship

Technologies such as AI have brought *privacy* and *ethics* issues related to the application of algorithms to the attention of the world. Existing regulatory gaps lead to the onset of lack of transparency. Combining ethics and technology for new technologies could represent a perspective to be pursued for the protection of all citizens. But new criteria, categories and “*languages*” are needed. When we talk about new technologies we are basically talking about algorithms [31]. In the world debate, the term “*ethics by design*” is used to describe the alignment with ethical principles of the whole process of designing, developing and implementing an artificial intelligence system. In the context of the debate on the ethical-legal implications, the issue of the processing of *personal data* plays a very important role. One example is app-related use. For example, to deal with the COVID-19 health emergency, the movements of affected people and their contacts were tracked via the app. Precisely for this reason, even when we talk about apps that are created with "social" purposes and for the protection of the community such as apps for COVID-19, the installation of the application is not mandatory, but takes place on a voluntary basis. Today the possibility of analyzing data and storing them over time is enormous. It is evident, however, that the progress and diffusion of apps of this type will be possible when there is the awareness that the confidentiality, integrity and availability of information and data is guaranteed [32]. There is still a lot to do. Let’s analyze some examples.

3.1 Legal and Data protection

When we talk about legal and privacy aspects, perhaps the best known example of fraud is related to facial recognition. It is now increasingly within everyone's reach to build a *facial recognition* system. In fact, facial recognition applications around the world have great potential in smart factories and in smart cities. However, so far the biometric recognition sector has remained almost completely unregulated. The global goal is to regulate and standardize the use of data in order to guarantee the rights of workers and citizens [33]. For example, **Fawkes** is a system aimed at preventing facial recognition and created by the SAND Lab at the University of Chicago. It is estimated to have 100 percent accuracy at masking photos and making them unusable. It is based on the "*cloaking*" technique, i.e. obscuring. The selfie presents changes that the human eye are imperceptible, while the facial recognition software will struggle to define the identity of the subject portrayed. Figure 7 shows a before-and-after that the team created to show the cloaking at work. On the left is the original image, on the right a "cloaked" version. The differences are noticeable if you look closely, but they look like the result of dodging and burning rather than actual alterations that might change the way you look.

Fig. 7. Comparisons of uncloaked and cloaked faces using Fawkes (source SAND Lab at the University of Chicago).

3.2 Rule and Standardization

On the subject of artificial intelligence, on 21 April 2021 the European Commission proposed a "regulation" whose goal is to ensure that Europeans can "trust" what the AI market has to offer. In this way it will be possible to guarantee the security and fundamental rights of individuals and businesses, strengthening the adoption of artificial intelligence in Europe and investments [34]. More specifically, the European Commission has identified four levels of risk, each of which refers to certain AI systems and related applications:

- **unacceptable risk** refers to artificial intelligence systems that are considered a clear security threat, including those applications that manipulate human behavior to evade users' free will (for example, voice assisted toys that encourage minors to engage in dangerous behavior);
- **high risk** refers to AI systems and technologies used in the context of, for example, critical infrastructures which, through an AI algorithm, could endanger the lives and health of citizens or school education;
- **limited risk**, on the other hand, concerns those artificial intelligence systems with specific transparency obligations such as, for example, chatbots;
- **minimal risk** is - just to mention a few examples - that of artificial intelligence-enabled video games or spam filters.

The novelty introduced by the new rules for AI lies in the obligations to which artificial intelligence systems classified as "high risk" will be subject before they can be placed on the market. Obligations that include, for example: risk assessment and mitigation systems or high quality data sets that will train the AI system, in order to minimize the risks of discrimination. In any case, in our opinion, there is still a lot to do in this area of research.

4. Global challenges for our future

The theme of sustainable development has become central as has the health of human beings. Well, in this context, AI will certainly play a strategic and decisive role. In fact, numerous reports highlight how, in general, the different areas and applications of AI can influence all 17 Sustainable Development Goals [35]. Artificial intelligence applications are capable of analyzing data collections, learning connections, inferring relationships and predictions. For example, AI can help identify areas of poverty using satellite images and support international action. Similarly, the technological advantages provided by AI can have a positive impact on the economy, thanks to the ability to increase productivity and automate certain decision-making processes [36]. AI is being used more and more often to understand DNA so that it can provide useful tools for medical treatment. The protection of biodiversity is also one of the areas of research AI is working on. Notable implications are certainly also in relatively recent discipline such as genetics, molecular biology and genomics, including bioinformatics, or computational biology [37]. These disciplines are growing rapidly thanks to the increased requests to analyze the enormous amount of data produced by modern sequencing and medical diagnostics methods. AI applications in clinical genomics tend to perform tasks that are difficult to implement using only human intelligence and are prone to errors when approached with standard statistical approaches. the purpose of applied AI in the field of genomics is not so much to replace the professionalism of the human expert, but rather to provide the expert with powerful tools capable of improving performance, reducing human errors and allowing accuracy so far unthinkable [38]. Today, after several million years, we are about to witness an epochal technological innovation that until a few years ago would have seemed like science fiction: re-writing the DNA that makes up the genome of all living organisms. Any type of plant cell, animal, including human, can be genetically modified and the correction can take place even for a single and slightest mistake, and anywhere in the genome. Among the pioneers of these studies is the American scientist Jennifer Doudna of the University of Berkeley, who revolutionized genetic engineering by winning the Nobel Prize for Chemistry 2020. Thanks to AI it has been shown that the modification inserted by the The cell's "repair kit" is predictable. In other words, artificial intelligence algorithms are able to predict how the cell will repair the molecule of DNA after being edited. A potential that leads us to think that we are close to a new singularity.

5. Conclusion

In conclusion we can affirm that AI is a tool, not an end. It has been around for decades, but has only recently acquired important new capabilities, powered by computing power. And if, on the one hand, it offers immense potential in numerous areas of application, on the other it also presents risks. The development and promotion of AI must be worldwide. It is an opportunity that, collectively, should be grasp firmly. There are many prospects in all sectors. In our opinion, the first one is to prepare the *next generation* for the future of AI. It means to integrate of human intelligence with AI in order to create a virtuous coexistence and strengthen the role of people in driving growth. Secondly, it should be crucial to *encourage regulations* geared towards AI. It means to update and create laws that can adapt and improve to narrow the gap between the pace of technological change and the pace of regulatory response. Finally, the importance of producing a *code of ethics* for artificial intelligence should be included in the political agendas. Definitely, an open and inclusive debate is needed that involves all our countries, focusing on the right way to use these new technologies, on how to respect fundamental rights such as privacy, freedom, security and non-discrimination.

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