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a cura di Marina Mistretta, Bruno Mussari, Adolfo Santini

Intelligenza artificiale per la gestione della complessità dei sistemi socio-economici verso Horizon 2020 e Agenda 2030

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I semi dell'Intelligenza Artificiale (AI) furono piantati da filosofi classici che tentarono di descrivere il processo del pensiero umano come la manipolazione meccanica dei simboli. L'AI è un'area di informatica che enfatizza la creazione di macchine intelligenti che funzionano e reagiscono come gli umani. Alcune delle attività che i computer con AI possono progettate includono: riconoscimento vocale, apprendimento, pianificazione, problem solving e set fuzzy. *Negli ultimi 15 anni, Amazon, Google e altri hanno sfruttato l'apprendimento automatico per il loro enorme vantaggio commerciale. L'apprendimento automatico alla base dell'AI è la pratica dell'uso di algoritmi per analizzare i dati al fine di fare una determinazione o una previsione su qualche fenomeno. La modellazione* fuzzy *ci aiuta ad affrontare i fenomeni inclusi i parametri e le condizioni incerti, ci fornisce strumenti per modellare il sistema considerato nel mondo reale e avvicinarci molto più al suo comportamento. Il* set fuzzy, *quindi, rappresneta una classe di oggetti con un continuum di gradi di appartenenza. Il quadro sopra descritto ci dà un modo naturale di affrontare fenomeni così imprecisi, quando le classi di oggetti mancano di criteri precisi di adesione per i loro elementi. Il contesto da consideare terreno fertile scientico concerne la gestione della complessità dei moderni sistemi antropici socio-economici (Città, Aree urbane e il loro sviluppo socio-sostenibile).*

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Artificial Intelligence for Managing the Complexity of the Socio-Economic Systems towards Horizon 2020 and Agenda 2030

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The Emergence of AI in the Age of Sustainable Development

Jeffrey Sachs, professor of health policy and management at Columbia University, postulated that the world is entering a new Age of Sustainable Development, an epoch in which the nations of the world must collaborate and contribute to address the most intractable problems of persistent extreme poverty, social exclusion, economic injustice, poor governance, and environmental degradation[1]. Sachs was also a senior advisor to the UN on the SDGs and the Millennium Development Goals and is currently the director of the UN Sustainable Development Solutions Network (UNSDSN). At the 2002 UN World Summit on Sustainable Development (WSSD) in Johannesburg, he proposed a framework for analyzing sustainable development through the four pillars of economic development, social development, environmental protection, and good governance. Each of these four components are independent and mutually reinforcing pillars, but they are all essential to sustainable development in the world (World Summit of Sustainable Development [WSSD], 2002). Through the UNSDSN, Sachs defined problems on sustainable development proposed solutions, and provided reams of data on phenomena related to global sustainability. However, AI is such a novel, dynamic and rapidly evolving phenomenon that its impacts on the work of advancing the SDGs are just emerging and have yet to be extensively studied.

1. Sachs 2015.

Much research has been published about the emergence of artificial intelligence from its inception until the current era. Industry trade magazines and academic journal articles have added to the body of research as innovators in various fields incorporate AI experimentally into theory, thought processes, and practical solutions to problems. At first, there was an abrupt rise in AI investment, and then, after narrow returns investments declined, increased, and declined, in a somewhat consistent pattern over AIs history[2]. AI has been on a roller coaster ride of success and failure.

While some people herald the increase in utilization of AI as a vision of increased economic prosperity, improved leisure and free time, others such as Elon Musk, Stephen Hawking, and Bill Gates, caution that increases in AI utilization will exacerbate global economic inequity and herald an existential crisis for humanity[3]. It could herald a new long wave of 40-60 years in length (called the Kondratiev Wave), which portends a new cycle of sustained industrial innovation and economic growth. Russian economist Nikolai Kondratiev first observed this phenomenon of business cycles of booms followed by busts in his 1925 book, *The Major Economic Cycles*, and Joseph Schumpeter named these economic cycles Kondratieff waves in his honor[4].

Undoubtedly, AI could be a powerful force that can spark decades of economic growth, which is one of the four tenets of sustainable development[5].

AI can currently be divided into two types: Narrow Artificial Intelligence (NAI) and artificial general intelligence (AGI). NAI, which includes all current AI, is considered to be a weaker form of AI. To date, AGI remains theoretical but is rapidly becoming feasible as its application proliferates. A subset of AGI is Human-Level Machine Intelligence (HLMI), which is idealized as being able to perform as effectively as an extremely gifted human in all intellectual tasks[6]. This is the specific genre of AI that causes fear in some people, since it would not just take jobs in the short term but could also supplant humankind as the apex species on the planet in the long-term.

AGI is closer to becoming reality as bio-humanoid roboticists, such as the life-like robots created by David Hanson, Ben Goertzel, and other pioneers in the field become more commonplace and acceptable[7]. These trail-blazing inventors seek to create a database that would collect the knowledge

2. Munoz, Naqvi 2018.
3. Sainato 2015.
4. Barnett 2002.
5. Sachs 2015.
6. Phis.Org 2018.
7. Goralski, Górniak-Kocikowska 2017; Goralski, Górniak-Kocikowska 2018.

of all bio-humanoid robots into one receptacle, OpenCog, that could be instantaneously distributed to all bio-humanoid robots. AI knowledge would be cumulative and evenly distributed. While AGI could cause widespread displacement of jobs through improved efficiencies in production and distribution, NAI is already causing gross displacement of jobs and disruptions in established professions. One example highlighted in an article titled *Artificial Intelligence* states that "Goldman Sachs employed six hundred traders in 2000, the corporation was able to reduce their number of human traders to two by 2017 because of advances in narrow AI". On the other end of the spectrum, people believe that the results of heightened utilization of AI could solve the problems of income inequality, which is related to Reduced Inequalities. However, since the results of superior production and efficiency gains have not been distributed equally in the past, it is unrealistic to believe that those who develop and own the next generation of AI technology, would distribute the rewards widely instead of narrowly by increasing their own wealth. This could create a concentration of wealth and increase the gap between the haves and have-nots.

This unequal distribution of wealth, knowledge, and power would not just exist on an individual level but would also be concentrated in specific countries and cities creating even deeper worldwide disparity, once again impeding the achievement of Reduced Inequalities. Work that has previously been exclusive to human experience can already be performed better and faster by AI, which not only creates a calamitous situation for employment, but also added stress for the human psyche[8]. A majority of workers could be displaced when AGI exceeds the capabilities of the average human in various economic roles. In January 2015, Stephen Hawking, Elon Musk, and dozens of artificial intelligence experts published an open letter calling for research on the societal impacts and unintended consequences of AI. The letter acknowledged the potential benefits of AI, but also raised the specter of automated weapons and uncontrollable machines escalating armed conflicts that may lead to human extinction[9]. Recently, Stanford University launched an institute for Human-Centered Artificial Intelligence (HAI) that will bring together experts from various fields like economics, philosophy, ethics, psychology et al.[10].

8. See note 7.

9. See note 3.

10. Marconi 2019.

AI and the Water Crisis: the Case of Smart Water Management

"Water is essential for life. For thousands of years, human settlement and advancement has been dictated by a reliable supply of clean, safe water. In the face of a fickle supply system, people flourished, moved or perished"[11]. Water and sanitation are at the center of the SDG resource triad. It touches on, and impacts, women's empowerment and gender equality, food and agriculture, energy and climate, and infrastructure & technology.

Water is widely used in agriculture, industry, and also in the domestic household. Each day, cities and communities around the world work on millions of tons of raw water, processed water and waste water to service the needs of human civilization. Water must be adequately treated and transported in accordance to hygiene and health standards to ensure its quality and properties will meet the specifications demanded by the end users. In recent years, there is movement to leverage on the emerging technologies to offer sustainable solutions for treatment, transportation and the recycling and reuse of water.

While the world's supply of water is more than adequate to meet all current needs and demands, the treatment and distribution facilities and networks are not[12]. There are still many communities in the developing world in which the water resources are inadequate to meet household, economic development and environmental needs. In such regions, the shortage of potable, clean water to meet human drinking water and sanitation needs continues to affect human health and productivity and hence economic development, as well as the protection of the environment and natural ecosystems.

The choices that communities, cities, and nations make regarding the management of water resources have great implications on our future welfare. Some have compromised their future security or sustainability by disrupting and overusing freshwater supplies, overdrawn groundwater aquifers; polluted natural water bodies such as estuaries, coasts and oceans; and degraded ecosystems that sustain the food chain. Humanity must leverage the advances in technology and AI innovation to enable it to satisfy short-term economic demand and at the same time safeguard the long-term environmental sustainability of natural ecosystems and bioregions.

While water sources and water supplies may not have changed substantially over time, the management tools available in the field have evolved. Water utilities are assisted by smart water

11. Hill 2018.

12. Cosgrove, Loucks 2015.

management that is powered by AI[13]. "Progress on new artificial intelligence (AI) technology could make monitoring at water treatment plants cheaper and easier and help safeguard public health"[14]. While the first AI-driven software utilized expert systems or rule-based algorithms to decide on outputs or to analyze alternatives in a field of choices, the newer AI tools replicate the way that humans learn in its just-in-time applications.

In the learning phase, the input data is correlated to known outputs to allow the algorithms to learn over time. Then, in the "operational phase", the program begins to make sense of patterns as new data is introduced. Because of AI's ability to constantly adapt and process large amounts of data in real-time, it is an ideal tool for managing water resources in an ever-changing environment, and the business of water, allowing water utility managers to maximize current revenue and effectively plan for the years ahead.

By utilizing these new software-as-service platforms, new dynamic strategic financial operations can be created and managed for water utilities to significantly improve productivity and cost-savings. The system also incorporates low-cost sensors and communication networks to track real-time water loss and manage distribution networks. "The power of AI unleashes the imagination of our water professionals"[15]. This is an interesting turn of phrase since at this time in the water utility industry, the ability of AI to combine growth projections with future water availability and infrastructure condition assessment allows managers to maximize decisions and investment in the infrastructure.

However, as with all narrow AI, the system is only as good at the data that is being supplied to it and the managerial under- standing of the output that is being produced by the data. And, as with all AI, as AI asks the questions and supplies the responses, humans are deprived of some of the insight that they previously had access to from finding solutions to the problems themselves. For now, human interpretation is still needed, but as AI becomes more astute and the responses and solutions become more prevalent, then human interaction will become less important and the tipping point will become more obvious. Ultimately, the goal of AI is not to be perfect, AI simply needs to do better than humans[16]. Despite the transition that may present some difficulty and risks, the use of AI in water management has the potential to increase productivity, improve water conservation of this precious resource and thereby advance the achievement of a number of Global Goals.

13. See note 13 and O'Connor 2017.
14. Phis.Org 2018.
15. See note 13.
16. Kaufman 2018.

Figure 1. Technology and Enviromment a Joint Combination for Sustainability, https://www.fundacred.org.br/site/2019/06/26/conferencia-internacional-debate-economia-verde-em-fortaleza/ (accessed 30 March 2019).

Conclusions

In this paper we present a model of AI for smart water management. All this effort would lead to the realization of an important sustainable development, it would create those conditions that would lead a decision maker to transfer AI facilities into the Socio-economic systems of the future with certain «smart» characteristics and produce a saving in economic terms and above all safeguarding those perishable raw materials, applying the Kyoto protocol as widely as possible.

The operating platform was provided by Horizon 2020 which, as an European operational strategy, had already laid the foundations for spreading a culture of sustainability declined in its various facets. As regards the concept of Smart city, urban sustainability *et similia* will find a great development thanks to the use of the tool of AI.

With this paper, we wanted to provide a timid but substantial contribution towards the identification of some of the scientific features concerning the AI, which naturally flow towards the achievement of the objectives identified with Agenda 2030 through Horizon 2020.

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