Intelligent Machines: Shaping the Future of Computer Science and Society

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Abstract

This paper discusses how smart machines would emerge and become a revolutionary change in computer science and society. It explores the history of artificial intelligence (AI), the technologies around which intelligent systems revolve and the ubiquitous utilization of intelligent systems in healthcare, transportation, education and finance among others. Other important issues that are discussed are algorithmic bias, lack of transparency, disruption of workforce, and ethical issues. Further down the road, the paper puts up a spotlight on future trends, such as emotional AI, general intelligence, edge computing, and quantum integration. As much as intelligent machines hold immense potential to enhance the human life, it requires responsible development, regulation and education. To live with these systems, there must be a middle-ground between innovation, ethics and teamwork to ensure that intelligent machines serve as a human booster instead of inequality or aggression.

Keywords:

Artificial intelligence, machine learning, intelligent machines, automation, computer vision, ethical AI.

Introduction

The 21st century brought up a different time in computing a time which is not only dominated by mere processing power, but by the time when intelligent machines began to exist. These are the ones that can learn, reason, adapt and in some instances make decisions without necessarily having to be given any directs or commands by a human being. Although early computers were capable of highly accurate and speedy execution of predetermined commands, its modern counterparts have gone much beyond that and are more intelligent tools [1]. They are capable of handling complicated data patterns, human language, detection of objects in pictures, and even having a chat- all attributes of machine intelligence.

We have not created the concept of smart machines. It is not a new element in science fiction, which has the robots created by Isaac Asimov and a self-aware machine in the HAL 9000 of the 2001: A Space Odyssey. Yet, more recent advances in AI, ML, and robots have made the fictional become reality [2]. The current machines which had to be hard-coded into logic to be operational learn via input, modify their conduct as suggested by responses and get better with age. These functionalities are not only raising industries, reinterpreting how people can interact with technology, but are also altering the ideologies of work, creativity and smartness [3].

The essence of intelligent machines is a branch of computer science that concentrates on imitation of human cognition. These areas are such things as neural networks, mimicking how the human brain learns information; natural language processing (NLP), whereby machines can create and read human language; and reinforced learning in which machines are allowed to learn by trial and failure, as human beings do. The technologies have been changing very fast and that is because computing has advanced hardware, huge datasets have been available and they have developed more efficient algorithms [4].

It is perhaps in the form of virtual assistants such as Siri, Alexa and Google assistant perhaps some of the most obvious outlays of intelligent machines. Those applications support recognition of speech, NLP, and machine learning to perform commands, search information, and accomplish the tasks. In the background, something similar happens to recommendation engines like those on YouTube, Netflix, and Amazon where user preferences are determined ahead of time by the ways they behave rather than through personal guidance [5]. At higher levels, smart machines drive auto cars, do medical diagnosis autonomously and write music or create art. The presence of intelligent machines is a miraculous phenomenon in the science of computers and an extensive change in the relationship we have with technology. They no longer serve as a means but are partners, translators and even, or sometimes, their own agents. In entering increasingly into this new intelligent age we need to learn more than ever about how these machines work and how they are going to impact upon our lives [6].

Exploring Machine Learning

Essentially, intelligent machine is a computer system that can resemble some facets of human intelligence: learning, reasoning, problem-solving, perception and even origination. But what truly names a machine so that it can act, so-called, intelligently? The question belongs to the confluence of computer science and artificial intelligence (AI), neuroscience, and philosophy. As opposed to traditional computers, where the computer works with set sets of instructions, intelligent machines work in dynamic environments, which are much unpredictable [7]. They are intelligent because they are adjustable, self-educational and capable of deciding independently. It is this flexibility that makes a genuinely intelligent system as opposed to a mere automated one.

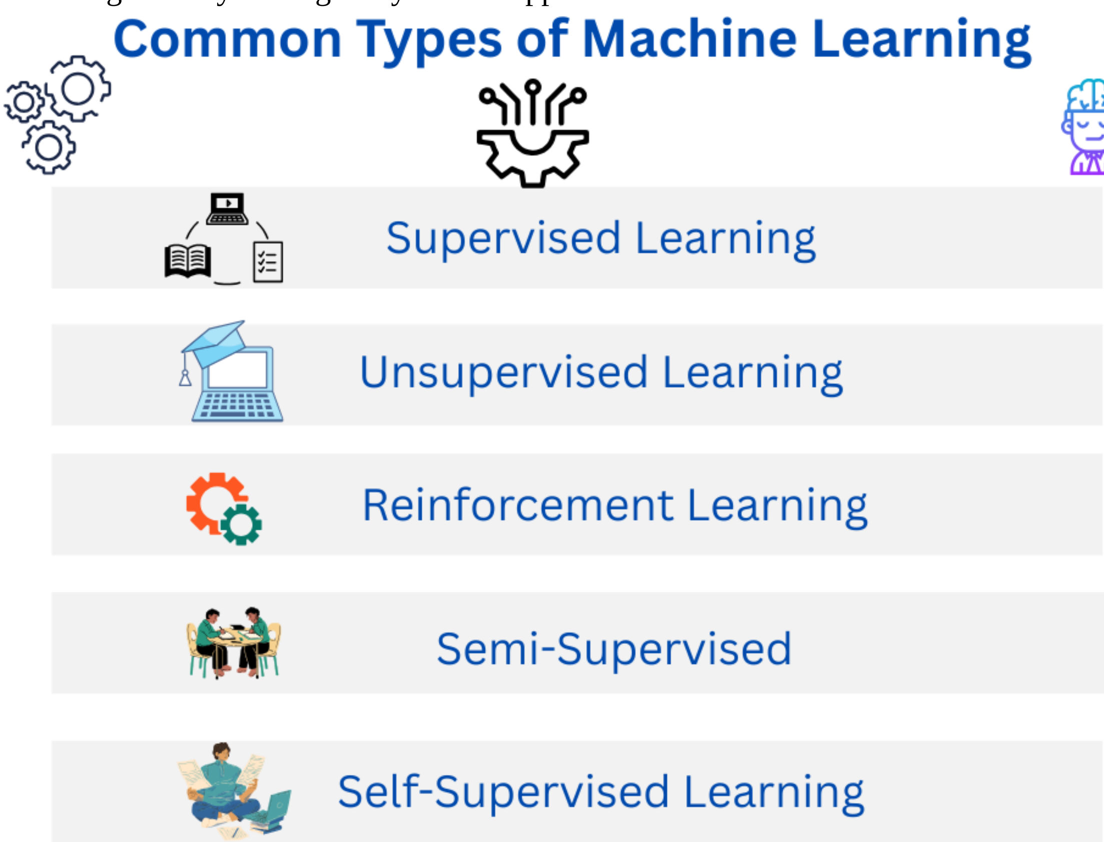

Figure: 1 showing common types of machine learning

As in the case of a spam filter, the more input of incorrect and correct context, the better the filter will work. Smart machines are capable of analyzing data, making a choice of options, and rendering decisions with the help of logics and probabilities. A reinforcement learning approach to decision-making can also apply to more complex AI systems in which the machine is rewarded or punished, depending on what behaviors it applies, and learns what is best [8]. A well-known presence of this is when Deep Mind Alpha Go beat human titans of strategy games through learning to play strategically via gigantic numbers of simulations.

Computer vision, speech recognition and sensor fitted machines can make sense of the surrounding world. Cameras and LIDAR are important to allow a self-driving car to sense the surrounding environment, detect things, and decide navigation in real-time. They use perception to handle the physical world, which is a necessity of robotics, drones, and smart home systems [9]. The topic AI can most impressively develop and learn to comprehend and produce human language. Using natural language processing (NLP), machines can communicate in a useful way, translate words, determine sentiment, and summarize the text. Type of linguistic intelligence The type of linguistic intelligence that large language models such as ChatGPT can exhibit previously only belonged to humans, as they can understand context, intent and tone [10].

There is no smart machine that operates with the lack of two basic elements, data and algorithms. The raw material that the machines learn form is data- images, text and numbers, sound. The instructions that show the machines the way to process this data are called algorithms. All together they make up the backbone of any AI. This highly depends on the quality, quantity, and diversity of data that define the level of smartness to which a machine can be developed [11]. It is the ability to behave intelligently not the apparent state of consciousness or having emotions that makes a machine intelligent by being able to act and operate like an intelligent human being, learning data and making choices, perceiving the world and conveying messages in right manner. With the development of technology, the most important border between artificial and natural intelligence becomes increasingly blurred, which changes how we think about the concept of intelligence [12].

The Short History of Intelligent Systems

The idea of smart systems as a machine, which is capable of thinking, learning or acting without control, interests people centuries. Many years before the creation of contemporary computers, philosophers and inventors hypothesized upon the ubiquity of artificial minds. Modern smart machines are a product of many decades of intellectual discovery, engineering advancement, and just an increasingly applied knowledge of the mechanism of thinking itself [13]. The ideas behind artificial intelligence were seeds that are dated back to ancient myths and primeval mechanical inventions. The ancient Greeks envisioned self-powered mechanisms such as with the large bronze automaton known as Talos and early Muslim innovators such as Al-Jazari created mechanical contrivances that resembled human and animal activities [14].

But up until the 20 th century, nothing became of the intelligent systems in a scientific context. Alan Turing proposed the idea in 1936 of a universal machine (also known given sufficient time and resources, could solve any computable problem), a pre-cursor to what was later the Turing Machine. This gave birth to the digital computer and mathematical theory of computation [15]. Artificial Intelligence (AI) was first coined in 1956 at the Dartmouth Conference where some of the pioneers in the field like John McCarthy, Marvin Minsky and Allen Newell stated that, it is possible to precisely describe each component of learning or any other aspect of intelligence such that a machine can be made to simulate them [16].

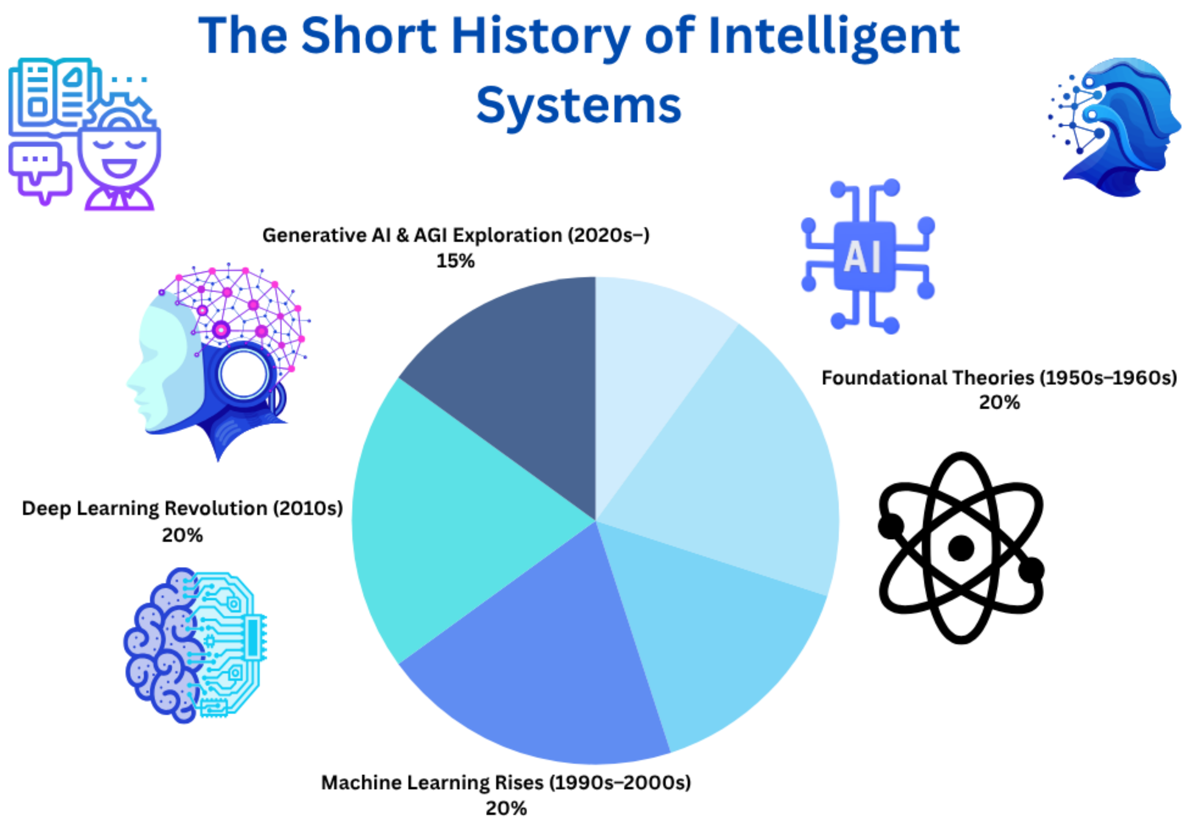

Figure: 2 sowing the short history of intelligent systems

Some of the earlier systems such as Logic Theorist and ELIZA showed that machines could solve logic problems or simulate human conversations. Scientists were sure that AI of human level would become at hand in a few decades. But, initial ones were restricted in computational capability, absence of data and even crude concept of intelligence. By the 1970s, work had slowed, and the area experienced what became known as an AI Winter a time of funding and interest decline because expectations had not been met [17]. The expert systems (or AI systems that relied on fixed rules to model decision-making) were developed in the 1980s with limited success applications in such fields as medical diagnosis and business automation.

Nevertheless, these systems were fragile and did not work in complex, uncertain circumstances. Until the 1990s the field was mostly academic, as more powerful computers, greater datasets to crunch and the invention of machine learning algorithms have led to a new burst of AI research.

Machine learning and, more specifically, deep learning based on artificial neural networks based on the human brain, were the real breakthrough in the fields of intelligent systems [18]. and Deep learning actually allowed the machines to perform image recognition, speech processing, language translation just as well as humans, with the emergence of huge data and highly efficient GPUs.

The most memorable moment can be considered the 2011 match when the natural language processing and large-scale data analysis demonstrated the power of IBM Watson to win Jeopardy! in a match against human champions. In 2016, the AlphaGo of Google DeepMind was the first to beat the world champion lee Sedol in the game of Go- a game deemed to be too tactical to use brute-force [19]. The AlphaGo achieved new heights in the field of AI as it mastered strategic decision-making, which involved reinforcement learning. Intelligent systems today come in the form of an infinite number of applications including virtual assistants (Siri, Alexa), recommendation engines, smart devices in the home, driverless cars and robotics. Artificial intelligence systems such as ChatGPT, DALL•E and robot learning are a synthesis of 50 years of advances in computation and mathematics and neuroscience [20].

These systems are not: rule-following programs, but instead, they are adaptive, that is, they can adjust themselves, they can make it improved and in most cases, they operate in a system where they are forced to handle some form of uncertainty and they have to do it, with incomplete information just as humans have to [21]. The background of the intelligent systems is the story of ambitions, failures, and the mind-blowing innovation. Every new wave of advancement has taught scientists more on what intelligence is, and it is just how hard it is to reproduce. In the context of the future, our current knowledge of the past can be beneficial to show the prospects and the restrictions to intelligent machines [22].

Real world usage in computer science

Intelligent machines no longer have exclusive effects in research laboratories or even as science fiction stuff because it is already fully integrated into our lives. Intelligent systems are changing practically every aspect of the society, including the manner we relate to each other, communication, shopping, and traveling, working, and getting medical services. Such applications are not merely speeding up the processes and activities, but they are also opening whole new unreachable opportunities. Intelligent machines are transforming diagnostics, treatment, and care of patients in healthcare [23]. Using artificial intelligence, the computer is able to consider huge amounts of medical information (the results of X-rays and MRIs, genetic chains) and identify the pathology with such precision that it is simply incredible. Some of them such as IBM Watson have been adopted to aid in cancer diagnosis and deep learning models are able to detect indicators of diabetic retinopathy or cancers at a faster rate than some human radiologists can do by looking at medical images [24].

Machine learning-powered wearable health devices are used to monitor vital signs and give real-time health information. Robotic surgical assistants and predictive analytics are used by hospitals to plan optimally and minimize the chances of equipment breakdown, increasing the accuracy and decreasing recovery time. The most evident, yet the most audacious application of intelligent machines is self-driving cars. There is a blend of sensors, cameras, LIDAR, GPS as well as artificial intelligence algorithms that these vehicles look up when perceiving their surroundings and make last-minute decisions about how to drive [25]. Organizations such as Tesla, Waymo, and Uber are making great investments in the autonomous transportation systems. In addition to passenger cars, intelligent machines are applied in drones allowing delivery, intelligent systems of ships to automate logistic flows, as well as the use of intelligent systems to adjust to the real-time situation on the roads that reduces traffic by increasing the number of lanes to drive in [26].

The use of AI-driven chatbots and virtual assistants in the customer service system has become paramount and transcends various industries. Anywhere you see a flight being booked, a device being fixed, or a bank balance being checked, there is most likely an artificial system that has been taught natural language processing. Such virtual assistants as Siri, Alexa, and Google Assistant cover all tasks, including timers and other alerts, music, and controlling appliances in smart homes [27]. These systems are always adapting to the way a user operates to provide more personal and relevant answers. Fraud detection, credit scoring, risk management, and automated trading are what allows the financial industry to use intelligent systems to a large extent. Artificial intelligence can handle millions of transactions a second and detect suspicious activity or anomalies that might be a sign of an insecurity threat [28].

Auto-investing services are automated investment management software that has predetermined algorithms to build and maintain an investment account on the basis of user desired outcomes and risk tolerance. Rational machines also study news sentiment, historical trends and financial exchanges in which decisions by hedge funds and asset managers are informed. Smart technologies are transforming education through personalization in learning [29]. Bayonet learning systems adapt to an individual learner using the assistance of AI to alter the rate, content, and problematic level of the lessons in reaction to the performance of learners. The use of virtual tutors and grading systems will improve and cut on the workload of the teachers to ensure timely feedback. It can of course be used to detect those students who are likely to fall behind and thus can be intervened with early and given targeted help. Moreover, AI-based technologies empowers students with disabilities, it could be real-time speech-to-text apps or visual aids [30].

Amazon, Alibaba, and shopify are online shops that personalize their recommendations, optimized logistics, and avoid scammers with intelligent machines. Such systems interpret browsing patterns, past buying experience, and even emotional reactions in such a way that it modifies the shopping experience. Targeted advertising, optimal optimization of campaigns, and the content creation of marketing: that is what AI tools can be applied to in marketing [31]. Marketers use machine intelligence to forecast customer behavioral patterns, customer segmentation, and evaluation of the effectiveness of the used strategies in real time. Intelligent machines also are employed in precision farming--studying information about the soil, weather and plant health to attain the best planting, watering and harvesting. Drones and autonomous tractors with AI make farmers gain more production and spend less on losses [32].

One of the applications of intelligent systems by environmental scientists is during climate modeling, wildlife tracking as well as disaster prediction. Wildfires detected with the help of satellite imagery, the level of pollution in ocean waters, etc. these applications are crucial to sustainability. The uses of intelligent machines are huge, as well as ground-breaking. And when those elements are integrated it offers a seamless operation to industries, fosters augmentation of human capabilities and solves problems thought to be unsolvable [33]. These technologies will become more mature and as they do, it is likely that their effects will strike much further and deeper into the way we live, the way we work and the way we comprehend the world around us.

Obstacles and Constriction in Computer Science

Although intelligent machines have already achieved astonishing progress and introduced the innovational changes to different spheres, the process of developing and introducing these machines is far not without challenges and limitations. Such barriers cut across the technical, ethical, economic, and societal fronts [34]. Those limitations are extremely vital to the responsible use of intelligent systems and making sure that they can be applied to the best of human interests and long-term objectives. The most demanding aspect of intelligent machines, particularly the machine-learning based ones is a significant number of data during training. The performance of the system, to a fair degree, is dependant on how efficacious the data is. In case biased, incomplete, and unrepresentative, the information is inputted, the machine will also make poor decisions [35].

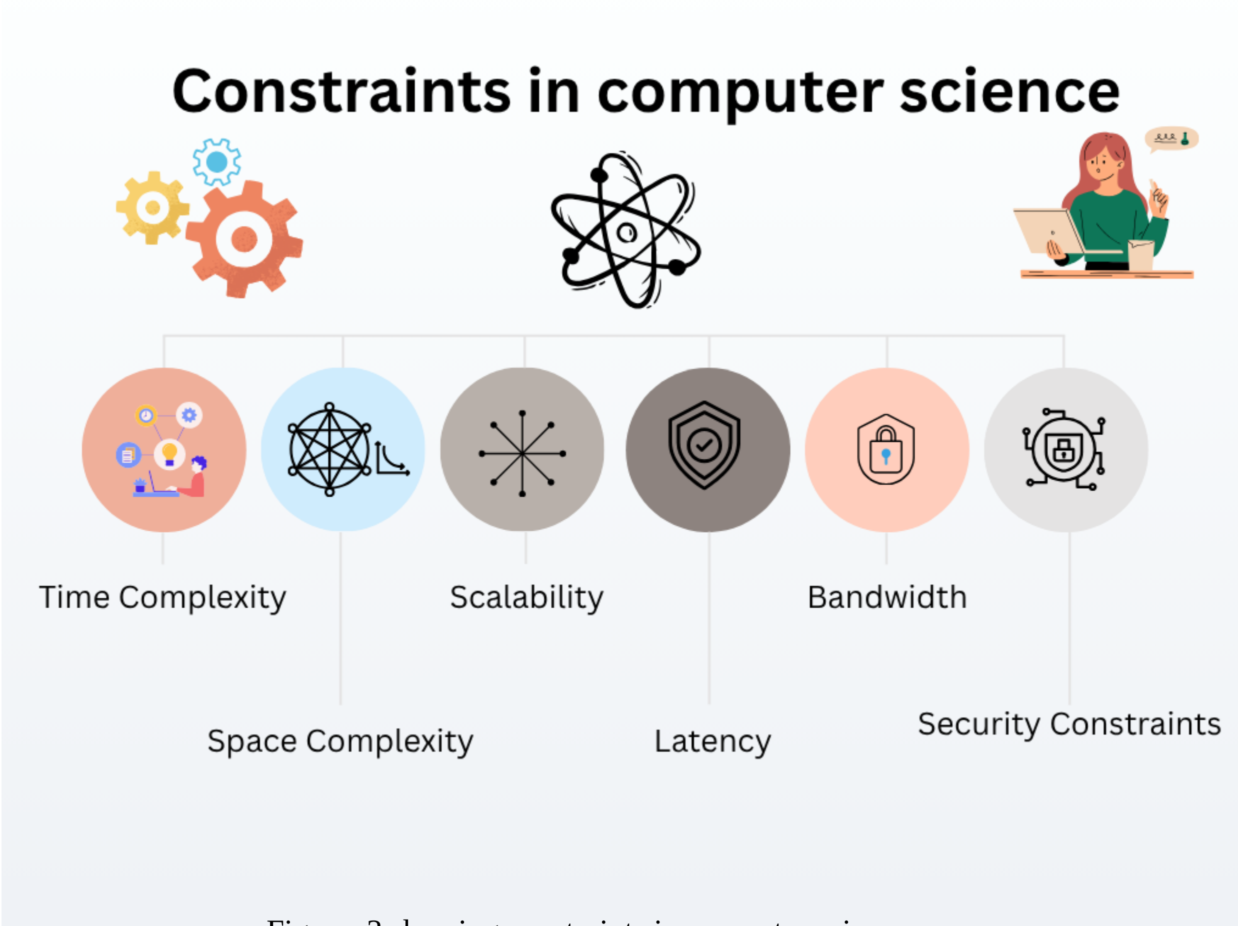

Figure: 3 showing constraints in computer science s

Where such a facial recognition has been trained on mostly lighter skin images, it will not recognize people with dark skin correctly and this was actually found to exist in real-life operations of a facial recognition model. Moreover, there is the possible privacy and security issue when dealing with such sensitive data as medical or financial records [36]. The AI systems have the biases of what they are trained with. It causes algorithmic bias, an unfairness of some groups, maybe marginalized as a result of treatment. This can lead to severe ramifications in real life in fields such as criminal justice, hiring, and lending as well as in the field of healthcare [37].

This may take the form of a hiring algorithm which favorably discriminates against women applicants at the expense of men applicants based on historical hiring information within a company with established bias. Bias will have to be countered not only with improved data but also with visible algorithms, workforce with different backgrounds, and robust ethics regulation. Most of the more sophisticated AI, particularly deep learning systems can be called a black box since it is complex to discern how they have reached a given decision or prediction [38]. Such uncertainty adds critical compelling complexities especially in exceptionally high stakes areas such as healthcare, finance or self-driving. To implement intelligent machines into use, developers must focus on explainable AI (XAI), which is highly rational in regard to its results and can be trusted by both users and regulators. In its absence, accountability becomes vague in case of things not going right [39].

Smart machines have been subjected to hacking and malicious manipulation. In others, input data that is slightly changed, like in an image, can result in totally wrong predictions by an AI system. It opens the way to manipulation of such systems as self-driving cars or surveillance cameras. There is also the risk of AI based malware, deep fakes, and cyber warfare tools that are automated. With more powerful intelligent machines, it is necessary to secure them to prevent ill uses more than ever before.AI poses serious ethical concerns [40]. Does a military drone have the right to independently decide if someone is to live or die? Will it be possible to set the prison terms or loan approvals by AI system?

There exist apprehensions of job displacement also. Due to the potential of performing cognitive and physical activities, millions of workers can become redundant, particularly, workers in the manufacturing industry, logistics, and customer service, and even in high-skilled jobs such as law and journalism. Ethics is the primary factor in reconciling progress. It is essential that the institutions should design and develop rules, structures and codes that will help intelligent machine application in the best interest of the society [41]. The process of training large models of AI usually demands very high computer capabilities, energy use, and high-cost infrastructure. This causes concerns of sustainability, accessibility and environmental impact. The smaller organizations and developing nations might not be able to compete with tech giants that can develop and produce sophisticated intelligent systems [42].

In such a case, with the increasing artificial intelligence of machines, there arises the danger of the human becoming completely dependent of the AI systems, and in the process losing irreplaceable skills. By way of example, we can become weak at navigating without GPS. At the work-stages, the staff could acquiesce to the AI suggestions too easily even though the latter are wrong. Such de-skilling can impact the individual competence and critical thinking in the long-term and human supervision plays an even greater role [43]. The risks and weaknesses of intelligent machines have a realistic and two-sided character. Although they do not reduce unlimited opportunities of AI, they remind us that the process of progress should be strict, open, and socially responsible. The importance is that, when we proceed to incorporate smart machines into our lives, we have to be smart, as well, we have to put these machines to work to benefit all humanity rather than only a few of those privileged few [44].

Smart Machines and the Employees

Probably the most controversial and influential feature of intelligent machines is their implications on the world workforce. With the further development of artificial intelligence (AI), machine learning and automation technologies, they completely transform not only the manner of work implementation, but also the people who will perform it as well as the sort of competencies that will be required. The changes are associated with opportunities and challenges that have to be grasped before getting ready to face the future of employment. Certainly, job displacement is perhaps the most immediate issue [45]. Lately, it is becoming increasingly clear that intelligent machines can do what only human beings could do. These are not only the menial, monotonous physical work, but also cognitive processes like data entry, planning, customer service, simplified accounting and even content generation.

Although AI can replace some of the jobs, the field is also likely to generate new jobs, many of which are yet to appear. Just as other technological revolutions in the past have done, automation brings into the fore new industries, and careers [46]. This is to say that nowadays we can find that occupation like These occupations frequently need some specialized skills, e.g. in the fields of programming, statistical analysis, systems design, interdisciplinary knowledge (e.g. law and technology, medicine and AI). In line with the mortification of healthcare, education, and creative professions, the emergence of so-called hybrid careers that involve the combination of domain specifics and technological savvy holds more and more value [47].

The pressing need to reskill and upskill has arisen to keep up with this emerging reality. The employees should have the chance to acquire new competencies applicable in an economy powered by artificial intelligence. Governments, academic and companies have to come together to offer affordable and accessible training in: As opposed to supplanting completely the role of human beings, intelligent machines are many times complementary to human skills [48]. It results in cooperative systems, whereby human and machine collaborate to give better results. An example: This kind of relationship of symbiosis can increase productivity and innovation with successful management. Nevertheless, it needs the workers to trust and comprehend the systems they deal with, all the more underlining the importance of transparency and ease of use [49].

Intelligent machines represent a threat to inequality unless they have even opportunities toward training, technologies, and fresh possibilities. This is because workers in lower income areas or sectors would suffer as their access to education, infrastructure and support systems is denied. In addition to that, the economic gains created by automation are likely to be concentrated in large tech firms and highly skilled people, and that makes the issue of unfair economic growth raising ethical and policy concerns [50]. There is the disruption and opportunity that comes with the introduction of intelligent machines in the workforce. Loss of job will occur but new occupation will develop. This is because the response of the societies is the key through proactive education, fair policies, and investment to the human capital [51].

Training to make this move is not the same as training people to code. It is associated with enhancing a culture of life-long learning, inclinations to creativity, and facilitation of mental and emotional strength to face forthcoming developments with pace in the world of work. Provided they are dealt with responsibly, Smart machines have the potential of empowering rather than replacing workers, which means that the future of work will be more inclusive, dynamic, and fulfilling [52].

Future Developments in the Work of Smart Machine Developments

The rate of innovation is perhaps unlikely to abate as the level of integration of smart machines in the society increases. The thing that used to be automated under the rules is now coming to deep learning, language generation, and ability to make decisions. And how about the future? The world of intelligent machines will be full of new tendencies which have the power to set new limits to what the machines are capable of performing and how they communicate with humans and the world [53]. The current AI systems are primarily narrow AI, which implies reaching a certain goal in bringing about a predetermined service or act, e.g., face recognition, album suggestions. Tomorrow is more about Artificial General Intelligence (AGI) though, i.e. computers that would understand, learn and apply knowledge in a broader scope of jobs, just like a person [54].

Although we are yet to see the dawn of true AGI, there is some important work going on to develop systems that reason more widely, generalize faster and learn to transfer knowledge even across wildly diverse domains. AGI has the possibility to change science, education, medicine up to the moon and beyond, however, it also brings up really deep ethical and philosophical questions relating to autonomy, consciousness, and control [55]. The other major trend is the creation of Emotional AI, or Affective Computing, systems capable of identifying, classifying, and acting upon human emotions. Based on data deciphered by a facial expression, tone of voice, physiological indicators, intelligent machines are learning to modify the response depending on the emotive state of the users [56].

Emotional AI is being applied more in customer service, medical field, as well as in learning. To give one example, a virtual tutor may recognize feelings of frustration in a student and adjust the method of teaching, a mental health chatbot may be able to provide some mental support based on the identified mood trends. Yet, privacy, manipulation, and consent are some of the things that emotional AI raises when discussing this technology, particularly when applied in surveillance or advertising [57]. With intelligent systems being utilized in increasingly important applications such as healthcare, law and finance, explain ability is becoming a necessity. The processes in which decisions are made must be known by the users and the regulators particularly at high stakes environments. The future of AI will heavily involve Explainable AI (XAI), also known as Explainable Artificial Intelligence, where the algorithms would be more transparent and related to a point of being explainable. This will enable human users to question, validate and trust any machine-generated results and eventually result in a more responsible AI systems that would resonate with ethical and legal principles [58].

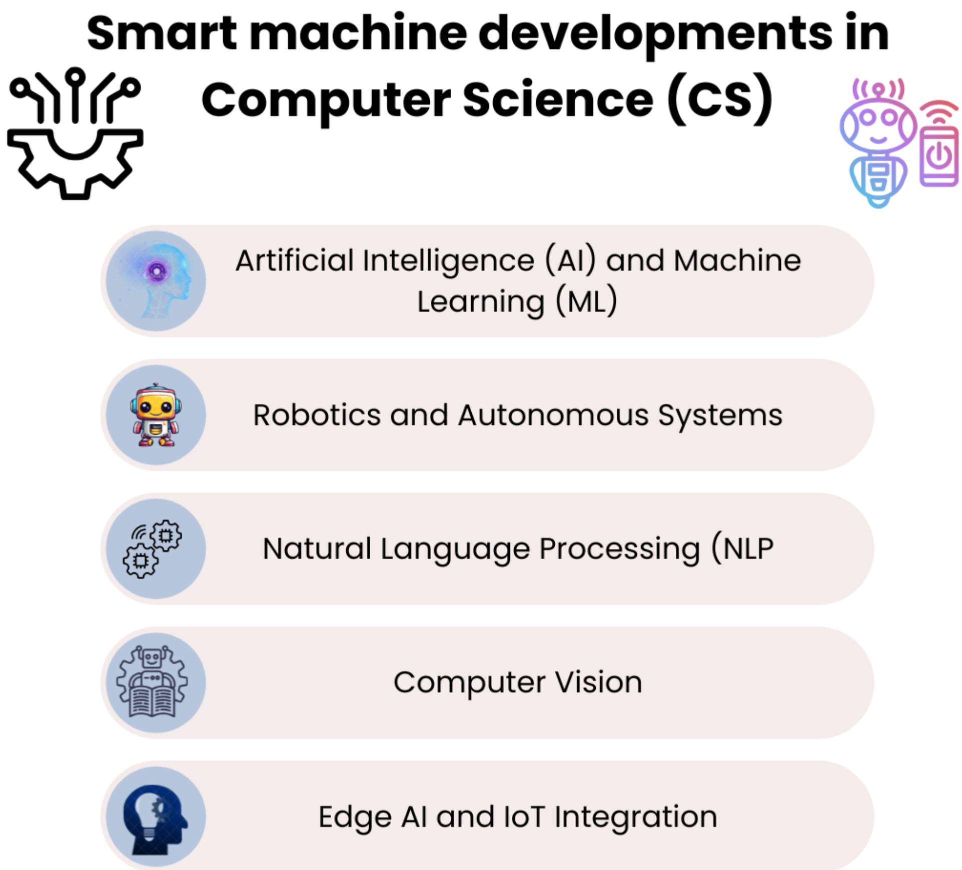

Figure: 4 showing the smart machines developments in computer science

Another astounding field that can bring AI to new heights much faster is quantum computing. Quantum computers are even now in their development stages, but once developed, they have the ability to analyze large data sets and perform expensive equations exponentially quicker than their classical counterparts. It is not only intelligent machines that reside on cloud but also on the edge. Edge AI is the idea of running AI models on any local equipment, including smartphones, IoT-sensors, and industrial equipment, instead of centralized servers [59]. The tendency contributes to real-time decision-making, decreases latency, and increases the level of data privacy.

It has a great value in autonomous vehicles, smart cities, and remote healthcare monitoring. With more powerful chips and devices, don&apos T be surprised to find more and more intelligence as near as possible to the data source. With a large power, there is a lot of responsibility. Due to growing autonomy and influence of intelligent machines, ethics and governance are going to be central in the development of such machines in the future. The governments and organizations are attempting to develop the regulations that will make AI more fair, accountable, and humanistic [60].

The future of intelligent machines is flexible, diversified and promising. Emotional intelligence and general intelligence to quantum acceleration and edge deployment may be just some of the trends that will endear a new era in computer science and cooperative work between humans and machines. Nevertheless, it is the advancement that should be balanced by thought. It is not only a matter of creating more intelligent systems but also a matter of creating smarter but also safer, more equitable systems [61]. Action today governs the answer to the question of whether intelligent machines take humanity to higher levels in the future, or out brain our capability to control it.

Conclusion

The swift evolution of intelligent machines is one of the most impressive changes in the technology history. Advancing scalable computing and symbolic reasoning as a theoretical possibility to current complex systems driven by neural networks, natural language processing, and deep learning, the use of intelligent machine has come a long way since their inception and nowadays can be estimated to have an impact on every aspect of our life. In this exploration, we have witnessed how smart machines are not programmed machines but are rather systems that have the ability to learn, change as well as decision independently. Their introduction is already reaping in the field of healthcare, transport, education, finance and agriculture among others. Robots are not only diagnosing the diseases, driving cars, assisting students to study, detecting financial fraud but also writing art. This infiltration to the actual world has come with ease, productivity, and advancement, however, it has come with burning issues we can simply not overlook.

Among the top issues of concern can be mentioned the issues of bias, transparency, and the dependency on data. Smart computers are taught on data- and it is no different in machine learning, which means that when you have bad data, the actions of the machine will also be bad. This creates an entry to unintentional discrimination, misinformation, and unjust end result. With decisions that impact human life being made with the help of AI systems, explain ability, and fairness are not only a technical requirement, but are necessitated by morality. Also valuable is the effect of intelligent machinery on the labor force. There is the existent danger of automation that is likely to render thousands of jobs redundant, especially those that require a lot of repetitive work. Meanwhile, there are new occupations opening up, in AI development, data analytics, and even human and AIs working together. The work world of the future will require lifelong learning, flexibility as well as a combination of technical and humanistic skills. The need to up skill the workers and to have systems in place to ensure that no one is left behind in this transformation will require societies to invest in this process.

Moving on to the future, there are the signs of new trends according to which intelligent machines will be more powerful and even more embedded into the everyday life. There is a massive disruption and innovation potential, from the development of Artificial General Intelligence to the emergence of emotional AI, edge computing, and systems that are harnessed with quantum capabilities. But this future should be steered not only by what is possible but what is responsible. The development of intelligent machines involves governments, teachers, developers, and even the users themselves in bringing out its course. These technologies must be developed ethically, with a firm regulation and through international collaboration, so that they tend to respect human dignity, safeguard privacy and promote the common good. Meanwhile, developers have to be concerned with transparency, inclusivity, and long-term safety at all levels of development and deployment.

But the bottom line is, we should learn to live with intelligent machines by being prudent in their use. It is to live with their frailties and to live with their strengths. It entails ensuring a relationship in which the human being is in control, not only technologically but in morals and social ways as well. IQ machines do not solve the problem of human potential, they are an enhancement of it. Well architected, they can augment, address global challenges and help shape a smarter, better and more sustainable world.

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