AI for Tomorrow
What AI can deliver for us tomorrow

Dr Subha Fernando

Introduction

We are at the dawn of the fourth industrial revolution in which Artificial Intelligence is a core element of this revolution. Artificial intelligence (AI) is a combined area of computer science, mathematics, and statistics, which involves the study of machines that are able not only to work and to think, but also to respond as we human beings. Since most have still not realized how powerful AI will become tomorrow, it is hard to recognize how significantly this technology can improve the way we work. AI research and its applications are continuously growing. According to technology writers, AI research has grown by 12.9% annually worldwide over the last five years. According to the world's leading research and advisory companies, enterprise adoption of AI has increased 270% during the last four years.

There are seven distinct research areas that are very significant in AI research: search and optimization (evolutionary computing), fuzzy systems, natural language processing, ontology and knowledge representations, computer vision, machine learning and probabilistic reasoning, planning and decision making. In today's AI, machine learning (deep learning is a specific branch of machine learning) and probabilistic reasoning, computer vision and natural language processing show the most substantial volume of research growth in AI.

This article explores the processing flow of AI system in the form of a flowchart of key technological processes, and discusses what AI has delivered today, and what it will deliver tomorrow, and finally the expectations in advancement of technologies in AI in the future.

Overview of AI System

The flowchart (Figure.1.) shows the main processes of an AI system. As shown in the flowchart, any AI system reads its environment and responds to the environment according to its objectives. The growth of applications and researches in the Internet of Things (IoT) has advanced the way AI could read and respond to its environment.

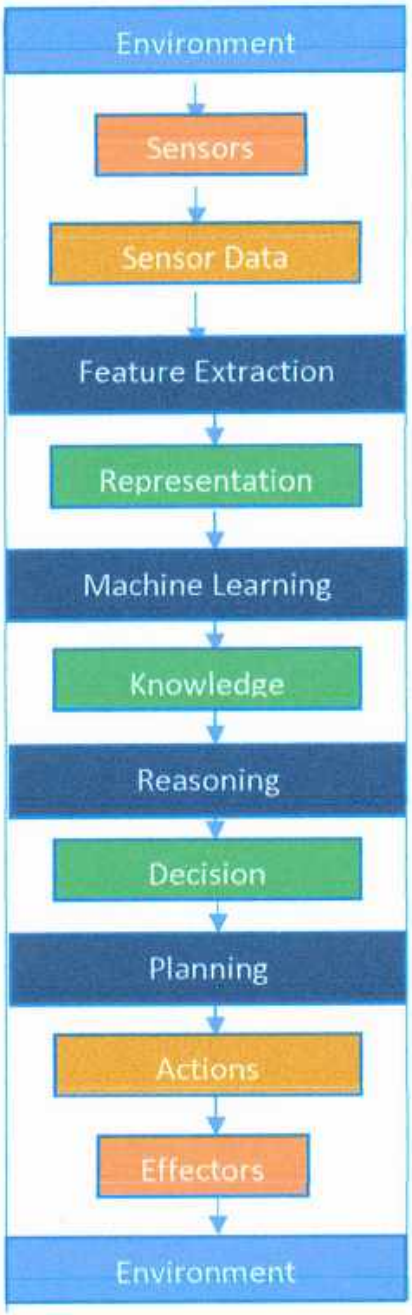
The first two processes in the flowchart, do read the situated environment where it interacts through sensors and, collects data. For example, collecting images from CCTV footages, collecting images from crops, collecting images of skin diseases, reading web blogs, reading reviews, listening to music, listening to a dialogue, etc. are examples of the first two processes. Once the data are collected, then by using deep learning algorithms: the most powerful technology of today's AI, is used to extract features, identify, and understand what you have sensed in the form of images, videos, audios, text, etc.

Then by using appropriate knowledge generation and knowledge evolving technologies in AI, such as machine learning or rules engines, from extracted features, a piece of knowledge is generated which explains the situation of the outside environment relative to the intelligence of the machine. For example, if this generated knowledge which is developed by applying machine learning algorithms and rules engine, is powerful; then it can understand complex behaviours on the dynamic environment such as identifying of unusual behaviours within a shopping mall, violations

of traffic rules on highly congested environment, non-ethical posts on Facebook, etc.
After knowledge generation, it comes to reasoning, and the planning phases, where the system reasons out its understanding about the current situation against its design objectives. It will help to make an optimal decision based on its understanding and available intelligence to reach the design objectives (the list of tasks that that has been delegated to be executed). Once it makes its decision, it comes up with a sequence of actions, referred to as a plan in AI, to execute its decision on the environment. These actions are connected to effectors which could be IoT devices that can be executed on the environment. These effectors can write, speak or draw images, or even assign a task to an external robot. These are possible today because of deep learning and other machine learning technologies. However, reasoning and planning is an area that still needs huge attention in making an optimized decision, based on the understanding, intelligence, sensors and effectors of the system.

AI for today and tomorrow – Industrial Perspective

Today we have very business-specific or single-purpose artificial intelligence known as narrow intelligence. An AI program or a robot, is a piece of hardware that has been programmed to do a specific task, fallen under the era of narrow intelligence. You can imagine an AI system which has expertise in the business task, such as to identify vehicles that violate traffic rules only. These systems are designed in a way that



have mastered or have expertise in performing a single business task. If they are trained to identify criminals, they can not be employed to detect intruders. Let us discuss how AI has been adopted by some industries for their tomorrow's tasks:

Manufacturing Industry:

In the manufacturing industry, major companies like General Electric (in 2018, GE is ranked as the 18th-largest firm in the U.S. based on the gross revenue), Siemens, Intel, NVIDIA, and Microsoft are moving towards the concept of smart manufacturing (it is also called industrial IoT and AI). According to recent market reports, the global manufacturing market will increase to over $320 billion by 2020 compared to $200 billion in 2019. They are trying to bring down labour costs, reduce the product defects, increase the production speed, and shorten the downtime by introducing industrial robots and machine learning. Because of massive investments on industrial robots in the manufacturing industry, according to the International Federation of Robotics, in future, more attention will forcussed on how to establish human-robot collaboration. This collaboration is required to be ensure safety and efficiency as more industrial robots are planned to move into the production floor. With the advancement of AI, these industrial robots will be able to handle more cognitive tasks and make autonomous decisions based on the exiting environment.

Agriculture Industry:

The agricultural industry is the oldest and the most important profession in the world. The industry is now adopting AI technologies in order to control pests, maximize the harvests, monitor soil and growing conditions, organize data for farmers, predict diseases, etc. Today the industry's main experiments in AI are on how to optimize the yield by determining right crops suited to the expected weather conditions, temperature and soil conditions.

Currently, a branch of the agriculture industry is now being transformed under the concept of precision agriculture, which uses AI technology to detect diseases in plants, nutrition deficiencies in plants, etc. In this business process, IoT devices enable reaching the target plants, while AI systems decide the amounts of fertilizers required for the given plant. Additionally, AI chatbots are used to answer agricultural questions and provide advice and recommendation on farming problems. Moreover, companies are developing autonomous robots to handle harvesting of crops at higher volume, with drone-technologies to monitor crop and soil health.

Education:

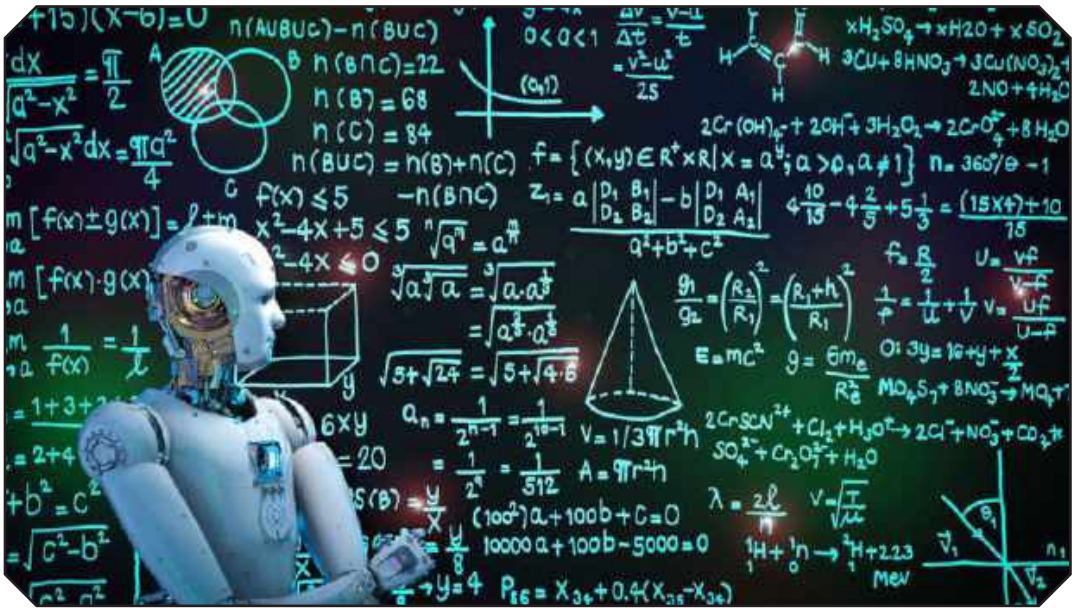
The rise in the use of information technology in classroom-activities in the education sector is impressive. In today's classroom, students are surrounded by smart boards, computers, laptops, and phones. Consequentially, this allows distance learning more practical, and reach greater audiences around the country and the world. With the dawn of the AI revolution, it is being predicted that AI will surely take over the administrative tasks of teachers, and may even replace teachers, or teacher-assistants within the classroom. Today IBM Watson, Third Space Learning and Duolingo Chatbot are forms of AI already being used to enhance learners' experiences. The development of AI in the education industry can be broadly seen under two significant aspects:

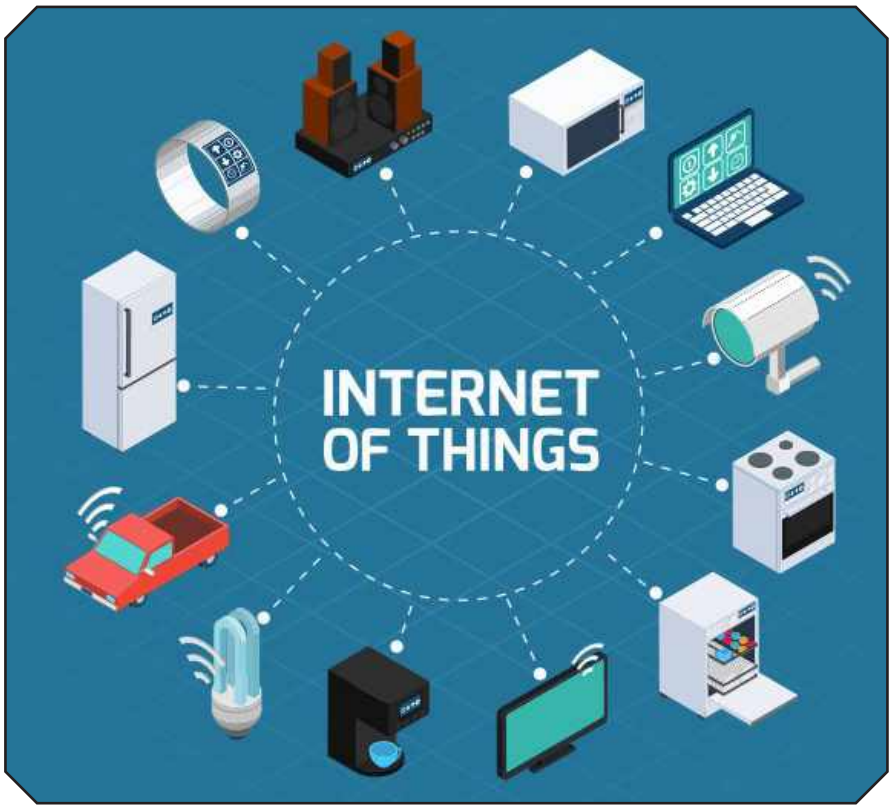
1.Automated admin tasks: Testing and grading consume a tremendous amount of time of the teachers. AI can step in and perform online or offline testing and gradings, while offering recommendations to the learner by closing learning gaps. For this purpose, computer vision and deep learning have been exploited to evaluate written answers with graphs.

2.Tutoring and personalized learning: AI supports to come in the form of chatbots to help learners with subject streams, such as Algebra, Science, English, etc. For example, an educational application has been developed by Peter Wozniak, a Polish inventor, that keeps track of what you are learning. Using AI, the application finds out what you are likely to have forgotten, and recommend that you revise it. Further, many AI applications have been introduced in the form of chatbots that adapt to the learner's pace of learning, and consistently offer much more complex tasks to accelerate learning.

AI in the near future

In the near future we can expect artificial general intelligence (AGI), a technology that will work across business disciplines. Accordingly AGI will not be a single standalone system, but an integrated system of many narrow intelligence systems that could perform tasks or achieve delegated goals across many business disciplines. Such an AI system can be used to detect intruders, generate a statistical summary of people inside the building, predict their behaviours, the energy consumption of electrical devices, generate reports on usage of electrical equipment inside the building, predict their downtimes, etc. In the alternative one can imagine a chatbot on a mobile phone, which works as a personal assistant. It will be able to make food orders, make calls, re-organize your calendar activities that minimize conflicts, read newspapers and generate summaries, generate action-plan for today's meeting,





write and prepare documents for your meetings, identify your diseases, symptoms and suggest treatments, make appointment to a suitable doctor after checking your availability etc. As shown in this example, these general AI applications are much powerful than narrow AI and require more reasoning algorithms that could work across many disciplines.

Thus this general AI is the combination of specialized AI that creates increasingly sophisticated specialized intelligence that makes it massively capable. When you see autonomous vehicles on our roads, that plans the journey before hand, starts without any human help, planning the tour covering all the places we want to visit, finding the optimal path while responding to traffic jams and accidents, act on emergency situations, ability of overtaking, ability to connect with other autonomous devices, etc.

then you are in the era of artificial general intelligence.

AI in future

Artificial Super Intelligence (ASI) is the way into the future. ASI will need to surpass human capability at absolutely everything. When an AI system is more capable than a human, then it is called ASI system. It is expected that ASI will be able to perform extraordinary work such as drawing arts under a given theme, develop self-awareness, develop common knowledge, establish emotional relationships, etc.

For the scientists, the main challenge they may face when stepping towards ASI is establishing and improving the cognitive abilities of AI systems. Many research projects are working towards mimicking human brains, and its cognizance to machines.

The Blue Brain project is one such project initiated by Swiss brain research with the aim of constructing a digital form of human-brain by reverse-engineering of mammalian brain circuits. In addition the, Google research team is aiming at developing quantum processors and devision quantum algorithms that will dramatically accelerate computing tasks for machine learning.

When the ASI, machines get more intelligent by learning, they will no longer depend or learning from humans. In such circumstances, ASI will be more powerful than human beings because of their capability of developing own-communication languages and societies without human help. Interaction with its society makes a human more powerful, practical and smarter. Similarly, the moment these ASI machines are capable of cognitive reasoning, develop self-awareness, self-learning, and developing own-communication language, a society of machines will be established, that will surpass the humans capability at absolutely everything.

Dr Subha Fernando
Dr.Eng, M.Eng, B.Sc (Special) (Hons)
Senior Lecturer
Department of Computational Mathematics
University of Moratuwa