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Issue on AI, an Extension of Human Intelligence

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## Artificial Intelligence (AI), an Extension of Human Intelligence (HI)

Editorial

J. Felix Raj, SJ



Today is the age of Amazon's Alexa, Apple's Siri and other voice assistants. They are here in our midst, in our offices, homes, cars, hotels and many other places. These digital assistants collect and use personal, potentially identifiable and possibly, sensitive information. The list of commands that Alexa can understand seems to grow daily and

Amazon calls these as 'skills'. Take our own Chitti, a humanoid robot portrayed by Rajinikanth in *Enthiran* and *Ra.One*. Chitti is programmed to understand human behaviour and emotions.

Alexa can set up routines where a single command of yours, 'Alexa, Goodnight' – shuts off all the lights, locks your doors, sets an alarm for you to wake up and sets your coffee pot to turn on at a certain time. The latest version of Alexa is able to perceive and acknowledge your frustrations, thought-processes and even your future plans. Alexa can now guess what we are thinking and what we have forgotten. Daniel Rausch, V.P.-in-charge of Alexa Smart Home Features, predicts that we have reached a stage where we can programme our intuition and machine intelligence will soon replicate human curiosity and insight.

Alexa or other personal digital assistants can violate the privacy and security of our life and data. They are a privacy nightmare and we cannot trust them. Possibly, this is a dark side to these virtual assistants. In 2019, Amazon had over 10,000 employees working on Alexa and related products. Over 100 million Alexa-enabled devices have been sold. There are now more than 70,000 skills available in the Alexa Skills store.

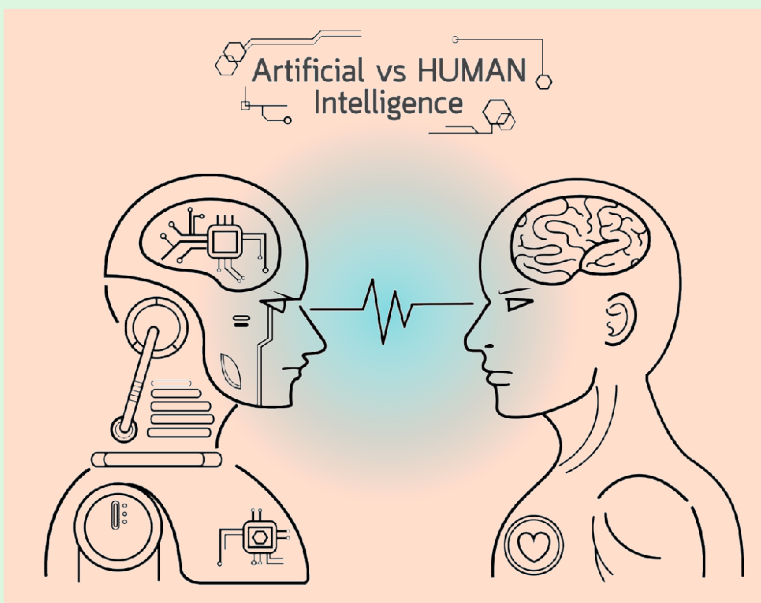
Artificial intelligence (AI), sometimes called machine intelligence, is human-like intelligence demonstrated by machines, in contrast to natural or human intelligence (HI). Machines (for example, robots or computers) are programmed to act as

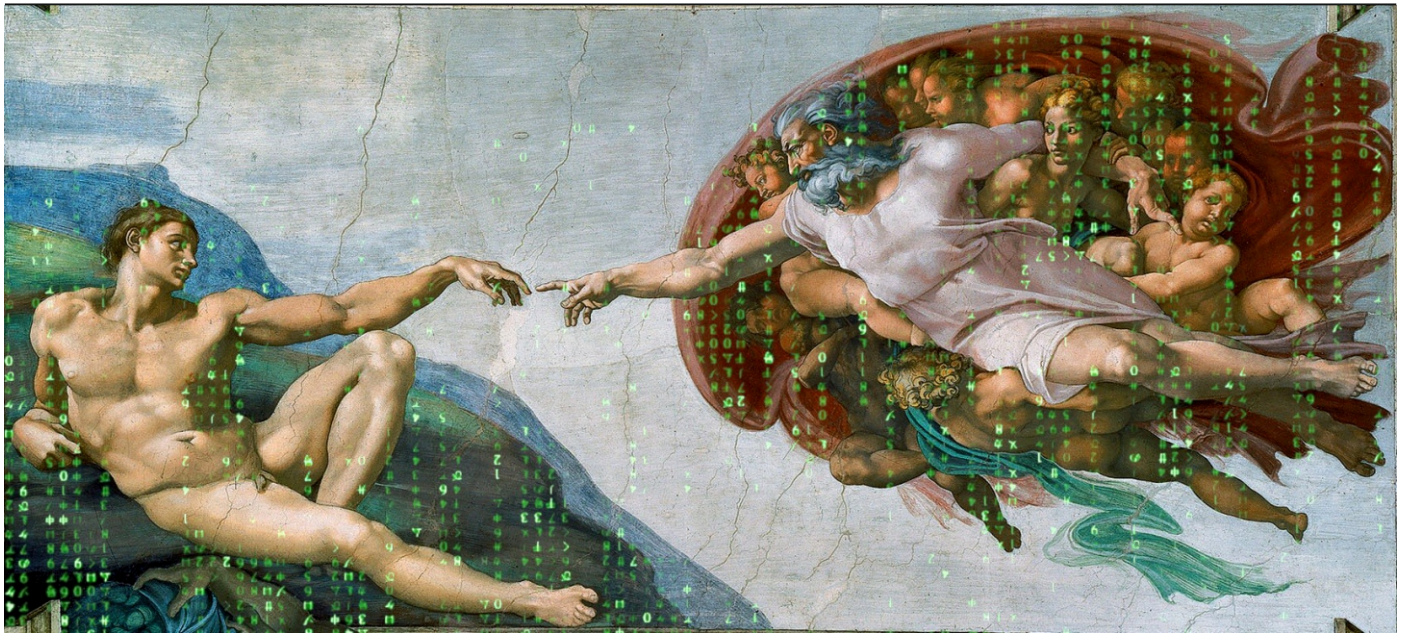
intelligent agents, artificial beings who perform cognitive functions associated with the human mind such as perceiving, learning, responding and taking actions that maximize its chance of successfully achieving its goals.

John McCarthy, an American computer scientist, is known as the father of AI, which began as an academic discipline in the 1950s and developed on the assumption that AI can precisely simulate HI. It is an idea which has been explored by myths and fiction for time immemorial in history.

There is a fear among people that AI can do things better than humans. Some people consider AI dangerous to humanity if it progresses unabated. They believe that AI, unlike other technological revolutions, will create a risk of mass unemployment. On the other hand, AI has become an essential part of the technology industry, helping to solve many challenging problems in computer science, software engineering and operations research.

Creation of human beings was an extension of God and his divine intelligence (DI). And AI is just an extension of HI. Humans can fix up and change the shortcomings in any AI robotic system. Human intelligence is bigger, broader and next only to divine intelligence (DI). As DI is the creator of





*Michelangelo's fresco of the near-touching hands of God and Adam*

HI, HI is the creator of AI. AI cannot replace HI. Yes, it is true that AI has incredible precision, accuracy and speed; it won't be affected by hostile environment, thus it is able to complete dangerous tasks, explore the space, and endure problems that would injure and kill human beings. Yet, I am optimistic that AI will not be intelligent enough to replace HI because, in the end, AI shall always depend on programmed codes that can only be written and erased by humans.

Is the future of humanity in danger? More than 99% of all species, amounting to over five billion species that ever lived on earth are estimated to be extinct. Many of them perished in five cataclysmic events. It is said there are currently around 8.7 million species on earth. According to a recent survey, seven out of ten biologists think we are currently in the throes of a sixth mass extinction.

Let Alexa, Siri and Chitti live with us. Let them become an integral part of our daily lives. They can intelligently and fluently interact with us providing us with adequate and accurate explanations and answers. Sure, we can benefit if they can understand and respond to our commands and

queries. Let us remember, a machine is a machine and it could fake emotions. Let us not allow machines to sit on our heads. Prevention is better than cure. Jesus once said, 'No servant is greater than his master, nor is a messenger greater than the one who sent him'. Therefore, no AI is greater than HI and no HI greater than DI.

This issue of the Goethals News focusses on Artificial Intelligence, exploring different areas of its application and effects through the minds of SXUK professors. While Dr. Somak Maitra highlights the emerging role of AI in higher education, Dr. Tuhin Utsab Paul discusses about rise of ethical issues in the field of Artificial Intelligence. Dr. Manodip Ray Chaudhuri discusses the dangers of AI and Dr. Indra Kanta Maitra analyses the application of AI in the field of Diagnostic Medical Image Analysis. Dr. Soma Sur's paper explains the basic roles of Artificial Intelligence, Machine Learning and Robotics.

I am confident that their ideas will make our readers think and initiate an on-going reflection on the topic. Our objective is to contribute towards a collective dialogue and praxis. 📖

## COVID-19 Effect (As of July 28, 2020)

Country	Total Affected (%)	Deaths (%)
World	1, 66,29,652 (100)	6, 55, 873 (100)
USA	44, 32, 552 (26.42)	1, 50, 425 (23.88)
India	14, 82, 503 (8.89)	33, 448 (5.99)

Source: Data from [COVIDVISUALIZER.COM](https://www.covidvisualizer.com).

Of the globally affected COVID cases of 27, 25, 923 on April 25 and 74, 52, 809 on June 12, the total number of cases in India was 17, 306 (0.63 %) on April 25 and 2, 87, 155 (3.85%) on June 12 respectively. As of July 28, the figure in India was 14, 82,503

(8.39%). Of the deceased cases in the world of 1, 91, 061 on April 25 and 4, 18, 919 on June 12, the number in India was 721 (0.38%) on April 25 and 8, 107 (1.94%) on June 12 respectively. Now on July 28, the number of dead was 33, 111 (5.99%).

The global increase of affected cases from April 25 to July 28 has been 402 % and of the deaths, 207 %. In India, the jump in number of affected cases from June 12 to July 28 has been very steep, from 2, 87, 155 to 13, 37,022, a 465.6% increase. The cases of deaths have increased from 8,107 on June 12 to 33, 448 on July 28, a 412.6 % jump. The death rate in India was 2.26% in July. 📖



# Relevance of Artificial Intelligence in Higher Education

Dr. Somak Maitra



Artificial intelligence (AI) plays a pivotal role in our lives, impacting every aspect of our social interaction. The term artificial intelligence was first coined at a workshop organised in Dartmouth College in U.S.A. in the year 1956. There is no fixed definition of artificial intelligence since it is continuously evolving as a technology. However, artificial

intelligence (AI) can be described as *'the simulation of human intelligence processes by machines, especially computer systems. Specific applications of AI include expert systems, natural language processing (NLP), speech recognition and machine vision'*. AI mainly focusses on three cognitive skills namely learning, reasoning and self-correction.

AI has been around for the last sixty years as a niche technology. For the past decade, AI has been experiencing an exponential growth largely due to substantial advancement of technological fulcrums, like faster computing technology, advancement in machine learning and big data analytics. AI has become an integral and all-pervasive part of our daily life. Yet we are often oblivious of its presence.

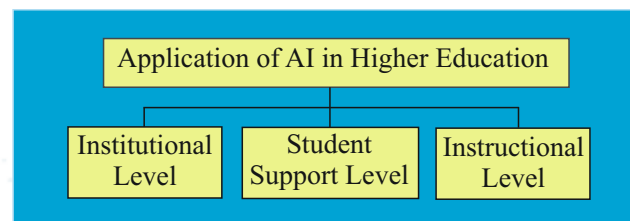
As Nick Bostrom has rightly pointed out, *'a lot of cutting-edge AI has filtered into general applications, often without being called AI because once something becomes useful enough and common enough it's not labelled AI anymore'*. Every day we are using AI in the form of Google Assistant or Amazon's Alexa or while browsing through video recommendations on Netflix. Presently, AI-based devices like Google Home or Amazon Echo are increasingly becoming commonplace in our living rooms. The recent transformative developments in AI, in the form of machine learning, neural networks and evolutionary algorithms are used in diverse fields including higher education.

Artificial Intelligence development mainly focusses on the various aspects of intelligence like reasoning, learning, problem solving and perception. Currently data-driven AI and knowledge-based AI are two forms of AI systems in existence. The success of AI is largely due to advances in data-driven AI, which harness the power of machine learning. The three main categories of machine learning are supervised learning, unsupervised learning and reinforcement learning. Data-driven AI relies totally on data and the outcome becomes more accurate when it is tested with a large amount of data. Big data is the primary enabler of the data-driven AI. One area where AI and big data is making far reaching progress is in the domain of autonomous vehicles. The power of neural networks is used to enable vehicles to be navigated without

any human intervention (driver). The level of autonomy in navigation is measured from 0 to 5, where levels 0 and 5, signify zero automation and full automation capabilities respectively. At present, Tesla is the only car manufacturer who has deployed its vehicles with level 5 autonomous capability.

In the domain of higher education, the educational data mining (EDM) and learning analytics (LA) are the areas where big data will be increasingly used in future. EDM is used to develop methods and techniques to analyse data collected during teaching and learning, with the aid of statistics, machine learning and data mining. Another interesting area is the field of artificial neural networks, where AI algorithms mimic the structure and function of biological neural networks (i.e., animal brains). Google is one of the leaders in this field and is aggressively developing AI-based microprocessors custom-built for neural networking. The microprocessor is called Tensor Processing Unit (TPU), which is an AI accelerator application-specific integrated circuit (ASIC), custom build for neural network and machine learning.

Artificial Intelligence in Education (AIED) has been in existence for three decades. But till date, AI-based teaching technology has not made any extensive inroad into classrooms. AI in higher education often conjures up the science fictional vision of humanoids replacing the teacher. Thankfully, AIED comprises a two-dimensional software that makes the deployment more manageable and scalable than humanoids.



The AI application in the higher education ecosystem operates in three levels, as discussed below:

**1. Institutional level** applications are developed to automate administrative function of the education institutions which can include various functions like recruitment, students' admission and enrolment, timetabling, attendance tracking etc. Today educational institutes are actively using 'enrolment analytics' by harnessing the power of machine learning to gauge the prospective student's interest level in joining their respective courses.

**2. Students' support level** applications mainly deal with the implementation of student's support systems by utilising the strength of machine learning. With the help of predictive analytics for analysing a wide array of available data

*Continued on pg. 7*

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# Ethical Problems in Artificial Intelligence

*Dr. Tuhin Utsab Paul*



In order to address the ethical issues in artificial intelligence, first, we need to analyze what gave rise to the ethical issues. Since the start of the computing era, computer programmes have been designed as a collection of instructions that can be executed by a computing device to perform a specific task such as

calculating numbers or displaying a message. But, with the development of technology, slowly the concept of artificial intelligence was introduced into the computing system. Intelligence, the ability to acquire and apply knowledge and skills, is the property that differentiates between the living and the non-living being in our world. The question of morality or ethical values arises only in the case of living beings such as humans, animals and plants. Morality is concerned with the principles of right or wrong behaviour. The definition of moral status by Francis Kamm states that: 'X has moral status = because X counts morally in its own right, it is permissible/impermissible to do things to it for its own sake'. [1]

A brick has no moral status. It may be crushed, pulverized or be given any treatment without any concern for the brick itself. But, a human, or for that matter any living being, cannot be treated only as a means, but its legitimate interest and well-being needs to be considered. Thus, it can be said that a human being or any living object has moral status. With the advent of technology, human beings are slowly progressing towards the era when this moral status, characterized by learning, reasoning, problem-solving, perception and communication ability, is becoming an integral part of computer systems in the form of artificial intelligence, thus creating the possibility of creating thinking machines which gives rise to a host of ethical questions associated with artificial intelligence.

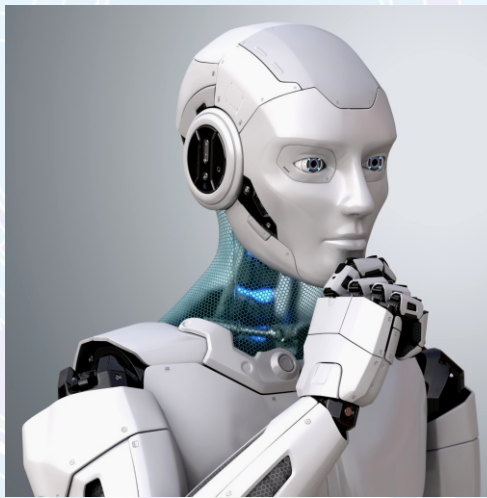
There are two types of ethical issues that come to the fore, one is to ensure that such artificially intelligent machines do not harm human or other morally relevant lives, and secondly, that the moral status of the machines is not harmed by others. The high degree of intelligence in humans makes the human race superior, but as machines

are getting intelligent we need to find out the challenges and ethical issues for ensuring that artificially intelligent machines operate safely and for a good cause. This gives us the scope to address the various ethical issue questions that need to be dealt with in the world of artificial intelligence.

## **1. Will men lose jobs to Robots?**

In today's world, self-driven cars are a reality and those have much less probability of street accidents. Even courier delivery is done using unmanned flying drones. This definitely speaks of the development of artificial intelligence but at the same time raises the very pertinent question - will our drivers and delivery boys lose their job? If we consider the lower risk of accidents, self-driving cars seem like an ethical choice. On the other hand, Artificial intelligence gives rise to opportunities for various jobs, where people shift from repetitive and physical jobs to undertaking more sophisticated, creative and strategic thinking jobs.

Instead of selling their time in hard-working jobs to earn their livelihood, people can now spend more time with their families and give back to human society. But this privilege will be available only to the rich and educated masses. As, employing robots allow the companies to pay 'No wages' to robots, so the company will earn more profits and the poor workers may lose their job. By using AI systems, companies can drastically reduce the workforce and that means that the profits will remain in the hands of fewer people. Thus, people who have shares in AI-driven companies, will have all the money. This may lead to further widening of the gap between the rich and the poor and give rise to a new societal setup.



## **2. What if a Robot acts stupid?**

Intelligence is acquired with experience. In the case of artificial intelligence, the bots are initially fed with test data for training and on completion of training, they are put to use with real-life data. What if the learning goes wrong? What if the robot makes mistakes in real life? Nowadays, surgeries are performed using AI. In the future, Artificial Intelligence may make more complicated mistakes, which can even be fatal to human lives. IBM Watson is an example of the failure of AI in healthcare. It was designed to revolutionize cancer treatment using AI and big data, but failed miserably. The question is about relativity – Do AI make more or less mistakes than humans? Can those



mistakes be fatal or can they be avoided? These questions need to be considered while designing AI systems for various applications so that those mistakes are bearable and not catastrophic!

### 3. If Human biasness is inducted into robotic biasness?

The term artificial means made or produced by human beings, rather than occurring naturally, especially as a copy of something natural. Since, in the AI machine, intelligence is a reflection of human intelligence of its creator, there is a strong possibility of injecting the various biases, such as related to ethnicity, gender, religion, etc. of its creator, into the machine. For example, Amazon recently found out that their Machine Learning based recruiting algorithm was biased against women as it was based on past recruitment data where more men were recruited. [2] How to tackle this biasness? AI developers must be more responsible and make conscious efforts and try to remove bias while developing and training AI systems.

### 4. Can AI Systems become pawns of today's Economic Warfare?

Nowadays, a constant battle is fought between the countries which is known as 'economic war', and today's world economy is in the cyber domain. In these wars, the damage is caused by hacking, malware, information-stealing, etc. that gives rise to the concept of cyber security. With the development of technological prowess, more powerful AI systems are being developed that are capable of producing catastrophic outcomes, if used maliciously. We are dealing with a technology that is faster and more capable than us, in magnitude. Research must be done in the area of cyber security, to counter any possible threat arising out of the use of AI in the cyber domain.

### 5. Human Rights vis-à-vis Robotic Rights:

As previously stated, intelligence is characterized by reasoning and perception, so with the advancement of AI system, in the near future, we can have robots that not only look like humans, but are also 'conscious machines' that can perceive, feel and act. In such a case when a robot becomes emotionally advanced like humans then what are the rights of robots? Will the rights be equal to or less than that of human beings? If a robot kills a human, will it be considered murder or technical malfunction? Will there be citizenship for robots? In 2017, a humanoid robot 'Sophia' was granted citizenship by Saudi Arabia. Can an emotionally advanced robot with high intelligence be enslaved and made to work 24 X 7? How do we define the humane treatment of AI? These ethical questions need to be considered seriously in the future and may require the alteration of certain laws.

### 6. If Robots become the Master of Humans?

Humans are considered the most advanced species on earth, because they possess a higher intelligence than other



living beings. But as technology is progressing, machines are becoming increasingly intelligent. So, a day may come, when machines become even more intelligent than human beings and they will be faster and more capable than us. This is known as 'Technical Singularity'. In this scenario, we can't just depend on 'pull the plug' option because the machine may anticipate that move and defend itself. Ray Kurzweil, Google's Director of Engineering believes, that this is a very real possibility that may even happen as early as 2045. [3] He believes that it will lead to the expansion of Intelligence as human intelligence will merge with artificial intelligence. However, humans need to prepare for 'technical singularity' and must figure out how to overcome it.

Yes, the ethical questions associated with AI are complex and need specific solutions. Moreover, the idea of AI systems surpassing human intelligence is scary. So, the answer to these issues lies in the design and development of the "Ethical AI" system. Enterprises, organizations, governments, legal experts and citizens should keep asking questions, and work towards developing ethical AI, and must also keep on fighting automated bots and malicious attacks, as AI is coming - whether or not we're ready. As we consider those risks and ethical issues, we need to keep in mind that, this technological development means better lives for mankind. AI has immense potential, but its responsible implementation is up to us.

### References:

- [1] Paraphrased from Kamm (2007, chap. 7)
- [2] Amazon Reportedly Killed an AI Recruitment System Because It Couldn't Stop the Tool from Discriminating Against Women, D. Meyer, Fortune, 11 October 2018.
- [3] Kurzweil, Ray. 2005. *The Singularity Is Near: When Humans Transcend Biology*. New York: Viking 📖

# Dangers of Artificial Intelligence

Dr. Manodip Ray Chaudhuri



With a question in the air, pondering on who has created machines, the answer that pops up, factually accentuates and heightens the answer that the human mind, human hands and human brain, have done so over the years. However, the time has come to say that man is no more the master of his own created machines; rather machines have overtaken humans and

have often posed a threat to mankind in turn. It seems machines have been smarter and more intelligent than their creators. The ever-evolving erudition, sophistication and intellectual escalation of machines most tortuously, sometimes colossally and inestimably, create dangers for humans in real terms.

The recent wallop and bash of a driverless car ushers a distinct warning about how algorithms can be poisonous, lethal and deadly. Likewise, there are clear dangers that are often evident and conspicuously palpable in situations of significant national services. These are, in most cases, technological interventions of artificial intelligence and the like in communications, financial trading, healthcare and transportation. These services depend on sophisticated algorithms, intricate procedures and complex processes, some relying on unpredictable and erratic artificial intelligence methods, such as deep learning, which are increasingly and progressively embedded in complex software systems. One needs to be expressively cautious in the use and application of the same. As search algorithms, high-speed trading, medical devices and autonomous aircraft become more widely implemented, applied, realized and executed, stronger checks become necessary to prevent failures and disasters with their use in practice in complex situations and in polygonal contexts.

## Voice of Notable Legends:

Renowned personalities like the well-known physicist, Stephen Hawking and Space-X frontrunner and trendsetter, Elon Musk propound that AI could possibly be very dangerous and harmful in the course of time. The co-founder of Microsoft, Bill Gates also feels that there are ample reasons to be predominantly watchful and vigilant about the use and implementation of AI. The case can be such that the good can outweigh the bad, if not hitched and harnessed appropriately. Most recent improvements and expansions in science and technology have brought in super-intelligent and highly-capable machines, which are able to accomplish composite and compound tasks much faster than initially expected. As a result, the time has come now to define what dangers and perils artificial intelligence may produce, in order for us to be

more careful and observant. Elon Musk has remarked, *‘The pace of progress in artificial intelligence (I’m not referring to narrow AI) is incredibly fast. Unless you have direct exposure to groups like Deepmind, you have no idea how fast it is growing at a pace close to exponential. The risk of something seriously dangerous happening is in the five-year timeframe. 10 years at most’.*

While mankind has yet not invented super-intelligent machines, it has become imperative to hold on to the gears of the pace of innovation to be safe and alert. The world around us with its legal, political, societal, financial and regulatory environment is now becoming increasingly complex and wide-reaching, it is now indispensable and obligatory to take a look at them effectively and effectually. This approach would perhaps help humans to be rightly prepared to safely operate such compound and multifactorial technology, when the time comes. Quite beyond concocting and fabricating a future with highly adept machines, the hour has now come to reconcile with the fact that artificial intelligence can cause dangers, hazards and menaces, as well.

## Some Key AI Risks and Jeopardies:

Programmes of AI crafted to perform something treacherous and unfaithful may pose critical risks for human kind. This is evident in the case of *autonomous weapons* that are programmed to eradicate and exterminate. It may even be conceivable and imaginable to expect that the nuclear arms race will be substituted and supplanted with a global autonomous weapons race in the days to come. As the Russian President, Vladimir Putin, says, *‘Artificial intelligence is the future, not only for Russia, but for all humankind. It comes with enormous opportunities, but also threats that are difficult to predict. Whoever becomes the leader in this sphere will become the ruler of the world’.* Furthermore, as humans, we must concede and admit to the fact that autonomous weapons and self-directed armaments would have a working 'mind' of their own as per the technical programs crafted within them. More importantly, once installed, shaped and deployed, it would be difficult, often impossible, to contest or disassemble them.





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Yet another risk zone in the context of AI is the *social media in the sphere of target marketing*. It has often been observed that social media is effective in target marketing with the use of its independent algorithms. With such algorithms in place, it can be quite easily comprehended who the customer is, his or her likes and dislikes, choices, tastes and preferences towards specific goods and services. With the use of automated animations, animatronic simulations and programmed posters, AI can unscrupulously and deceitfully target customer segments and may spread unsolicited and unwelcome information to the masses in the market. This can transform fact to fiction and would be pretty much detrimental and damaging to many in the business world.

Indubitably, AI can be extremely hazardous and menacing to mankind today with its self-determined ability to *trace and investigate an individual's personal information, moves and motives*. This is unquestionably a very serious matter of concern. Super-technological instruments like facial recognition programmes, handwriting detectors, smell detectors, visual scanners etc. can track through a person's most personal and intimate moments of life in a dishonest and fraudulent manner. This may lead to an unhealthy invasion of privacy, which in turn can generate a superfluous and pointless coercion and repression in society.

Furthermore, there is an inherent risk of *misalignment between the expectations and the actuals relating to the AI technology and its presentation in the field*. There has to be a considerable clarity of the fact that there is an effective and clear alignment of the goals and actual performance of machines; else perilous and death-defying disasters may inevitably occur. Suppose if AI provides a command such as 'Get me to the shopping mall as quickly as possible'; this might have calamitous consequences. Without specifying the rules of the road, such an AI program may churn out a trajectory of accidents, a stream of mishaps and a creek of deaths.

### Conclusion:

A word of caution is that any influential and commanding technology can be distorted and tainted. Similarly, this holds good for AI as well. AI has lot many meaningful, worthwhile and industrious uses in society. But unfortunately, as our AI proficiencies and modern-day AI-related interventions expand, magnify and inflate, we will gradually witness an increase in dangerous or malicious actions as well. It is therefore pretty much imperative for us to begin to deliberate and contend upon the best potentials and prospects for AI, to hold and bind it positively, while minimizing its disparaging, corrosive and caustic intentions. 📖

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## Relevance of Artificial Intelligence in Higher Education

(academic, non-academic and operational), student's early warning system are put in place. These systems proactively spot students at risk of getting low grades or having mental health issues. Implementation of AI enabled chatbots for interactions with students at various levels has been quite successful across various universities.

**3. Instructional level** applications consist of creation of pedagogical systems capable of addressing the individual learner's capability and progress. Such software monitor students' academic progress and deploys course contents customised for individual students. One of the most popular AI based systems is the Intelligent Tutoring Systems (ITS). ITS provide step-by-step individualized content for each student, through topics especially in structured subjects. Relying on domain knowledge for pedagogy and discipline. Analysing student's response, ITS determines an optimal customised step-by-step learning pathway for each student.

In order to understand the AI strategy of higher education, Microsoft and Times Higher Education jointly conducted a survey across various Universities in 2019 and the major findings of the study were:

- AI as a technology will lead to an increase in demand for graduate students in the industry and will not lead to the closure of universities.
- Majority of the universities did not have an AI strategy in place.

- AI will be able to perform various functions like providing real-time analytics and feedback to the students.
- In the long run, the Introduction of AI in universities will not reduce their staff strength. On the contrary, the head count may increase over time.

AIED has made extensive advancement, but it has hardly scratched the surface. AI solutions in higher education will help in taking over repetitive labour-intensive tasks. Thereby, helping the administrators and faculty members to channelise their energy, in engaging the students in a more targeted manner. Higher education institutes are evaluating these opportunities and the leaders are investing judiciously in AI. In October 2018, the Massachusetts Institute of Technology announced a commitment of 1 billion US dollars to address the global opportunities and challenges of AI, by establishing a new college of computing and artificial intelligence.

The future of AI is very exciting, with learning tools like collaborative learning, continuous assessment and AI learning companions, it will reimagine the higher education landscape. As with any cutting edge technology there are certain serious issues of ethics, data privacy and singularity, which need to be monitored and addressed in order to do away with unintended consequences. Thus, we can conclude by saying that artificial intelligence will have a positive influence on the quality of higher education, contributing towards better learning outcomes and progress. 📖

# Application of Artificial Intelligence (AI) in the field of Medical Image Analysis: A Brief Introduction

*Dr. Indra Kanta Maitra*



Medical imaging is the visual representation of the human body or parts of it for clinical analysis and medical intervention. It provides a proficient way for non-invasive mapping of the human anatomy. Medical Image Analysis is critical to numerous biomedical applications such as detection of abnormalities, tissue measurement, surgical

planning and simulation, and much more. Medical Imaging is used to determine the relative change in size, shape and the spatial relationships between anatomical structures. Radiologists are particularly interested in observing the size, shape and texture of the organs and/or parts of organs for recognition, levelling and quantitative measurement of the specific objects and structures, which are involved in the analysis of medical images.

In the past decade, significant improvements have been recorded in the field of medical imaging due to the innovation of much faster and more accurate devices. Radiography, Mammogram, Ultrasonography (USG), Computed Tomography (CT), Magnetic Resonance Imaging (MRI) are some well-appreciated medical imaging techniques used for clinical diagnosis. The quality and characteristics of images obtained depend on different sensors, parameters set by the operators and individual characteristics of patients. A variety of medical imaging techniques can produce pictures of the structures and activities inside human body. The selection of the type of imaging depends on the symptoms and the parts of the body that are concerned.

Generalised feature extractions from such images are difficult due to involvement of different technologies. The only commonality among all imaging technologies is the entropy, i.e., the intensity feature exhibited by them. DICOM (Digital Imaging and Communication in Medicine) image format is universally accepted among all the above technologies. In general, the grayscale image pixel is represented by 8 bits in DICOM format having 256 ( $2^8$ ) grayscale colour intensities. Now-a-days, the computer

is a tool that is used in every discipline of study to solve critical problems. Different inter-disciplinary subjects are evolving which is dealing with super specialised areas of knowledge. Computer technology has had a tremendous impact on medical imaging. Radiology is using computer in the field of image interpretation processes, which introduces a new flexibility into the system.

The grey-scale image information produced by the imaging techniques can be further enhanced by using image-processing algorithms. Image processing is a procedure of converting an image into a digital form and carrying out some operations on it, to extract further information from it and acquire an improved image. Mathematically, image processing is defined as the processing of a two-dimensional picture by computer algorithms. The necessity of digital image processing is due to two principal reasons, the first being the improvement of pictorial information for human interpretation and the second being the processing of a scene data for an autonomous machine perception. It is the most sought after technique for identifying, isolating and extracting information from an image. The extracted information needs to be interpreted automatically to reduce the burden on the radiologist and to deliver accurate decision-making systems. Computer Aided Detection/Diagnosis (CAD) is the solution for the same.



By definition, CAD is a set of automatic or semiautomatic tools developed to assist radiologists in the detection and / or evaluation of medical images. CAD is a comparatively young interdisciplinary subject in conjunction with the components of Artificial Intelligence (AI), Computer Vision (CV) and radiological image processing. CAD can reduce the time of medical image

analysis and evaluation by radiologists, substantially. The evaluation of medical images, however, is still almost entirely dependent on human intervention but in the near future the scenario will change and more often CAD will be used as a necessary tool for image interpretation. Currently, CAD is applied in some routine clinical exercises as a 'second opinion', to assist the radiologists in image interpretation including tumour detection, etc.





Neighbour Rule (e.g., k-nearest neighbours), Minimum distance classifier, Cascade classifier, Naive Bayesian Classifier, Artificial Neural Network, Radial basis function network (RBF), Support Vector Machine (SVM), Principle Component Analysis (PCA) etc.

Now a days, the application area of CAD is spreading from detection of cancer of the breast, lung, colon, prostate and bone to coronary artery disease, congenital heart defect, Alzheimer's disease, diabetic retinopathy to different dental disorders and

The first step of CAD is to prepare the image for interpretation. This is called pre-processing, which involves artefacts removal, internal and external noise reduction and applying different filtering to enhance the image for further processing. Any AI-based system requires the standardisation of input data. Hence, pre-processing of an image is essential in securing accurate results.

In CAD, image segmentation is also an essential step, which partitions the medical image into different non-overlapping regions, such that each region is nearly homogeneous and ideally corresponds to some anatomical structure or region of interest (ROI). The accuracy of CAD to detect abnormalities on medical image analysis requires a robust segmentation algorithm. This is considered as the second step in image analysis.


The segmentation process refers to the decomposition of a screen into its constituent parts, such that each level of subdivision depends on the problem to be solved. Segmentation is discontinued once the ROI in a specific application has been isolated and edge points of an image are obtained. The next step of CAD is to identify the region(s) with abnormality among normal regions. Now the question, is what is the feature that indicates the abnormalities and how can that be identified by a decision-making system? AI is the solution for the same. It can be implemented using different statistical models or can introduce some sort of machine learning methods to isolate heterogeneous structures from a homogeneous environment.

The final step is to interpret the abnormality into a concrete diagnosis for further medical decision-making. The success of CAD always depends on the appropriate use of AI methods and algorithms like the use of Nearest-

many more. But success of CAD actually depends on its efficiency. The efficiency can be proved by using different mathematical and statistical measures. However, in standard practice, higher true positive (TP) ratio of CAD is extremely important for successful diagnoses and at the same time, false negative (FN) ratio should be substantially low in comparison with false positive (FP) ratio. Otherwise, it may be fatal in terms of further medical treatment and surgery.

Since the last decade, several research agencies across the globe are intensively involved in the development of AI-based CAD because of its ability to reduce the human intervention and as it produces diagnosis that is much more accurate in a shorter period. It is extremely important in the field of mass screening programmes like breast cancer detection, skin cancer, cervical cancer, lung function test, etc. Application of CAD is very important in developing countries like India due to its economic feasibility and ability to handle mass population in significantly shorter time.

In conclusion, the researches related to AI-based CAD are in the nascent stage worldwide with immense potentiality for the future. Another important challenge of CAD and its applications, is the social acceptance of this among different beneficiaries. Until date, medical practitioners are not very sure about CAD and patients are hesitant about the results. Therefore, it has a long way to go to achieve substantial success in terms of technological, economic and social objectives.

*[Source: Collection from my research papers published in different International Journals and Book Chapters from 2010 till date. For any further reference, please visit my Google Scholar page.]* 

# Artificial Intelligence, Machine Learning and Robotics - Basics

Dr. Soma Sur



Artificial Intelligence, Machine Learning and Robotics are the three most common and often used buzz words in emerging technologies. These are often used interchangeably but in fact, they are conceptually different. What do these actually mean and how are they related?

**Artificial intelligence (AI)**, describes machines programmed to think, work and react like humans. The term is frequently applied to the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings, such as the ability to reason, discover meaning, generalize or learn from past experiences.

What used to be science fiction is now being brought to life, like self-driving vehicles. These self-driving cars actually have a safety level substantially greater than that of a human driver. The use of artificial intelligence is global and a lot of people are now familiar with the once rare technology. It is common in videos games, smartphones, automobiles, etc.

AI system is concerned about maximizing the chances of success. On the basis of capabilities, AI can be divided into three types, which are, **Weak AI, General AI and Strong AI**. It includes learning, reasoning and self-correction.

Weak or narrow AI is when machines are designed to manage specific tasks, such as software to recognize images. Popular Home assistants (iPhone's Siri and Amazon's Alexa) offering voice-activated assistance usually respond to what they are programmed to do. They do not understand or derive meaning from what you said.

On the other hand, strong AI functions more like the human brain. They don't classify or use clustering and association

to process data. This means there isn't a programmed answer to your requests, as can be seen in weak AIs, and the results of their programming and functions are largely unpredictable. In strong AI they evolve and improve to handle any task. A popular example of strong AI is the one found in games. It is more independent than weak AI and can learn and adapt to different situations

Although weak AI is the more common version, strong AI has also been a crucial part of the AI revolution. It is often described by scientists as the 'true representation of human intelligence in machines.' It is an emerging area of AI and brings us to the concept of Machine Learning.

**Machine learning** is the ability to learn without being explicitly programmed. It is the science of training devices or software to perform a task and improve its capabilities by feeding it data and information so it can learn over time. For example, a chatbot designed with machine learning capabilities would be able to learn new terms and questions and adapt itself to give the most appropriate answers.

Machine Learning is an application of AI, capable of identifying patterns from a large set of data with the help of algorithms. It is self-learning in nature and becomes 'smarter' over time. It could be deployed to predict future outcomes and identify trends. Identifying an email as SPAM or otherwise, is a SPAM Filter application, which, looking at already available emails tagged as SPAM, learns to correctly identify it. Machine Learning is mainly concerned about accuracy and patterns.

Machine Learning is a great solution to problems for which existing solutions require a lot of hand-tuning or long lists of rules; one Machine Learning algorithm can often simplify a code and perform better, like SPAM Filter. A Machine Learning system can adapt to new data and to fluctuating environments such as, Speech Recognition for different languages and accents. Machine Learning involves getting insights about complex problems and large amounts of data and discovery of patterns. It includes learning of the differences and self-correction when introduced with new data.

In Machine Learning, there are both supervised and unsupervised learnings. Supervised learning is a process of an algorithm-based learning from the training data set. Learning stops when the algorithm achieves an acceptable level of performance. Prediction of stock market



The development of full artificial intelligence could spell the end of the human race.

— Stephen Hawking —



prices is an example of supervised learning. Whereas in unsupervised learning there are no correct answers and there is no training data. Algorithms are left to their own devices to discover and present the interesting structure in the data. Grouping customers by purchase behaviour is an example of such learning situations. Online recommender systems, search algorithms, auto friend-tagging suggestions in social media are all application areas of machine learning.

**Robotics** is a term, which is also used under the artificial intelligence banner, but not all robots are smart. Robotics

is a branch of technology that deals with physical robots. Robots are programmable machines that usually interact with the physical world via sensors and actuators and are able to carry out a series of actions autonomously or semi-autonomously.

In whatever way you choose to define a robot, robotics involves designing, building and programming physical robots, which are able to interact with the physical world.

Artificially intelligent robots are the bridge between robotics and AI. These are robots that are controlled by AI programmes. Most robots are not artificially intelligent. Up until quite recently, all industrial robots could only be programmed to carry out a repetitive series of movements which, do not require artificial intelligence. However, non-intelligent robots are quite limited in their functionality. AI algorithms are necessary when you want the robot to perform more complex tasks.

Among these three terms AI and Machine Learning have a greater correlation, as ML is a subset of AI and Artificially intelligent robots serve as the overlapping area between AI and Robotics.

### **Business Applications:**

AI in business intelligence is evolving into everyday business as we know it. Companies can now use machine algorithms to identify trends and insights in vast reams of data and make faster decisions that potentially position them to be competitive in real-time. The ultimate goal of AI is to improve the quality of human life. With AI, analysts could focus on high-quality tasks which create bottom-line impact. AI is being used for Business Dashboards, predicting repairs and upkeep of machinery, monitoring machine fleets and factories, and extensively in Industrial

Manufacturing. There is increasing prevalence of sensors in machinery, vehicles, production plants.

Every business needs some form of telecommunications infrastructure to communicate with suppliers and customers. Robots can simplify a business' call center and handle incoming phone or internet traffic. Automated calling robots place prerecorded calls, including appointment reminders and customer satisfaction surveys.

AI and Robotics are already solving this problem for dozens of industries including healthcare, media and

insurance, entertainment, finance, transportation, defense and energy management. AI could tap into company data and historical outcomes to either completely automate the decision or to support an analyst with insight for



decision-making to drive better outcomes.

### **Where are we headed?**

AI and Robotics generate a wide spectrum of emotions. On one end, some view AI as capable of improving the quality of life, while on the other, it gets viewed as a threat to human livelihood and jobs.

Robotics, AI and Machine Learning will only see even wider adoption in the Industry. Robotics and machine learning have improved productivity and enhanced the economies of many nations. The internet of things (IoT) is facilitated by high-speed networks and remote sensors to connect people and businesses. In all of this, there is a possibility of a new era that could improve the lives of many people.

While the discussion of 'Jobs Lost, Jobs Gained,' continue, it is estimated that 30 percent of 'work activities' could be automated by 2030 and up to 375 million workers worldwide could be affected by emerging technologies.

As these technologies get easier to implement and become more accessible, we shall see a much wider adoption and may be an even greater foray into our day-to-day lives. 📖

**The next issue - October - December 2020, will focus on "Servant Leadership".**

## Article Contributors

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**Dr. Indra Kanta Maitra** is the Controller of Examinations of St. Xavier's University, Kolkata. He completed his Ph.D. in Computer Science from University of Calcutta in the year 2015. He is associated with a research project of national importance funded by Govt. of India in the field of Biomedical Image Analysis and CAD. He is the recipient of

Best Poster Award at the 96th Indian Science Congress, 2009 at Shillong, India. He has published around 50 research papers in refereed international journals and conferences since 2009.

**Dr. Tuhin Utsab Paul** received his Doctorate degree in Computer Science and Engineering in 2020 from the University of Calcutta. He is currently working as an Assistant Professor in St. Xavier's University, Kolkata. His research interests include image processing, object recognition, image cryptography and Intelligent Internet of Things. He has published quite a few research papers in international journals and conferences.

**Dr. Soma Sur**, Professor of Management, Xavier Business School, St. Xavier's University, Kolkata has a teaching experience of more than 25 years in different B-Schools and Universities. She has several publications in renowned international and national journals and books to her credit and has supervised many Ph.D. Scholars.

## Goethals Blog

### Discovery of the First Belgian Jesuit's Grave at Lower Circular Road Cemetery

*Fr Jeyaraj Veluswamy, SJ*

When both of us, Fr. Etienne Degrez and myself, set out from St. Xavier's College, Kolkata at around 10.15 am on 28 December, heading towards the Lower Circular Road Cemetery, we said to ourselves, *'Let us give it a try. Even If we don't get to see anything, it doesn't matter. We could enjoy a nice morning walk together.'* All we took along with us was a small piece of paper with one name and one date: **Fr. Peter Van der Straeten, SJ**, died on **11 September, 1860** in Calcutta.

Fr. Peter Van der Straeten, SJ was one of the First Seven Jesuits from Belgium and England to land in Calcutta on 28 November 1859 to found the famous **B e n g a l M i s s i o n**. Unfortunately, his end came too soon, making him the first victim of the infamous hot climate of Kolkata, before he could hardly complete ten months in the city. He was thus the first and the only Jesuit to be laid to rest at the Lower Circular Road Cemetery.



After a two-hour long painstaking search in the old section of the LCR cemetery, we chanced upon a forward leaning tombstone cross bearing this engraving: **SACRED TO THE MEMORY OF REV. PETER VAN DER STRAETEN, SJ OF ST. XAVIER'S COLLEGE, BORN IN BELGIUM, DIED IN CALCUTTA, 11<sup>TH</sup> SEPTEMBER 1860, AGED 42 YEARS.**

Fr. Peter Van der Straeten, SJ was born on 15 December 1818 in Eyne in East Flanders in Belgium. Joined the Society on 2 November 1844 and arrived in Kolkata on 28 November 1859. Fr. Peter Van der Straeten was the Prefect and sub-prefect at the newly established St Xavier's School. In August he was struck down by a liver illness that carried him off on September 11 at the age of 42.'

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