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Artificial Intelligence and High-Performance Data-Driven Medicine.

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Abstract

The rise of data, both structured and unstructured at sheer volume coming at us from every direction and with the expansion of iCloud as a platform of repository of the these in size of Big Data (BD), leaves us no choice except turning to a system of Artificial Intelligence (AI) integrated with its sub-system of Machine Learning (ML) and Deep Learning (DL). The rise of artificial intelligence in healthcare is an inevitable event in our near future and long-term scenario. We are in definite need of AI as a capability to be able to process these BD both tactically and strategically without any doubts.

Key Words: Healthcare, Modern Life, Artificial Intelligence, Machine Learning, Deep Learning, Heart Attacks and Heart Strokes, Data Analytics and Predictive, Common Separated Value (CSV) Data

Introduction:

In the past decade or so, Artificial Intelligence (AI) has become known to us as a human being, and with these day's innovative technical approach such as Machine Learning (ML) and Deep Learning (DL) as integrated sub-systems to AI, combined are an excellent augmentation in our daily life.

The rise of Artificial Intelligence (AI) in healthcare applications is an inevitable necessity, and sufficient conditions as Big Data and Machine Learning and consequently Deep Learning (DL) (i.e., see Figure-1) are having an impact on most aspects of our modern life, from entertainment, commerce, banking industries, sports, cybersecurity, energy both renewable and non-renewable and healthcare as well.

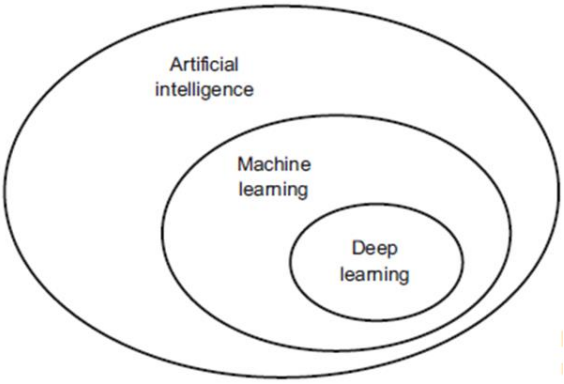

Figure 1: Artificial Intelligence, Machine Learning, and Deep Learning at Work

These days due to the capabilities and functionality of an integrated system of AI, ML, and DL as a whole (i.e., See Figure-1), such system and sub-system have penetrated and been utilized across every industry and enterprise these days that dealing with sheer data for analysis including the field of medical and medicine as well. [1]

In the medical field, for the purpose of research and creating a new way of treating patients by collecting new sets of information from these massive volumes of data plays a dominating role for the scientist involved in this field.

With the augmentation of AI system and sub-system of ML and DL, as a whole, companies like Netflix knows which films and series people prefer to watch, based on the data collection and cataloging builds from habit and behavior consumer can figure this matter out.

Amazon knows which items people like to buy when and where, and Google knows which symptoms and conditions people are searching for. All this data can be used for very detailed personal profiling, which may be of great value for behavioral understanding and targeting and can predict healthcare trends.

There is great optimism that the application of artificial intelligence (AI) can provide substantial improvements in all areas of healthcare, from diagnostics to treatment. It is generally believed that AI tools will facilitate and enhance human work and not replace the work of physicians and other healthcare staff as such. [2]

Another example, where AI along with ML and DL sub-system boost the search engine such as Google and driving its Data Analytics (DA) and consequently Predictive Analytics (PA), as effective as it can be and allow Google to know which symptoms and conditions people are searching for. It makes its search engine to be brilliant and valuable to end users for finding just about any with the world of the Internet and the Intent of Things (IoT).

All the data within iCloud in the sheer volume of Big Data can be used for very detailed personal profiling, which may be of great value for behavioral understanding and targeting and can potentially predict healthcare trends. There is great optimism that the application of Artificial Intelligence (AI) can provide substantial improvements in all areas of healthcare, from diagnostics to treatment.

Given the progress and innovation that is taken toward AI in the recent decade, Business Intelligence (BI) is giving its place in the industry to Artificial Intelligence (AI). [3]

There is great optimism that the application of Artificial Intelligence (AI) can provide substantial improvements in all areas of healthcare, from diagnostics to treatment. It is generally believed that AI tools will facilitate and enhance human work and not replace the work of physicians and other healthcare staff as such. AI is ready to support healthcare personnel with various tasks from administrative workflow to clinical documentation and patient outreach and specialized support such as image analysis, medical device automation, and patient monitoring. In this chapter, some of the major applications of AI in healthcare could be discussed, covering both the applications that are directly associated with healthcare and those in the healthcare value chain such as drug development and ambient assisted living, however covering all these details are beyond the scope of this short review this article and we encourage our reader to refer to reference [2] here.

By increasing the amount of data that the doctors, insurance companies, researchers need of artificial intelligence to achieve their task in hand much better to reach their set goals. There, we can see the rise of AI in healthcare and medicine going to the future period.

The demand for healthcare services is ever-increasing, and many countries are experiencing a shortage of healthcare practitioners, especially physicians.

Healthcare institutions are also fighting to keep up with all the new technological developments and the high expectations of patients with respect to levels of service and outcomes as they know it from consumer products, including those of Amazon and Apple. [4]

Note that, although the United States is considered as one of the rich and most technological countries among the other rich countries, yet it can be observed that the life expectancy in America among Americans have a lower life expectancy than people in those other rich countries, despite paying so much more for health care as illustrated in Figure 2.

As it is illustrated in Figure 2, the United States of America clearly stands out, as the chart indicates. Based on collected data, Americans spend far more on health than any other country in the world, yet the life expectancy of the American population is shorter than in other wealthy countries that spend far less. One of the reasons these authors here are using to lay out the ground for such a problem is the fast-paced life that Americans live in it, given the modern technology that is taking over traditional technology and the rise of depression, in particular among youngsters. [5,7]

However, this argument can be deferred to another article and short review, possibly in the near future.

The US has achieved very substantial progress in health outcomes over the last 140 years: in 1880, the life expectancy of Americans was 39 years; since then, it has doubled. But this extremely positive trend has come to an end. While life expectancy for people worldwide continued to increase, Americans' life expectancy has declined since 2014.

With the pandemic of 2020 – which already caused more than 225,000 deaths due to COVID-19 and 300,000 excess deaths – it is unfortunately already certain that the decline of life expectancy in the US will continue this year. [8]

These are typical data in healthcare that we need help from a smart system such as Artificial Intelligence integrated with its sub-systems as Machine Learning and Deep Learning, see Figure1.

Among these data, we can track and obtain information about:

1. Smoking,
2. Obesity,
3. Homicides,
4. Opioid Overdoses,
5. Suicides, in particular due to sever depressions,
6. Road Accidents,
7. Poverty and Economic Inequality, and finally,
8. Access to Health care

Are among the Big Data of healthcare, and information that is driven by AI, ML and DL that makes us as human being knowledgeable. [9]

High-Performance Medicine:

The convergence of human and artificial intelligence is and integrated enforcement and driving momentum behind the high-performance medicine.

The use of artificial intelligence, along with machine learning and the deep learning subsystem as illustrated in Figure-1, in particular, has been enabled by the use of data labeled big data, along with markedly enhanced computing power that is known as

High Power Computing (HPC) and cloud storage, across all sectors or now these day via Internet of Things (IoT). In medicine, this is beginning to have an impact at three levels: for clinicians, predominantly via rapid, accurate image interpretation; for health systems, by improving workflow and the potential for reducing medical errors; and for patients, by enabling them to process their own data to promote health. The current limitations, including bias, privacy and security, and lack of transparency, along with the future directions of these applications will be discussed in this article.

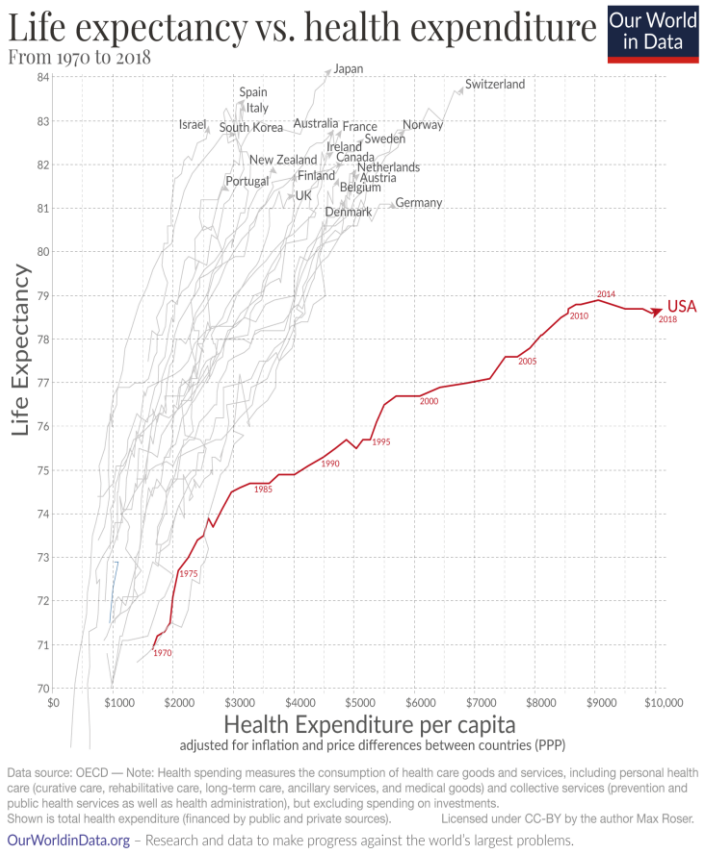

Figure 2: Life Expectancy Vs. Health Expenditure

Over time, marked improvements in accuracy, productivity, and workflow will likely be actualized, but whether that will be used to improve the patient–doctor relationship or facilitate its erosion remains to be seen and for that more data need to be collected and cataloged over time and data analytics and predictive analytics required to be performed, given the Service Level Agreement (SLA) to be implemented to perform these analyses.

Medicine and Artificial Intelligence Integration:

Where artificial intelligence and medicine cross path comes with its consideration of application, implications, and limitations aspect of it.

The future of 'standard' medical practice might be here sooner than anticipated, where a patient could see a computer before seeing a doctor.

As we stated the sheer volume of data in the name of Big Data and technological thrive of artificial intelligence along with high-performance computing, doctors would be able to treat their patients much better by looking at a collection of information resulting from these data In particular by comparing present data taken from a visiting patient and comparing it with historical data of the same patient, the doctors are able to see the trend of their treatment by continuing to make a right medical decision and prescribe the right medicine at the right dose.

Implementation of AI within the medical field and medicine even allows the doctors to build new sets of data for new patients as well, and ML with help from DL can keep track of any changes in a patient can feed the information to AI, and doctor can see them immediately.

Through advances in artificial intelligence (AI), it appears possible for misdiagnosis days and treating disease symptoms rather than their root cause to move behind us.

Think about how many years of blood pressure measurements you have or how much storage you would need to delete to fit a full 3D image of an organ on your laptop?

The accumulating data generated in clinics and stored in electronic medical records through common tests and medical imaging allows for more artificial intelligence and high-performance data-driven medicine applications. These applications have changed and will continue to change the way both doctors and researchers approach clinical problem-solving.

However, while some algorithms can compete with and sometimes outperform clinicians in a variety of tasks, they have yet to be fully integrated into day-to-day medical practice.

For AI to be able to perform its task intelligently, the intelligent algorithm needs to be in place in order for these algorithms to meaningfully impact medicine and bolster the power of medical interventions, although requires for numerous regularities to be taken under consideration, where we need to be concerned, and we need to address them first.

An AI, through its Neural Network (NN) system as illustrated in Figure-3, needs to be trained via its ML and consequently DL very similar like a doctor that needs to go through many years of schooling and education as well as training before he or she becomes fully qualify licensed physician.

Generally, the jobs AI algorithms can do are tasks that require human intelligence to complete, such as pattern and speech recognition, image analysis, and decision making. However, humans need to explicitly tell the computer exactly what they would look for in the image they give to an algorithm, for example.

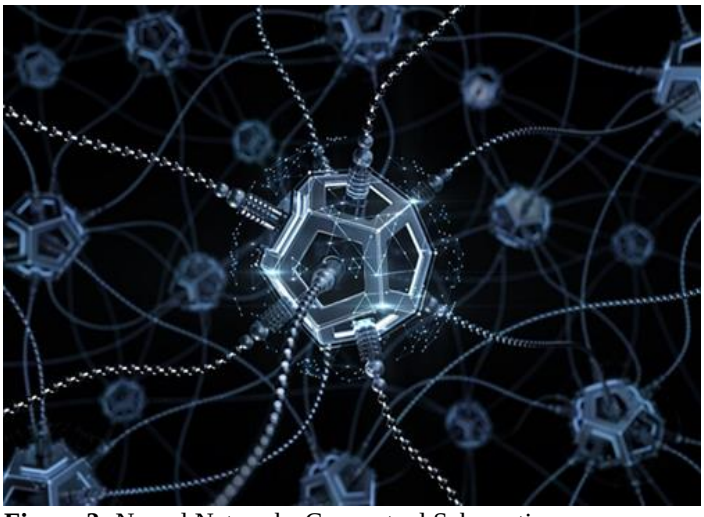

Figure 3: Neural Networks Conceptual Schematic

In short, AI algorithms are great for automating arduous tasks and sometimes can outperform humans in the tasks they are trained to do. [9]

Furthermore, Prior to having access to an actual doctor, trained AI bots can qualify whether certain symptoms warrant an actual conversation with a physician. Many questions are asked of the patient, and based on each response, the software encourages the user to take specific actions. These questions and answers are often vigorously reviewed by medical professionals at each stage to account for accuracy. In critical cases, a general response of "You should see a doctor" is given, and the patient is directed to book an appointment with a primary care physician.

Augmentation of AI in Medicine:

Recent applications of Artificial Intelligence (AI) with its sub-systems of Machine Learning (ML) and Deep Learning (DL) can be seen based on technological advances in new High-Power Computing (HPC) and Quantum Computing (QC) that we are researching to manufacture them in a very near future. [10]

Graphic Processing Unit (GPU) and Tensor Processing Unit (TPU) are taking over of old fashion Central Processing Unit (CPU) that are not fast enough to deal with these Big Data (BD), and these units are the center of performance for these high-power computing platform as a new generation of computers.

Advances in computational power paired with massive amounts of data generated in healthcare systems make many clinical problems ripe for AI applications. Below are two recent applications of accurate and clinically relevant algorithms that can benefit both patients and doctors through making diagnoses more straightforward.

In the fall of 2018, researchers at Seoul National University Hospital and College of Medicine developed an AI algorithm called DLAD (Deep Learning based Automatic Detection) to analyze chest radiographs and detect abnormal cell growth, such as potential cancers (Figure 4).

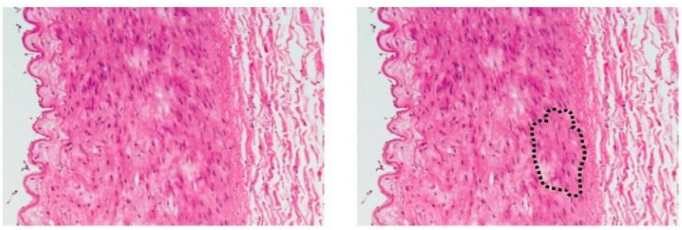

Figure-4: Applications of AI Algorithms in Medicine. [11]

In Figure 4, The left panel shows the image fed into an algorithm. The right panel shows a region of potentially dangerous cells, as identified by an algorithm that a physician should look at more closely.

The algorithm's performance was compared to multiple physician's detection abilities on the same images and outperformed 17 of 18 doctors. [11]

Conclusion:

Although the data are growing so big at the level of big data and processing them in real-time for the right information and having the power of right knowledge demands a system-sets of AI, ML, and DL, however, there is a limitation to such system. AI approach is 100% bulletproof solution. There certain limitations and flaws are involved with such a system. [12]

Proper understanding of the limitations of algorithms by clinicians and proper understanding of clinical data by programmers is key to creating algorithms usable in the clinic. It might be necessary for companies to sacrifice the secrets of their algorithm's functionality so that a more widespread audience can vet the methods and point out sources of error that could end up impacting patient care.

With progress in inventing a better intelligence system by moving through a path of Artificial Intelligence (AI) to a Super Artificial Intelligence (SAI), we might be able to overcome all these flaws and limitations any time soon. However, we still seem far away from writing the intelligent algorithms that could operate independently in clinics without the presence of a human in the loop of clinical treatment while addressing the potential sources of error in the algorithm's decision-making.

Given human intelligence, these authors believe the AI nor SAI can substitute their human partner at any given time. We, as humans, have two distinct advantages over AI and SAI, and that is we have the capability of being Homofabian and Homosapien forever and as long as we exist, with our wet computer that is known as our brain with a logical reasoning capabilities to assess and compare.

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