Journal of Cell and Tissue Research Vol. 20(2): 6999-7002 (2020)
(Available online at www.tcrjournals.com)
ISSN: 0973-0028; E-ISSN: 0974-0910

Review Article

APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN HEALTH CARE: A REVIEW

GUPTA, M.[1] AND BHARGAVA, R.[2]

[1]Research Engineer, 2751 S. Norfolk St. San Mateo, CA – 94403, United States.
E. mail: mridulg@alumni.cmu.edu; [2]Machine Learning Scientist, 2751, S. Norfolk St.
San Mateo, CA – 94403, United States, E. mail: bhargavr@purdue.edu, Cell : 1. 412. 519. 8153

Received: August 31, 2020; Accpted: September 18, 2020

Abstract: Advancements in the field of Artificial Intelligence has led to a widespread adoption of its tools and techniques in the analysis and interpretation of structured and unstructured healthcare related data and processes. In this article we discuss the adoption of different artificial intelligence technologies like neural networks, natural language processing, computer vision and robotics in the healthcare domain. We also provide a brief overview of various industry leaders who are developing AI tools for adoption in the space as well as challenges in adopting these tools within the healthcare industr*y.*

Key words: Artificial Intelligence, Healthcare

INTRODUCTION

In the past years, the progress in the Artificial Intelligence (AI) field has been substantial with the development of neural networks, natural language processing techniques, computer vision, robotics etc. These techniques have helped healthcare specialists to leverage complex health care data for various tasks e.g., providing more accurate medical diagnostics, drug discovery, treatment variability, patient out-processes etc.

Artificial Intelligenceis a new engineering field that has been developed formally in the past 50 years. John McCarthy [1], who coauthored the document, that coined the term artificial intelligence, defined AI as the "science and engineering of making intelligent machines" field which encompasses many different

[1]**Mridul Gupta** is a research engineer at a large cloud computing technology company, working on artificial intelligence technologies and software industry based out of Silicon Valley, California. He graduated from IIIT-Hyderabad and obtained research master's degree from Carnegie Mellon University in 2012. He specialized in artificial intelligence.

[2]**Radhika Bhargava** is currently a Machine Learning Engineer for a social networking platform. She received master's degree and PhD in computer science from Purdue Univ. in 2019 where she worked on Adversarial Machine Learning. She published her work in peer reviewed journals, and attended workshops in the fields of machine learning and computer security

Dedication: We are very happy and honoured to dedicate this paper to Prof . P.D. Gupta at this auspicious occasion of his 81st birthday, whose academic career we deeply admire.

technologies and tools. As for example computer vision is a field of the artificial intelligence which trains a machine to understand the visual world. Computer vision has been adopted in the health care field for various tasks e.g., using thousands of CT scans to identify the presence or the absence of a neurological disease [2]. Natural Language Processing (NLP) is another field of AI which aims at making computers understands human language and recognizes meaning from unstructured spoken and written form of human language. NLP is being applied in the healthcare field for identifying entities in Electronic Health Records to improve clinical data integrity, summarizing clinical notes by identifying key phrases or context etc. It is also being applied to learn complex language models of medical texts.

In this article we give a brief overview of the different AI fields and how the health care industry is leveraging them for improving patient services by providing better clinical diagnosis, leading to new developments by helping in drug discovery and a myriad of other related applications.

Deep learning in healthcare: Deep learning, a subfield of machine learning (ML) which has seen a dramatic resurgence in the past decade, largely driven by increases in computational power, the availability of new hardware such as Graphical Processing Unit (GPUs) and massive new datasets. Deep learning comprises of methods which are based on artificial neural networks that facilitate representation learning of complex structures such as images, text and audio signals. The "deep" in the learning comes from using multiple hidden layers, consisting of neurons, in the network, much like the human brain.

The application of deep learning and deep neural net work (DNN) architectures in drug discovery have been numerous and include cheminformatics – Which focuses on mining chemical information from large compound databases [3], ***de novo*** molecular design using variation auto-encoders (a form of generative neural networks) [4]. Synthesis prediction [5] used neural networks for generating and ranking candidate reaction outcomes and biological image analysis. More recently, identifying potential drugs for2019-nCoV has leverage deep learning methods to this end [6].

NATURAL LANGUAGE PROCESSING (NLP) IN HEALTHCARE

NLP is a subfield of artificial intelligence whose goal is to provide structure for text expressed in natural language so that it can be understood by machines by combining and leveraging rules of linguistics with deep learning and other ML-based methods. According to Liddy [7] the goal of NLP is "to accomplish human-like language processing" (Healthcare industry leverages these techniques in a myriad of applications as outlined below).

1. Clinical decision support system: The goal of clinical decision support (CDS) is to help healthcare professionals to sift through enormous amount of digital data with the purpose of informing the professional for the next steps to be taken w.r.t patient care and to catch potential problems e.g. dangerous combination of medications. Alemzadeh [8] used unstructured clinical notes and structured patient records to identify disease control status from clinical notes. They leveraged the IBM Watson Patient Record NLP analytics tool to develop models to predict disease control status with an accuracy of 0.77.

2. Extracting structured information from unstructured electronic health records (EHR): The task of extracting structured information from unstructured text (EHR) has been a challenging task as text in these records is free-form and often embedded with structured objects like tables, lists etc. Named Entity Recognition (NER) is a task in NLP that focuses on identifying domain specific named entities (e.g. identifying names of drugs and diseases in an EHR) and their corresponding spans which can help health care professionals to extract information and store this useful knowledge in medical databases while avoiding unnecessary and irrelevant information. Batbaatar and Ryu [9] used a deep recurrent neural network (a neural network to encode sequences of words in text) to identify health related entities from an unstructured Twitter dataset consisting of daily tweets from users.

3. Computational phenotyping and biomarker discovery – Phenotype are the visible characteristics of an individual that result from the interactions of a genotype and its environment. Traditionally, phenotypes in the healthcare field have been summarized by experts based on expertly curate clinical observations. One of the most basic approach for Computational Phenotyping is keyword extraction. However, NLP have developed

techniques which extend beyond basic key word extraction by leveraging complex features such as relationships between medical concepts. These relationships help provide greater expressive power when encoding patient status [10]. NLP has also been applied for detecting neurocognitive disorders such as Alzheimer's by analyzing speech patterns [11].

Computer vision in healthcare: Computer vision is a field of AI which aims at making a machine understands the visual world. The healthcare industry has leveraged computer vision techniques for assistance in medical diagnosis extensively. The basic methodology which is applied for disease diagnosis follows this structure: the machine relies on the extraction and combination of features and signals from images (e.g., faces of patients, ocular images, CT scans), which are then used to build visual models that can make predictions and generalize on unseen but related images. Any new image (with features extracted in a spatial or spatio-temporal dimension) is then input into a classifier to predict the existence of a disease or to assess the severity of the disease [12].

Convolutional neural networks (CNNs) are a class of deep neural networks which are basically applied to analyze visual images. Recently, CNNs have been successfully implemented in the medical domain to assist disease diagnosis. Acharya et al. [13] successfully applied CNNs to do the analysis of encephalogram (EEG) signals which are used in the diagnosis of epilepsy with an accuracy of 88.67%. Zeng et al. [10] used mammograms and CNNs to diagnose breast cancer with an accuracy of 88.18%.

Physical robots and robotic process automation: Surgical robots assist surgeons in performing complex surgeries and procedures with greater precision and flexibility. Common surgical procedures using robotic surgery include prostrate, head, neck and gynecological surgeries [14]. Robotic process automation (RPA) are computer programs and information systems which rely on business rules to act as a user of the system. In healthcare, they are used for automating tasks such as updating patient records, billing etc.

Industry leaders in developing AI tools for health care: Several startup companies and larger organizations are focusing on developing tools that can be utilized for advancing healthcare. For example, IBM has developed Watson Health which aims at providing support for clinical decisions. Microsoft's Hanover project aims at developing cancer drug treatment options available for patients. Google's Deep Mind has developed algorithms to diagnose health related risks using data collected through mobile devices. Jvion offers a 'clinical success machine' that identifies patients most at risk, as well as those most likely to respond to treatment protocols. More recently, they have developed a system which can identify a person's mortality and morbidity risk because of acute reparatory illness similar to COVID-19. These systems could help healthcare professionals to find the best diagnosis and treatment for patients.

Challenges in adopting AI for health care: Artificial intelligence is becoming ubiquitous in its adoption in healthcare, but healthcare providers are still concerned that adoption of AI could threaten security and privacy of patients due to its reliance on data. Another significant challenge in adopting AI in healthcare is that accuracy does not necessarily represent clinical efficacy, machine learning algorithms will use whatever data and signal is available to achieve the best possible result. Without a good understanding of specific features and signals that are used by neural networks for making decisions, it will be difficult to generalize and interpret these complex algorithms.

CONCLUSION

In this article, we have reviewed various fields of artificial intelligence and how it is being adopted in health care to provide better patient care and support, accelerate the process of development and discovery of new drugs etc. A myriad of AI technologies like neural networks, convolutional neural networks, natural language processed have assisted the health care practitioners in analyzing and interpreting the complex medical data which is in the form of images, text, speech to provide better prevention, diagnosis and treatment to the patients.

REFERENCES

[1] McCarthy, J. What is artificial intelligence? www-formal.stanford.edu/jmc/whatisai/whatisai.html (2003).

[2] Titano, J.J., Badgeley, M., Schefflein, J., Pain, M., Su, A., Cai, M. and Mocco, J.: Nature medicine, 24(9): 1337-1341 (2018).
[3] Lo, Y.C., Rensi, S.E., Torng, W., and Altman, R.B.: Drug discovery today, 23(8): 1538-1546 (2018).
[4] Blaschke, T., Olivecrona, M., Engkvist, O., Bajorath, J. and Chen, H.: Molecular informatics, 37(1-2): 1700123 (2018).
[5] Coley, C.W., Barzilay, R., Jaakkola, T.S., Green, W.H. and Jensen, K.F.: ACS central science, 3(5): 434-443 (2017).
[6] Zhang, H., Saravanan, K.M., Yang, Y., Hossain, M.T., Li, J., Ren, X. and Wei, Y.: Interdisciplinary Sciences, Computational Life Sciences, 1. (2020).
[7] Liddy, E.D.: Natural language processing. (Drake, M.A. ed), Encyclopedia of library and information science. 2nd ed. New York: Marcel Decker Inc. (2001).
[8] Alemzadeh, H. and Devarakonda, M.: An NLP-based cognitive system for disease status identification in electronic health records. In: IEEE EMBS Intern. Conf. Biomed. Health Inform., (BHI). pp 89-92 (2017).
[9] Batbaatar, E. and Ryu, K.H.: Intern. J. Environ. Res. Public Health, 16(19): 3628 (2019).
[10] Zeng, Z., Deng, Y., Li, X., Naumann, T., and Luo, Y.: IEEE/ACM Transac. Comput. Biol. Bioinform., 16(1): 139-153 (2018).
[11] Orimaye, S.O., Wong, J.S., Golden, K.J., Wong, C.P. and Soyiri, I.N.: BMC Bioinform., 18(1): 34 (2017).
[12] Thevenot, J., López, M.B. and Hadid, A.A.: IEEE J. Biomed. Health Inform., 22(5): 1497-1511 (2017).
[13] Acharya, U.R., Oh, S.L., Hagiwara, Y., Tan, J.H. and Adeli, H.: Computers Biol. Med., 100: 270-278 (2018).
[14] Davenport, T. and Kalakota, R.: Future Healthcare J., 6(2): 94 (2019).