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EXPLORING THE POSSIBILITIES OF USING MACHINE LEARNING IN HEALTH CARE

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Abstract: In current days, professional trying to use machine learning in finding solutions of problems from almost every domain. The proposed study is conducted to check the feasibility of using machine learning in health care domain. We introduce the core concepts of machine learning with available types of algorithms. The study also consider the challenges that may encounter while integrating machine learning with clinical processes. A part of the study focusses on some of recent works on using machine learning as a solution of some health care problems. At the end, we discusses the future possibilities of machine learning in health care domain.

I. INTRODUCTION

From the inception, health care professionals, researchers and institutions faced the lack of resources to counter the problems of medical fields. Even in 20th century many countries are not able to provide adequate medical facilities to every citizen. In this situation, machine learning comes into the picture.

Machine Learning (ML) deals with designing of algorithms such that the algorithms can learn from data. In other words, ML is extraction of knowledge from data. ML is very different approach compared to traditional programming language as shown in Fig. 1 [1].

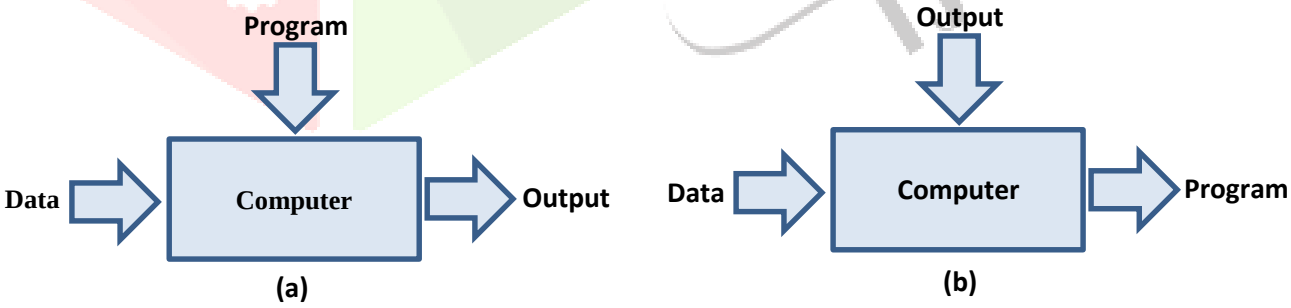

Fig. 1. (a) Traditional Programming Approach. (b) Machine Learning Approach.

ML try to identify patterns in the provided data along with sample desired output, to learn these patterns to output useful models so that precise predictions can be made. ML techniques are divided into Supervised learning (where input data is labelled or classified) and Unsupervised learning (where the input data is not labelled) [1].

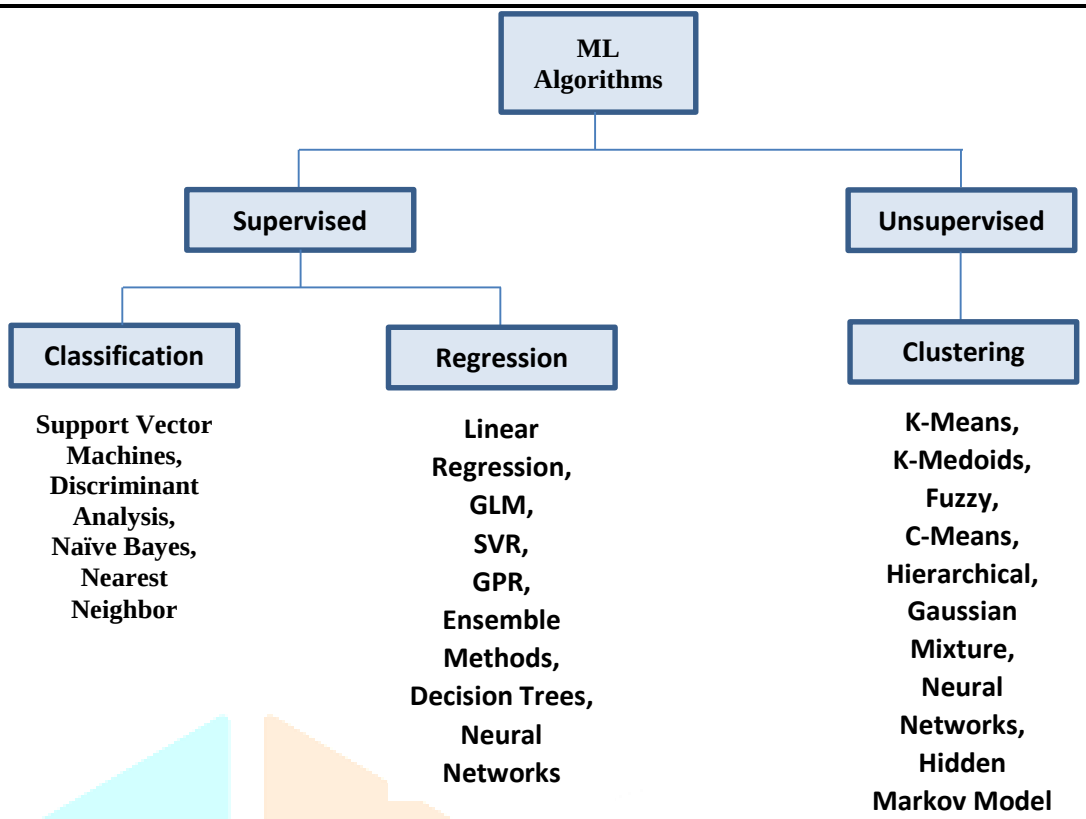

Fig. 2. Classification of Machine Learning Algorithms.

Fig. 2 shows a classification of ML algorithms [1]. One hybrid approach is called Semi-supervised learning (where input data contain both labelled and unlabelled instances).

II THE CHALLENGES

Although ML can be very useful in health care, currently there are very less examples integration of ML models with clinical care. It requires an intense inter-disciplinary collaboration, alignment of goal so that the theoretical equations can be implemented to solve real life medical problems [2].

One problem that may arise is that the clinical reasoning uses statistical models to find patterns in health care data where data is taken across institutions, while ML models usually takes data from limited number of institution(s) and very difficult to get generalized. For example, when Clostridium Difficile model was used to test data from two medical centres, it was revealed that variables in data from one medical centre results in risk factors different than variables in data from other one [2].

It requires a significant amount of resources and time to validate a newly proposed ML model in a particular environment [2].

Also there is a problem of proper inter-disciplinary domain expertise to prepare ML model from remotely collected, stale data [2].

Modern machine learning techniques focus on generalization beyond a training dataset, not on generaliza¬tion to different sites. To address the issue, it is required to develop transfer learning methods, and in the meantime generalization must be achieved through localization. When a model is adapted for a local environment, it requires special set of skills to extract relevant data and use it to train models again at every location or a willingness to leverage capabilities from outside institutions [2].

The accuracy and performance of models is ensured by methods that evaluates and monitor models, but these methods are still in their earlier stage. For example, we can use a machine learning model to pre¬dict the beginning of infection in a patient due to sepsis. Based on the predictions made by the model, preventive actions can be taken to stop infection. But it is difficult to observe that whether results are correct or not because of no proper way to classify a prediction as successful or as false alarm. To resolve the issue, after the implementation the model can be trained again using a different dataset, but it may also give biased results which are very difficult to establish. Such kind of complex issues results in need of development of new machine learning methods to address them [2].

Since rural population receives less attention compared to urban one, they are not aware of healthy practices and thus shows higher rate of chronic illness. Also the data collected from such remote locations sometimes is not precise due to lack of intent of personnel involved [3].

III RECENT WORK

There are significant amount of work already completed and outgoing to combine clinical practices with the ML techniques. In this section we discuss some of the recent approaches that are either proposed or implemented which may help health professionals to detect or predict medical problems.

Ephzibah et.al proposed a framework for the disease diagnosis process supported with big-data management and machine learning using rule based, instance based, statistical, neural network, and support vector method [4].

Polaraju et.al performed multiple linear regression analysis to predict chance of heart disease using training data sets containing 3000 instances with 13 features like age, chest pain type, fasting blood sugar, rest ECG, number of major vessels coloured by fluoroscopy, blood pressure, serum cholesterol, maximum heart rate achieved etc [5].

Iyyanki et.al considered regression predictive model by Jason B (2018) that uses confidence interval to create a model that predicts crude birth rate and crude mortality rate in India in six different states namely Andhra Pradesh, Assam, Madhya Pradesh, Uttar Pradesh and Dadra & Nagar Haveli and the data was collected from the year 1981 to 2011 [5].

Wouters et.al arrived at a four-model approach that most adequately grasps the diversity of learning health care systems within each model as well as the ethical issues raised by these systems. The first model called Optimization Learning Health Care System or Optimized LHS because conditions within care and research structures are optimized to create an environment that encourages patients to participate in research and professionals to translate scientific insights into clinical practice. Crucially, patients in this type of LHS are included as participants in a study, explicitly crossing the Rubicon from care to research. The model 2 called Comprehensive data LHS generate evidence by routinely collecting and processing vast quantities of clinical data. From a methodological perspective, comprehensive data LHSs resemble longitudinal cohort studies, which are also observational and prospective in nature. The model 3 called Real-time LHS is the combination of clinical decision-support algorithms with routine clinical data collection. Combining these elements in a real-time LHS allows professionals to translate novel insights derived from the treatment of previous patients directly into patient management, which in turn yields data that can be used to evaluate and fine-tune clinical decisions in the future. Finally the fourth model called Full LHS require that patients who would normally be treated in a clinical care setting will be treated in a setting that is explicitly designed as a scientific study. Here, research and care would be fully integrated. Whereas comprehensive data and real-time LHSs produce generalizable knowledge as a by-product of how care is organized, clinical care in a full LHS is remodelled on research principles to the extent that the care delivery process becomes a prospective interventional trial [6].

IV THE FUTURE

Since a lot research has been already conducted and ongoing, the medical professionals is now focussing towards the underlying platforms required to efficiently scale ML across health care. The time is about to come that both machine learning experts and medical researchers should collaborate to optimized ML models so they can be seamlessly integrated into clinical care process. The advanced ML tools and algorithms can be refined to assist medical professional from rural area, so that they can receive desired information thus helps them to provide better health care in such rural region at comparatively affordable cost. As it already begins IoT (Internet of Things) devices can be combined with ML analytics to develop wearable devices coupled with smartphones to provide precise real time data that is much more useful in monitoring a person's health.

V CONCLUSION

As we can see there are endless possibilities of using ML techniques in the field of health care. ML is rich in the sense of various algorithms that are available and can be used to improve health facilities. Especially in the country like India which does not have adequate doctors in rural area the ML will surely help. But there are challenges to integrate ML with health process because we lack the inter-domain expertise which is crucial to the successful development of ML models for clinical care. Still significant amount of work is carried out which includes using regression models, neural networks, decision trees, LHSs etc. The future of ML in health care is very bright but some concerns have to be addressed like security of health personnel data, amount and integrity of data available, precision of the results generated, training of health care professionals etc.

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