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Big Data Deep Learning in Healthcare for Electronic Health Records

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Abstract: **-**

Deep learning is now more popular research domain in machine learning and pattern recognition in the world. Deep learning is widely success in the in-depth of applications specifically in healthcare, speech recognition, and natural language processing using the absolute amount of data accessible nowadays, big data takes opportunities and transforms possible design for several sectors. Further, it also performs on the unpredictable defies to connecting data and information. The size of the data is getting larger, and deep learning is imminent to perform a vital part in big data predictive analytics. This paper provides an available outline of deep learning and focuses recent exploration in analyze of medical images, diagnose diseases accurately and provide personalized medicines.

Keywords: ***-Big data, Machine Learning, Deep Learning, Healthcare, Convolutional Neural Network.***

1. Introduction

Nowadays, People are now turning over the highest importance to their health. They assume the highest level of precaution and service unrelatedly to cost and further expressive almost to this field on refining the health of residents, dropping the cost of care and improving the patient experience. In medical imaging field, machine learning is used for numerous services like computer-aided diagnosis, image segmentation, image registration, image annotation, and image –guided therapy. Deep learning methods are usual of algorithms in machine learning. These algorithms are intended for automatically study multiple levels of representation and abstraction, which supports in making sense of data.

Expertise is now concentrating on computing deep learning methods in the medical domain. Big data and Deep learning are the two hottest topics rising quickly in the real world. While the big data has defined in many ways, it raised to becoming more growth and excellent accessibility of digital data in shapes and size, is increasing at beyond belief rates. (Xue-wen Chen & Xiaotong Lin, 2014). Big data suggestions great potential for developing all features of our humanity, gathering of valued information from big data is not such an easy task. The significant and rapid growing of hidden information in the unmatched capacities of non-traditional data needs together with the improvement of innovative technologies and relating to more than one branch of knowledge in close by collaboration.

Currently, machine learning techniques, organized with improvements in available computational control, have come to play a dynamic role in Big Data analytics and knowledge discovery (Xue-wen Chen & Xiaotong Lin, 2014). In compare to best conventional learning methods, which are well thought-out using shallow-structured learning architectures, deep learning refers to machine learning techniques that practice supervised and unsupervised approaches to spontaneously learn hierarchical representations in deep architectures for classification (Gu et al., 2015).

Deep learning implemented successfully in industry domains that perform very well on an enormous amount of ordinal data (Najafabadi et al., 2015). Firms similar to MRIs, CT scans, and X-rays gather and explore massive volumes of images each and every day, violently insistent to deep learning associated projects. To influence innovative analytics to develop new insights from data sets with the objective of improving diagnostics and enhanced predicting outcomes

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machine learning and deep learning turned out the health systems in the field of healthcare.

2. Background

Deep learning is modernizing a wide range of scientific fields. There will be not any more application of new proficiency than refining patient care. The trends that drive the deep learning revolution are mainly three additional powerful GPUs, Classy neural network algorithms exhibited on the human brain, and admittance to the fit of data from the internet.

2.1 Mining medical data for enhanced and quicker treatment

Medical records such as doctor's reports, test results and medical images are a gilded source to health data. GPU-accelerated deep learning to process and study patient's illness over time and to relate one patient compared to a large population can help the doctors to afford better treatments. The new clinical data center will relate a patient's test and the past with the data from a huge population of other patients to improve detection, diagnosis, treatment and management of the disease.

Researchers examined the records using deep learning, a kind of artificial intelligence that can explain difficult technical difficulties like face or speech recognition, on occasion even topper than a human concert. It required computers to know many types of health records prescriptions or reviews of visits to doctors, for example in various formats (Ranjith, D et al., 2016). Another task was tracking changes in the records over time to provide a full picture of patient health.

Not like old-style machine learning, deep learning does not need a human practiced to define each problem the computer should evaluate the data a time-intensive process. GPUs are providing the speed essential to train the neural networks, where the learning takes place in deep learning on the hundreds of thousands of health records.

2.2 Enhanced and Faster diagnosis

Medical images like MRIs, CT scans, and X-rays are the best significant tools doctors use in diagnosing situations ranging from spine injuries to heart disease to cancer. However, analyzing medical images can frequently be a hard and time-consuming manner. Researchers and startups are utilizing GPU-accelerated deep learning to computerize analysis and increase the accuracy of diagnosticians. A startup is working to shrink the number of improper diagnoses by making it easier for healthcare practitioners to recognize diseases from ordinary radiology image data. It provides technology to visualize and quantify heart flow in the body using any MRI machine. The goal is to help speed diagnosis. Explores medical images to find tumors, almost unseen fractures, and other medical disorders (Kamalakannan et al., 2015).

2.3 Genomics records for Personalized Medicine

Genomics records are gathering in incomparable sizes, in the case of scientist's skill to learn from hereditary factors such as mutations lead to disease. Deep learning leads to what's known as personalized or "precision" medicine, to treatments custom-made to a patient's genomic makeup.

2.4 Computer Aided- diagnosis (CADX)

This process consists of a computerized procedure that provides a second objective opinion for the assistance of medical image interpretation and diagnosis. The most important CADX applications are the differentiation of malignancy/benignancy for tumors. The introduction of Deep Learning techniques in the CADX domain has generated promising results in various medical applications, like the computerized diagnosis and treatment of Alzheimer's disease, organ segmentations, and mild cognitive impairment. Deep Learning techniques can alter the design paradigm of the CADX framework. It can also directly uncover features from the training data. As a result, the effort of explicit elaboration on feature extraction reduced. With Deep Learning methods, the accuracy of CADX and its performance can be tuned more easily in a systematic way.

AI and Deep Learning are transforming the world of medicine. Deep Learning systems can allow physicians and other healthcare providers in faster diagnoses and can help in reducing uncertainty in their decisions thereby avoiding costs and hazards and saving time.

3. Deep patient dataset

The theoretical framework to develop deep patient representation shown in Figure1. The health records are extracted from health data warehouse to preprocess the data to recognize and normalize under clinical relevant and set the patients vectors. The grouped vectors acquired from patients used as the input for feature learning algorithm to determine high-level descriptors. The features denote each patient in the data warehouse, and such deep representation can apply to various clinical tasks. The patient representation with a multi-layer neural network in a deep learning architecture (i.e., deep patient) (LeCun et al., 2015). Every layer of the network is trained to create a higher-level representation of the detected patterns, based on the data it obtains as input from the layer below, by optimizing a local unsupervised condition (LeCun et al., 2015).

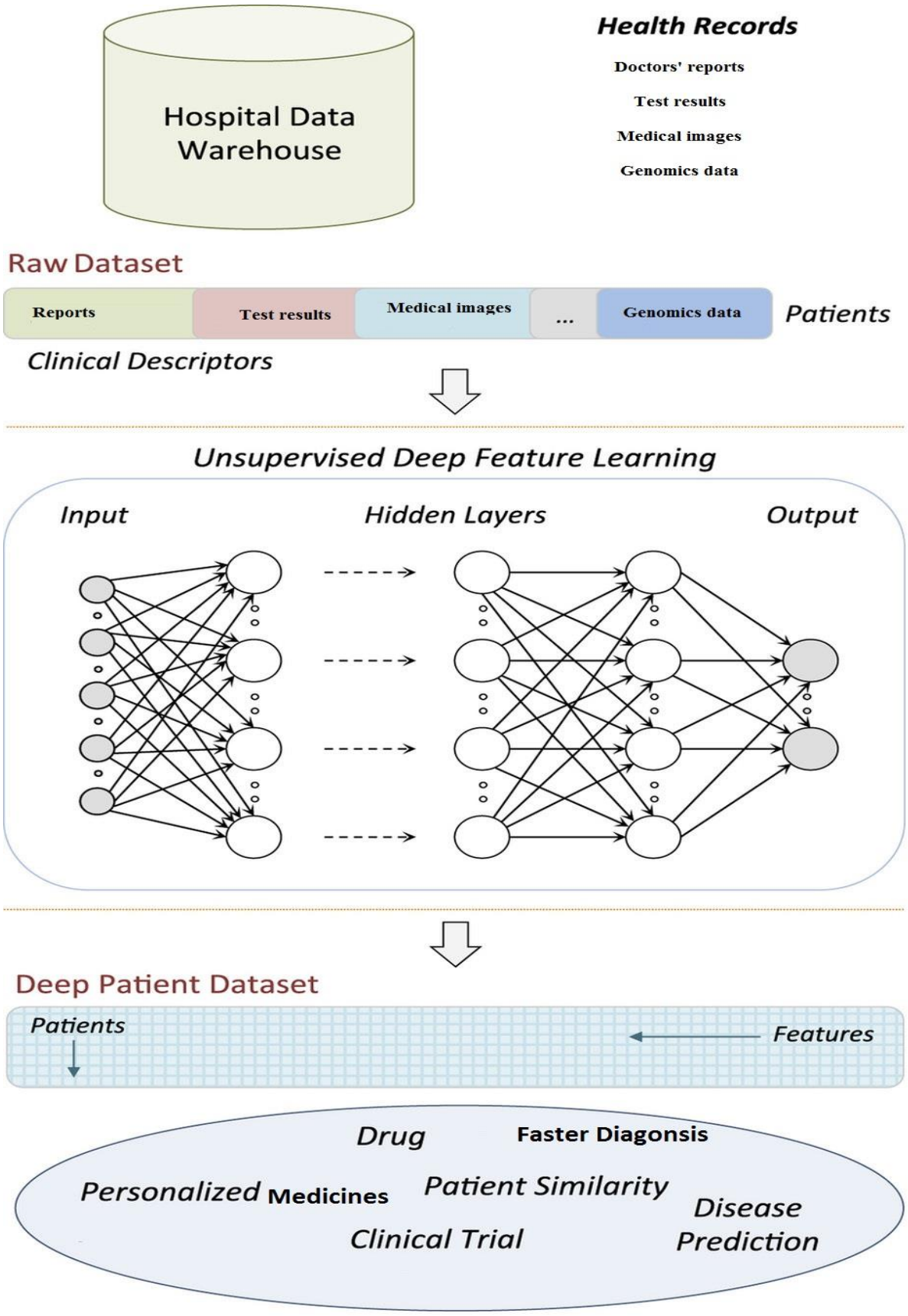

Figure 1. Theoretical framework of Health Data Processing using Deep Learning

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4. Proposed Work

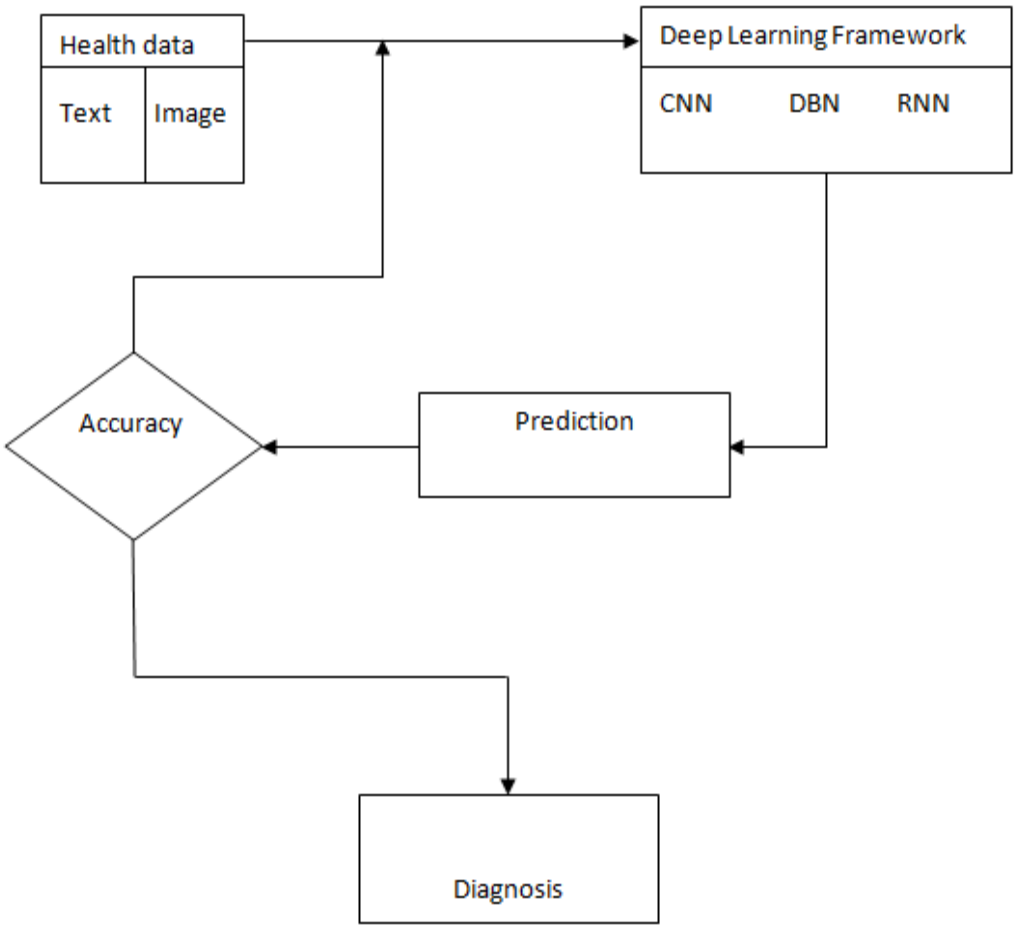

Figure 2. Flow Diagram for health records processing in Deep learning

The dataset collected from patient's medical reports may be in the form of structured or unstructured format. However, most the datasets are unstructured data type format only. The unstructured data contains data like text, image, audio, and video. The unstructured data should preprocess before giving as input to deep learning methods. The inputted data is performed using major deep learning methods like convolution neural networks (CNN), deep belief networks(DNN), and recurrent neural networks (RNN). The suitable methods used for medical data for images the CNN performs better than DNN and RNN. The outcome result from the performance of deep learning methods the prediction of patient results is checked by accuracy using the ROC. The result is achievable then it considered for diagnosis treatment for patient and accuracy is low value it again trained using models and algorithms to make better predictions in the result.

The example images, while performing the difficulty is to differentiate which may have various visual features. The distinguish metrics are done by sensitivity and specificity:

$$\text{Sensitivity} = \frac{\text{True positive}}{\text{Positive}}$$

$$\text{Sensitivity} = \frac{\text{True negative}}{\text{Negative}}$$

Where 'true positive' shows number of correctly predicted and 'true negative' shows number of false.

The sensitivity and specificity is calculated by probabilities of choosing threshold and prediction of each image at the time interval of 0-1.

5. Results and Discussion

Our classification method is a deep CNN; Data flow is from left to right: a medical image is in order perverted into a probability distribution above clinical classes of images using Google Inception V3 CNN architecture trained on the ImageNet dataset and fine-tuned on our dataset with unlike diseases.

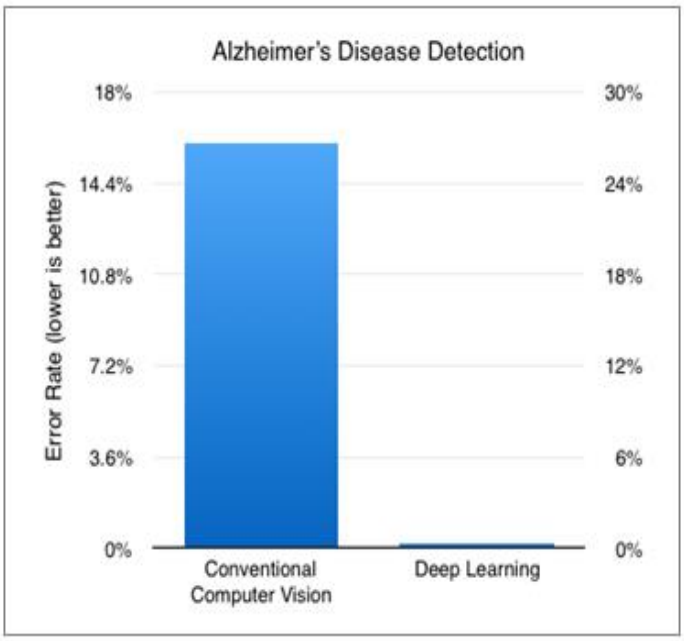

Figure 3. Comparison of CNN and Deep Learning Shows less error rate in deep learning.

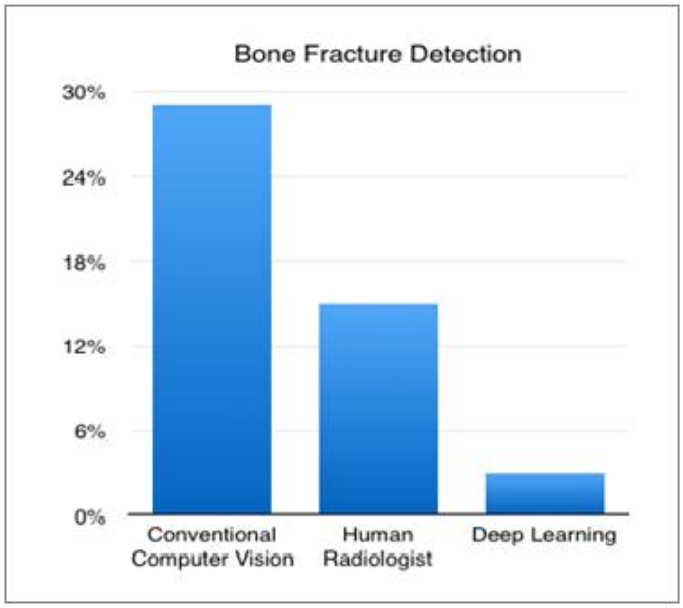

Figure 4. Comparison between CNN, Human Radiologist and deep learning detects well.

Overall the performance of CNN is well medical images, buts when performed using health records in disease prediction the error rate is high. The comparison of the data with manual i.e, human intervention, CNN and* deep learning methods, the error rate is reduced to low when compared to human intervention and CNN while performing with deep learning. The Figure3 and Figure4 above shows the result of data analyzed in Alzheimer disease and bone fracture detection deep learning performs well.

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