Chapter 7
Assessment of Cardiac Dynamics and Risk Factor Analysis Using Deep Neural Nets

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ABSTRACT

Cardiovascular disease (CVD) is a medical condition that leads to risk of heart disease such as stroke or cardiac arrest. Cardiac attack is a medical condition found in different age groups irrespective of gender. In a clinical study, there are many ways of interpreting the risk factors. The most common risk factors indicating sudden cardiac arrest are glucose, body mass index (BMI), and habitation such as smoking. The difficulties faced by the clinicians are the primary focus of this study. The complexity in clinical stages in examination of medical condition needs to be resolved considering the symptoms and other risk factors leading to sudden cardiac arrests and deaths. Thus, validation of clinical examination at times is a laborious and time-consuming process, while tracking patient history is voluminous over a period of time. This chapter presents the analysis of risk factors causing cardiovascular diseases. The statistical significance and clinical validation of the computer-assisted tool is presented in this study.

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INTRODUCTION

The analysis of risk factors leading to stroke started with a collection of multiple datasets from the Kaggle repository. This dataset consists of twelve variables including the class label, and the presence and absence of stroke. The primary task of the pipeline begins with data wrangling which transforms the raw inputs into a form more suitable for model development, fitting, and evaluation. This stage is followed by exploratory analysis which gives insights into characteristics of features for the extraction of interesting patterns. The pre-processed data was fed into the following baseline models Logistics regression (LR), support vector machine(SVM), Random Forest (RF), Naive Bayes Classification (NB), Gaussian Naive Bayes (GNB), Bernoulli NB, Decision tree classifier (DTC), k nearest neighbor classifier to benchmark the training and test split on the dataset. The proportion of data spitted for train and test split is 80% and 20% respectively. The accuracy score on the classification of presence and absence of stroke is reported using receiver operating characteristics (ROC). The area under the curve will help to report the metrics on classification known as the confusion matrix. When unseen data is fed into the model, the machine learning system will report the following viz, true positives, for those instances where the presence of stroke in the dataset is classified as stroke. Similarly, true negatives are those instances where the absence of stroke in the dataset is classified as no stroke. Likewise, the misclassified instances are reported as false positives and false negatives. The area under the curve shows the performance of the machine on the classification task undertaken. The region under the curve specifies the accuracy, the higher the area covered by the curve higher the accuracy reported by the model. The weakly learned models can be enhanced by boosting the performance individually through an ensemble approach. This includes mixing weak learners, training datasets, and models combined at different levels, known as meta-learners.

Risk factor analysis for Cardiovascular Disease (CVD) is clinically a challenging problem. To address the difficulties of clinical validations of such risk factor analysis, the role of Artificial Intelligence and Machine Learning was recently established. Electrocardiogram (ECG) is the principal source for the examination of cardiac electrical activity (Alfaras Miquel et al, 2019). This modality assists cardiologists for the diagnostic examination of cardiac abnormalities. The profound availability of ECG records has highly motivated us in analyzing cardiac dynamism by classifying the heartbeat using Electrocardiogram (ECG) signals. Recent research findings have reported the significance of unsupervised deep nets in capturing the cardiac dynamics on electrical activity by classifying heartbeats (Moddy et al, 2001). The unsupervised deep convolutional neural nets the variant of one dimensional CNN that has three layers viz flatten, dense, and dropout have shown promising results in the classification of heartbeat (Alfaras Miquel et al, 2019; Armando Fandango, 2018).

The role of Artificial intelligence and Machine learning (AIML) was recently established in the clinical validation of such complex analysis. Artificial Intelligence-based software development tools are highly demanded clinical validations (Aziz et al, 2021). In this perspective, TensorFlow, Python, R, and Data analytics shall play a vital role in developing AI-based tools. The objective of this chapter is to elaborate on the automation of clinical workflow using the primer of AIML concepts in risk factor analysis (Armando Fandango, 2018). Further, this chapter presents the machine learning workflow for the classification of a heartbeat from an ECG signal. Hence this work primarily aims at a classification of heartbeat and augments the machine learning workflow in reporting the anomalies causing the variation in heart rate. The initial phase of this research started with a collection of ECG signals with 15 classes of cardiac dysfunctions from a public source https://archive.physionet.org/physiobank/annotations.shtml under GNU public license. This tool would assist the physicians in Clinical validations and diagnostic

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