Hospital Readmission Prediction Of ICU Patients Using Deep Learning Algorithms

by

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Introduction

- A Hospital readmission is an episode when a patient who had been discharged from a hospital is admitted again within a specified time interval.
- Previously baseline classification models were used to estimate the Hospital Readmission Rates. Then Deep Neural Network (DNN) came into picture. A Deep Neural Network (DNN) is an Artificial Neural Network with multiple hidden layers between the input and output layers. Similar to shallow ANNs, DNNs can model complex non-linear relationships. It has been widely used in fields including computer vision, speech recognition, natural language processing, audio recognition, social network filtering, machine translation and bio-informatics where they produced results comparable to and in some cases superior to human experts.

Motivation

- For Medicare patients, hospitalizations can be stressful, even more so when they result in subsequent readmissions. A number of studies show that hospitals can engage in several activities to lower their rate of readmissions, such as clarifying patient discharge instructions, coordinating with post-acute care providers etc.
- The purpose of this thesis is to use deep neural networks which can work effectively to predict the result that can be utilized to avoid unnecessary hospital readmissions.

Key related research

Author (Year)	Paper Name	Comments
Ghassemi et al. (2014)	A data-driven approach to optimized medication dosing: a focus on heparin	An approach is developed that help clinicians determine the optimal initial dose of a drug to safely and quickly reach a therapeutic aPTT window.
Pirracchio et al.(2015)	Mortality prediction in intensive care units with the Super ICU Learner Algorithm (SICULA): a population-based study.	A super learner algorithm is used for predicting hospital mortality in patients.
Liang and Hu (2015)	Recurrent convolutional neural network for object recognition	Combination of convolution and recurrent neural network model is used for object detection.

Review of key related research

Author (Year)	**Paper Name**	**Comments**
Che et al.(2016)	Interpretable deep models for icu outcome prediction	Interpretable mimic learning is introduced that uses gradient boosting trees to learn interpretable models.
Jhonson et al. (2016)	MIMIC-III, a freely accessible critical care database	Medical Information Mart for Intensive Care (MIMIC-III) consists of data about patients admitted to various critical care units in a large hospital.
Hanson et al.	Improving protein disorder prediction by deep bidirectional long short-term memory recurrent neural networks	Long short term memory rnn in both directions is used to predict disordered proteins.

Review of key related research

Author (Year)	Paper Name	Comments
Greff et al.(2017)	LSTM: A search space odyssey	Overcomes the vanishing gradient problem of traditional RNN.
Franco et al. (2017)	Impact of prealbumin on mortality and hospital readmission in patients with acute heart failure	Statistical Analysis is used to find the mortality and readmission rates.
Reddy and Delen (2018)	Predicting hospital readmission for lupus patients: An RNN-LSTM-based deep-learning methodology	Utilizes deep learning methods to predict rehospitalization within 30 days by extracting the temporal relationships in the longitudinal EHR clinical data.

Research Gaps

In literature survey we find the following research gaps. These are points that we will be focused on in this thesis.

- The results obtained in these techniques can be improved using novel classification algorithms. Most of the researchers have used existing machine learning algorithms and it is expected that deep learning techniques will surpass the conventional techniques.
- These previous works were not able to model high dimensional nonlinear relations as good as RNN.
- Descriptive statistics were being used in earlier methods. However, these statistics like mean, median mode are always under the risk of loosing some vital information.
- Deep learning algorithms are still under shadow for variety of healthcare applications.

Objectives

The primary objective of this thesis is:

- To develop Deep Neural Network(DNN) models for Healthcare application i.e Hospital Readmission.
- To predict hospital readmission of patients using deep neural networks.
- To compare results between Deep Learning Models and with exiting algorithms.

Novelty of the proposal

- With this thesis, the aim is to use deep learning algorithms to overcome the drawbacks of conventional machine learning algorithms.
- The thesis aims to use nature inspired algorithms for feature extraction.
- The thesis also aims to use hybrid model (Convolution Recurrent Neural Network) which can further increase the accuracy of the proposed model.

Plan of action

The thesis can be divided in following phases:

- Phase 1
  - Literature Survey
  - Identification and study of available techniques previously used
  - Data Retrieval
- Phase 2
  - Data Pre-processing
  - Extraction of relevant data
  - Feature extraction
  - Dealing with missing values
  - Normalization

Plan of action

- Phase 3
  - Implementation of Deep Learning Models(RNN, LSTM, BRNN)
  - Train models on the training dataset.
  - Analyzing the performance of the different models
- Phase 4
  - Testing and validating using test dataset.
  - Drawing Conclusion
  - Documentation and Paper Writing

Plan Of action

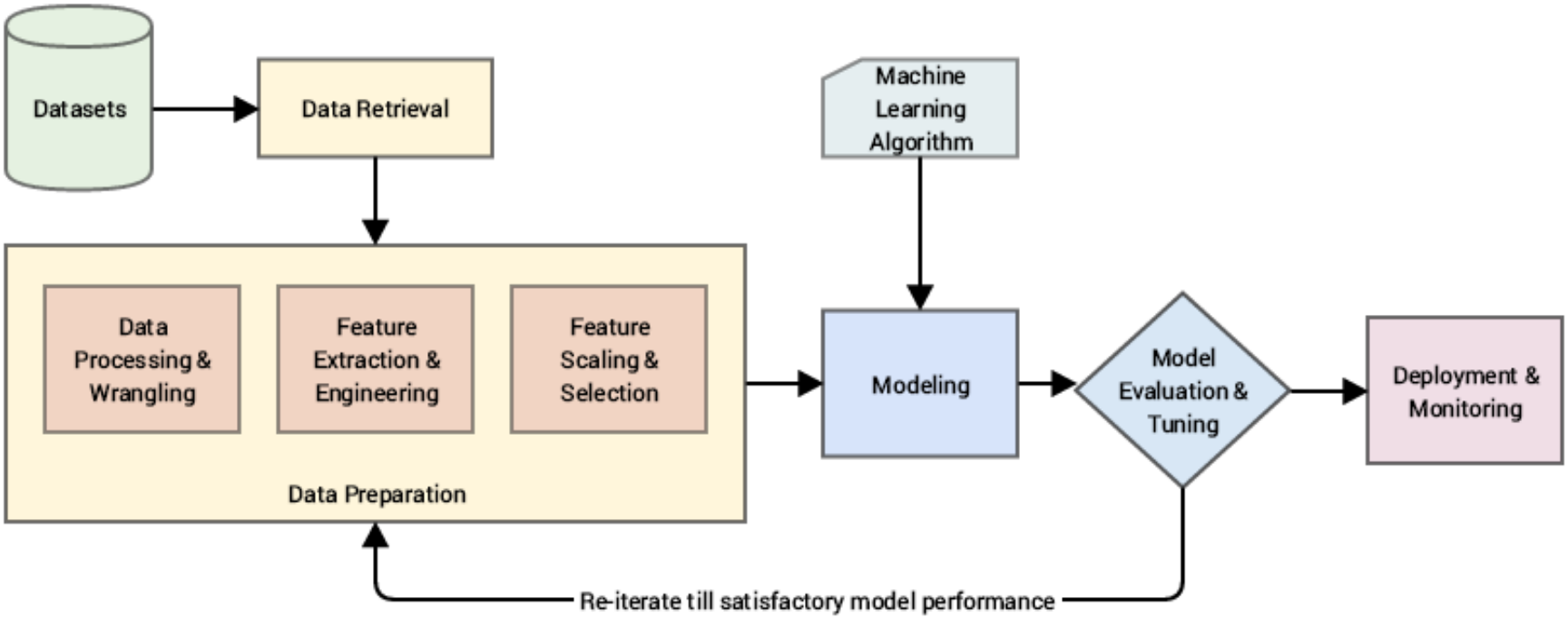

Figure: Flow Diagram

Expected research outcome

- Accuracy (on Test Data)
- AUC (Area Under ROC Curve)
- Results obtained from proposed model will be comparable with state-of-art literature.

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