一般口演
# 一般口演27
# データ活用・解析
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[4-D-2-OP27-6] Classification of Look-Alike Sound-Alike (LASA) Drug Incidents using deep learning method

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Medication names that look alike and sound alike (LASA) are one of the common causes contributing to medication errors. This study is built upon the foundation of previous probing study of statistical classifiers for identifying medication incidents due to look-alike, sound-alike (LASA) mix-ups published in Health Informatics Journal in 2014. We retrieved two hundred and twenty-seven patient safety incident advisories from the Canadian Patient Safety Institute’ s GPSA system with the indication of LASA case binary marker. The study aims to assess the performance of deep neural network (DNN) models in classifying LASA incident reports, and compared the model’ s performance with that of other state of the art classifiers (including logistic regression, support vector machines and the decision-tree method). The base model setting is a 2 hidden layers DNN model with 200 neurons each via rectifier activation function. Ten folds cross-validation result shows that the mean accuracy is at 0.833 at the base DNN model setting. The average values obtained for under the curve (AUC) is reported as 0.921, indicating that the DNN model offered a superior classification approach. The study explores the applicability of using deep learning method for patient safety information retrieval from free-text medical incidence reports.

ディープニューラルネットワークを用いた名称類似に関する薬物事件の分類

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Classification of Look-Alike Sound-Alike (LASA) Drug Incidents using Deep Learning Method

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Abstract: Medication names that look alike and sound alike (LASA) are one of the common causes contributing to medication errors. This study is built upon the foundation of previous probing study of classifiers for identifying medication incidents due to look-alike, sound-alike (LASA) mix-ups published in Health Informatics Journal in 2014. We retrieved two hundred and twenty-seven patient safety incident advisories from the Canadian Patient Safety Institute's GPSA system with the indication of LASA case binary marker. The study aims to assess the performance of deep neural network (DNN) models in classifying LASA incident reports, and compared the model's performance with that of other state of the art classifiers (including logistic regression, support vector machines and the decision-tree method). The base model setting is a 2 hidden layers DNN model with 200 neurons each via rectifier activation function. Ten folds cross-validation result shows that the mean accuracy is at 0.833 at the base DNN model setting. The average values obtained for under the curve (AUC) is reported as 0.921, indicating that the DNN model offered a superior classification approach. The study explores the applicability of using deep learning method for patient safety information retrieval from free-text medical incidence reports.

Keywords: Natural language processing, Deep neural network, Medication errors

1.Introduction

It has been recognised that medication names that look-alike and sound-alike (LASA) are one of the most common cause of medication errors [1]. According to the reported pharmaceutical near-miss events occurred at pharmacies conducted by the Japan Council for Quality Health Care (JQ), drug mix-up due to similar product name contributed to about 13% of the total drug dispensing incidents in April to December 2009 [2].

Text classification is an important means of quantitatively analysing a large amount of mined textual data on reported patient incidents. State-of-the-art models were used to model high-level abstractions of textual incident data – some example of these models are logistic-regression models [3], support vector machines (SVMs) [4] and decision trees [5]. Previous study has successfully developed statistical classification of drug incidents for look-alike sounds-alike mix-ups using machine learning methods and achieved reasonable performance on the classification task [5].

Recently received high attention in machine learning discipline, deep neural network (DNN) is artificial neural networks (ANNs) with multiple layers of nodes between input and output. The use of deep-learning algorithms has achieved some major advancement [6, 7] in the extraction of intricate structures from large datasets, particularly those containing high-dimensional data. Deep-learning approaches can be used to build models composed of multiple processing layers, offering insights into hidden representations of data. Incorporating more hidden layers, this methodology enables complex nonlinearity functions to be nested and networked to represent more complicated functions. DNNs have recently been applied in various domains - including natural language processing [8], image recognition, speech recognition, drug discovery and genomics, and achieved dramatically improvement on the performance in comparison with the state of the art models [7].

The aim of this study is to explore deep learning classification performance for LASA incident identification using free-text incident related reports, referencing the natural language processing (NLP) research framework established by previous probing study [5].

2. Methods

In this study, we utilised the medication related advisories in textual format obtained by the Global Patient Safety Alerts (GPSA) [9]. Developed by the Canadian Patient Safety Institute with the support of World Health Organization (WHO), GPSA is a global platform for sharing patient safety information with

frontline healthcare providers and healthcare organisations worldwide. It incorporates patient safety alerts, advisories and recommendations collected from the contributing organisations from Japan, Hong Kong, Australia, Canada, Demark, and the US and provides access to patient safety incident advisories grouped into medications, devices, surgery, care management, suicide, and blood products/transfusions. Two hundred and twenty-seven patient safety incident advisories from the Canadian Patient Safety Institute's GPSA system with the indication of LASA case binary marker were used. We followed the procedure of structured data preparation given in [5] to pre-process the structured mined text and obtain features set.

We classified LASA case via DNN as a means of analysing GPSA medication related advisories and evaluate the performance of those DNN models. Increased computational power and data availability enable deep-learning tasks to be conducted. Beginning with an input layer that matches the feature space, the weighted combination $\alpha = \sum_{i=1}^{n}(w_i x_i + b)$, where bias *b* accounts for the neurons' activation threshold. DNN models train multiple layers in a non-linear fashion and terminate with signals, *f(α)*, to match the output space for classification [10]. We tested classification performance with 2 hidden layers and each hidden layer consists of 200 neurons. Nonlinear activation functions of rectifier without dropout were utilised. To ensure the stability of the experimental results, we made the DNN model function reproducible by setting a fixed seed and running the model on one thread pool during the training phase. Ten folds cross-validation was performed and the performance of the models was reported relative to the threshold of the highest F1 score. Classifier performance from 10-fold cross-validation using the metrics of specificity, sensitivity, F1 score, accuracy and area under the receiver operating characteristic (ROC) curve (AUC) are reported as means and standard deviations. An h2o environment [10] running on R platform was set up. Deep-learning computations were performed in the h2o cluster and initiated by the h2o R package [11].

3. Results and discussion

The cross-validation results were shown in Table 1. The results indicate that the DNN mean accuracy is at 0.833 (standard deviation: 0.201). In comparsion of previously reported best performed classifiers using logistic regression models [5], the DNN model achieved percentage increases of sensitivity of 46%, F-score of 30%. The average AUC values of DNN model is reported as 0.921 (standard deviation: 0.058), indicating that the DNN model offered a superior classification approach on this problem.

Cross-Validation Performance Evaluation Metrics Summary	**Mean**	**Standard Deviation**
Accuracy	0.833	0.201
Precision	0.710	0.232
F-score	0.747	0.196
Sensitivity (recall)	0.773	0.216
Specificity	0.855	0.207
AUC	0.921	0.058

We explored the performance of DNN models in classifying LASA incident reports in this study. It is noted that DNN model potentially bypasses the feature selection steps and analyzes the tokenized text directly. This could be experimented in future studies. Furthermore, the DNN model settings that fit for this kind of textual-based medication safety learning problem can be further investigated.

4. Conclusion

This study is built upon the foundation of previous probing study of statistical classifiers for identifying medication incidents due to look-alike, sound-alike (LASA) mix-ups published in Health Informatics Journal in 2014 and explores the applicability of using deep learning method for patient safety information retrieval from free-text medical incidence reports.

Acknowledgements

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