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Modelling methods of artificial intelligence in medical application

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Abstract. Artificial intelligence is a branch of computer science, an intelligent system that can simulate human thinking, recognize complex situations, acquire learning abilities and knowledge, and solve problems. With the continuous development of information technology, artificial intelligence techniques are increasingly being improved and applied to large-scale genetics research, image detection and classification in medicine. Predictive models for medical data can be built using a wide range of machine learning algorithms: decision trees, multilayer perceptrons, plain Bayes, random forests, and support vector machines, etc., thus processing massive, high-dimensional data and conducting medical research. This paper addresses the specific applications of artificial intelligence in medical practice.

Keywords: artificial intelligence, medical machine learning, artificial intelligence.

1. Introduction

There will be an explosion of medical data as electronic health records, high-resolution digital imaging, histology, and smart wearables become increasingly common. Precision medicine's tendency to rely on big data will result in significant shifts in healthcare's educational system, research paradigm, and way of thinking. Clinicians will need to employ computers to analyze and interpret numerous reports and records in order to extract pertinent information and make treatment decisions because the complexity and diversity of medical information greatly exceeds the capacity of the human brain for thought and analysis [1].

John McCarthy coined the phrase "artificial intelligence" in 1956 at the Dartmouth Conference, referring to the use of computers to mimic human-level reasoning and intelligence. After fifty years of progress, big data, cloud computing, and the Internet of Things, as well as the emergence of deep neural networks, helped to usher in a new era for artificial intelligence research and application around 2010. After computers and information technology, artificial intelligence is regarded as the next major advancement that will have a significant impact on medical research, medical technology, and even the healthcare system [2].

Machine learning, which first appeared in the 1960s and 1970s, uses an algorithm rather than a specific program to automatically evaluate data, extract features, and eliminate redundant and irrelevant data. In the 1990s, machine learning had a boom and started to be applied to "big data" analysis. Deep neural networks for image identification, speech recognition, and text extraction, machine learning for medical large data mining, natural language processing for speech recognition, and surgical robots are some of the current representative applications of AI in healthcare. In order to complete the transition from the laboratory to the clinic and alleviate the shortage of medical resources, increase diagnostic effectiveness, and boost medical quality, these tasks are integrated into medical scenarios or processes, such as disease monitoring, early screening, risk prediction, supporting diagnostic and treatment decisions, developing new therapies, etc.

The potential uses of AI in medicine are limitless in the present. We urgently need to carry out in-depth research and reflection, organize the discipline's development history, summarize the needs for development and the current state of affairs, clarify the key scientific problems of AI in medicine, forecast the future development trend, and offer recommendations on the main axes of our future development strategy.

2. A machine learning based data modeling for medical diagnosis

The approach taken for machine learning-based modeling for the prediction of medical data is described in this section. The two steps of the study methodology are shown in detail in Fig. 1: (1) First Period and (2) Second Period. There are two modules in the first period: (i) Data Acquisition, where medical data is obtained from a nearby healthcare organization as well as benchmarking internet data repository. The sections that follow address the specifics of the considered medical data. The collected medical data is processed (particularly useless and undesired information is removed) and changed into a format that is appropriate for modeling and prediction.

Correlations are found in the methodology's second period. As an input for data prediction, the strongly associated features (i.e., attributes) of the data under consideration are chosen and given the name Selected Features. As a result, in the first period, machine learning algorithms are applied to the entire set of medical data. Additionally, the Selected Features of the medical data are subjected to the same machine learning methods. The second period of the process aids in obtaining predictions that are more accurate than those made in the first period [3].

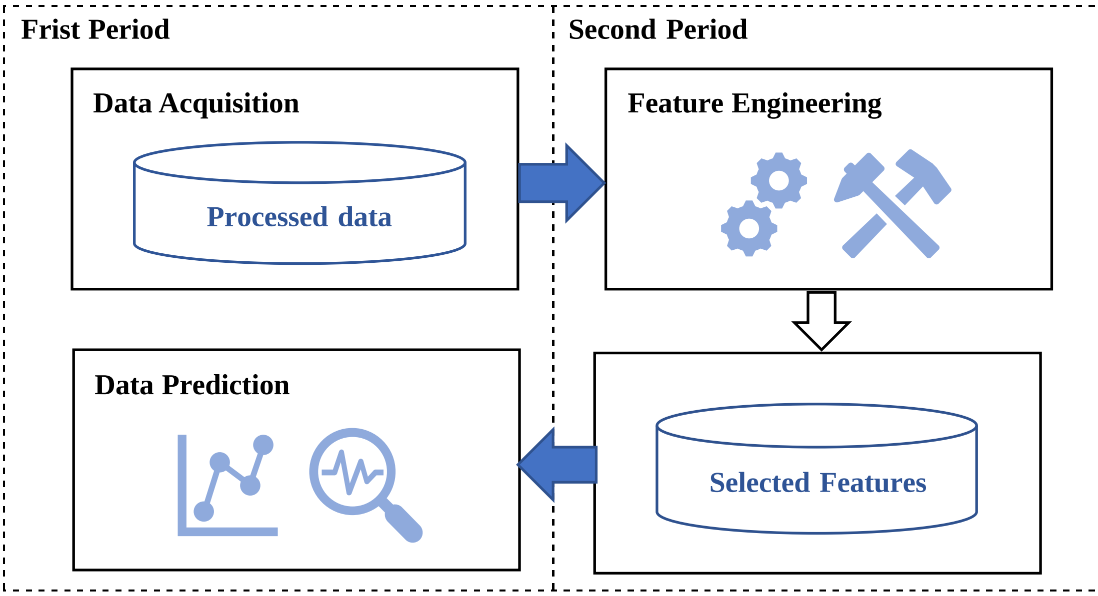

Figure 1. Modeling steps.

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3. Data prediction methodology

3.1. Decision tree (DT)

A supervised learning system with both classification and regression capabilities is the decision Tree (DT) method. The decision tree classification algorithm uses a dataset to generate a tree of conditional probability distributions over the feature space, a collection of association rules focusing on the differences between data categories, which can be used to classify the dataset. When generating a decision tree, the samples contained in the branch nodes of the decision tree should belong to the same class as much as possible. A certain metric is usually needed to indicate the classification ability of the features, and information entropy is one of the most commonly used metrics to indicate the measure of uncertainty of random variables.

3.2. Random forest (RF)

The most typical machine learning prediction method is the random forest (RF) algorithm, which is a classifier containing multiple decision trees. Each classifier is generated using random vectors sampled independently of the input vectors to improve the predictive power of CART.

3.3. Naive bayesian (NB)

The NB algorithm is one of the few classification algorithms based on probability Theorem. According to NB, every attribute of the provided data is self-reliant and contributes equally to the ultimate predictive value. Because NB takes into account each attribute separately, it is quick and insensitive to unimportant data attributes [4].

3.4. Multilayer perceptron (MLP)

Multilayer Perceptron (MLP) is a type of artificial neural network that predicts using backpropagation. MLP typically has several levels, such as an input layer, a hidden layer, and an output layer. The activation function and weights provide the basis for the hidden layer's operation, which may include a number of neurons. MLP often requires more time than other supervised learning algorithms because backpropagation is used to find more accurate predictions and lower error rates [5].

3.5. Support vector machine

The most popular supervised learning methods include Support Vector Machine (SVM). SVM is applied to both linear and non-linear classification issues. SVM is derived using a linear function and is similar to logistic regression. SVM classifies output class identity but does not offer probabilities, in contrast to logistic regression. A given dataset is classified using SVM by locating an n-dimensional hyperplane. When the linear function is positive, the SVM predicts a positive class, and when it is negative, it predicts a negative class. It determines the best decision boundary (also known as a hyperplane), which divides each class in a dataset. SVM typically works better for datasets where there is a distinct margin between each class and the number of dimensions exceeds the number of samples.

4. Applications

4.1. Quality assessment of mass spectrometry files

Mass spectrometry-based quantitative proteomics studies are of great significance to the life sciences and the diagnosis of the occurrence and development of many human diseases by characterizing the dynamic patterns of changes in proteome abundance [6]. A method for analyzing data sequences of mass spectra in quality assessment, comprising: obtaining a collection of data sequences including a plurality of types of mass spectra, wherein each data sequence of mass spectra includes a plurality of mass spectral data, and has a quality marker of the data sequence of mass spectra, and each mass spectral data includes a generation moment and signal intensity of the mass spectral signal; for each data sequence of mass spectra in the collection: mapping the data sequence of mass spectra of data of the mass spectrum to a

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predetermined plurality of generation moments; and normalizing the signal intensity of the mass spectrum data in the data sequence of the mass spectrum; and performing a quality assessment of the data sequence of the mass spectrum to be measured based on the data sequence of the mass spectrum in the set, the type of the data sequence of the mass spectrum, and the quality marker. The flowchart is shown in Figure 2.

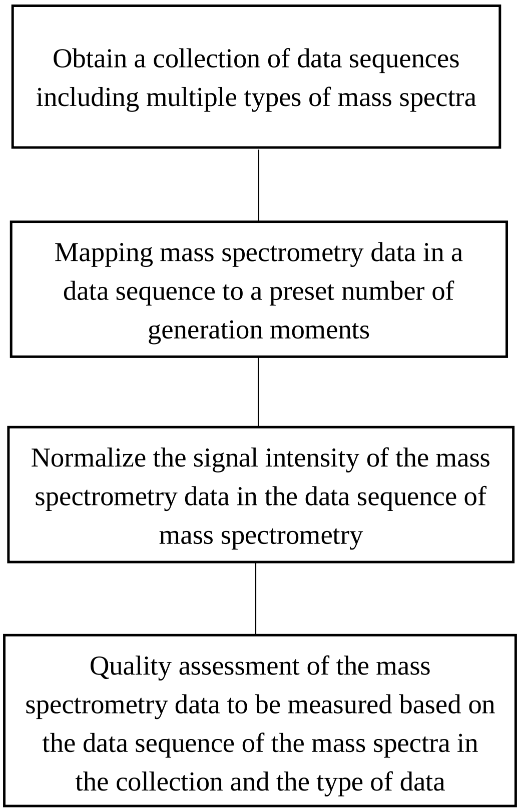

Figure 2. Mass spectrometry flow chart.

Quality assessment is performed by machine learning models: LSTM model, bidirectional LSTM model, Multilayer Perception (MLP) model, Support Vector Machine (SVM) model, Random Forest model or e Xtreme Gradient Boosting (XGBoost) model.

A way of training a machine learning model is described below as an example of a bidirectional LSTM-based neural network model. In some embodiments, for each data sequence of the mass spectrum in the ensemble: the data sequence of the mass spectrum is input to the bidirectional LSTM model; the type of the data sequence of the mass spectrum is encoded; the output of the bidirectional LSTM model and the result of this encoding are spliced to obtain a splicing vector; and the splicing vector is input to the fully connected layer to obtain a prediction result of the fully connected layer. Then, the loss values are determined based on the prediction results corresponding to the data sequences of the mass spectra in the collection and the mass markers, and the parameters of the bidirectional LSTM model and the fully connected layer are adjusted based on the loss values.

In still other embodiments, the parameters of the network are updated using a gradient descent method based on Adam (Adaptive momentum). For example, the initial learning rate is set to 0 .05, such that the parameters in Adam betas = (0 .95, 0 .9995). The probability values are obtained by computerized machine learning models and used as loss functions by calculating the categorical BCE loss (binary cross-entropy loss) between them and the quality markers. By minimizing the loss function, the error gradient can be calculated and the gradient of the network can be updated by back propagation [7].

4.2. Quantum machine learning in medical image analysis

More and more studies have recently used machine learning techniques to advance the state of medical image analysis (MIA), in response to the characteristics and growing amount of medical image data. Quantum computing is one of the most widely used computer paradigms for modulating quantum information units for computation. It is based on the principles of quantum physics.[6]

Classification, which is the process of predicting discrete categories of data objects using a function that establishes the category to which the incoming data belongs. Binary classification problems and multi-classification problems are two categories of classification. The three steps that make up the categorization task solution are as follows: Identifying the model f(x), together with the category to which it belongs and the inputs and outputs, 2) creating the loss function L(f), and 3) identifying the most advantageous parameters that lessen the loss function. Decision trees, support vector machines, k-nearest neighbors and Bayesian are all respectable answers for the classification problems among the different technical techniques of machine learning. Classification is a common task in machine learning and is important [8].

5. Conclusion

With the continuous development of medical-industrial integration, artificial intelligence technology has become an integral part of medical applications. Artificial intelligence-based intelligent diagnosis and health management is reflected in the whole process of patient's access to medical care, which provides comfort to the beneficiaries of medical care conditions [9]. It also brings technological upgrades and intelligent management for doctors and hospitals. However, there are still problems in the application of AI technology in the medical field, such as technology and talents, which have become bottlenecks in the development of medical-industrial integration. In order to solve the problems correctly and reasonably, promote the integration of technology and accelerate the training of talents, the transformation of traditional medical treatment to intelligent medical treatment can be realized, and then promote the further development of the medical field [10].

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