Lee Silverman Voice Treatment (LSVT) SYSTEM for ASSESSING the VOCAL PERFORMANCE As ACCEPTABLE or UNACCEPTABLE

Sohaila Mohamed, Ahmed Gamal, Amr Abdelsalam, Mohamed Gamal, Shrouk Abdallah.

Abstract in this paper, a Lee Silverman Voice Treatment (LSVT) system made for assessing the vocal performance as acceptable or unacceptable. This assessment may be considered as a binary classification problem. Vocal performance degradation is a common symptom for the vast majority of Parkinson's disease (PD) subjects, who typically follow personalized one-to-one periodic rehabilitation meetings with speech experts over a long-term period. The classifier is a binary classifier; meaning that we have only 2 classes to decide between: The required system needs to state whether the patient's voice is acceptable or unacceptable.

I. INTRODUCTION

Lee Silverman Voice Treatment is a treatment for speech disorders associated with Parkinson's disease (PD). It focuses on increasing vocal loudness and is delivered by a speech therapist in sixteen one-hour sessions spread over four weeks. A derivative of this treatment, known as LSVT BIG, is used in treating movement aspects of Parkinson's disease. Thus, we are classifying the patients into having this this disease or not, healing or not.

We have two mechanisms to do this process, First: **NAIVE BAYES[2]** classifiers are a family of simple probabilistic classifiers based on applying Bayes' theorem with strong (naive) independence assumptions between the features. Naive Bayes classifiers are highly scalable, requiring a number of parameters linear in the number of variables (features/predictors) in a learning problem. Maximum-likelihood training can be done by evaluating a closed-form expression which takes linear time, rather than by expensive iterative approximation as used for many other types of classifiers.

It is a simple technique for constructing classifiers: models that assign class labels to problem instances, represented as vectors of feature values, where the class labels are drawn from some finite set. There is not a single algorithm for training such classifiers, but a family of algorithms based on a common principle: all naive Bayes classifiers assume that the value of a particular feature is independent of the value of any other feature, given the class variable.

The other one is **KKN[3]** the k-nearest neighbors algorithm is a non-parametric method used for classification and regression. In both cases, the input consists of the k closest training examples in the feature space. It is based on feature similarity: How closely out-of-sample features resemble our training set determines how we classify a given data point.

KNN is a type of instance-based learning, or lazy learning, where the function is only approximated locally and all computation is deferred until classification. The k-NN algorithm is among the simplest of all machine learning algorithms both for classification and regression, a useful technique can be used to assign weight to the contributions of the neighbors, so that the nearer neighbors contribute more to the average than the more distant ones.

II. MATERIALS AND METHODS

i. EQUATIONS

1. NAIVE BAYES

$$p(c|E) = \frac{p(E|c)p(c)}{p(E)}.$$

And, classify with:

$$f_{nb}(E) = \frac{p(C=+)}{p(C=-)} \prod_{i=1}^{n} \frac{p(x_i|C=+)}{p(x_i|C=-)}.$$

2. KNN

In the classification setting, the K-nearest neighbor algorithm essentially boils down to forming a majority vote between the K most similar instances to a given "unseen" observation. Similarity is defined according to a distance metric between two data points. A popular choice is the Euclidean distance given by:

$$d(x, x') = \sqrt{(x_1 - x'_1)^2 + (x_2 - x'_2)^2 + \ldots + (x_n - x'_n)^2}$$

ii. DATA SET[1]

The dataset was created by Athanasios Tsanas (tsanasthanasis '@' gmail.com) of the University of Oxford, extracting clinical information from speech signals which were provided by LSVT Global, a company specializing in voice rehabilitation. The original study used 309 algorithms to characterize 126 speech signals from 14 people, a robust feature selection mechanism to determine the most parsimonious feature subset, and Support Vector Machines (SVM) and Random Forests (RF) to predict the binary response (acceptable vs unacceptable phonation during rehabilitation). Both cross-validation (10-fold cross validation with 100 repetitions for statistical confidence) and leave one subject out methods were used for the validation of the findings. In both cases we demonstrated a near 90% accurate replication of the clinicians' assessment.
(http://archive.ics.uci.edu/ml/datasets/LSVT+Voice+Rehabilitation#.).

III. RESULTS AND DISCUSSION

	HOLD OUT		K-FOLD	
	NAIVE	KNN	NAIVE	KNN
Accuracy	61.66%	65.8%	63.89%	66.7%
Sensitivity	100%	-	100%	-
Specificity	87.5%	-	45.83%	-

IV. CONCLUSION

All given features are splinted into training and test sets then reduced to be ready for classification, then getting the probability of each features given the class. Furthermore, they all multiplied in order to get the probability of all features given the class.

V. REFERENCE

[1]

http://archive.ics.uci.edu/ml/datasets/LSVT+Voice+Rehabilitation#

[2]
https://en.m.wikipedia.org/wiki/Naive_Bayes_classifier

https://www.geeksforgeeks.org/naive-bayes-classifiers/

https://www.dataschool.io/simple-guide-to-confusion-matrix-terminology/

[3]
https://kevinzakka.github.io/2016/07/13/k-nearest-neighbor/