Tatami Grammatical Evolution for Feature Extraction with Multi Fitness Evaluation

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Abstract

Feature Extraction is a significant topic in classification problem solving. Until now, there is no such a standard way to determine the best features of a data. In this thesis, grammatical evolution with multiple fitness evaluation approach (named as GE Tatami) has been developed in order to extract best features of the data. The method generate n-1 features which are able to separate data hierarchically, with n is number of classes.

Some methods has been evaluated in this research, including genetics algorithm, grammatical evolution with global fitness measurement, grammatical evolution with multi fitness measurement, grammatical evolution with Tatami fitness measurement, and Gavrilis's grammatical evolution.

It is shown in the experiment that Tatami method produce a better result compared to the four other methods for synthesis data using decision tree classifier. The synthesis data is hierarchicaly separable. However Tatami method show a bad result when it is failed to determine ideal features or using SVM classifier.

***Index Terms* — Keywords: feature extraction, grammatical evolution, classification, multi-fitness.**

I. INTRODUCTION

Feature Extraction is a process to determine transformation mapping of original features set into new features set that will produce better class separability [5]. Feature extraction is a significnt topic in classification problem. Good features set can boost classification accuracy, while bad features set tend to make classification accuracy worse.

Some genetics algorithm based method has been developed to extract features. In [3] and [4], grammatical evolution has been conducted for feature extraction purpose. The authors create a method that produce a set of new feature with classifier's accuracy as fitness function. In [5] and [6], similar method has also been used for different cases. However, sometime there are unusefull features produced and attached in a new feature set.

In [1], the authors create a new approach by measure per-feature accuracy rather than using a set of features altogether as a fitness function. However, this tend to produce bad accuracy since only one feature used to separate the data.

In this paper, we propose a multi fitness evaluation to hierarchicaly separate the data. This multi fitness evaluation is named as Tatami Grammatical Evolution (GE Tatami) since it show a figure looks like Japanese traditional tatami. We also provide several previous methods as comparison.

II. DATA AND FEATURE SPACE

A data usually consists of several features (also called as dimension). Given a set of data, as in table 1.1, one can say that there are two features, x and y, and 3 classes (A, B and C).

Since the data consists of 2 dimension, it is possible to plot it in order to produce better visualization. Figure 1.1 show how the data plotted.

As shown in the plot, it is impossible to separate the data by using just one of the features. The features should be used altogether to produce a space that make the data separable.

Table 2.1 Example of Numeric Data

Original Features		**Class**
x	**y**	
0.3	0.5	A
0.4	0.9	B
0.6	0.2	A
0.9	1.0	C
1.0	0.3	C
0.8	0.2	B
...	...	...

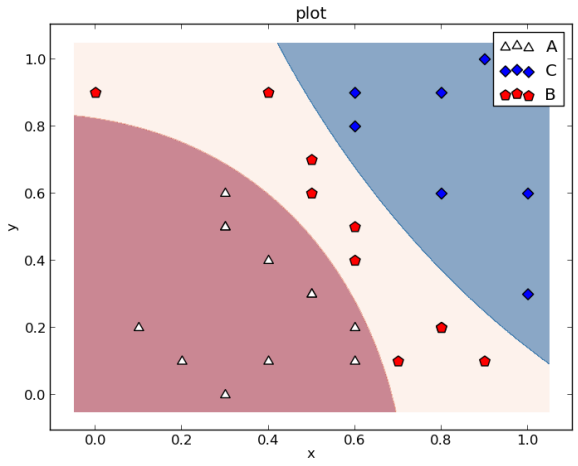

Figure 2.1 Feature Space Produced by Original Features and Classification Process by Using RBF SVM

A commonly used classifier such a SVM or neural network can separate the data very well. However the separation cannot be done linearly. The separator line should be a bit curvy which is mathematically complex.

III. FEATURE EXTRACTION

Feature Extraction is basically a mapping from original feature space to another one. The mapping can produce higher dimension, or lower dimension.

In classification problem, it is intuitive to map the unseparated (or dificultly separated) data into higher dimension. Higher dimension tend to produce more possibility to separate the data. However, this will lead to more complex calculation.

The goal of feature extraction is to produce a set of feature that consist of as few as possible member, but also able to separate the data as simple as possible.

In order to explain the purpose of feature extraction, one can transform the data on table 2.1 which consists of 2 features (x and y) into a new feature space containing just 1 dimension, sqr(x)+sqr(y). The feature space is shown as in figure 3.1

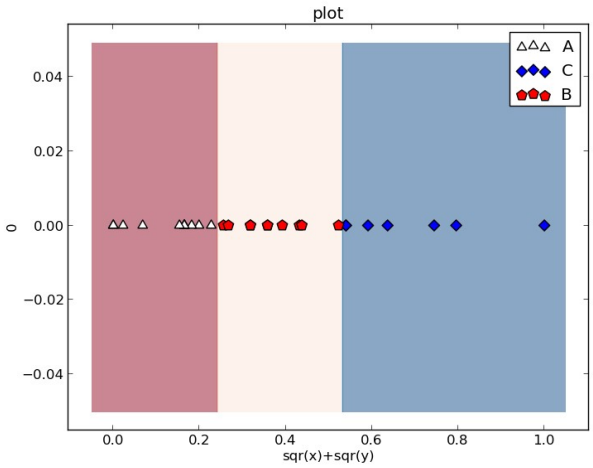

Figure 3.1 Feature Space Produced by New Feature (sqr(x)+sqr(y))

IV. CONCLUSION

The conclusion goes here.

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The authors would like to thank...

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