THE COMPARISON OF THE POTENTIAL PROCEDURE WITH THE FIXED FRACTION PROCEDURE

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Abstract. *The Potential Procedure (PP) and the Fixed Fraction Procedure (FFP) are two methods which are used in artificial learning theory. The artificial process of learning of intelligent machines is possible by using the conexioniste models. For training these models we dispose by several training methods from which take part PP and FFP. This paper studies the advantages and disadvantages of use one or other from these two methods.*

1. Introduction

The classification theory is one of the statistical parts in which is applied the conexionists models and their procedures (see [3], [4]). The PP and FFP are two training methods based on error correction that would be appear when an object is incorrect classified. This paper contains a comparative study of these two artificial learning classifier training methods in case of existence of much more than two classes. The methods for two classes are in extenso presented in Dumitrescu [1]. Other authors also made a lot of work in this area (see [2], [5], [6], [7]).

Let $A_1, A_2, ..., A_n$ linear separable classes from R^d and a learning set $x^1, x^2, ..., x^p$ with $x^i = \left(x_1^i, x_2^i, ..., x_d^i\right)$, $x^i \in R^d$

These vectors form the learning set and if they are taken infinite times then form the learning sequence.

Both of the methods taken in discussion, consider defined a decision function $g(x)$, but for each method this decision function has a different expression. More exactly, for PP the decision function is equal with one of potential function, here we consider the following potential function (see [1]):

$$K\left(x, x^i\right) = \frac{1}{1 + a^2 \left\|x - x^i\right\|^2}$$

and total potential: K: $R^d \to R$

$$K(x) = \sum_{k=1}^{p} q_k K\left(x, x^k\right)$$

In the potential function definition q_k is the charge placed in x^k.

The PP method has the decision function: g(x)=K(x)

For FFP the decision function is linear and has the expression:

$$g\left(x^i\right) = w_i^T x^i$$

where w_i is the weight vector.

2. A Comparative study

Our comparative study searches the answer of the following question: *Which of the methods is the most preferable when the number of classes is small and which is the most preferable when the number of classes is increased.*

For this aim we implemented both of the methods and made some calculation in Microsoft Excel for the three examples. First example is for three classes, the second one is for four classes and the last example is for five classes. We observe the number of steps that are needed for to arrive at the correct classification. For the PP method we considered the a=1 and the point charge the unit.

Example 1. For learning set x^1, x^2, x^3, x^4 with $x^i \in R^4$

$x^1 = (1,2,0.2,1)$, $x^2 = (4,1,0,1)$, $x^3 = (4,0,0,1)$, $x^4 = (2,0,1,1)$

$x^1 \in A_1$, $x^2 \in A_2$, $x^3 \in A_2$, $x^4 \in A_3$

FFP gives the correct classification after five steps.

i	w_1^i	w_2^i	w_3^i
1	**(2,3,1,2.3)**	**(5,2,6,1)**	**(4,2,7,2)**
2	**(0.6,9.1,1.7,4.7)**	**(4.3,-0.7,3.6,-1.6)**	**(6,-1.4,8.5,2.1)**
3	**(0.6,9.1,1.7,4.7)**	**(7.6,0.1,3.6,-0.7)**	**(2.7,-2.3,8.5,1.3)**
4	**(0.6,9.1,1.7,4.7)**	**(10.8,0.4,1.1,-1.2)**	**(-0.4,-2.6,11.1,1.8)**
5	**(0.6,9.1,1.7,4.7)**	**(6.8,0.4,-0.8,-3.2)**	**(3.5,-2.6,13.1,3.8)**

PP gives the correct classification after four steps.

Example 2. For learning set x^1, x^2, x^3, x^4 with $x^i \in R^4$

$x^1 = (1,0.2,0.2,0)$, $x^2 = (0,1,1,1)$, $x^3 = (3,0,1,1)$, $x^4 = (4,0,1,0)$

$x^1 \in A_1$, $x^2 \in A_2$, $x^3 \in A_3$, $x^4 \in A_4$

FFP gives the correct classification after nine steps.

i	w_1^i	w_2^i	w_3^i	w_4^i
1	**(0,1,1,2.3)**	**(1,0,8,0)**	**(1,2,0,9)**	**(0,3,1,0.3)**
2	**(0.1,8.1,1,2.3)**	**(1.3,-0.5,0.1,-1.5)**	**(-1.1,1.1,7.9,1.1)**	**(1.6,4.1,0.7,8.7)**
3	**(0.4,5.3,1,7.3)**	**(3.3,0.1,7.9,-0.5)**	**(2.2,-0.3,7.5,0.3)**	**(0.5,3.1,9.3,4.9)**
4	**(0.4,5.3,1,7.3)**	**(6,-1.4,8.5,2.1)**	**(-0.9,-3.7,1.1,0.8)**	**(0.2,9.1,-1.5,3.7)**
5	**(0.4,5.3,1,7.3)**	**(4.8,0.4,0.1,-0.2)**	**(0.5,-1.6,11.1,2.9)**	**(2.8,2.8,1.2,2.2)**
6	**(0.4,5.3,1,7.3)**	**(4.8,1,0,-1.1)**	**(1,0.2,7.8,-2.9)**	**(3.2,-3.1,1,2.3)**
7	**(0.4,5.3,1,7.3)**	**(4.8,-0.5,2.6,-1.1)**	**(2,-1.4,1.5,-5.1)**	**(1.3,9.0,1.7,5.6)**
8	**(0.4,5.3,1,7.3)**	**(1.9,0.1,2.5,-0.2)**	**(3.7,-0.3,6.5,1.3)**	**(0.7,1.1,0.1,1.8)**
9	**(0.4,5.3,1,7.3)**	**(0.8,0.5,-1.7,-0.2)**	**(-1.4,1.6,1.1,-1.4)**	**(1.4,0.1,1.6,-4.1)**

PP gives the correct classification after twenty steps.

Example 3. For learning set $x^1, x^2, x^3, x^4, x^5, x^6, x^7$ with $x^i \in R^4$

$x^1 = (1,0.2,0,1)$, $x^2 = (0,1.1,0,1)$, $x^3 = (4,1,0,1)$, $x^4 = (0.3,0,4,1)$, $x^5 = (1,3,1,0)$, $x^6 = (3,0,0,1)$, $x^7 = (1,1,0,0)$

$x^1 \in A_1$, $x^2 \in A_2$, $x^3 \in A_2$, $x^4 \in A_3$, $x^5 \in A_4$, $x^6 \in A_4$, $x^7 \in A_5$

FFP gives the correct classification after seven steps.

i	w_1^i	w_2^i	w_3^i	w_4^i	w_5^i
1	**(1,0,1,8.3)**	**(4,2,4,1)**	**(3,0,3,2)**	**(0,1,1,1.3)**	**(8,1,2,1)**
2	**(1,0.1,7.8,0.7)**	**(3.3,1.5,1.1,-0.7)**	**(3,-4.4,0.5,8.1)**	**(1.6,4.3,1.4,2.8)**	**(1.3,0.8,-3.6,2.6)**
3	**(1,0.3,5.3,1.1)**	**(0.4,0.2,2.4,-0.5)**	**(2.6,-5.3,8.7,0.3)**	**(1.6,4.3,1.4,2.8)**	**(1.4,0.1,5.5,-8.0)**
4	**(1,0.3,5.3,1.1)**	**(10.9,0.7,1.6,-0.2)**	**(-2.4,-2.6,1.1,11.8)**	**(1.6,4.3,1.4,2.8)**	**(1.4,0.3,0.1,-8.2)**
5	**(1,0.3,5.3,1.1)**	**(6.7,1.6,-0.7,-4.0)**	**(-2.4,-2.6,1.1,11.8)**	**(1.6,4.3,1.4,2.8)**	**(1.4,0.3,0.1,-8.2)**
6	**(1,0.3,5.3,1.1)**	**(6.5,2.0,5.4,-1.1)**	**(-2.4,-2.6,1.1,11.8)**	**(1.6,4.3,1.4,2.8)**	**(1.4,0.3,0.1,-8.2)**
7	**(1,0.3,5.3,1.1)**	**(6.3,-0.9,2.6,-1.5)**	**(-2.4,-2.6,1.1,11.8)**	**(1.6,4.3,1.4,2.8)**	**(1.4,0.3,0.1,-8.2)**

PP gives the correct classification after thirty steps.

3. Conclusions

The purpose of this study has been to explore when one of these two methods is better to be applied when we dispose of many classes. We saw how the PP gives good results when the number of classes is small and when we increase the number of classes we saw that the FFP gives better results.

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