Primal least squares twin support vector regression

原空间最小二乘孪生支持向量回归机

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- The training algorithm of classical Twin Support Vector Regression (TSVR) can be attributed to the solution of a pair of quadratic programming problems (QPPs) with inequality constraints in the dual space. However, this solution will be affected by time and memory constraints when dealing with large datasets

- A least squares version for TSVR in the primal space, termed Primal Least Squares TSVR (PLSTSVR), is first presented. By introducing the least squares method, the inequality constraints of TSVR are transformed into the equality constraints. Furthermore, we attempt to directly solve the two QPPs with equality constraints in the primal space instead of the dual space; thus, we need only to solve two systems of linear equations instead of two QPPs

This paper presents two algorithms including linear PLSTSVR and nonlinear PLSTSVR as follows:

Algorithm 1

Input: the datasets.

Output: the results of linear primal least squares support vector regression

Step1: Define $G=[A \quad e]$, $f=Y-e\varepsilon_1$ and $h=Y+e\varepsilon_2$.

Step2: Select suitable up- and down- bound parameters $\varepsilon_1, \varepsilon_2$ and regularization term parameter ω.

Step3: Determine parameters w_1, b_1, w_2, b_2 of two non-parallel functions using (29) and (32).

Step4: Obtain the estimated regressor $f(x)$ using (33).

Algorithm 2

Input: the datasets.

Output: the results of nonlinear primal least squares support vector regression

Step1: Select a suitable kernel function K.

Step2: Define $E=[K(A,A') \quad e]$, $f=Y-e\varepsilon_1$ and $h=Y+e\varepsilon_2$.

Step3: Choose the suitable up- and down- bound parameters $\varepsilon_1, \varepsilon_2$ and regularization term parameter ω.

Step4: Determine parameters w_1, b_1, w_2, b_2 of two non-parallel functions using (41) and (42).

Step5: Obtain the estimated regressor $f(x)$.

Conclusions

In this paper, in order to improve the learning speed of TSVR, we propose a new algorithm called Primal Least Squares TSVR (PLSTSVR). The experimental results on the artificial dataset and 10 UCI benchmark datasets have shown that PLSTSVR compares favorably with SVR, LS-SVR, and TSVR, while PLSTSVR also has a good generalization ability. Finally, PLSTSVR is used to predict the opening price of stock. The experimental results show that PLSTSVR is an effective method in stock prediction.