CS 419 Assignment 1

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Dataset (Computer Hardware)

- Regression
- 10 attributes (6 predictive, 2 non-predictive, 1 goal field, 1 linear-regression’s guess)
- 1. vendor name: 30 (string)
- 2. Model Name: many unique symbols (string)
- 3. MYCT: machine cycle time in nanoseconds (integer)
- 4. MMIN: minimum main memory in kilobytes (integer)
- 5. MMAX: maximum main memory in kilobytes (integer)
- 6. CACH: cache memory in kilobytes (integer)
- 7. CHMIN: minimum channels in units (integer)
- 8. CHMAX: maximum channels in units (integer)
- 9. PRP: published relative performance (integer)
- 10. ERP: estimated relative performance from the original article (integer)

Dataset (contd)

	Min	Max	Mean	SD	PRP Corr
MYCT	17	1500	203.8	260.3	-0.3071
MMIN	64	32000	2868.0	3878.7	0.7949
MMAX	64	64000	11796.1	11726.6	0.8630
CACH	0	256	25.2	40.6	0.6626
CHMIN	0	52	4.7	6.8	0.6089
CHMAX	0	176	18.2	26.0	0.6052
PRP	6	1150	105.6	160.8	1.0000
ERP	15	1238	99.3	154.8	0.9665

Problem

5. Linear regression. In terms of training and test set error, compare solutions with:

   (a) Least-square regression

   (b) Ridge-regression

   (c) Support Vector Regression (L1-Loss Linear SVR[4])

   Wherever required, perform 10-fold cross-validation to choose the best hyper-parameter.

- Compare training and test error from different regressive models(LS regression, ridge regression, L1-support vector regression) on the computer hardware data
- Predict PRP on the basis of values of MYCT, MMIN, MMAX, CACH, CHMIN, CHMAX

Approach

- Read, organise data
- Construct regressive model
  - Select hyper-parameter using 10-fold cross-validation (if applicable)
- Compute training set mean square error
- Compute test set mean square error
- MATLAB - LS regression, Ridge regression
- Python - L1-loss SVR

Approach (contd)

- Least Squares Regression $\hat{\boldsymbol{\beta}} = (X^T X)^{-1} X^T \boldsymbol{y}.$
- Ridge Regression $\widehat{\beta} = (\mathbf{X}^T\mathbf{X} + \lambda\mathbf{I})^{-1}\mathbf{X}^T\mathbf{y}$
- Support Vector Regression

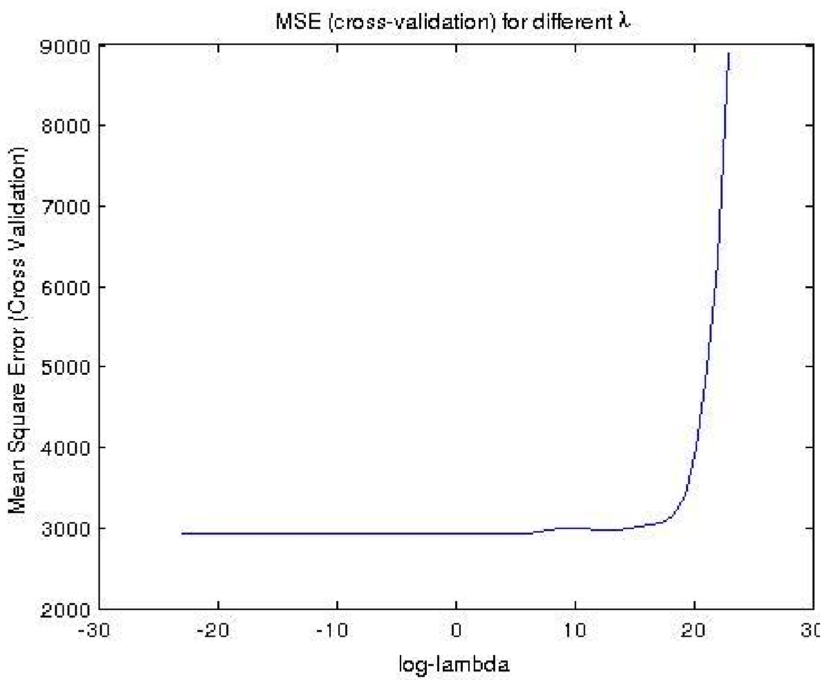
$$\min_{\mathbf{w}} \quad f(\mathbf{w}), \quad \text{where} \quad f(\mathbf{w}) \equiv \frac{1}{2}\mathbf{w}^T\mathbf{w} + C\sum_{i=1}^{l}\xi_\varepsilon(\mathbf{w};\mathbf{x}_i,y_i).$$

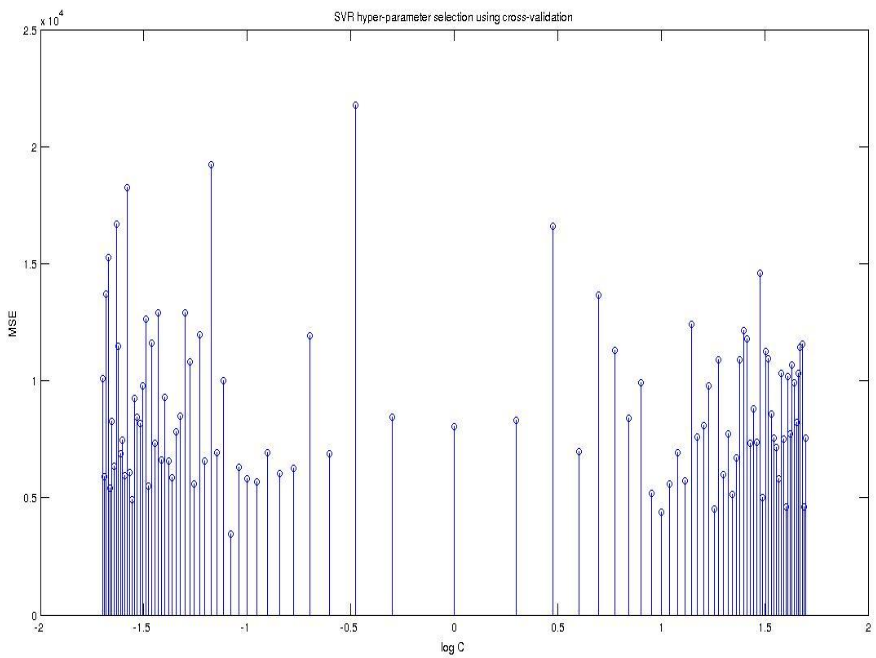
In Equation (1), $C > 0$ is the regularization parameter, and

$$\xi_\varepsilon(\mathbf{w};\mathbf{x}_i,y_i) = \begin{cases} \max(|\mathbf{w}^T\mathbf{x}_i - y_i| - \varepsilon, 0) & \text{or} \\ \max(|\mathbf{w}^T\mathbf{x}_i - y_i| - \varepsilon, 0)^2 \end{cases}$$

Observations

	Training Set MSE	Test Set MSE
Least Squares Regression	1592.1	9390.7
Ridge Regression (λ = 175.7511)	958.66	13326
L1-loss SVR (C = 0.0833)	3459.16	57104.5





Results

- There is overfitting in each of the models, as is evident from the fact that

  testMse > trainMse
- From the values in the previous slide, Least Square Regression model seems to be the optimum on the basis of Test and Train mse

Thank You!