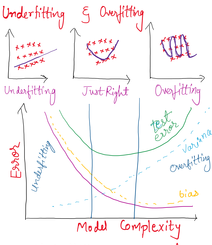
Model Evaluation and Regularization

Saturday, 22 March 2025 7:57 PM

Underfitting & Overfitting



→ Underfitting occurs when a model doesn't give good fit on the training data itself.

→ Overfitting means the model fits training data very well However, performs very badly on unseen data.

→ Typically, too simplistic models tend to underfit and too complex models tend to overfit This is also called bias-variance tradeoff.

→ To prevent underfitting
- Use more training data
- Use slightly more complex model

→ To prevent Overfitting

Regularization

Some Popular Types of Regularization

1. L2 Regularization

Eg: $\|Ax-b\|_2^2 + \lambda \|x\|_2^2$

$\lambda > 0$ (Ridge Regression)

2. L1 Regularization

Eg: $\|Ax-b\|_2^2 + \lambda \|x\|_1$

$\lambda > 0$ (LASSO Regression)

3. Elastic Net Regularization

Eg: $\|Ax-b\|_2^2 + \lambda_1 \|x\|_2^2 + \lambda_2 \|x\|_1$

4. Dropout Regularization

5. Early Stopping.

Model Selection :-
- Use training, validation and test sets
- Create a model using training data
- Tune it using validation set
- Choose a version that performs best on test data

Evaluation Metrics :- (Regression)

i) Mean Squared Error

$$\frac{1}{n}\sum_{i=1}^{n}(\hat{y}_i - y_i)^2$$

ii) RMSE

$$= \sqrt{\frac{1}{n}\sum_{i=1}^{n}(\hat{y}_i - y_i)^2}$$

iii) MAE

$$= \frac{1}{n}\sum_{i=1}^{n}|\hat{y}_i - y_i|$$

Classification :-

Confusion Matrix

Predicted Values \ Actual Values	P	N
P	TP	FP (Type 1)
N	FN (Type 2)	TN

$$\text{Accuracy} = \frac{TP+TN}{TP+TN+FP+FN}$$

$$\text{Precision} = \frac{TP}{TP+FP}$$

$$\text{Recall} = \frac{TP}{TP+FN}$$

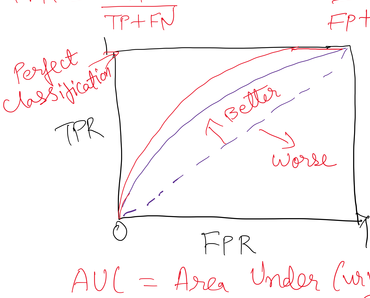
$$\text{F1 Score} = \frac{2}{\frac{1}{\text{Precision}} + \frac{1}{\text{Recall}}}$$

$$= \frac{2(\text{Precision})(\text{Recall})}{\text{Precision}+\text{Recall}}$$

$$= \frac{TP}{TP+\frac{1}{2}(FP+FN)}$$

ROC curve

$$TPR = \frac{TP}{TP+FN} \qquad FPR = \frac{FP}{FP+TN}$$



AUC = Area Under Curve

Higher the better