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Welcome to

INTERNSHIP STUDIO

Module 04 | Lesson 05

Model evaluation and selection

Model Selection

Model Selection is the process of choosing between the different learning algorithms for modelling our data, for solving a classification problem the choices could be made between Logistic Regression, SVM, Tree-based algorithms etc. And for a regression problem decisions also need to be made for the degree of linear regression algorithms.

It is done by comparing various model candidates on chosen evaluation metrics calculated on a designed evaluation schema. Choosing the correct evaluation schema, whether a simple train test split or a complex cross-validation strategy, is the crucial first step of building any machine learning solution.

Model Evaluation

Model Evaluation aims to check the generalization ability of our model, i.e ability of our model to perform well on an unseen dataset. It is done by calculating quantitative performance metrics like F1 score or RMSE or assessing the results qualitatively by the subject matter experts. The machine learning evaluation metrics you choose should reflect the business metrics you want to optimize with the machine learning solution.

How to evaluate machine learning models and select the best one?

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Step 1: Choose a proper validation strategy

Step 2: Choose the right evaluation metric

Step 3: Keep track of your experiment results.

Step 4: Compare experiments and pick a winner

Model selection in machine learning (choosing model validation strategy)

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1. Resampling methods
2. Random Split
3. Time-Based Split
4. K-Fold Cross-Validation
5. Bootstrap

How to evaluate ML models (choosing performance metrics)

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Classification metrics:

	Actual 0	Actual 1
Predicted 0	True Negatives (TN)	False Negatives (FN)
Predicted 1	False Positives (FP)	True Positives (TP)

Accuracy:

$$Accuracy = (TP+TN)/(TP+TN+FP+FN)$$

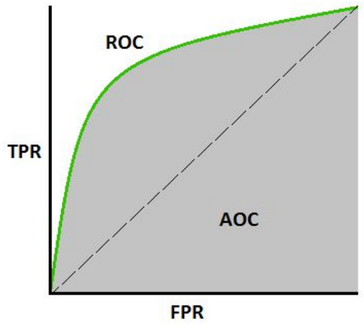
Recall:

$$Recall = TP/(TP+FN)$$

Precision:

$$Precision = TP/(TP+FP)$$

AUC-ROC:



AUC - ROC Curve [Image 2] (Image courtesy: My Photoshopped Collection)

F1 Score:

$$F1Score = 2 * ((precision * recall)/(precision + recall))$$

How to evaluate ML models (choosing performance metrics)

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Regression metrics

Root Mean Squared Log Error or RMSLE

$$RMSLE = \sqrt{\frac{1}{n}\Sigma_{i=1}^{n}(log(x_i+1)) - (log(y_i+1))^2}$$

Mean Squared Error or MSE

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

R Squared

$$R{-}Squared = 1{-}(UnexplainedVariation/TotalVariation) = 1{-}(Variance(model)/Variance(Average))$$

Root Mean Squared Error or RMSE: RMSE is the root of MSE and is beneficial because it helps to bring down the scale of the errors closer to the actual values, making it more interpretable.

Mean Absolute Error or MAE

$$MAE = \frac{1}{n}\sum_{i=1}|x_i - x|$$

How to evaluate ML models (choosing performance metrics)

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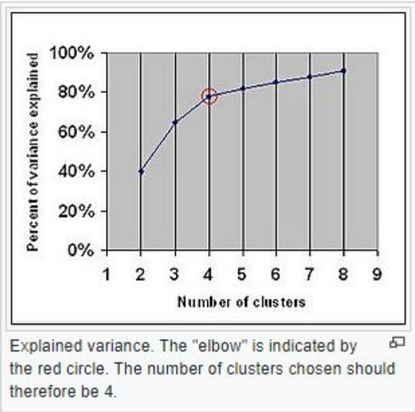
Clustering metrics

Dunn Index

$$Dunn\ index(U) = \min_{1 \le i \le c} \left\{ \min_{1 \le i \le c, j \ne i} \left\{ \frac{\delta(x_i, y_j)}{\max_{1 \le k \le c} \{\Delta(Xk)\}} \right\} \right\}$$

Elbow Method



Explained variance. The "elbow" is indicated by the red circle. The number of clusters chosen should therefore be 4.

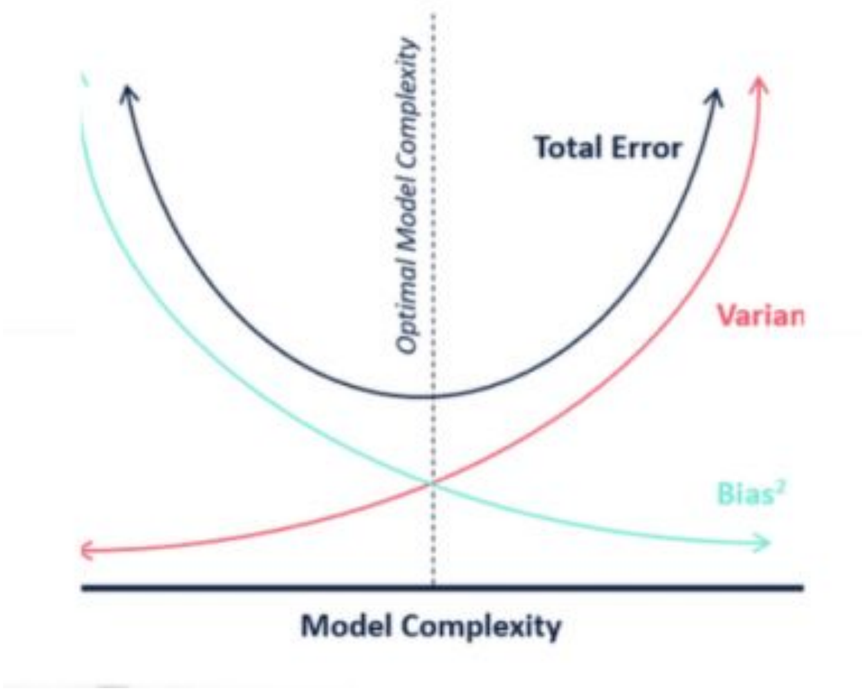
Silhouette Coefficient

Silhouette Coefficient tracks how every point in one cluster is close to every point in the other clusters in the range of -1 to +1.:

- Higher Silhouette values (closer to +1) indicate that the sample points from two different clusters are far away.
- 0 indicates that the points are close to the decision boundary
- and values closer to -1 suggests that the points have been incorrectly assigned to the cluster.

Trade-offs in ml model selection

Bias vs variance



SUMMARY

You got this

- ✔ 1 What is machine learning and its types
- ✔ 2 Learn about Linear regression and other basic algorithm
- ✔ 3 Clustering and classification algorithms
- ✔ 4 Model selection and evaluation

Next session

- 1 Introduction to Artificial neural network and deep learning
- 2 Different algorithms of Deep Learning
- 3 Practical implementation in python