Evaluation

Evaluation Metrics

Breakout task: 15 mins

1. Go to: https://www.kaggle.com/competitions
2. Pick a competition from the list
3. Determine problem type: Classification? Regression? Other?!
4. Read the **Evaluation** tab

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Metrics metrics metrics!

Classification:

- Accuracy (when is this misleading?)
- Mean class accuracy
- Precision:
  - How **precise** are your predictions of class A?
- Recall:
  - Of the data which are truly in class A, how many do you correctly classify?
- F-measures
- Log loss (cross-entropy)
- AUC

Regression:

- RMSE - Root Mean Squared Error
- MAE - Mean Absolute Error
  - When would RMSE > MSE and vice versa
- MSLE - Mean Squared Logarithmic error
  - RMSE but log y and y_{pred}
  - Why?!
- R^2

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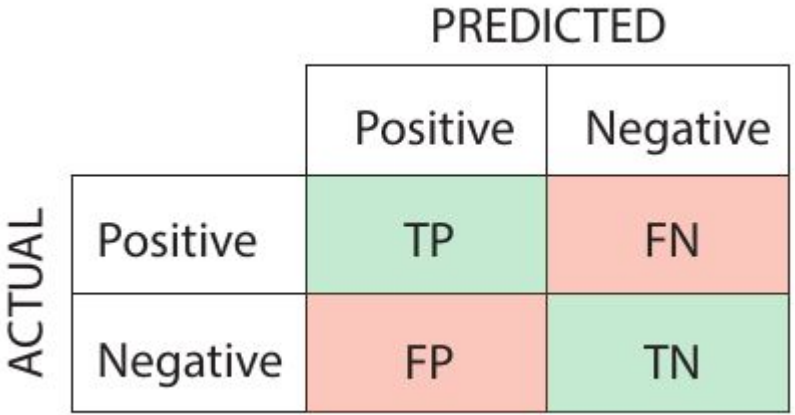
True/False Positives/Negatives

- Confusing Terminology!
- True/False - whether your prediction was correct
- Positive/Negative - the class that you predicted
- Example:
  - A true negative: $y_{pred}=0$ and $y=0$
  - A false positive: $y_{pred}=1$ but $y=0$

Relation to metrics



Accuracy:

(TP + TN) / N

Sensitivity/Recall:

TP / (TP + FN)

Precision:

TP / (TP + FP)

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Hands-on session

evaluation_metrics.ipynb (1 hour)

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Model validation - Hyperparameter tuning example

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Leads to information about the test set being leaked into the model! (overfitting)

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You should only use the test set for a final assessment of the model...

Training-Validation-Testing

1. Take a slice of the training data -> validation set
2. Apply the same procedure as before to adjust the model but using the smaller training set and validation set
3. Report performance on the untouched test set

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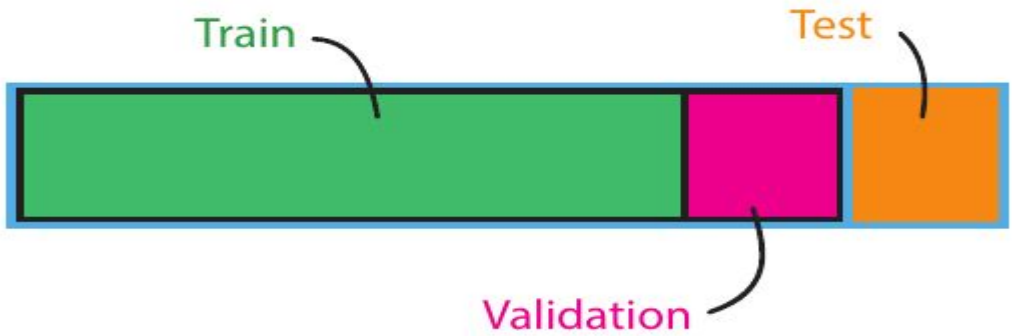

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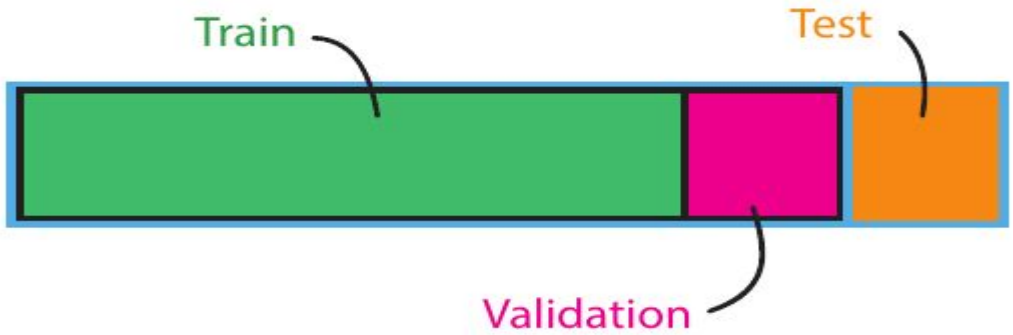

Nice but we're not using the whole training data...

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From validation to cross-validation

We would like to:

- Use something like validation to tune our model without looking at the test set
- Exploit all the data from the initial training set

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N-fold cross validation

1. Shuffle the training set and slice it in N parts (or folds)

For each part n:

2. Hold part n out as validation data
3. Use the rest of data to train the model
4. Evaluate the model on the held out part n

After evaluated on each of the N folds:

5. Average the evaluations
6. Repeat entire process for each model or hyperparameter setting you want to test

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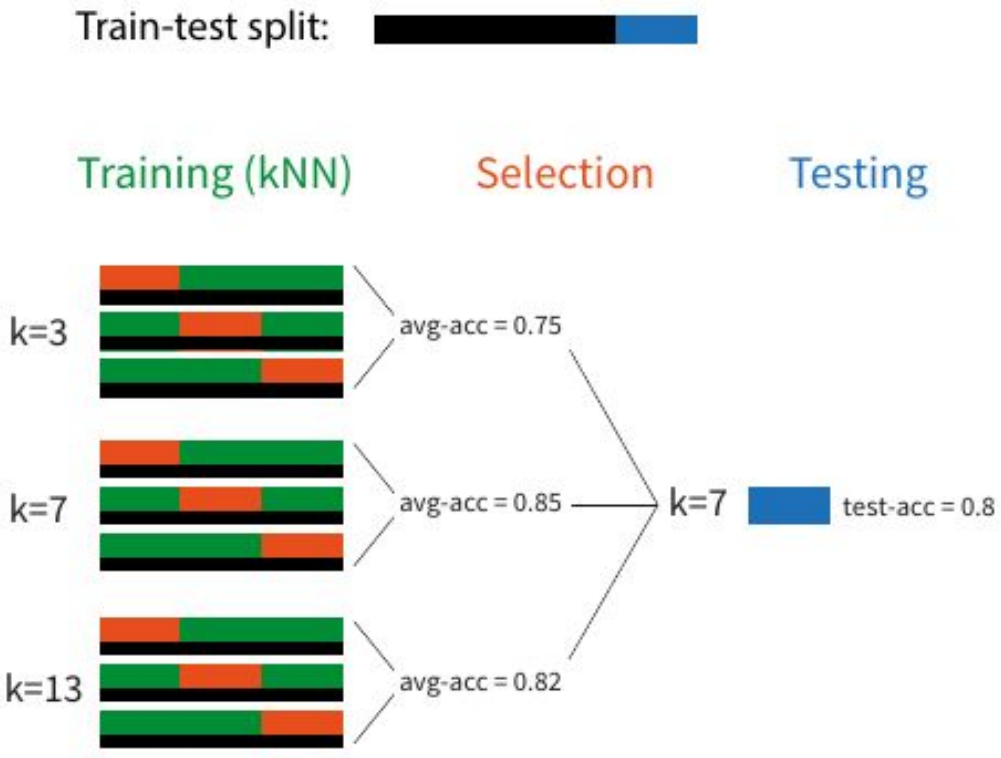
3-fold cross validation example

Here we are doing a hyperparameter comparison of knn with k = {3, 7, 13}.

For each model, we perform 3-fold cross validation.

We then compare the average accuracy and decide to use k=7

Finally, we evaluate on the held out test set.



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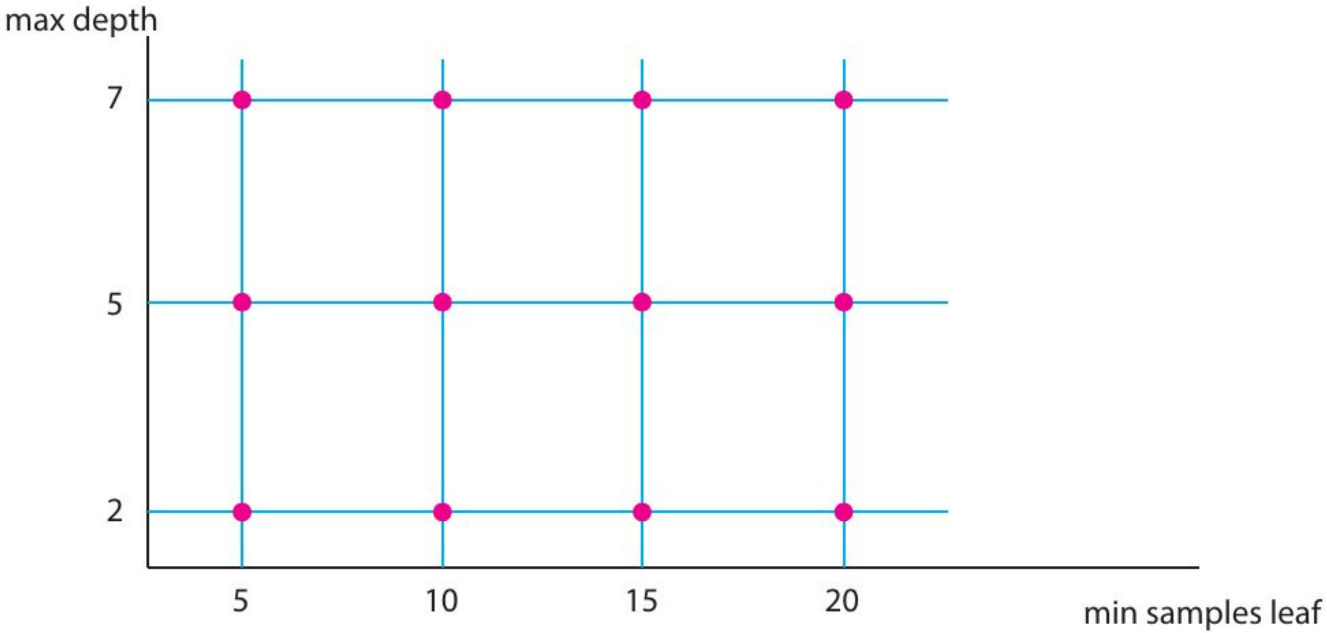
N-fold cross validation

Now that we have a way to evaluate models with different parameters, how do we choose the parameters we want to test?

Grid Search



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Hands-on session

model_validation.ipynb (15 mins)

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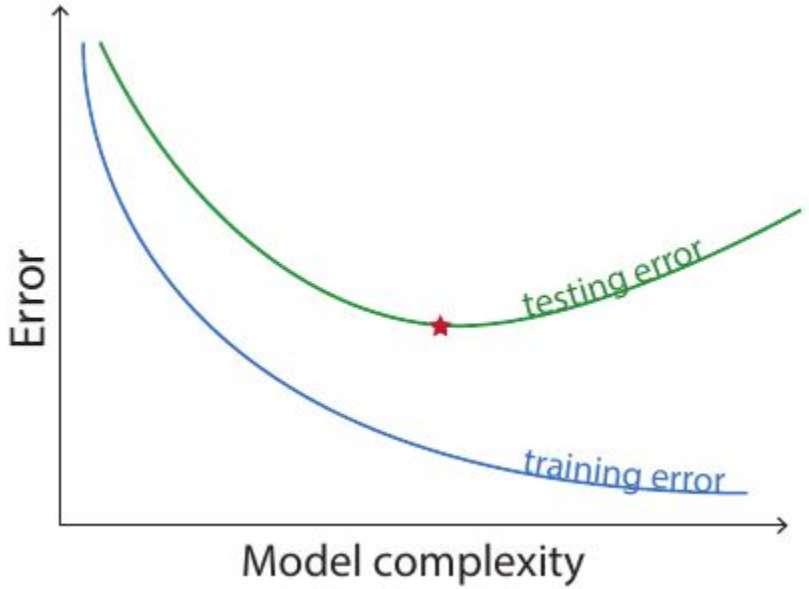
A reminder of the goal...



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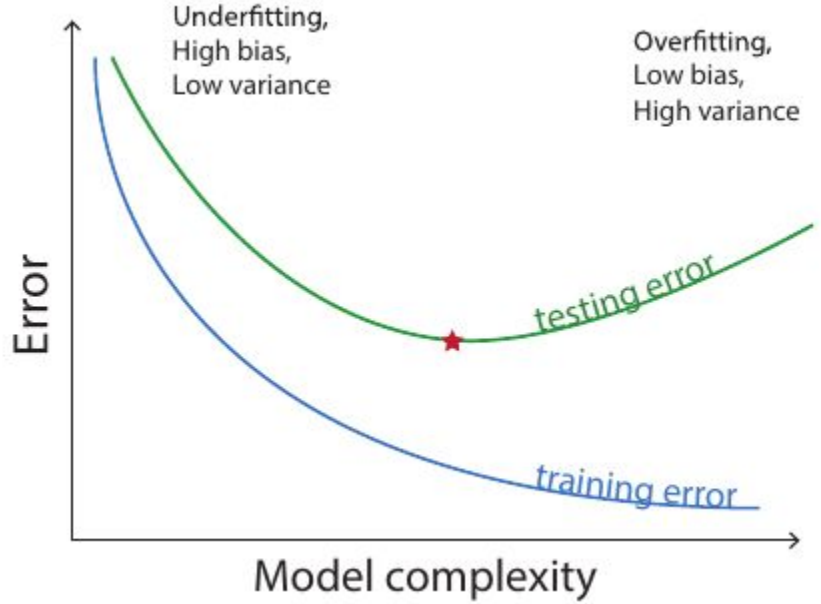
Bias-Variance Tradeoff



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Bias and Variance

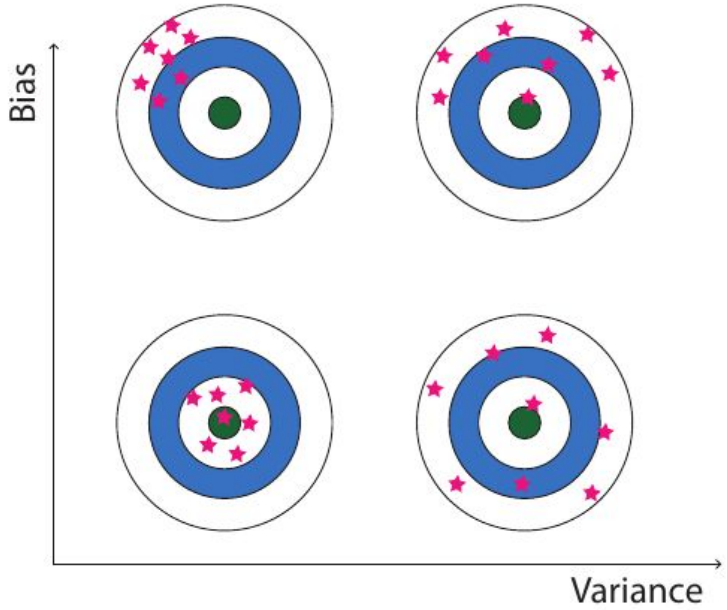
Think of your model as a darts player. One fit of your model is a single dart throw. Each dart board is the result from one player/model.

How would your fit have changed if your data was slightly different?

- Small change -> the model has low variance
- Desirable!
- High variance models could ‘get lucky’ (see bottom right model - one fit is a near bullseye)

How accurate is your model averaged over different training data?

- Low average error -> low bias
- Watch out: variant but unbiased models are still rubbish!



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Further reading

Look no further than the scikit learn docs:

http://scikit-learn.org/stable/modules/model_evaluation.html