Evaluating Performance II

Lecture 09

Spot the misstep

1

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2. You take your historical data, normalize it, then split it randomly into a training and test set

3. You train on the training data, test on the test data

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Results:
Your predictions are correct 56% of the time

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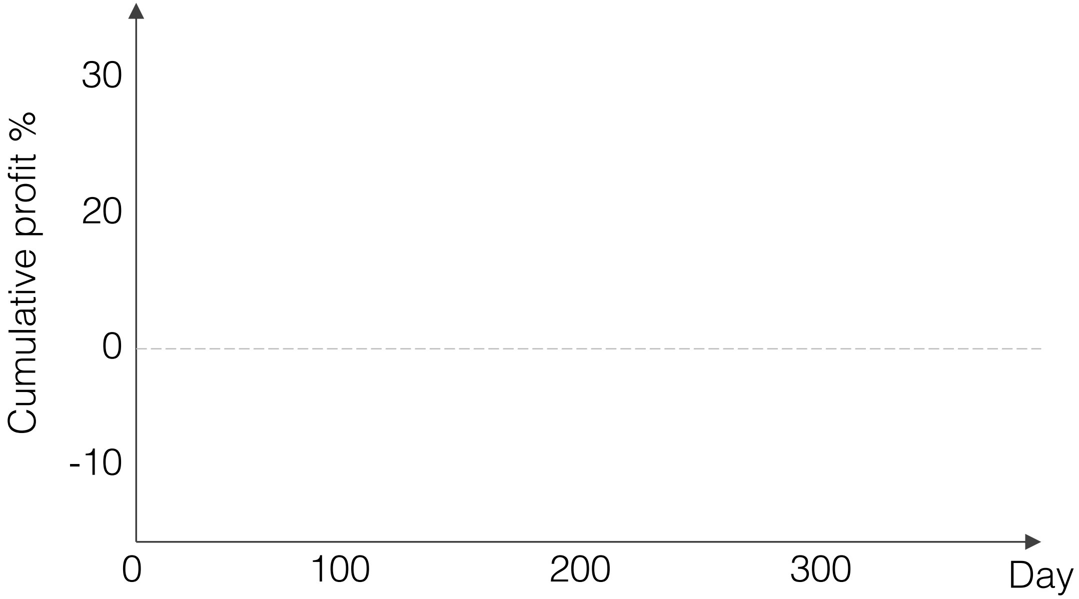

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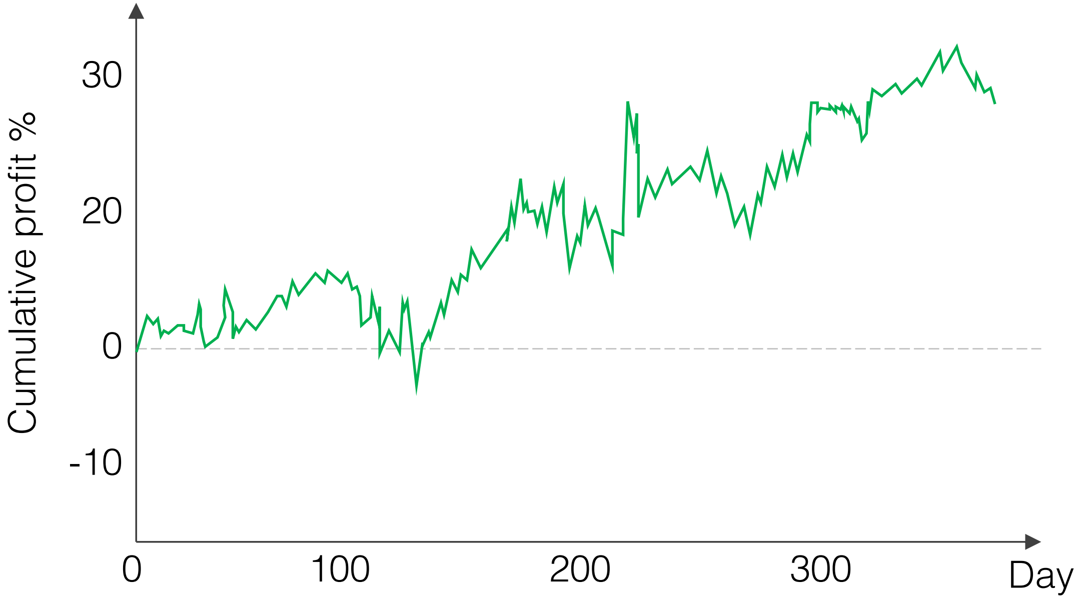

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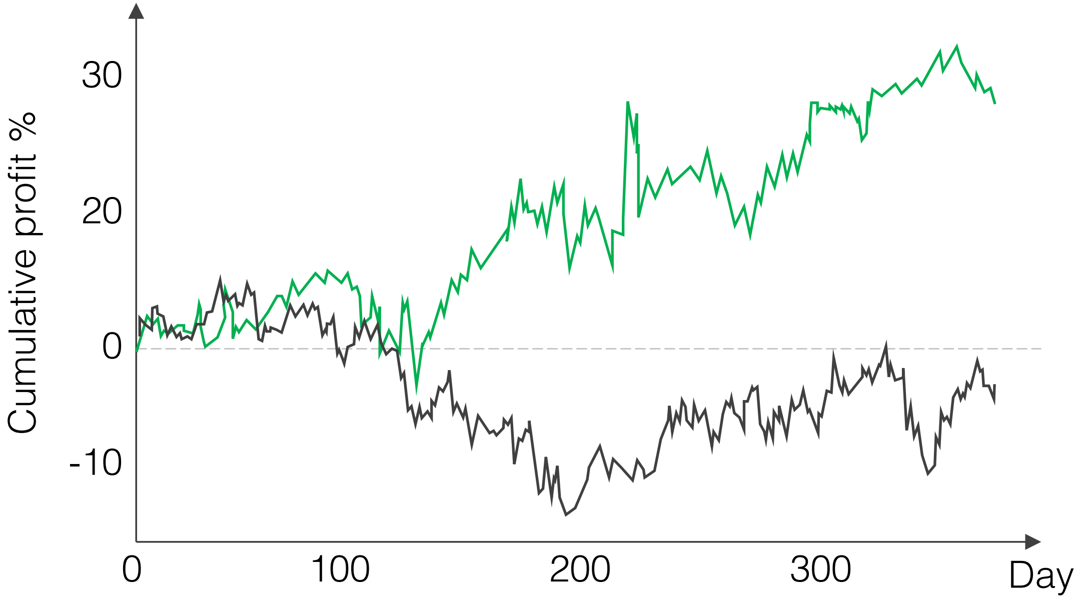

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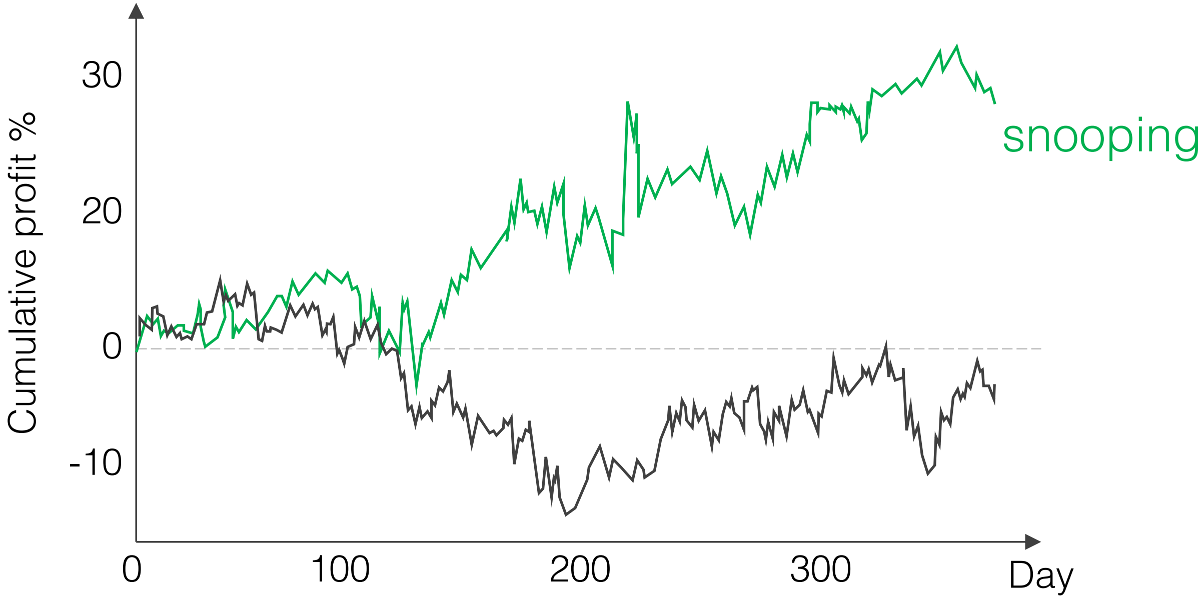

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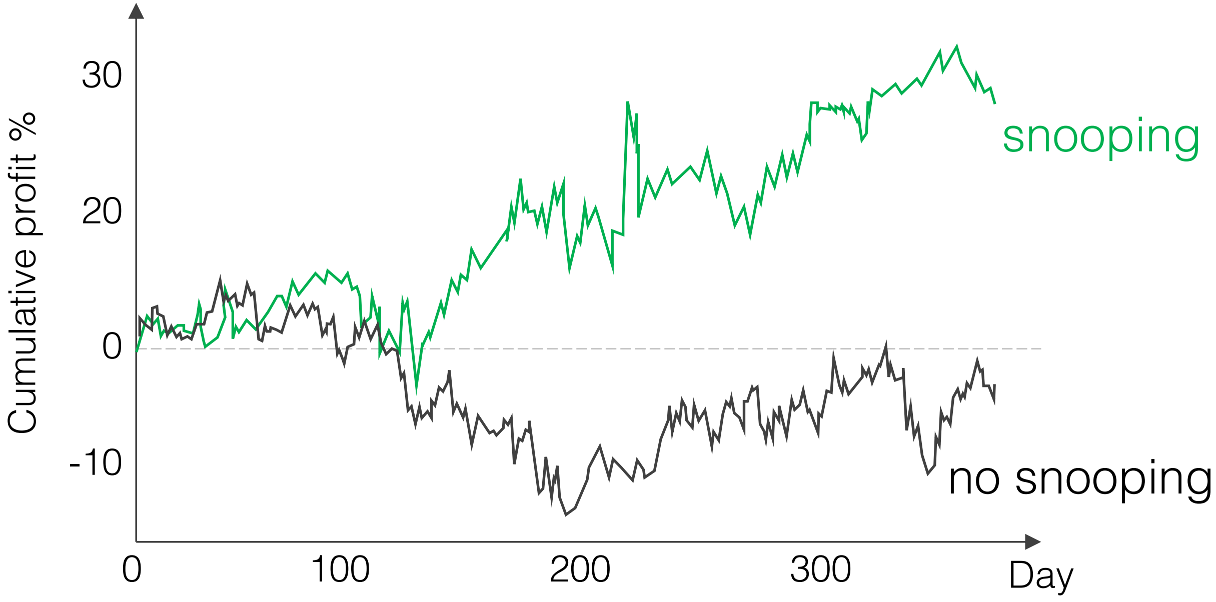

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    1. Train your model on the training data
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    3. Evaluate performance

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4. You iterate on the following process two dozen times:
    1. Train your model on the training data
    2. Test your model on the test data
    3. Evaluate performance
5. Report that you were able to achieve 98% accuracy on your test set!

3

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3

1. Goal: predict long-term performance of a “buy and hold” strategy in stocks

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1. Goal: predict long-term performance of a “buy and hold” strategy in stocks
2. You collect 50 years of data and include all currently traded companies in the S&P500
3. You randomly split your data into a training and test dataset.
4. You assume you will strictly follow the “buy and hold” strategy
5. You then use apply your model on the current portfolio and predict that you will be rich in retirement!

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Data snooping

a.k.a. data leakage

If a test data set has affected **any step** in the learning process, its ability to assess the outcome has been **compromised**.

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Sampling bias

Are the data we're using for machine learning **representative of the population**?

Avoiding data snooping

Don’t touch your test dataset until you’re ready to evaluate your model’s performance

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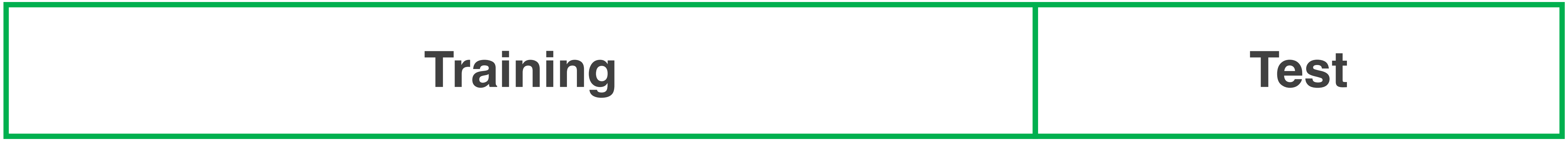
Training, Test Split

Learning model parameters



Training

Test

Learn model parameters

Evaluate generalization performance

Training, Test Split

Learning model parameters

Training

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Learn model parameters

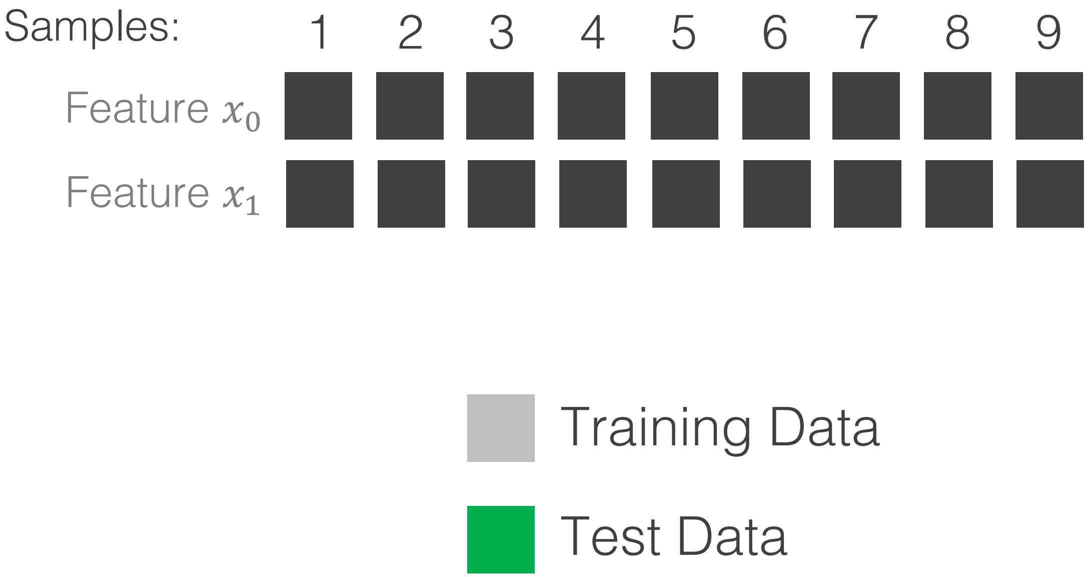
Evaluate generalization performance

For small datasets, this reduction in dataset size may be detrimental

Cross-validation

K-fold cross validation **K = 3**

Original feature set with 2 features and 9 samples



Cross-validation

K-fold cross validation **K = 3**

Original feature set with 2 features and 9 samples

Samples:	1	2	3	4	5	6	7	8	9
Feature x_0	■	■	■	■	■	■	■	■	■
Feature x_1	■	■	■	■	■	■	■	■	■

	Samples:	1	2	3	4	5	6	7	8	9
Fold 1	Feature x_0	□	□	□	□	□	□	🟩	🟩	🟩
	Feature x_1	□	□	□	□	□	□	🟩	🟩	🟩

□ Training Data

🟩 Test Data

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Feature x_0	▨	▨	▨	▨	▨	▨	🟩	🟩	🟩
Feature x_1	▨	▨	▨	▨	▨	▨	🟩	🟩	🟩

Fold 2

Samples:	1	2	3	4	5	6	7	8	9
Feature x_0	▨	▨	▨	🟩	🟩	🟩	▨	▨	▨
Feature x_1	▨	▨	▨	🟩	🟩	🟩	▨	▨	▨

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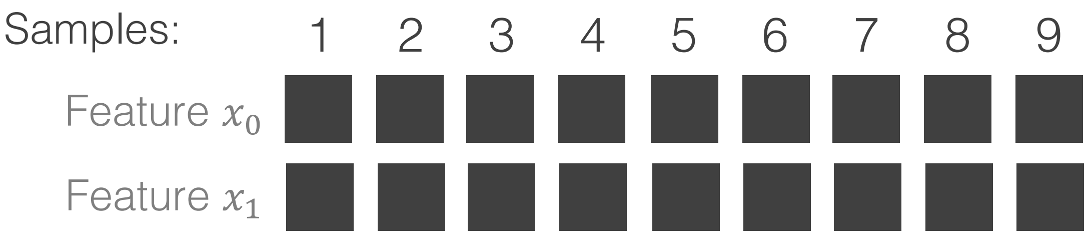

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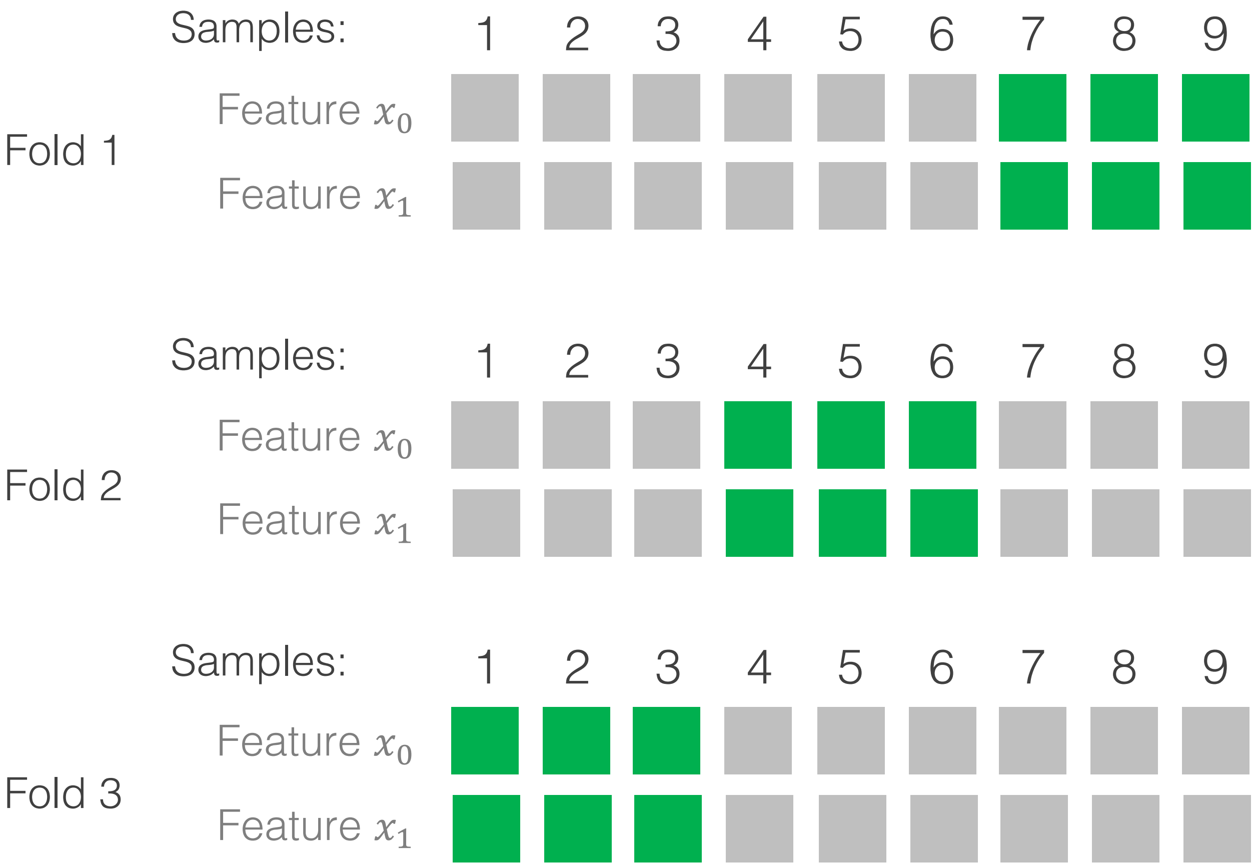

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Fold 2

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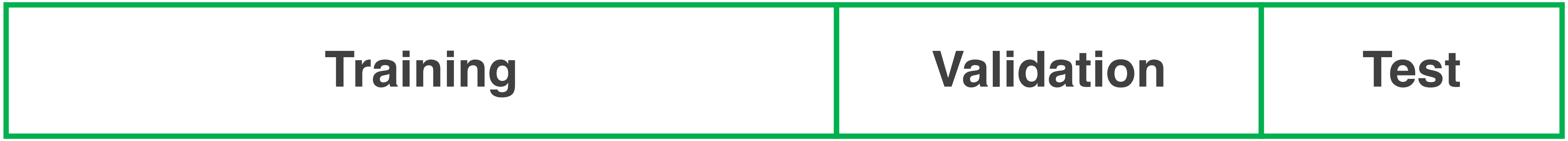
Feature x_0	⬜	⬜	⬜	🟩	🟩	🟩	⬜	⬜	⬜
Feature x_1	⬜	⬜	⬜	🟩	🟩	🟩	⬜	⬜	⬜

Fold 3

Samples:	1	2	3	4	5	6	7	8	9
Feature x_0	🟩	🟩	🟩	⬜	⬜	⬜	⬜	⬜	⬜
Feature x_1	🟩	🟩	🟩	⬜	⬜	⬜	⬜	⬜	⬜

Training, Validation, Test Split

Learning parameters AND hyperparameters



Training	Validation	Test
Learn model parameters	Learn hyperparameters	Evaluate generalization performance

Hyperparameters: parameters of your learning algorithm or parameters of you model that are set before training begins

Bootstrap sampling

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Sampling **with replacement**

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Often used to estimate standard errors and confidence intervals

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Integral part of model ensembles (i.e. bagging in random forests)

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