# Model Selection: Training, Test and Validation sets Cross Validation

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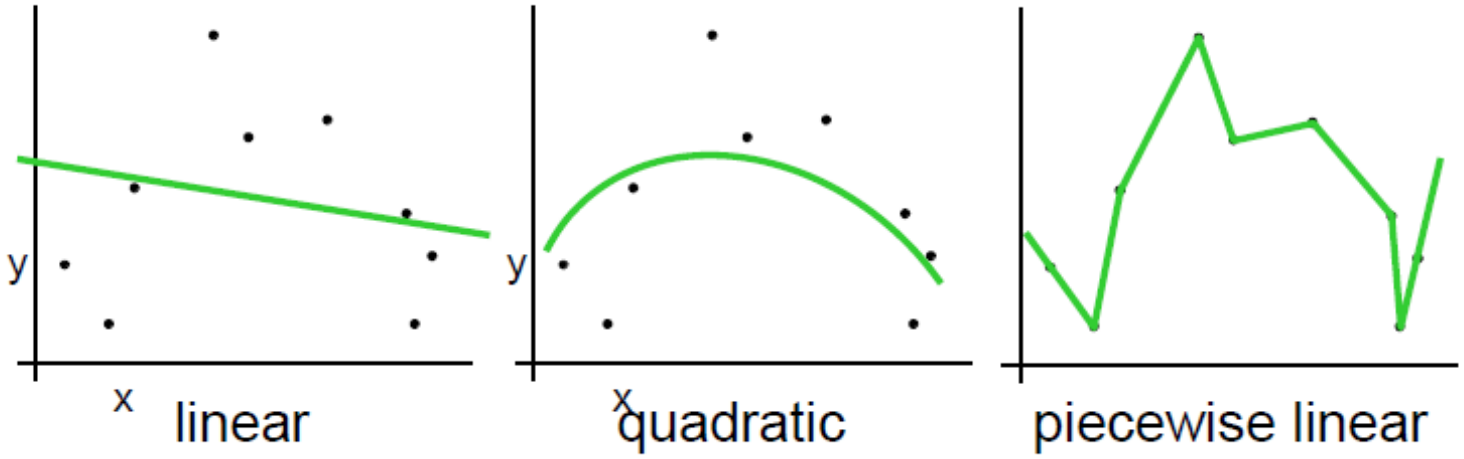
# What do we really want?

- Given: A Dataset
- Machine learning: 100 methods
- Why not choose the method with the best fit to the data?
  - Not a good idea because **Generalization** is important!!
  - It matters how well you classify future unseen data

# Example




Which model will I select?

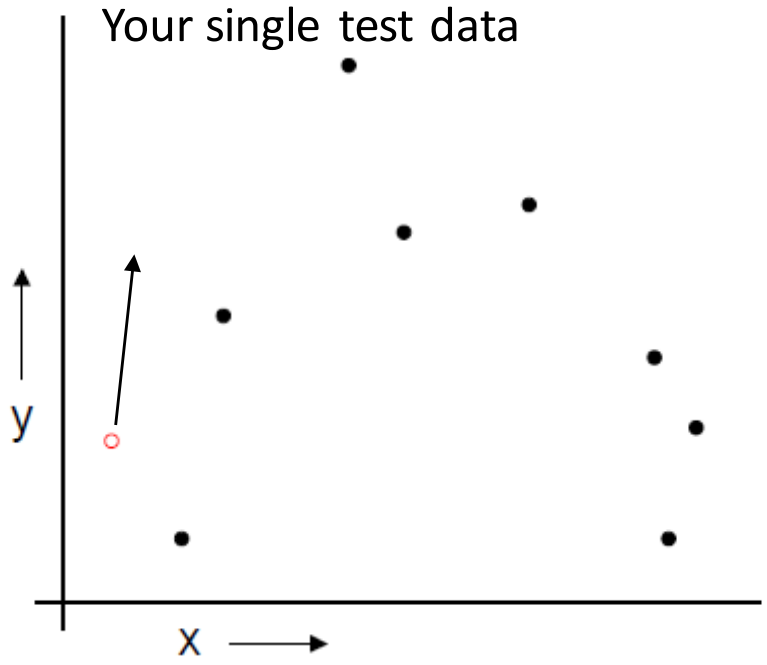
# Training-Validation-Test method

- Randomly split the data into
  - Training
  - Validation
  - Test
- Train on training, tune on validation and find how well the tuned model performs on the test data
- Model giving highest accuracy on test wins

# Cross Validation

Recycle the data!

# LOOCV (Leave-one-out Cross Validation)




Let say we have $N$ data points
$k$ be the index for data points
$k=1..N$

Let $(x_k, y_k)$ be the $k^{th}$ record

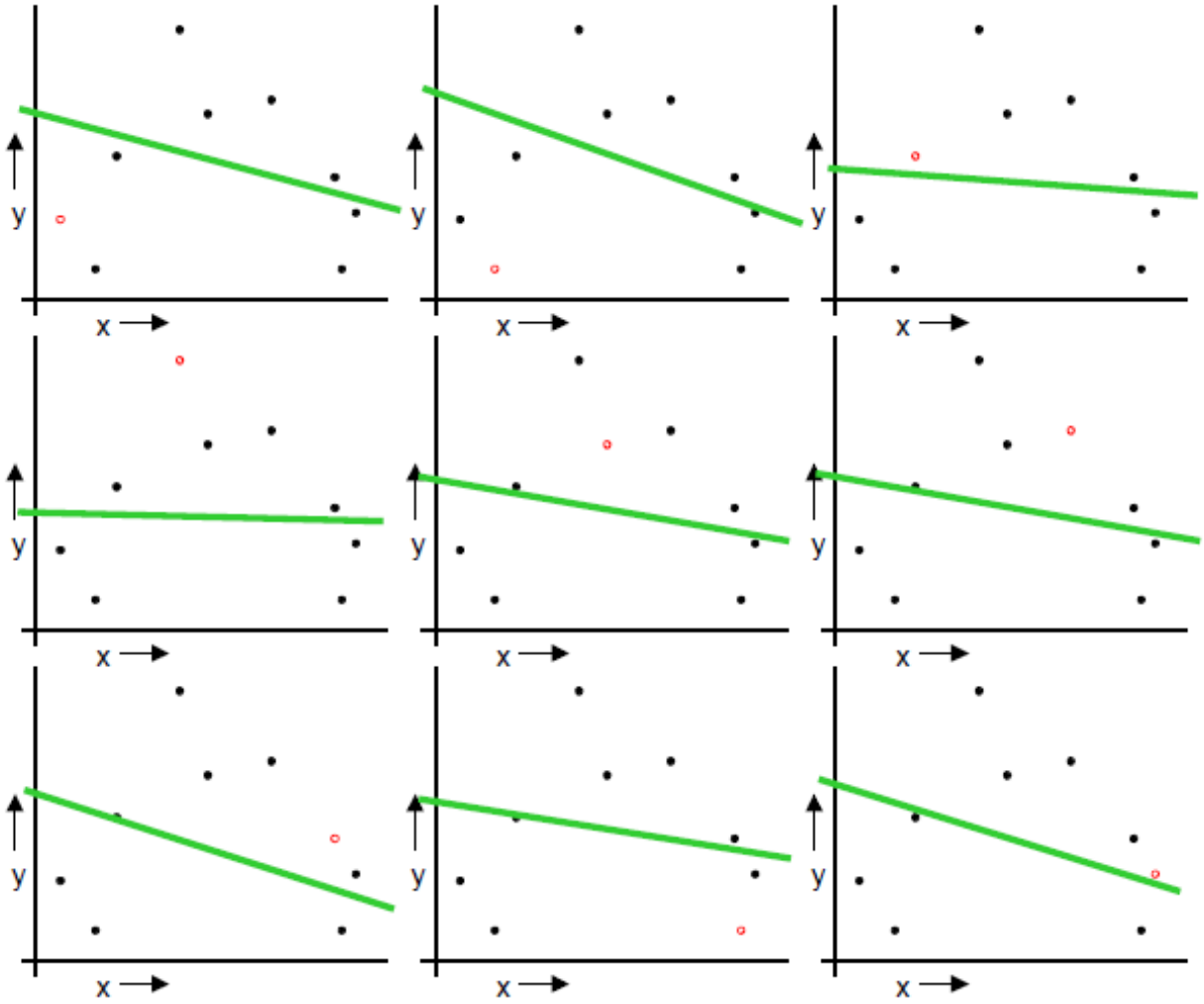
Temporarily remove $(x_k, y_k)$ from the dataset

Train on the remaining N-1 Datapoints

Test your error on $(x_k, y_k)$

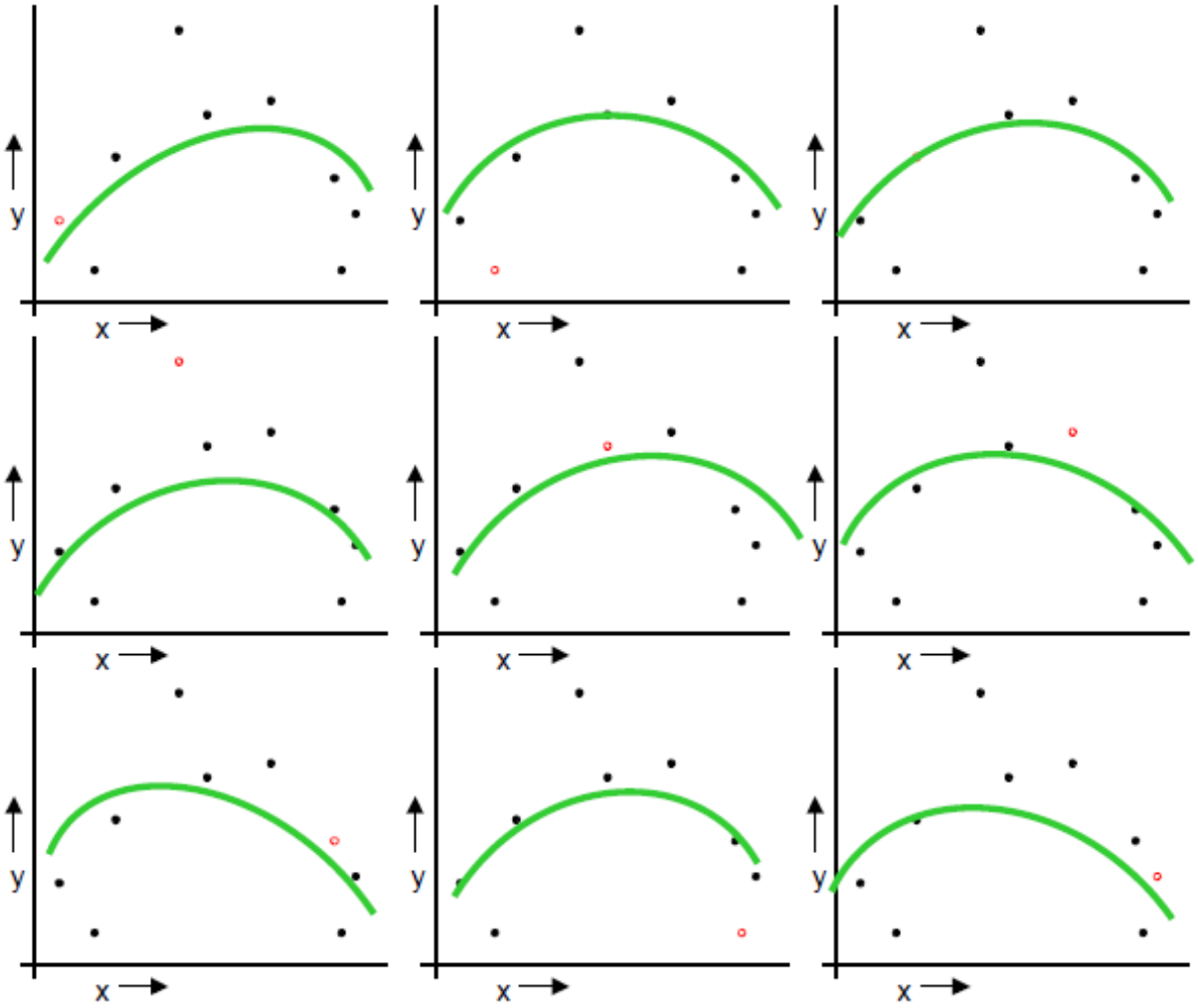
Do this for each k=1..N and report the mean error.

# LOOCV (Leave-one-out Cross Validation)



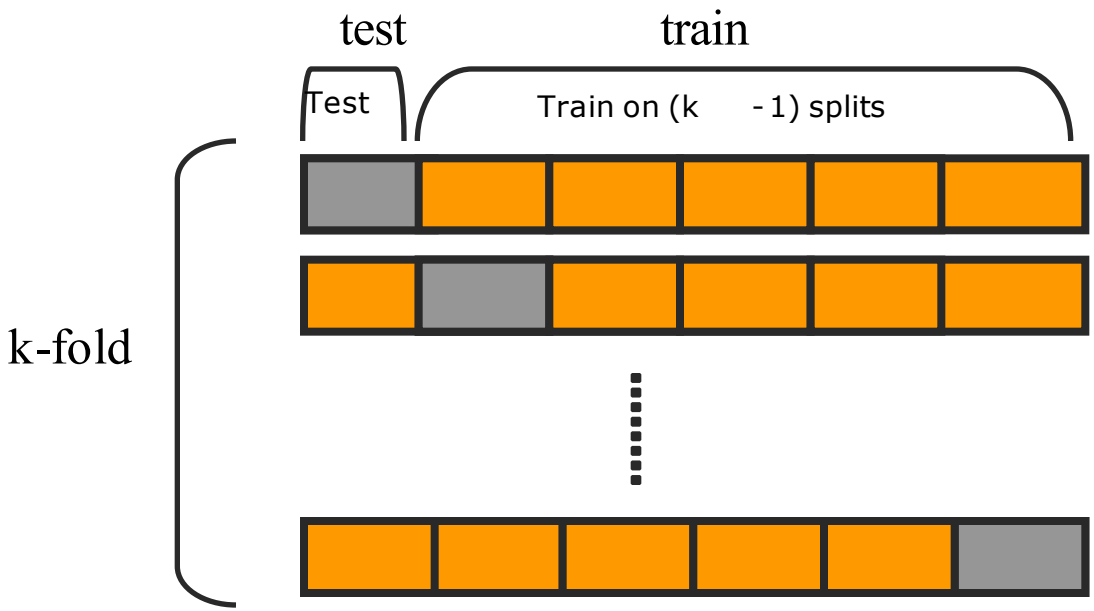

There are N data points..
Do this N times. Notice the test data is changing each time

# LOOCV (Leave-one-out Cross Validation)




There are N data points..
Do this N times. Notice the test data is changing each time

# K-fold cross validation




In 3 fold cross validation, there are 3 runs.
In 5 fold cross validation, there are 5 runs.
In 10 fold cross validation, there are 10 runs.

the error is averaged over all runs