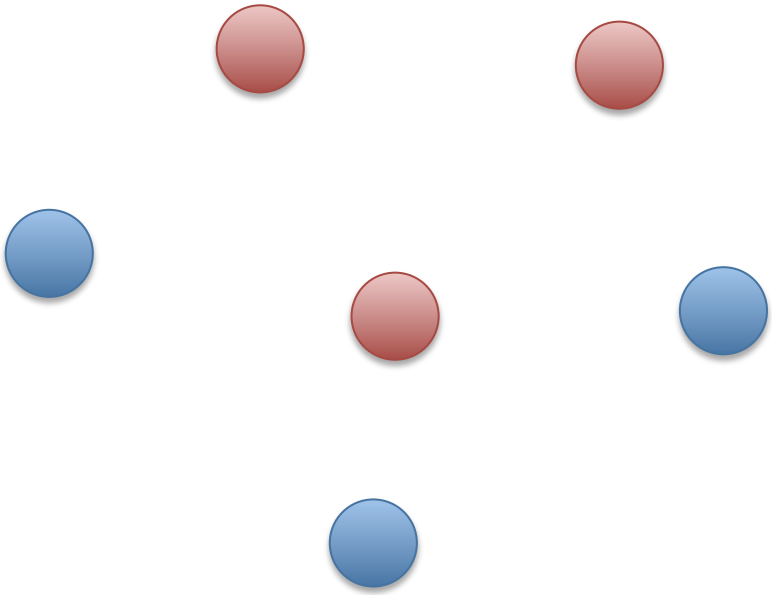
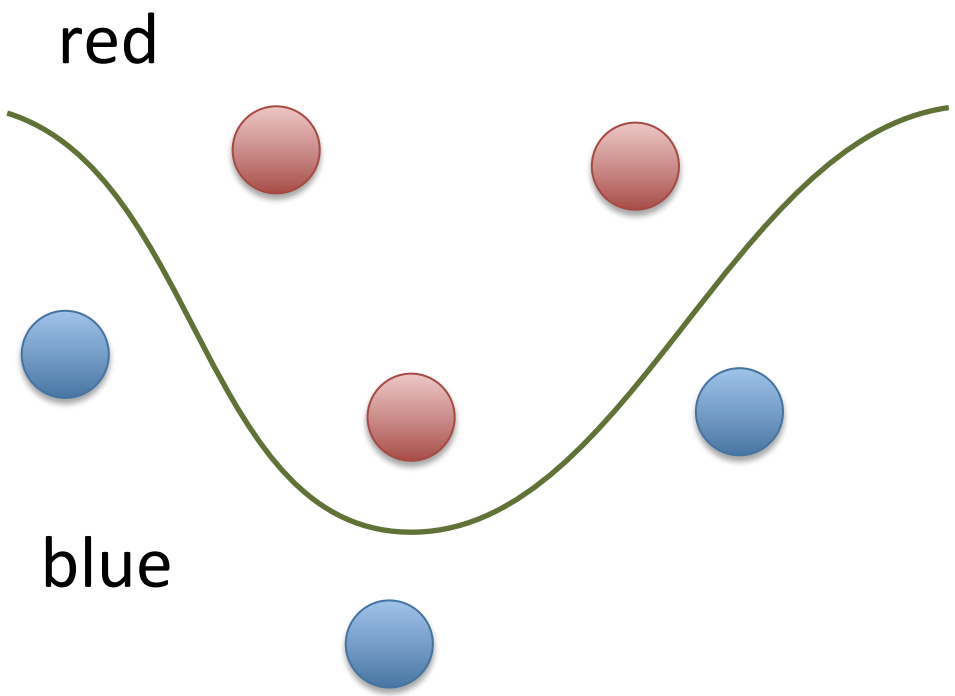
# A major risk in classification: overfitting

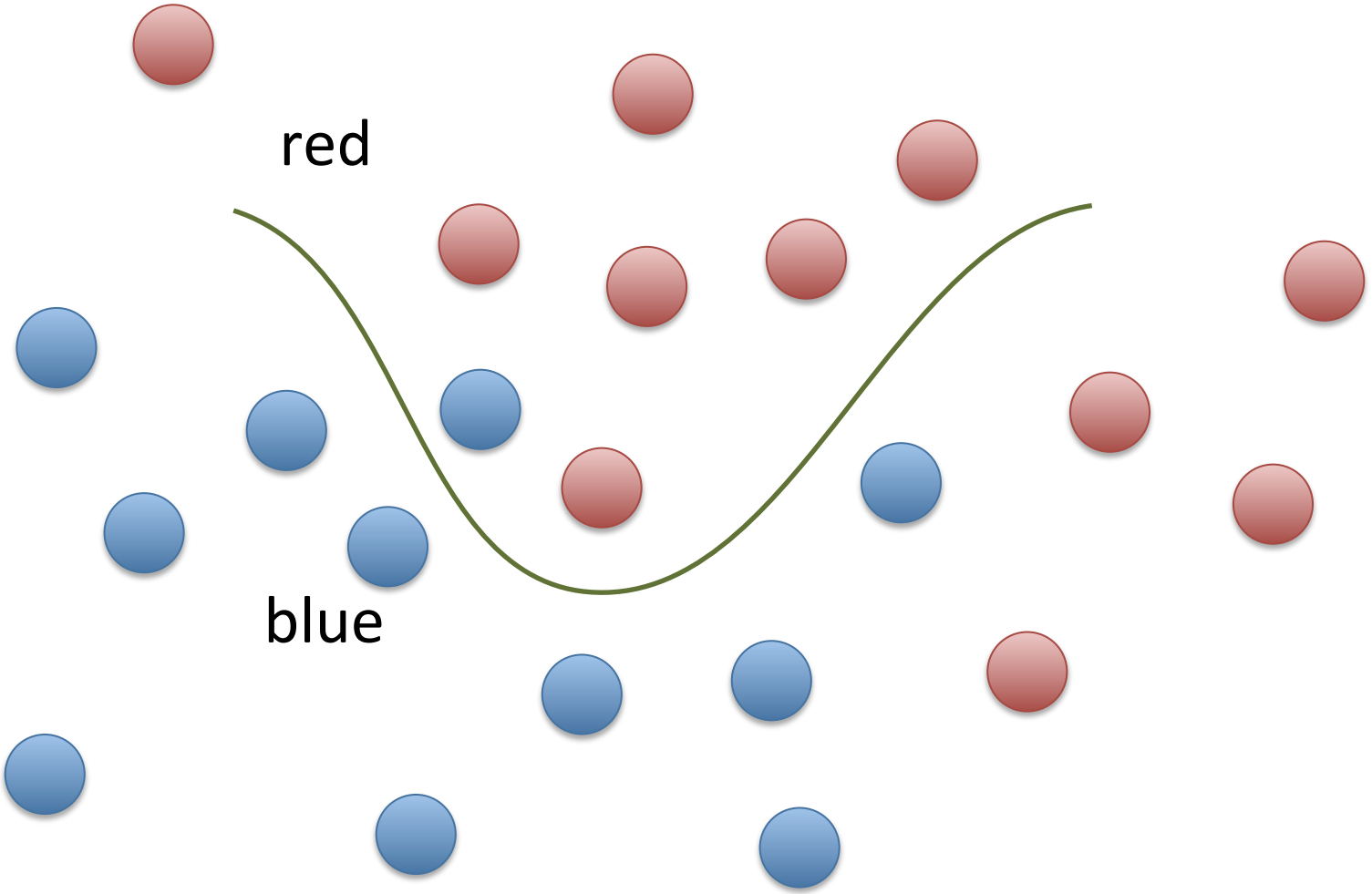
# Assume we have a small data set



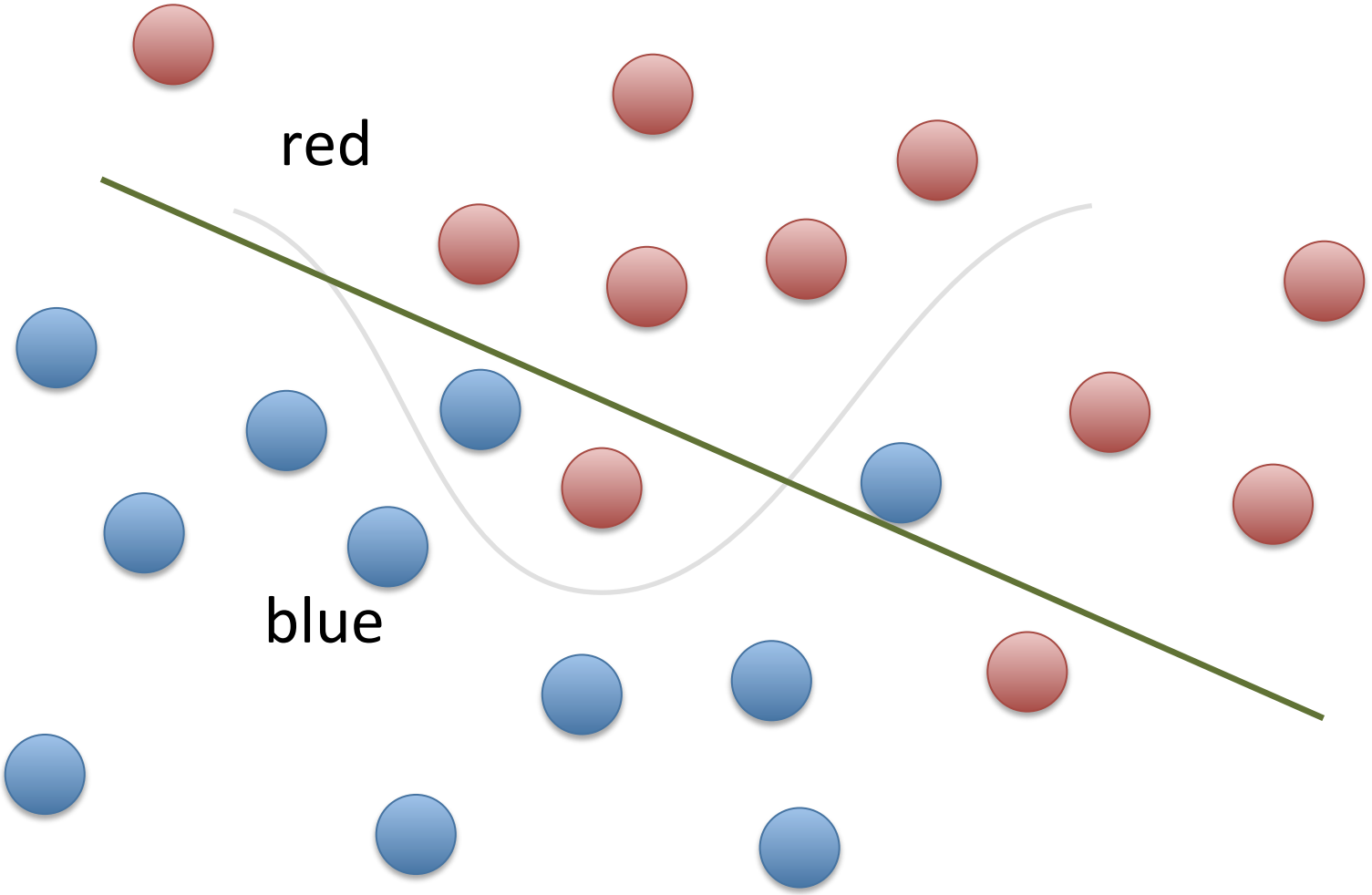
# We fit a model that separates red and blue



# When more data becomes available, we see that the model is poor

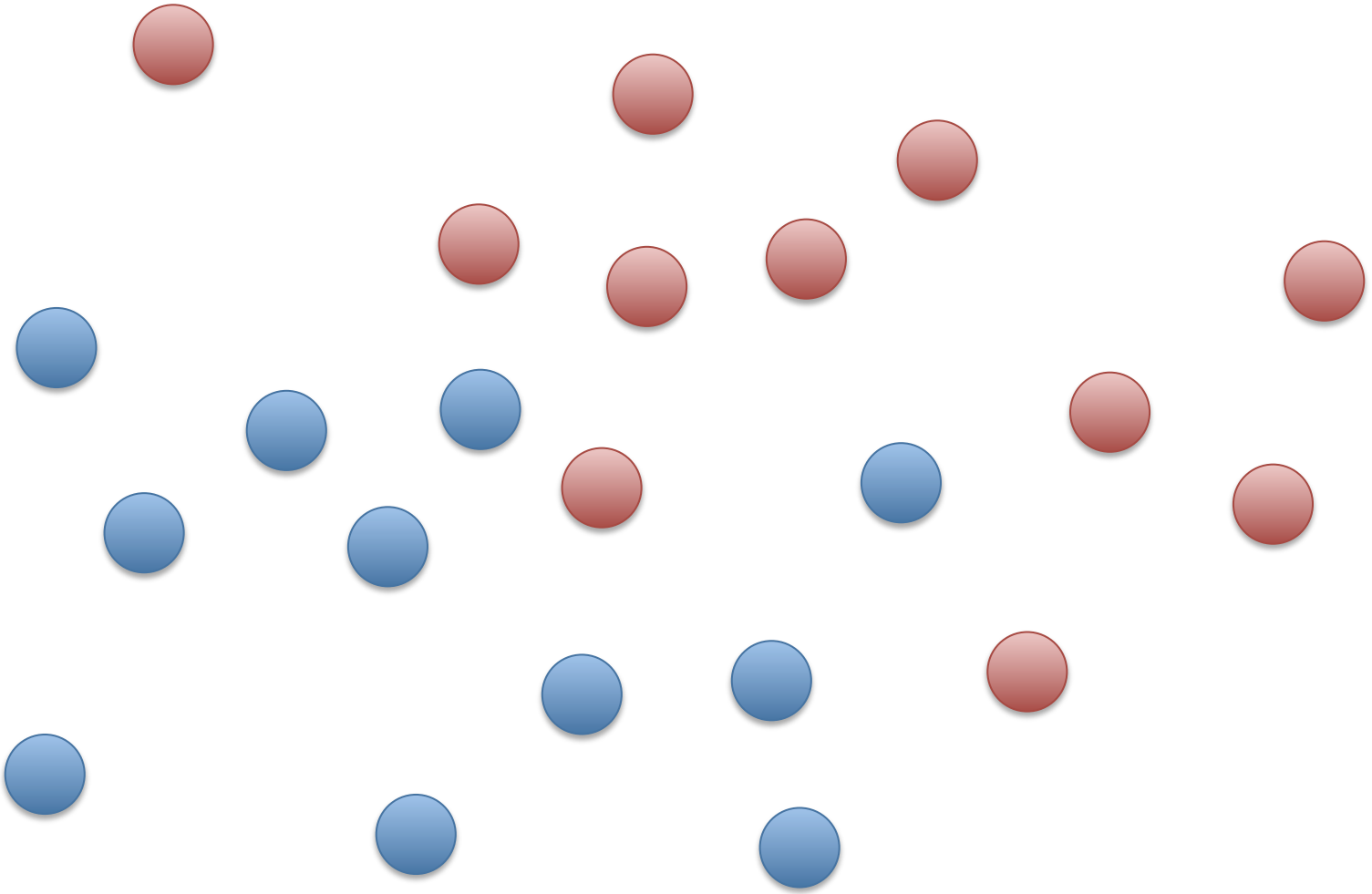


# A simpler model might have worked better



# A predictor always works best on the data set on which it was trained!

# Solution: divide data into training and test sets



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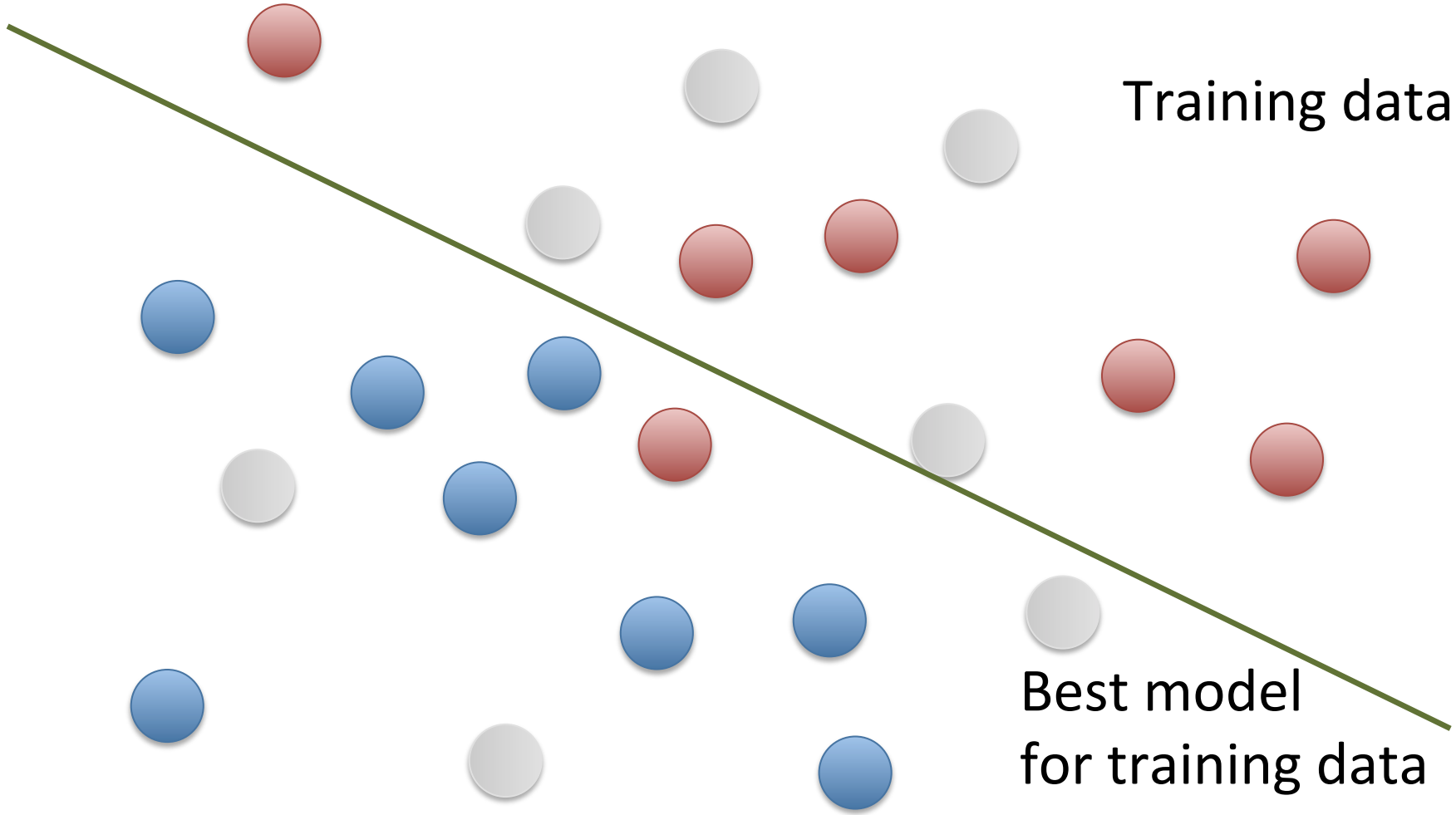

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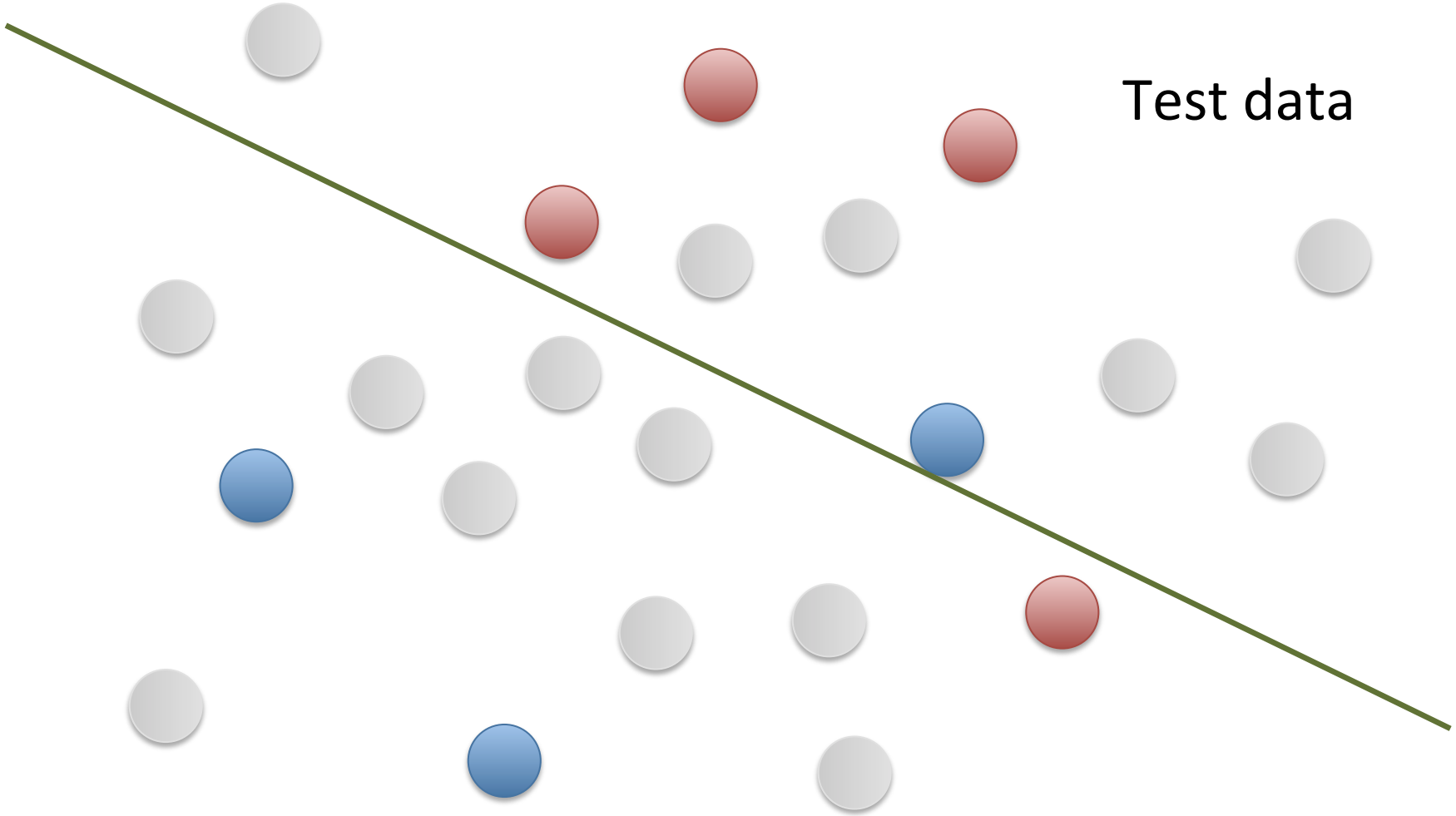


Evaluate model on test data

# Frequently used approach: *k*-fold cross-validation

- Divide data into *k* equal parts
- Use *k*–1 parts as training set, 1 as test set
- Repeat *k* times, so each part has been used once as test set

# Also: Leave-one-out cross-validation

- Fit model on $n$–1 data points
- Evaluate on remaining data point
- Repeat $n$ times, so each point has been left out once

# And: Repeated random sub-sampling validation

- Randomly split data into training and test data sets
- Train model on training set, evaluate on test set
- Repeat multiple times, average over result