Testing and Error Estimation

Machine Learning

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Motivation

1. The perceptron
   - our first learning classifier
   - linear classifier
   - implmentation; reads data from file
2. Data set
   1. breast cancer data from Wisconsin
   2. two classes: benign and malign
3. Does the classifier work?
   - How do we test it?

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Outline

1 Error Estimation

2 Statistical Estimation

3 Evaluation Heuristic

4 Summary

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What do we measure?

- Evaluation heuristic
- How do we measure classifier quality?

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Testing data

Step 1

To test, we need data

1. Split the data set into two parts
   1. n_1 rows for training
   2. n_2 rows for testing
2. Make sure either set is representative
   - How?

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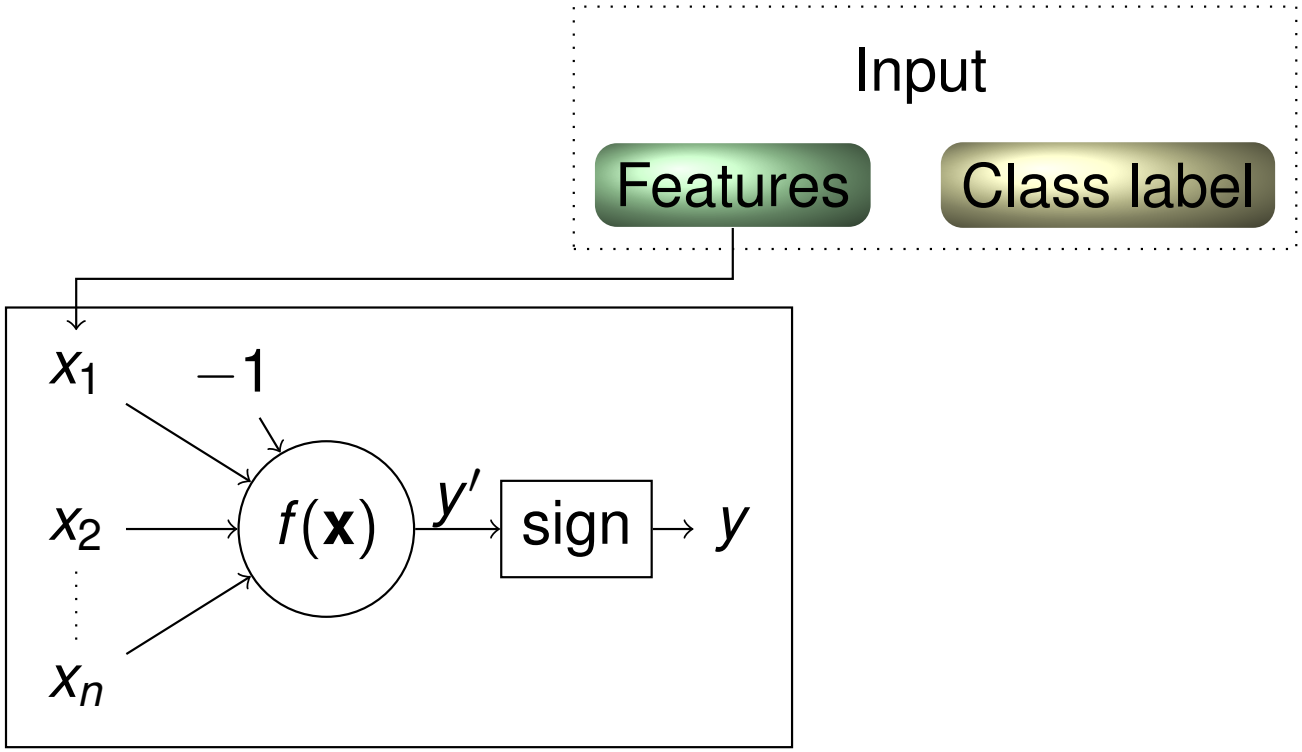
Testing the Neuron

Step 2



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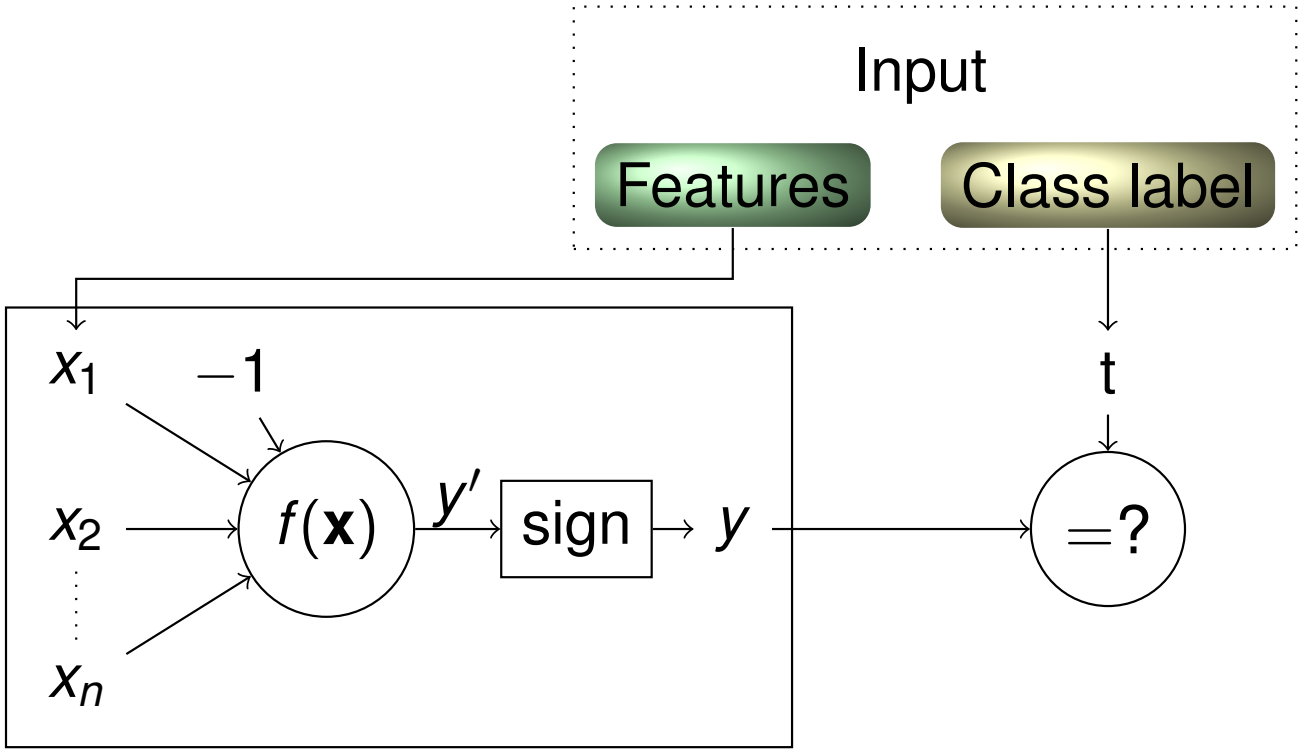
Testing the Neuron

Step 2



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Testing the Neuron

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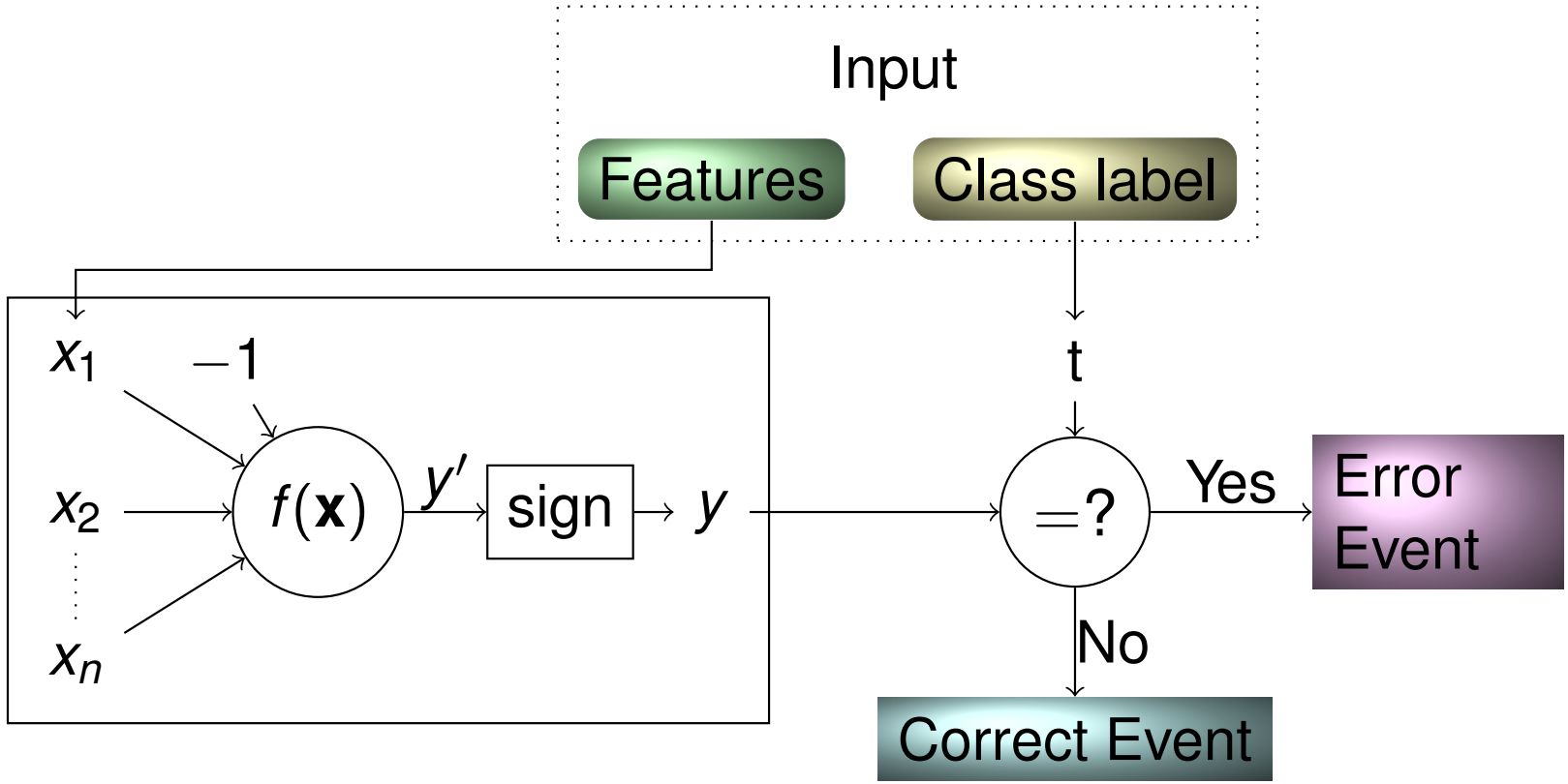

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Testing the Neuron

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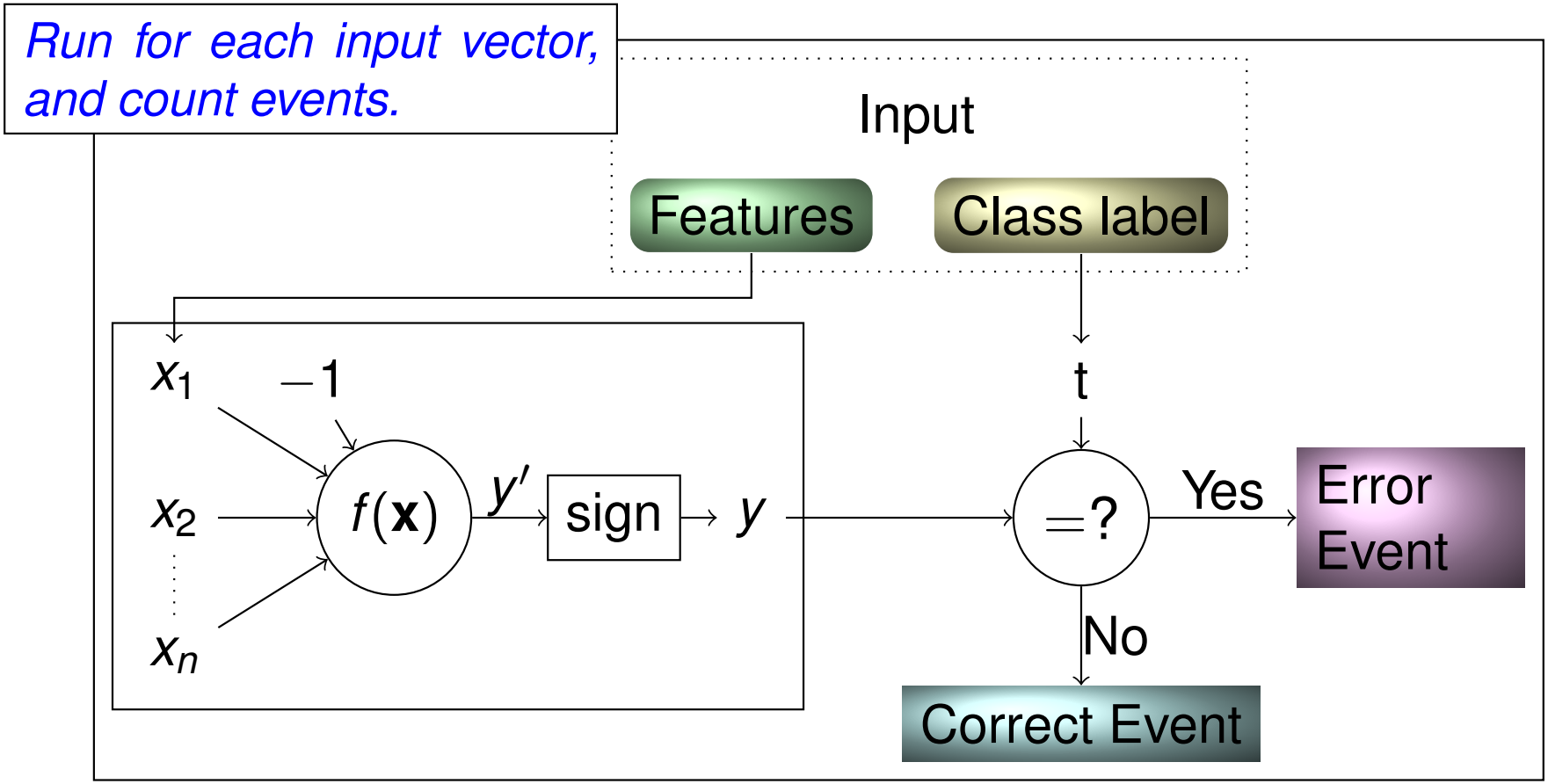

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Error Rate

1. Count
   1. e error events
   2. e correct classifications
2. Calculate error rate: $\frac{e}{e+c}$

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Error probability

1. What is the probability of an error?
   1. when recall is used
   2. on a random object in the wild?

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Point estimation

- Parameter: error probability p_e
- Estimator: error rate $\hat{p}_e$ (stochastic variable)
- Estimate: observation of the estimator r_e (error rate)

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Interval estimation

- Upper and lower estimator (l, u)
- p% confidence interval
- p% probability that $p_e \in (l, u)$

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Confusion Matrix

		Prediction	
		Malign	Benign
Actual Class	Malign	True Positive	False Negative
	Benign	False Positive	True Negative

1. We can count separate error rates for
   - false positives
   - false negatives
2. and estimate separate error probabilities

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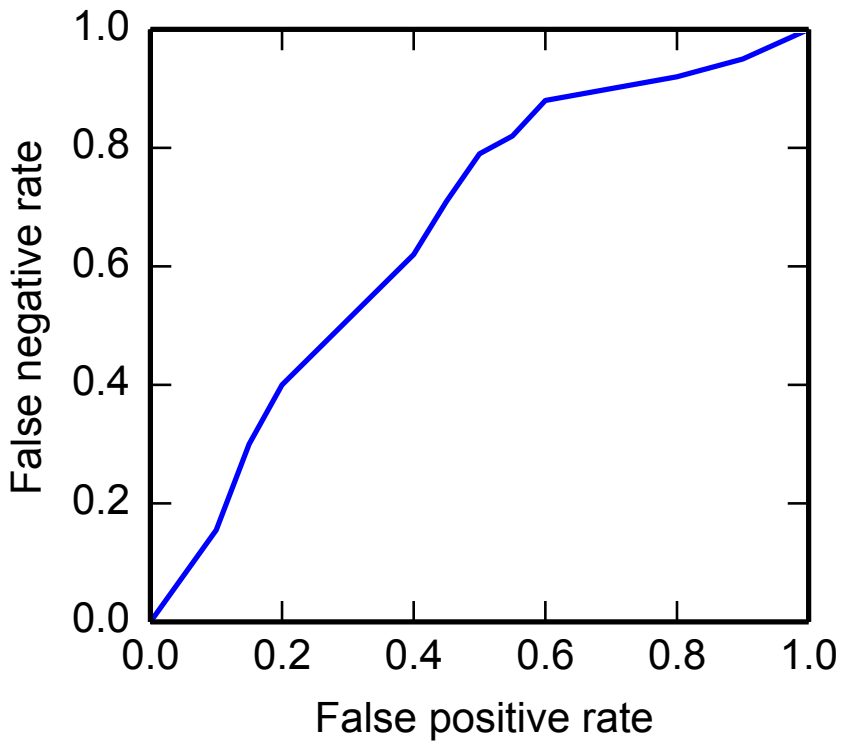
The ROC curve

Variable threshold

- We can vary w_0
- Receiver operating characteristic (ROC)



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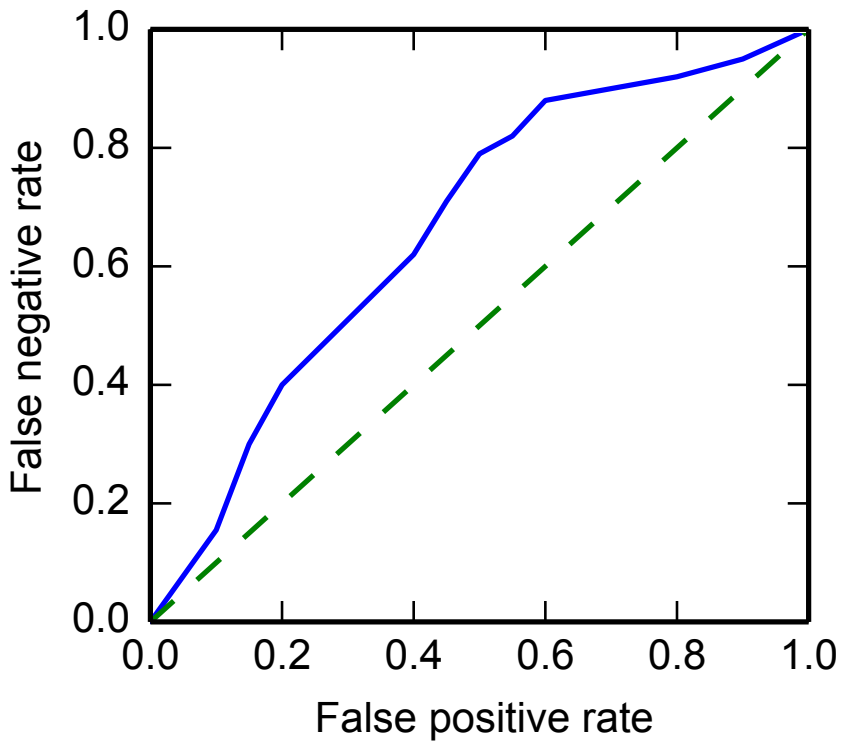

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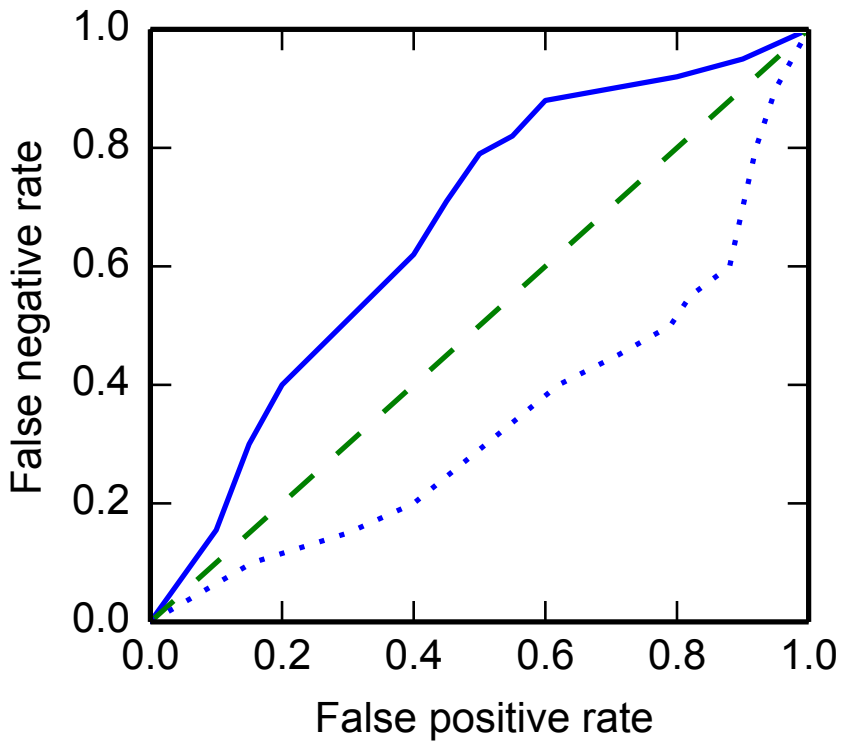

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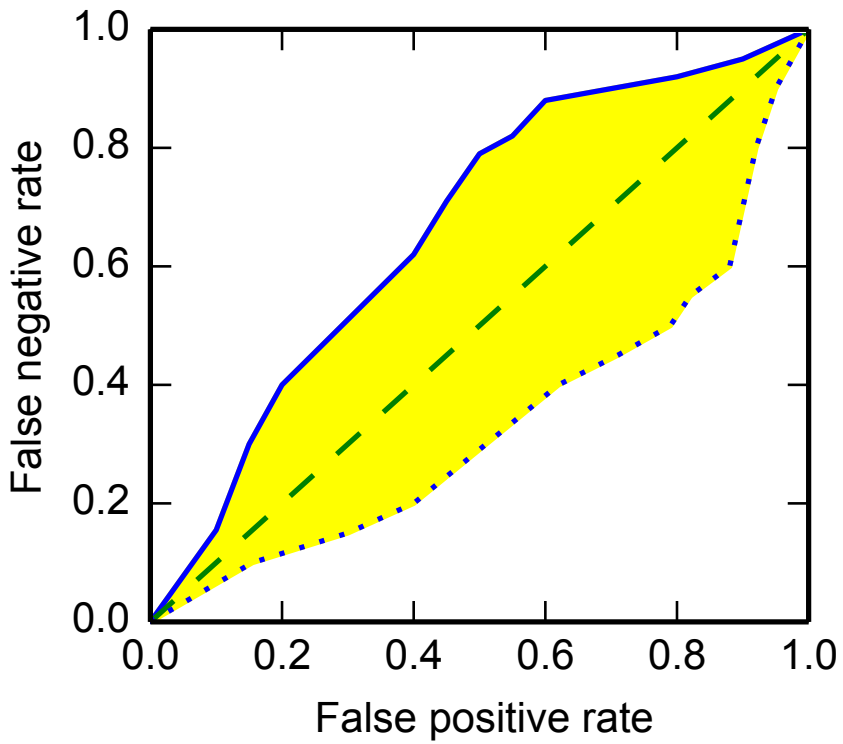

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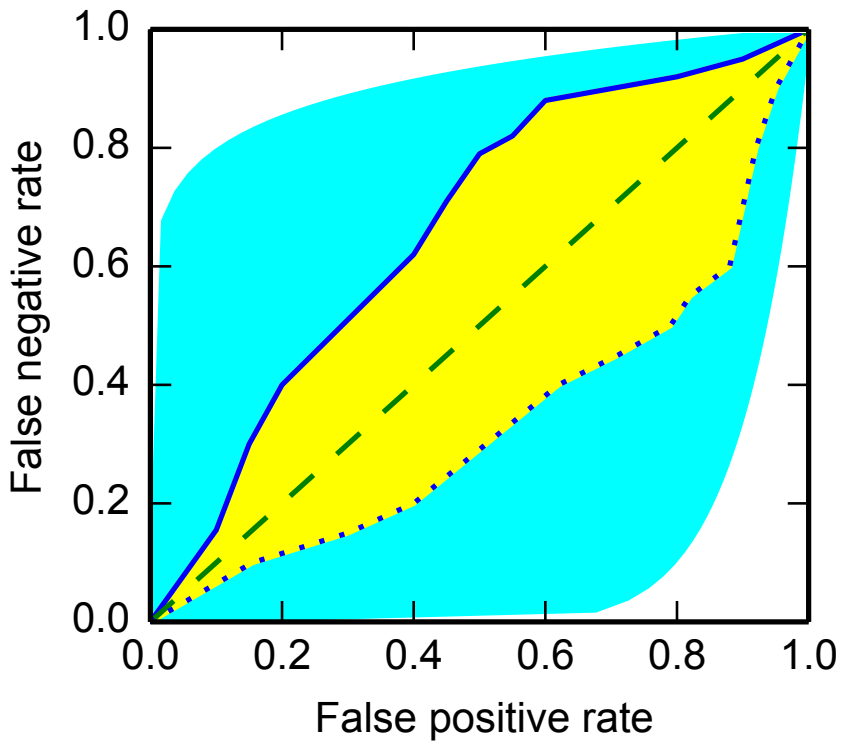

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Summary

Testing

1. Use a test set independent of the training set
2. Test set with known class labels
3. Do recall, and compare to known labels

Evaluation

1. Statistical analysis of test results
2. How large test set?

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