Classification error metric

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Choosing the right error measurement

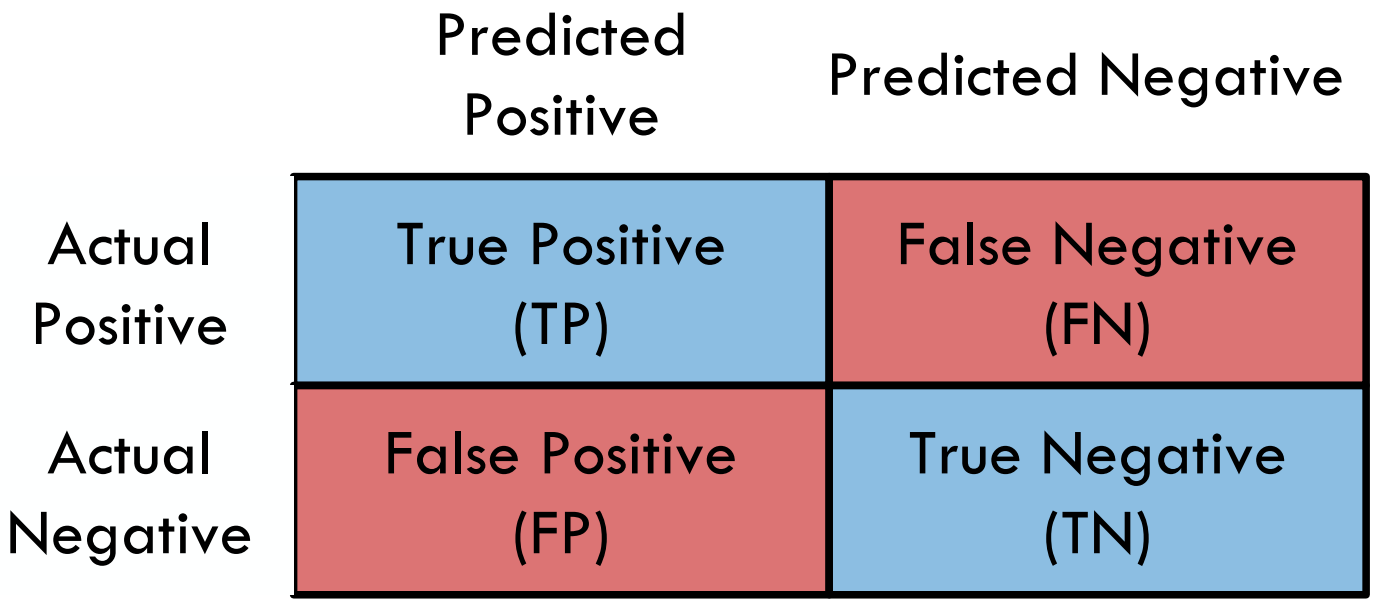
- You are asked to build a classifier for leukemia
- **Training data**: 1% patients with leukemia, 99% healthy
- **Measure accuracy**: total % of predictions that are correct

Choosing the right error measurement

- You are asked to build a classifier for leukemia
- **Training data**: 1% patients with leukemia, 99% healthy
- **Measure accuracy**: total % of predictions that are correct
- Build a simple model that always predicts "healthy"
- Accuracy will be still 99%...

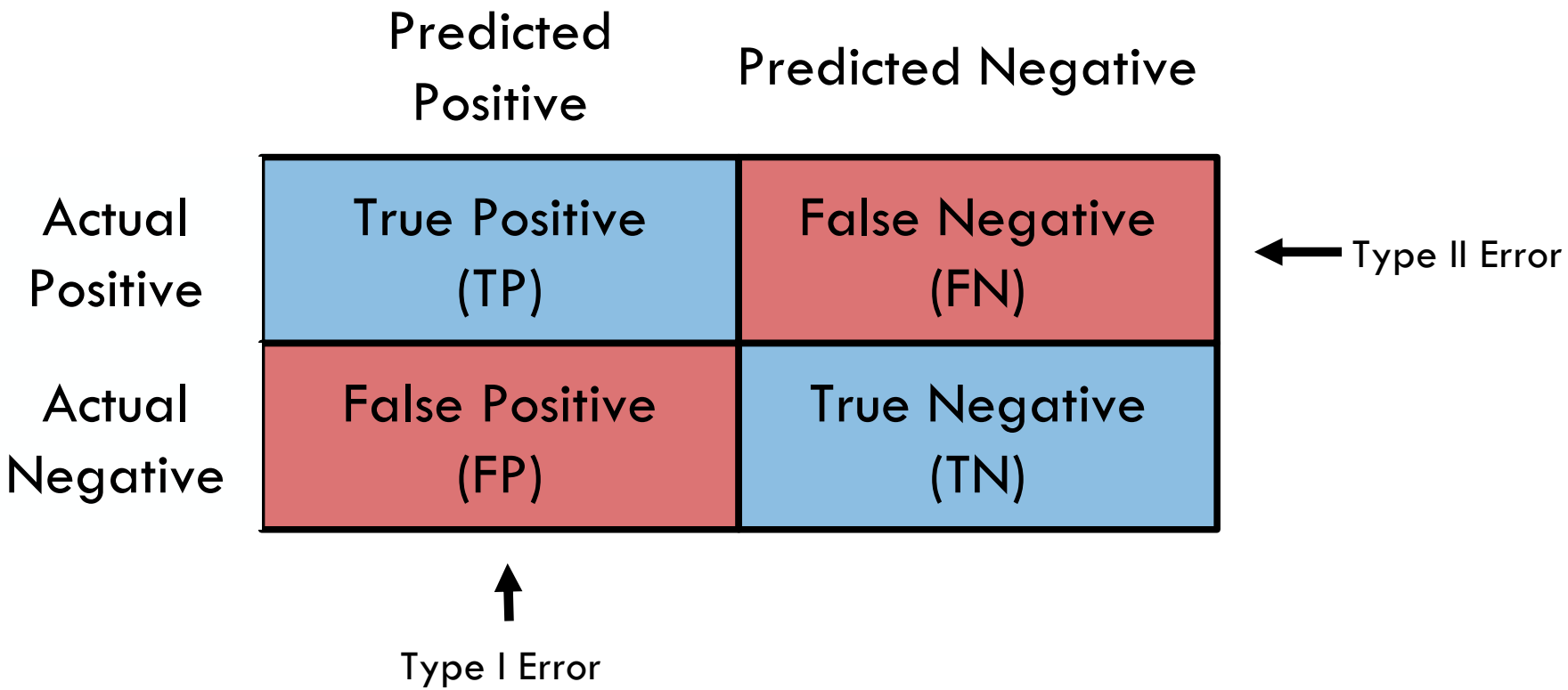
Confusion matrix

- Confusion matrix



Confusion matrix

- Confusion matrix



Confusion matrix (continued)

- Confusion matrix - accuracy

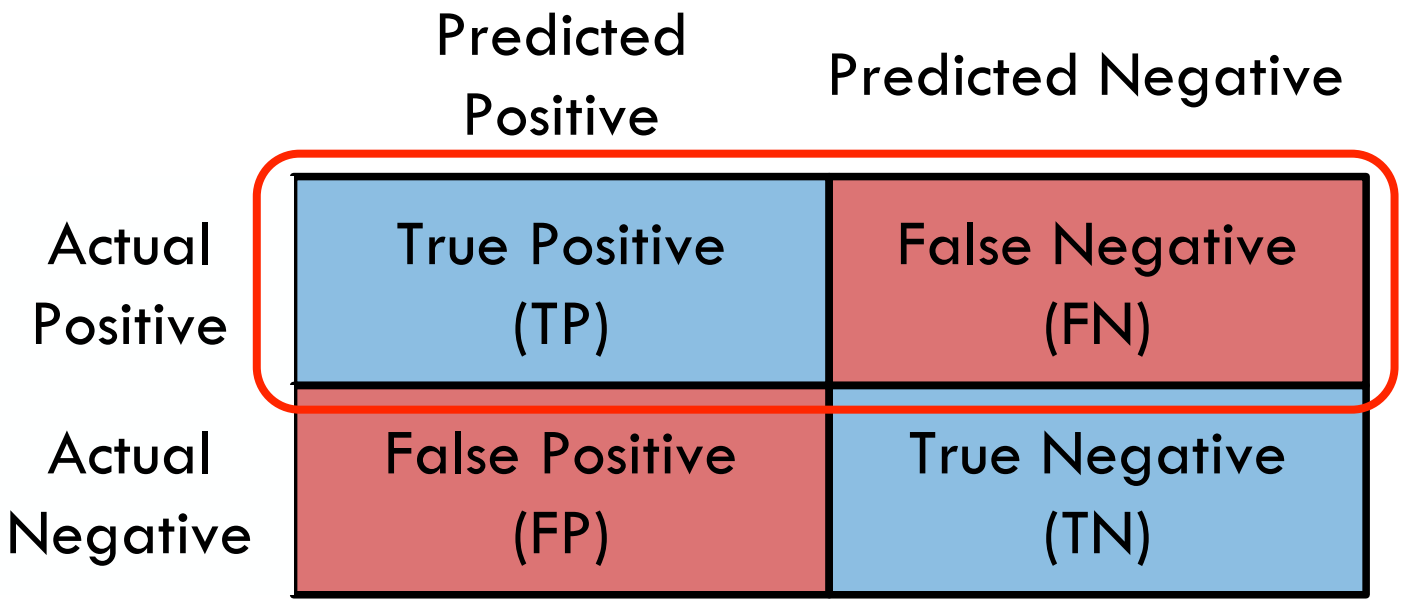
$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN}$$

	Predicted Positive	Predicted Negative
Actual Positive	True Positive (TP)	False Negative (FN)
Actual Negative	False Positive (FP)	True Negative (TN)

Confusion matrix (continued)

- Confusion matrix – recall or sensitivity

$$\text{Recall or Sensitivity} = \frac{TP}{TP + FN}$$

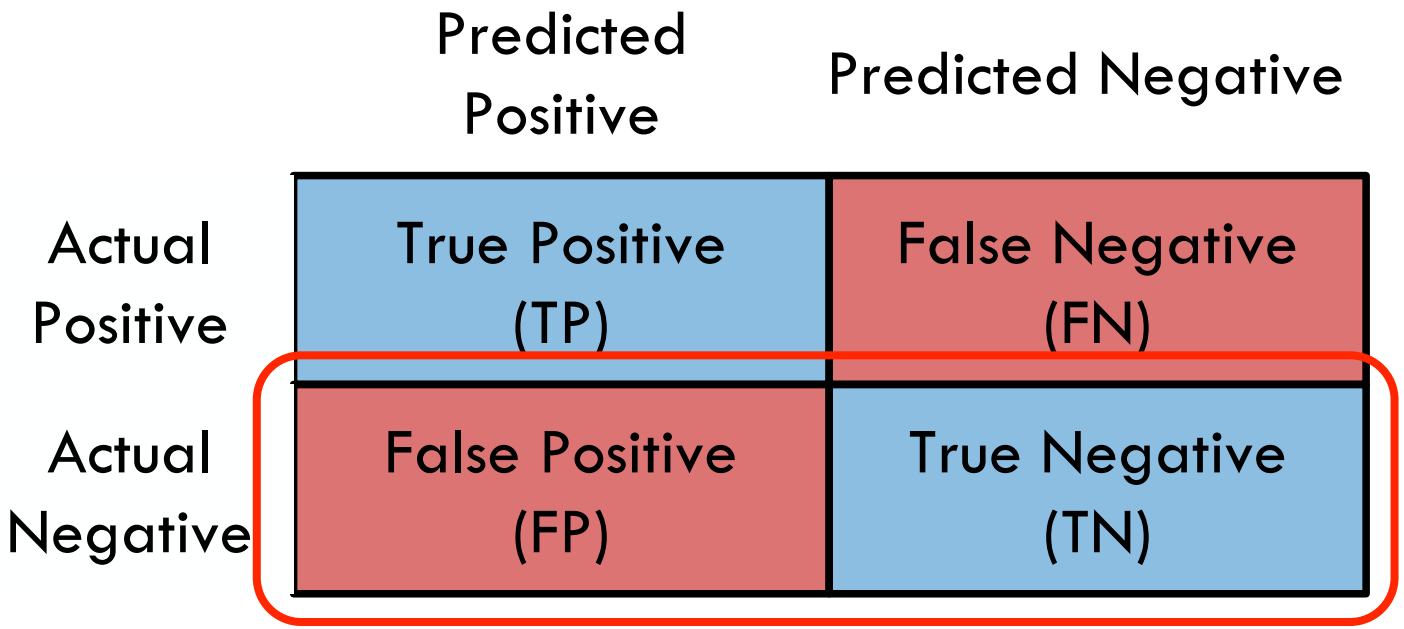


A negative result in a test with high sensitivity is useful for ruling out disease. A high sensitivity test is reliable when its result is negative, since it rarely misdiagnoses those who have the disease

Confusion matrix (continued)

- Confusion matrix - specifity

$$\text{Specificity} = \frac{TN}{FP + TN}$$

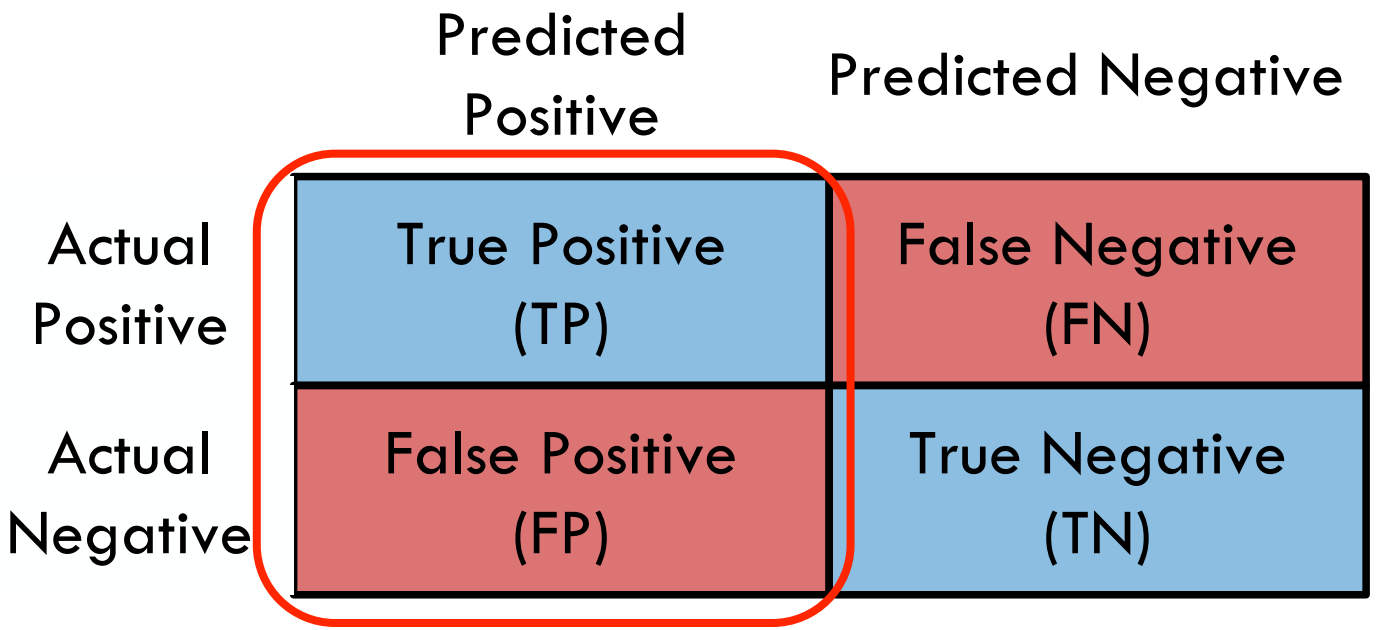


A positive result in a test with high specificity is useful for ruling in disease. The test rarely gives positive results in healthy patients. A positive result signifies a high probability of the presence of disease.

Confusion matrix (continued)

- Confusion matrix - precision

$$\text{Precision} = \frac{TP}{TP + FP}$$



Confusion matrix (continued)

- Confusion matrix − precision
  - a computer program for recognizing dogs
    - 10 cat images and 12 dog images
    - The program identifies 8 dogs -- actually, 5 dogs (true positive) and 3 cats (false positive)
    - Precision 5/8 (true positive / selected items)
    - Recall 5/12 (true positive / all relevant items)
  - Search engine
    - Return 30 pages
    - Only 20 are relevant (true positive) / fail to return 40 additional pages
    - Precision 20/30
    - Recall 20/60

Confusion matrix (continued)

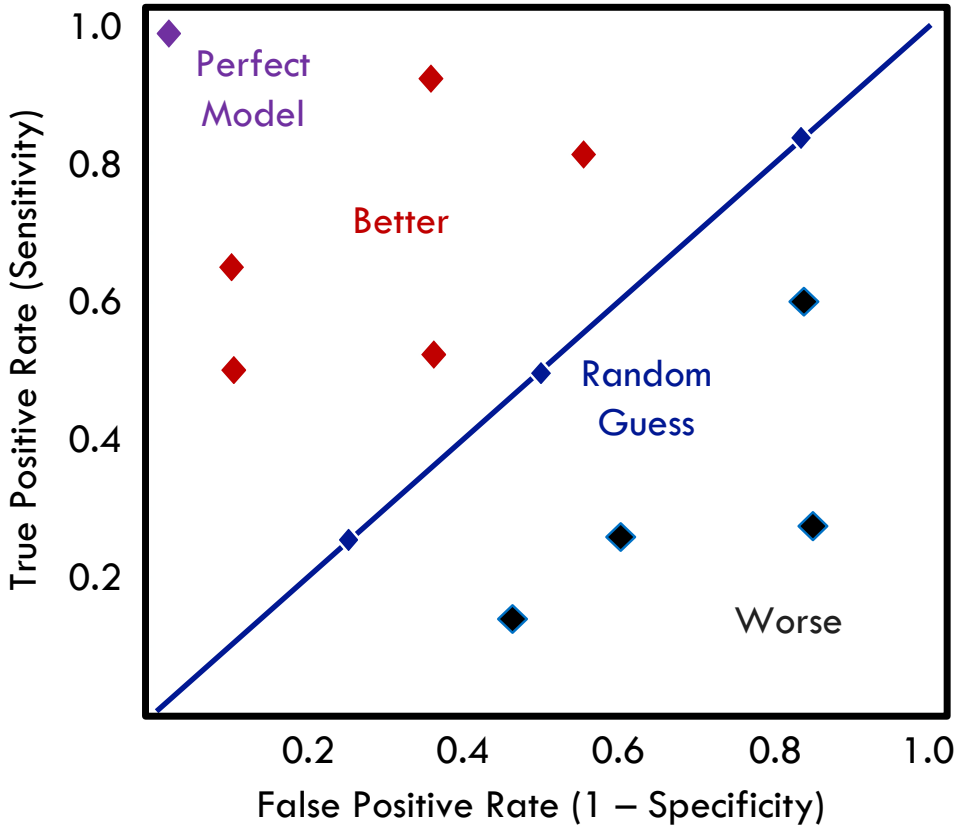
- Confusion matrix – F1 score

$$F1 = 2 \frac{\text{Precision} * \text{Recall}}{\text{Precision} + \text{Recall}}$$

	Predicted Positive	Predicted Negative
Actual Positive	True Positive (TP)	False Negative (FN)
Actual Negative	False Positive (FP)	True Negative (TN)

Receiver operating curve (ROC)

- Evaluation of model at all possible thresholds



Area under the curve

- Measures total area under ROC curve