Machine Learning 5

Evaluation Metrics

Accuracy – Sensitivity – Specificity
Precision – F1 Score – Confusion Matrix

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Accuracy

$$\frac{\text{True Decisions}}{\text{All Decisions}}$$

- **Imbalanced Data**
  - 90 normal cases (negative class)
  - 10 cancerous cases (positive class)

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Sensitivity - Specificity

- **Sensitivity, Recall, True Positive Rate**

$$\mathrm{TPR} = \frac{\mathrm{TP}}{\mathrm{P}} = \frac{\mathrm{TP}}{\mathrm{TP} + \mathrm{FN}}$$

- **Specificity, Selectivity, True Negative Rate**

$$\mathrm{TNR} = \frac{\mathrm{TN}}{\mathrm{N}} = \frac{\mathrm{TN}}{\mathrm{TN} + \mathrm{FP}}$$

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Sensitivity - Specificity

- **Precision, Positive Predictive Value**

$$\mathrm{PPV} = \frac{\mathrm{TP}}{\mathrm{TP} + \mathrm{FP}}$$

- **F1 Score (Harmonic Mean of Precision and Sensitivity)**

$$\mathrm{F}_1 = 2 \times \frac{\mathrm{PPV} \times \mathrm{TPR}}{\mathrm{PPV} + \mathrm{TPR}} = \frac{2\mathrm{TP}}{2\mathrm{TP} + \mathrm{FP} + \mathrm{FN}}$$

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Example

20 samples: 10 cancer + 10 normal

- **Algorithm1:**

  - all predicted cancer

$$TPR = \frac{TP}{P} = 100\% \qquad PPV = \frac{TP}{TP + FP} = 50\% \qquad TNR = \frac{TN}{N} = 0\%$$

- **Algorithm2:**

  - 5 cancerous samples predicted correctly

  - 15 samples predicted normal

$$TPR = \frac{TP}{P} = 50\% \qquad PPV = \frac{TP}{TP + FP} = 100\% \qquad TNR = \frac{TN}{N} = 100\%$$

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Precision and recall

From Wikipedia, the free encyclopedia

In pattern recognition, information retrieval and classif
from a collection, corpus or sample space.

Precision (also called positive predictive value) is the
the fraction of relevant instances that were retrieved. E

Consider a computer program for recognizing dogs (th
twelve dogs, the program identifies eight dogs. Of the
cats (false positives). Seven dogs were missed (false
(true positives / selected elements) while its recall is 5

When a search engine returns 30 pages, only 20 of wh
tells us how valid the results are, while its recall is 20/

Adopting a hypothesis-testing approach from statistics
type I and type II errors (i.e. perfect specificity and ser
(no false negative).

sensitivity, recall, hit rate, or true positive rate (TPR)

$$\mathrm{TPR} = \frac{\mathrm{TP}}{\mathrm{P}} = \frac{\mathrm{TP}}{\mathrm{TP} + \mathrm{FN}} = 1 - \mathrm{FNR}$$

specificity, selectivity or true negative rate (TNR)

$$\mathrm{TNR} = \frac{\mathrm{TN}}{\mathrm{N}} = \frac{\mathrm{TN}}{\mathrm{TN} + \mathrm{FP}} = 1 - \mathrm{FPR}$$

precision or positive predictive value (PPV)

$$\mathrm{PPV} = \frac{\mathrm{TP}}{\mathrm{TP} + \mathrm{FP}} = 1 - \mathrm{FDR}$$

negative predictive value (NPV)

$$\mathrm{NPV} = \frac{\mathrm{TN}}{\mathrm{TN} + \mathrm{FN}} = 1 - \mathrm{FOR}$$

miss rate or false negative rate (FNR)

$$\mathrm{FNR} = \frac{\mathrm{FN}}{\mathrm{P}} = \frac{\mathrm{FN}}{\mathrm{FN} + \mathrm{TP}} = 1 - \mathrm{TPR}$$

fall-out or false positive rate (FPR)

$$\mathrm{FPR} = \frac{\mathrm{FP}}{\mathrm{N}} = \frac{\mathrm{FP}}{\mathrm{FP} + \mathrm{TN}} = 1 - \mathrm{TNR}$$

false discovery rate (FDR)

$$\mathrm{FDR} = \frac{\mathrm{FP}}{\mathrm{FP} + \mathrm{TP}} = 1 - \mathrm{PPV}$$

false omission rate (FOR)

$$\mathrm{FOR} = \frac{\mathrm{FN}}{\mathrm{FN} + \mathrm{TN}} = 1 - \mathrm{NPV}$$

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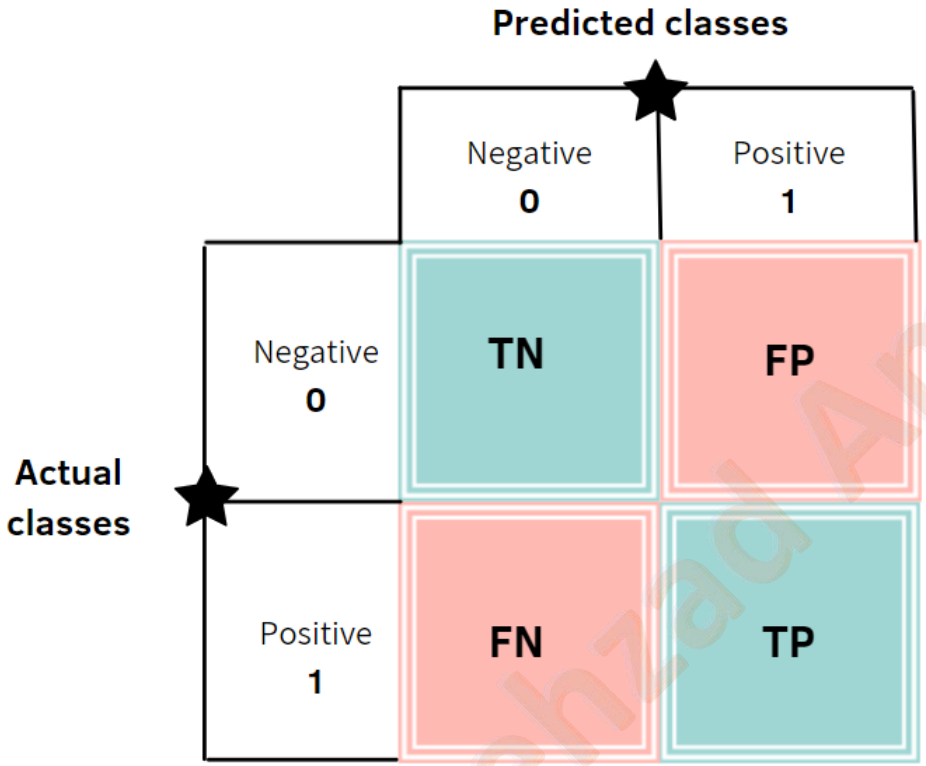
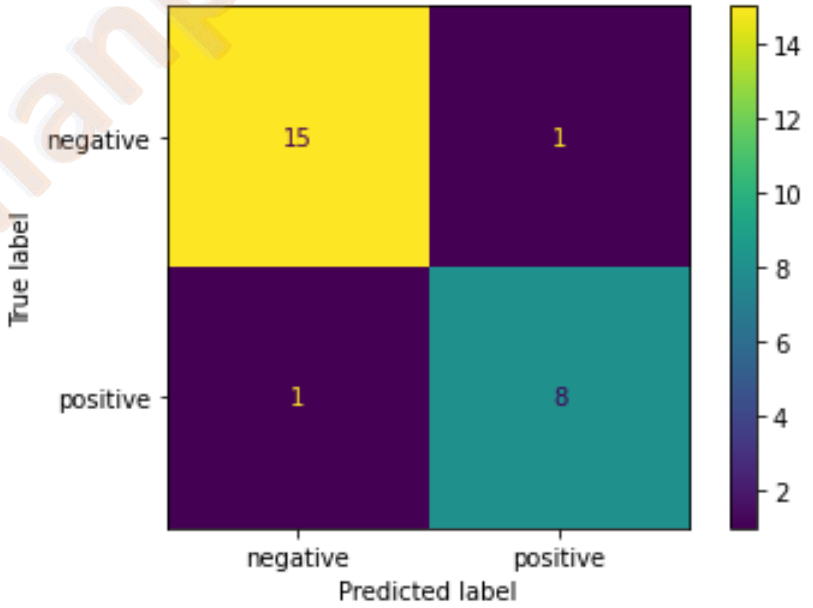
Confusion Matrix (Matching Matrix)





https://towardsai.net/p/data-science/how-to-evaluate-you-model-using-the-confusion-matrixe

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