Supervised Learning Evaluation, Computer Vision

Artificial Intelligence @ Allegheny College

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A feature is a measurable property or a characteristic of the object we are trying to analyze (columns in a data set).
A **feature** is a measurable property or a characteristic of the object we are trying to analyze (columns in a data set).

**Discrimination** attempts to separate distinct sets of objects.

**Classification** attempts to allocate new objects to predefined groups.
Performance Measures

- **Cost ratio** is a ratio of *false positives* (given condition is present when it is not) to *false negatives* (given condition is not present when it actually is).

- **Confusion matrix** (error matrix): a table to visualize the performance of an algorithm with rows/columns representing instances of predictions and columns/rows representing instances of actual class.
Performance Measures

- **a** is a true positive (TP).
- **d** is a true negative (TN).
- **c** is a false positive (FP).
- **b** is a false negative (FN).

The accuracy formula is:

$$\text{accuracy} = \frac{(a + d)}{(a + b + c + d)}$$
Performance Measures

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Classification Accuracy

Number of correctly classified examples divided by the total number of examples.

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\]

\[
Error = 1 - Accuracy \tag{2}
\]
Performance Measures

\[ \text{Recall} = \frac{TP}{TP + FN} \quad (3) \]

Higher the recall the better class is correctly recognized (small number of \( FN \)).
Performance Measures

Recall \[= \frac{TP}{TP + FN} \tag{3}\]

Higher the recall the better class is correctly recognized (small number of FN).

Precision \[= \frac{TP}{TP + FP} \tag{4}\]

Higher the precision the better indication of an example labeled as positive being indeed positive (small number of FP).
Performance Measures

- High recall, low precision: Most of the positive examples are correctly recognized (low FN) but there are a lot of false positives.
- Low recall, high precision: Miss a lot of positive examples (high FN) but those we predict as positive are indeed positive (low FP).
Performance Measures

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\[
F1 = 2 \frac{Precision \times Recall}{Precision + Recall} \tag{5}
\]

F1 Score is used to find a balance between Precision and Recall.
Performance Measures

- Receiver Operator Characteristic **ROC curve**: plot of TP vs. FP.
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- ROC Curves summarize the trade-off between the true positive rate and false positive rate for a predictive model using different probability thresholds.
- Precision-Recall curves summarize the trade-off between the true positive rate and the positive predictive value for a predictive model using different probability thresholds.
- ROC curves are appropriate when the observations are balanced between each class, whereas precision-recall curves are appropriate for imbalanced datasets.
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What-If Tool

Smile Detection Demo
https://pair-code.github.io/what-if-tool/
Computer Vision

Make computers understand images and video.
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Computer Vision

- What kind of scene?
- Where are the cars?
- How far is the building?
Why computer vision matters?

Safety

Health

Security

Comfort

Fun

Access
Applications of Computer Vision

“Face Recognition”  “Pose Estimation”  “Body Tracking”

“Speech Reading”  “Palm Recognition”  “Car Tracking”
Segmentation

- Compact representation for image data in terms of a set of components.
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- Components share “common” visual properties.
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- Components share “common” visual properties.
- Properties can be defined at different level of abstractions.
Tokens
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Segmentation

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- **Bottom up segmentation**
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- **Bottom up segmentation**
  - tokens belong together because they are locally coherent.

- **Top down segmentation**
  - tokens belong together because they lie on the same object.
What is Segmentation?

Clustering image elements that “belong together”

- Partitioning
  - Divide into regions/sequences with coherent internal properties.

- Grouping
  - Identify sets of coherent tokens in image.
An open source BSD licensed computer vision library
- Patent-encumbered code isolated into “non-free” module (SIFT, SURF, some of the Face Detectors, etc.)

Available on all major platforms
- Android, iOS, Linux, Mac OS X, Windows

Written primarily in C++
- Bindings available for Python, Java, even MATLAB (in 3.0).

Well documented at http://docs.opencv.org

Source available at https://github.com/Itseez/opencv