Mobile and Wearable Computing SA 2024-2025
Università della Svizzera italiana

# Assignment 4

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https://github.com/USI-Projects-Collection/mobile_ass_04.git

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## Note

The assignment is at the end of the tutorial file (Paolo_Deidda_Assignment04.ipynb)

## Exercise 0

### Results

The balanced accuracy for 5-fold and Leave-One-User-Out (LOUO) cross-validation was computed for both the old dataset (`example_data_w_engagement.csv`) and the new dataset (`assignment_data.csv`). Below are the results:

#### 5-Fold Cross-Validation

| Model | Old Dataset (%) | New Dataset (%) | Change |
|---|---|---|---|
| XGBoost | $68.75 \pm 0.78$ | $63.40 \pm 0.67$ | Decreased |
| DummyClassifier | $47.58 \pm 0.31$ | $50.49 \pm 0.24$ | Increased |

Table 1: 5-Fold Cross-Validation Results

#### Leave-One-User-Out (LOUO) Cross-Validation

| Model | Old Dataset (%) | New Dataset (%) | Change |
|---|---|---|---|
| XGBoost | $45.27 \pm 23.23$ | $41.92 \pm 16.32$ | Decreased |
| DummyClassifier | $49.47 \pm 1.02$ | $49.83 \pm 1.21$ | No Change |

Table 2: Leave-One-User-Out Cross-Validation Results

### Discussion

**Did the results change?**
Yes, the results for both 5-fold and LOUO cross-validation changed when using the new dataset.

**Why did the results change?**
The observed changes can be attributed to differences in dataset characteristics:

- **Feature distribution:** The new dataset likely has a different distribution of features, which impacts the model's ability to generalize.
- **User variability:** Leave-One-User-Out validation is more sensitive to changes in user-level data. This is reflected in the decreased performance of XGBoost for LOUO.
- **Class balance:** The slight increase in DummyClassifier's balanced accuracy suggests that the class distribution in the new dataset might be closer to uniform.

## Exercise 1

The balanced accuracy scores for the Leave One Day Out (per user) paradigm are as follows:

- **XGBoost:** $63.95 \pm 2.17\%$
- **DummyClassifier:** $49.63 \pm 1.76\%$

Compared to other paradigms, the results here are more favorable. Specifically, the standard deviation is significantly lower than with the LOUO paradigm, indicating a tighter clustering of values around the mean with less fluctuation.

## Exercise 2

| Model | 5-Fold | LOUO | LODO |
|---|---|---|---|
| **Support Vector Machine (SVC)** | $50.11 \pm 0.23\%$ | $47.03 \pm 36.51\%$ | $50.17 \pm 0.38\%$ |
| **Random Forest** | $63.92 \pm 0.78\%$ | $42.00 \pm 16.24\%$ | $64.33 \pm 1.79\%$ |
| **Naive Bayes (GaussianNB)** | $54.74 \pm 0.68\%$ | $28.44 \pm 22.44\%$ | $54.79 \pm 2.25\%$ |

Table 3: Performance of various classifiers across different validation paradigms.

Among the tested models, the Random Forest Classifier outperformed XGBoost. For the Naive Bayes classifier, a normal data distribution was assumed during its application. The performance results for each model across different paradigms are summarized below: