Human Activity Recognition

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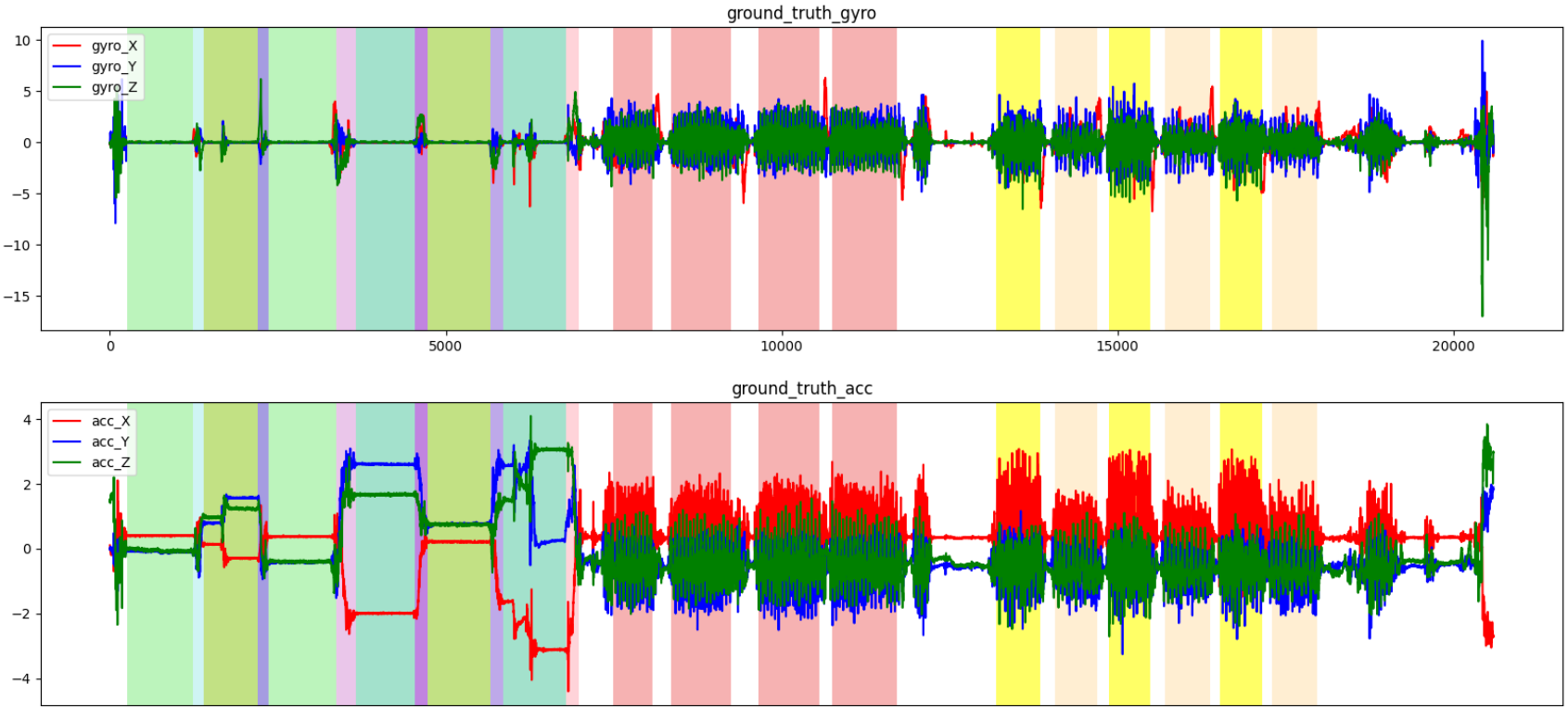
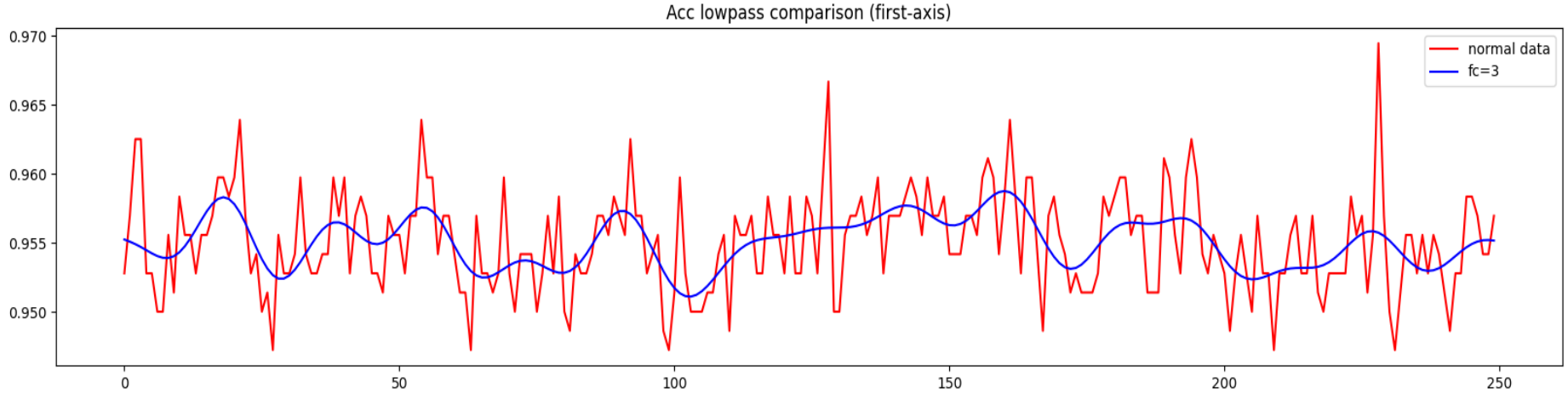
Introduction

- Human Activity Recognition (HAR) aims to classify ones activity based on sensor data.
- HAPT Dataset provides tri-axial smartphone data from a accelerometer and a gyroscope.



Input Pipeline

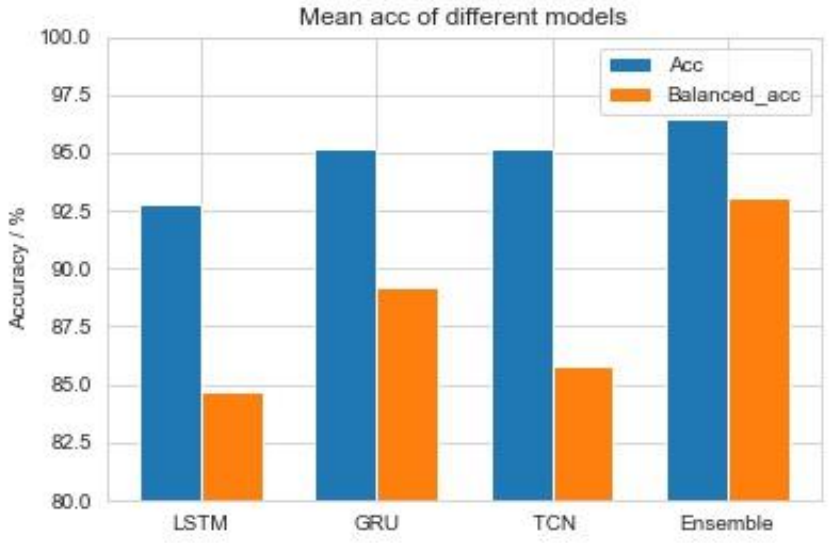
- **Remove** unlabeled data from the dataset.
- Hard coded label assignment strategy.
- **Z-score normalization** for multi channel data.
- Sliding window for data augmentation (window size: 250, window shift: **75**).
- **Low-pass filter** to eliminate high frequencies.
- Dataset is **resampled into two groups**.



Model and Training

- **Models:** LSTM and GRU based RNN models, Temporal Convolutional Network (TCN).
- **Training:** Adam optimizer with cosine decay learning rate, weighted loss in sparse_categorical_entropy_loss (focus more on transition samples).
- **Bayesian hyperparameter optimization.**
- **Results:**

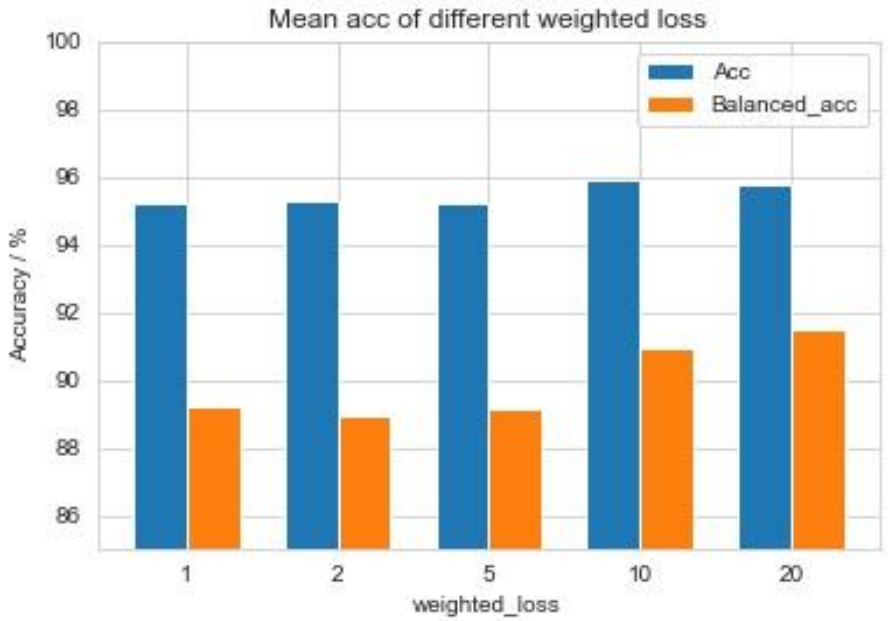
Model	Acc [%]	Balanced-Acc [%]
LSTM	96.10 (92.78)	90.26 (84.72)
GRU	96.87 (95.20)	92.24 (89.21)
TCN	96.15 (95.17)	92.45 (85.78)
Ensemble	96.46	93.04

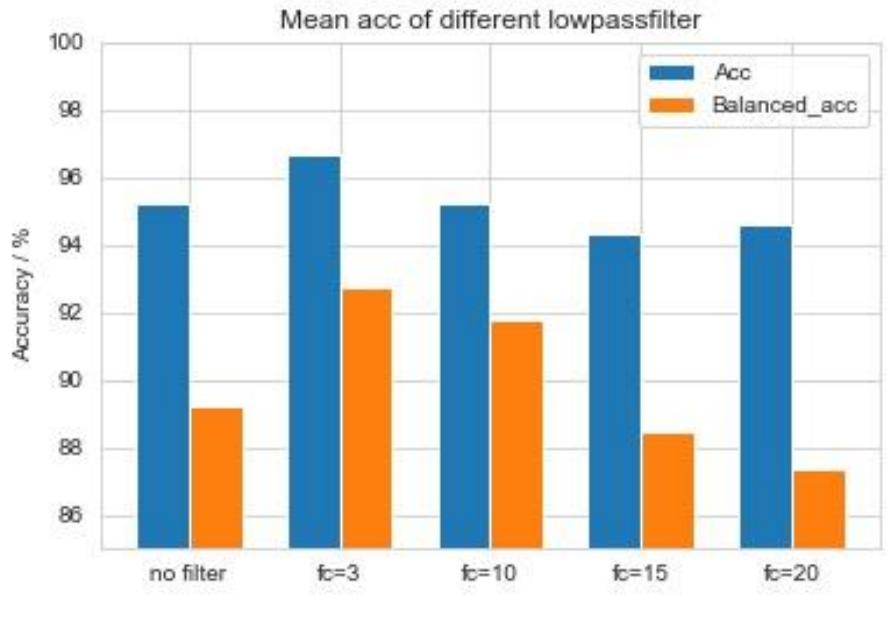


- **The GRU-based architectures were found to be more reliable in terms of reproducibility. The ensemble learning has further improved the result.**

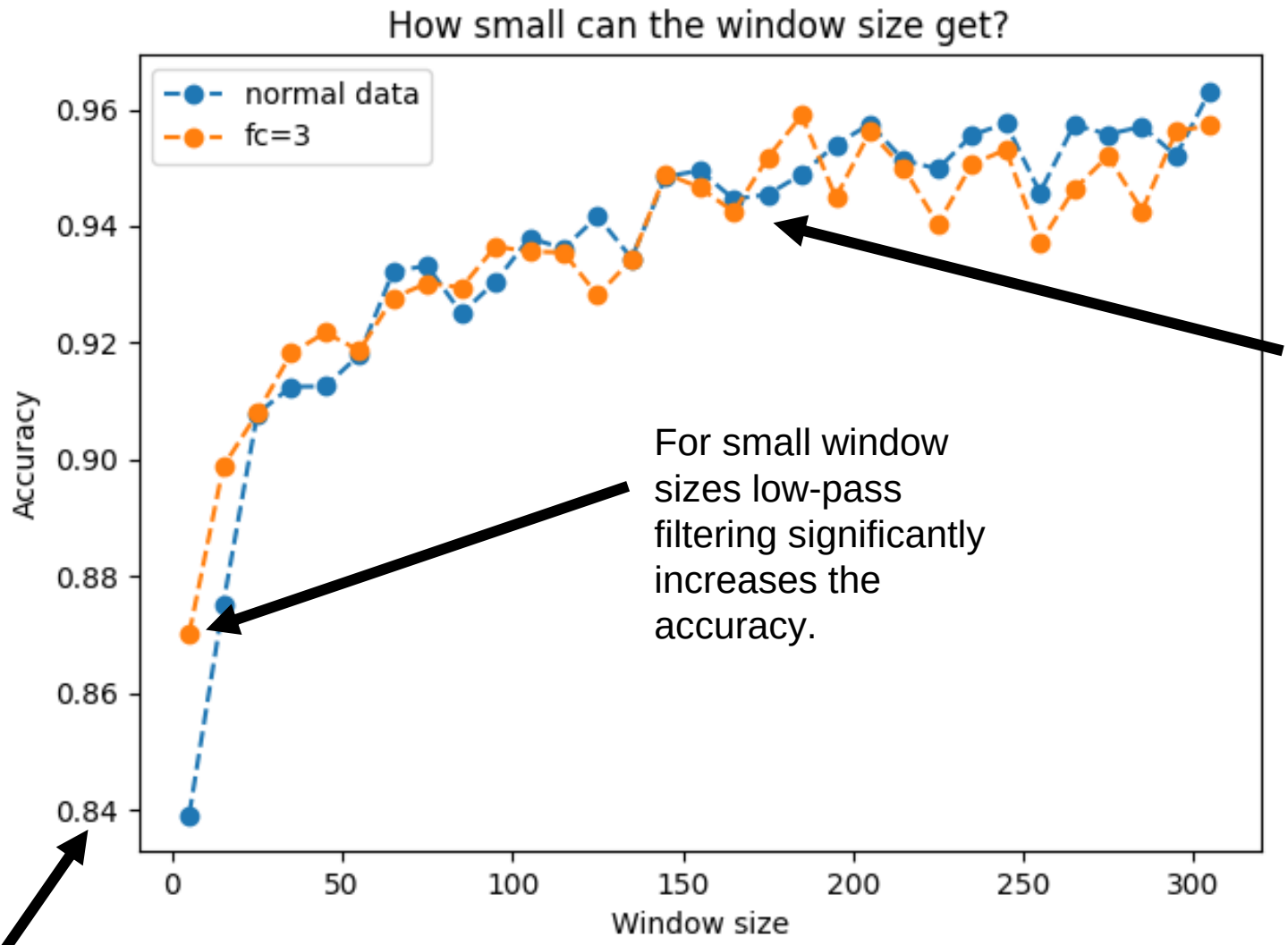
Ablation

- **Initialization:** He_normal kernel initializer has better performance.
- **Bidirectional:** Normal rnn layers have better performance than bidirectional layers.
- **Low-pass filter :** Smaller cutoff frequency Fc will make signal smoother and less sensitive to noise.
- **Weighted loss:** The weighted loss introduces better balanced acc.





How much temporal information is needed?



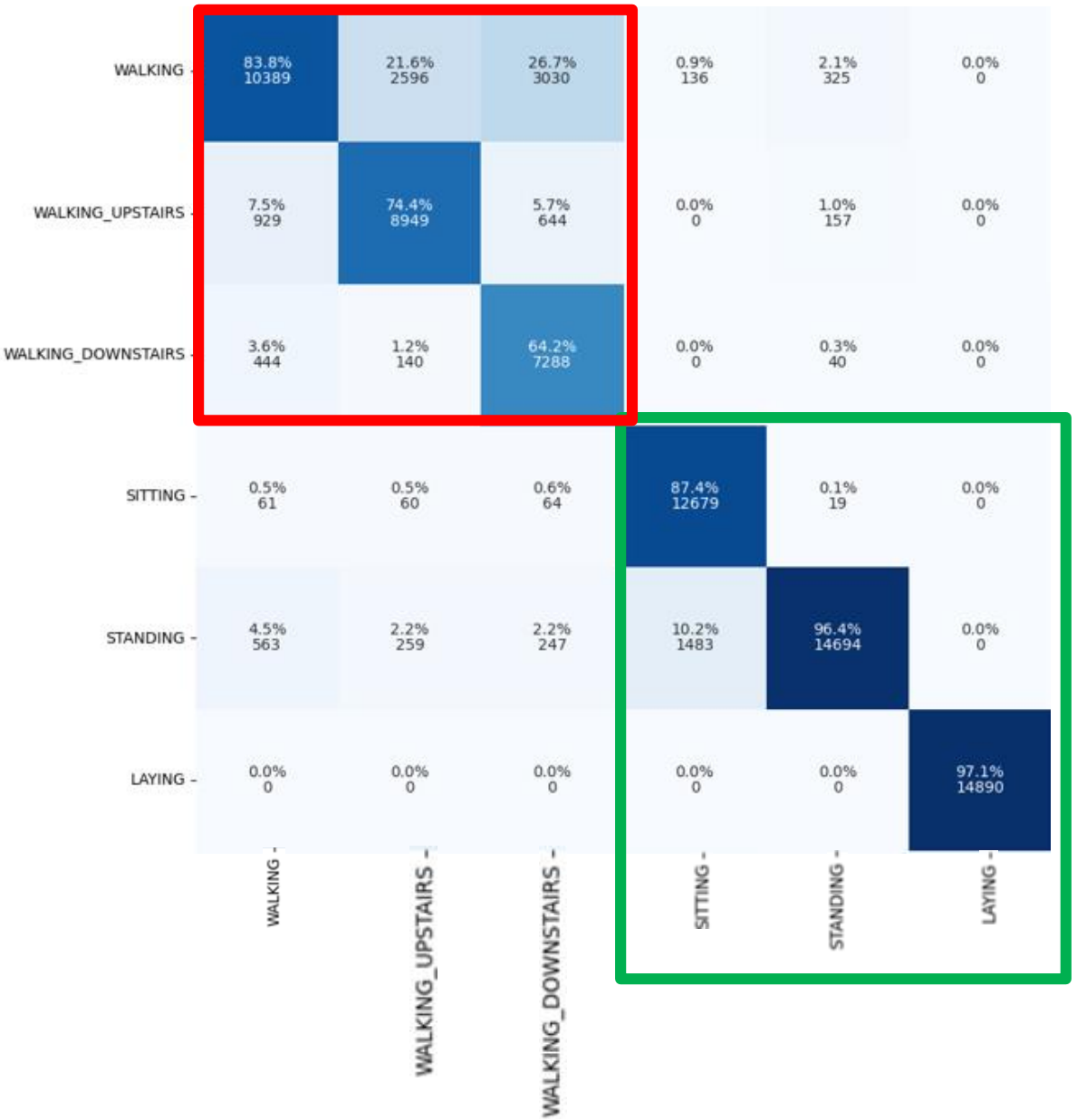
In general, larger window sizes yield better accuracy scores.

For small window sizes low-pass filtering significantly increases the accuracy.

Still reasonable results for small window sizes.

… and for which classes?

window size= 2, fc=3

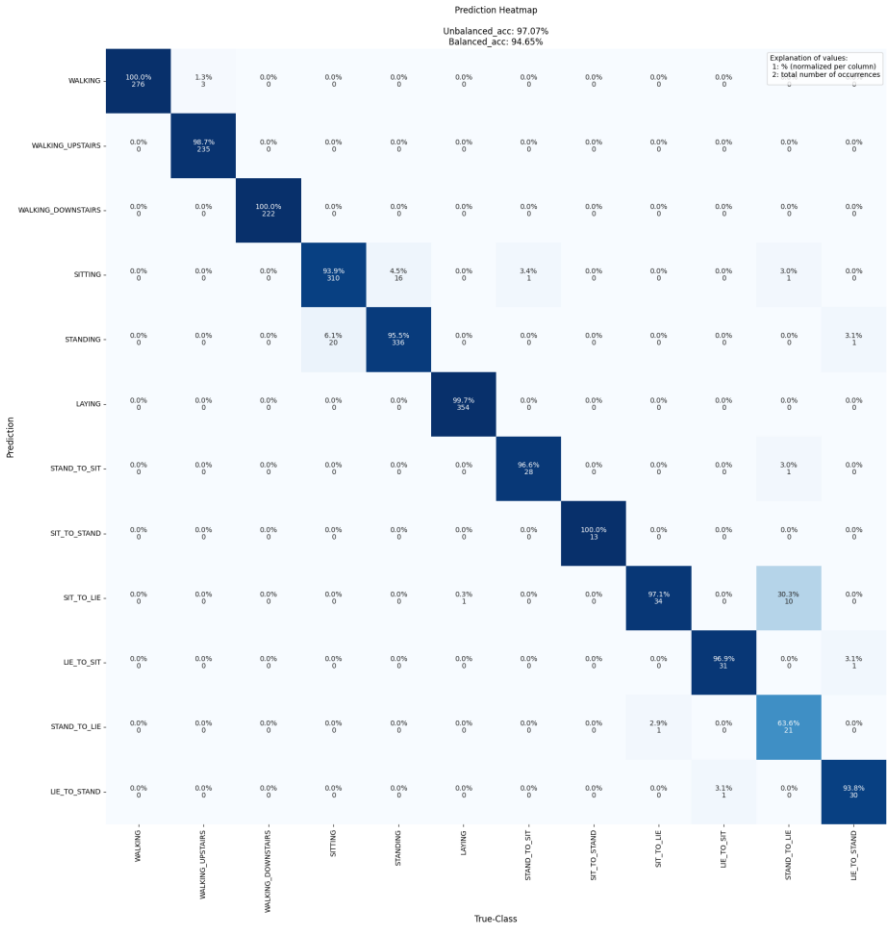


Static activities are not time related and therefore can be detected very accurate without temporal information.

Thank You !

… and for which classes?

window size= 250



window size= 2