HUMAN ACTIVITY RECOGNITION

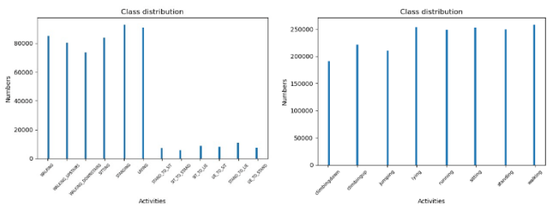
Zheming Yin and Ziheng Tong

Institute of Signal Processing and System Theory, University of Stuttgart, Germany

1. Input Pipeline

For HAPT and HAR datasets, we are using the TFRecord files to accelerate the input process.

- HAPT [1]
  This dataset contains twelve labels including transitional positions and also some data are unlabelled.
  - Preprocess:
    - Remove the unlabelled data
    - Perform the Z-Score normalization channel-wise
    - Divide into windows with variable size and shift
    - Prepare for both sequence and label prediction (S2S and S2L)



- HAR [2]
  A large dataset with inconsistent recording interval.
  - Preprocess:
    - Concatenate devices at different positions for each activity and subject
    - Fit the data into a function using nearest interpolation
    - Perform the Z-Score normalization and delete first and last five seconds
    - Oversample the label of jumping to balance the dataset

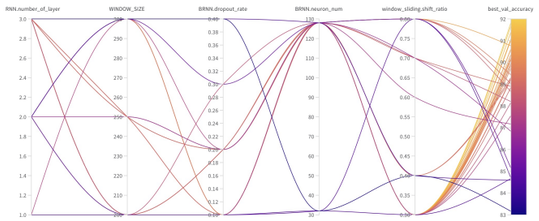
2. Model

We utilized three different models, namely RNN, BRNN and GRU and obtained the following best test accuracy:

Model	S2S	S2L
BRNN	95.3%	93.6%
RNN	93.4%	93.5%
GRU	83.8%	80.7%

- Hyperparameter tuning
  With the help of W&B, we applied sweep with Bayes method and got the best result at:

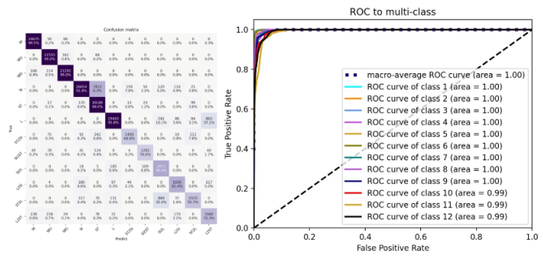
Parameter	Value
window size	200
window shift	60
dropout rate	0.1
recurrent layers	3
dense layers	1
learning rate	0.0001
stateful	false



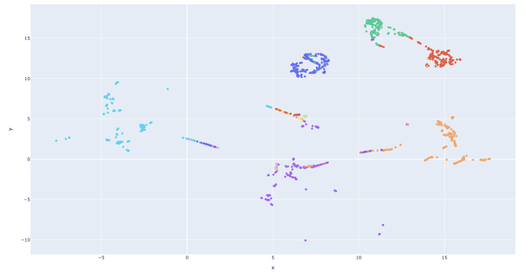
3. Evaluation

- HAPT

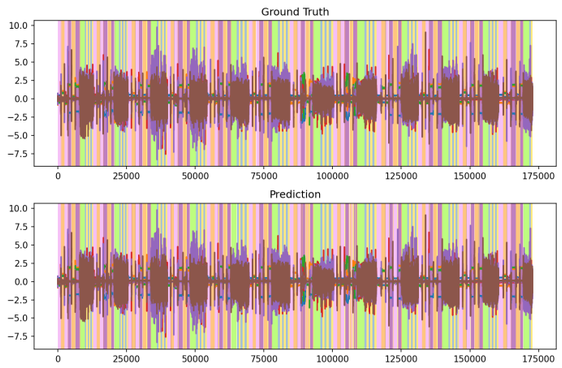
We use the confusion matrix and ROC to evaluate the result.



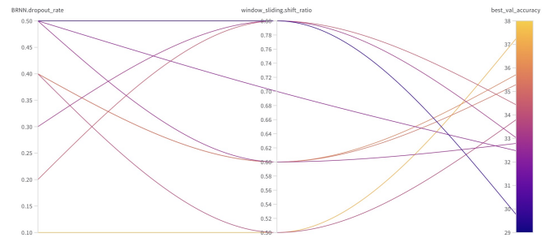
We also use the dimensional reduction to visualize the result of S2L.



- Activity recognition

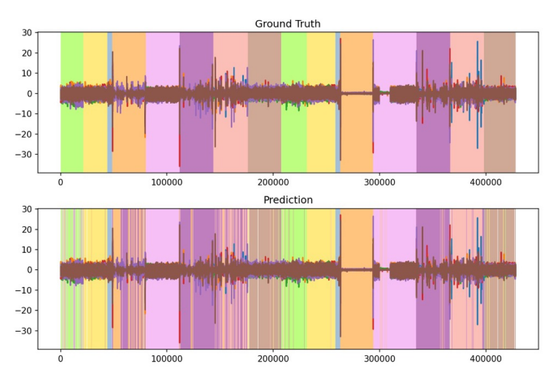


- HAR
  We tried BRNN model with dropout rate of 0.1, window size of 250, and window shift of 125 with reference to the random sweep based on the sensor at upperarm.



Position	Test accuracy	F_measure	Recall	Precision
waist	84.0%	85.7%	85.5%	87.6%
shin	80.8%	82.9%	83.2%	83.2%
chest	79.0%	80.6%	81.4%	81.5%
upper arm	76.2%	77.4%	78.8%	77.1%
forearm	69.9%	71.6%	72.2%	73.1%
head	67.9%	70.4%	69.9%	72.0%
thigh	61.1%	63.2%	61.7%	68.7%
multiple	73.0%	70.8%	72.2%	70.8%

- Activity recognition (waist)



4. Conclusion

To summarize, we achieved best performance with BRNN for HAPT dataset, and the test accuracy is 95.3%. BRNN also get the best result for HAR dataset at the position of waist.

[1] https://archive.ics.uci.edu/ml/datasets/Smartphone-Based+Recognition+of+Human+Activities+and+Postural+Transitions.
[2] https://www.uni-mannheim.de/dws/research/projects/activity-recognition/dataset/dataset-realworld/

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