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# Activity recognition from time series using NNs

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## 1 Description

Activity recognition from time-series data [1, 2, 3, 4, 5] is a difficult problem for machine learning due to the complexity of time series analysis, the commonly large dimensionality of the data, and the noise present in this type of problems. Feature engineering and an appropriate choice of the classifiers are two key questions when addressing this type of problems.

## 2 Objectives

The goal of the project is to predict what type of activity is carried out by 15 individuals from the analysis of a time series produced by a wearable sensor. A database will be used for the analysis<sup>1</sup>. A supervised classifier that includes an NN component should be created to predict the activity. Since a high variability between individuals is possible, a different classifier could be learned for each individual.

The project should apply Neural Networks for: I) Find suitable feature representations for this problem that are very usable for other ML classifiers, OR, II) Implement NN-based classifiers for this problem, OR III) The combination of I and II (e.g., using an RBM to find the features and a Multi-layer Perceptron to classify the problem using the extracted features). In case II), the students are free to decide which feature representation is more appropriate for the data. In case I), they can use any classifier with the NN-based features.

The student should: 1) Design any preprocessing of the time series the dataset; 2) Define and learn the classifier using the training data. 3) Design the validation method to evaluate the accuracy of the proposed classification approach. 4) Answer to the following questions in the report:

- What class of problems can be solved with the NN? (e.g., supervised vs unsupervised problems)
- What is the network architecture? (e.g., type and number of layers, parameters, connectivity, etc.).
- What is the rationale behind the conception of the NN?
- How is inference implemented? (e.g., How is the information extracted from the network?). Type of prediction or type of inference process.
- What are the learning methods used to learn the network ? Algorithms used for learning the network.

As in other projects, a report should describe the characteristics of the design, implementation, and results. A Jupyter notebook should include calls to the implemented function that illustrate the way it works.

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<sup>1</sup>The “Activity Recognition from Single Chest-Mounted Accelerometer” dataset can be downloaded from <https://archive.ics.uci.edu/ml/datasets/Activity+Recognition+from+Single+Chest-Mounted+Accelerometer>

### 3 Suggestions

- Carefully read the README in the “Activity Recognition from Single Chest-Mounted Accelerometer.zip” file.
- See relevant literature related to the general problem of activity recognition (e.g., [1, 2, 3, 4, 5]) and particular the papers related to this dataset and linked in the web page of the dataset <https://archive.ics.uci.edu/ml/datasets/Activity+Recognition+from+Single+Chest-Mounted+Accelerometer>.
- Extracting features is a key question for this type of problems. NNs can be applied on a set of originally extracted features.
- Implementations can use any Python library.
- If classes are not well balanced you may use performance measures different to the accuracy.

### References

- [1] Media Anugerah Ayu, Siti Aisyah Ismail, Ahmad Faridi Abdul Matin, and Teddy Mantoro. A comparison study of classifier algorithms for mobile-phone’s accelerometer based activity recognition. *Procedia Engineering*, 41:224–229, 2012.
- [2] Akram Bayat, Marc Pomplun, and Duc A Tran. A study on human activity recognition using accelerometer data from smartphones. *Procedia Computer Science*, 34:450–457, 2014.
- [3] Pierluigi Casale, Oriol Pujol, and Petia Radeva. Human activity recognition from accelerometer data using a wearable device. *Pattern Recognition and Image Analysis*, pages 289–296, 2011.
- [4] Wenchao Jiang and Zhaozheng Yin. Human activity recognition using wearable sensors by deep convolutional neural networks. In *Proceedings of the 23rd ACM international conference on Multimedia*, pages 1307–1310. ACM, 2015.
- [5] Adil Mehmood Khan, Ali Tufail, Asad Masood Khattak, and Teemu H Laine. Activity recognition on smartphones via sensor-fusion and kda-based svms. *International Journal of Distributed Sensor Networks*, 10(5):503291, 2014.