First Year Project
Mini-Project 3: Human Activity Recognition by Wearable Sensors

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1 Learning Goals

In parallel to working towards the general learning objectives of the First Year Project course, you are intended to

- Become familiar with the practical the application of human activity recognition using wearable sensor data
- Analyse and segment complete sensor data
- Explore, select and apply suitable machine learning techniques for the application of activity recognition
- Evaluate and report the activity recognition results.

2 Requirements

The same as in previous mini-projects.

3 Description

Have you ever wondered, how does your smart phone know what you are doing right now? In this mini-project, we will use a smart phone data set of 30 volunteers that performed six activities (walking, walking-stairs-up, walking-stairs-down, sitting, standing, laying) using phones with embedded accelerometer and gyroscope. The mini project is a segmentation problem

where the focus will be on in data munging and learning. The data to be analysed is provided on LearnIT.

In the research articles [2, 1, 3], there is a detailed description of a possible solution for the human activity recognition problem. Your assignment is to design and implement something similar that works as well as possible. There are numerous other papers on the internet that you could take inspiration from. You should explore other possible solutions to the problem and find your own way. You also have to select an appropriate method to numerically evaluate your result.

You can implement your method either in Python or R. You are also free to use data analysis libraries/tools you find suitable. However, it is advisable to first implement as a simplest base solution as soon as possible and then refine the solution towards a better one closer to the mini-project deadline.

You must train the activity recognition by *only* the training data and use the test data *only* in the method evaluation.

4 The hand-in (and oral presentation)

You must hand in

1. The github contributors log (in pdf),
2. The code scripts in plain text (no Python nor R notebooks),
3. The project report.

Project report. Your hand-in should be no longer than 3 pages (with 1.5cm margins and 11pt font size), excluding references, and should consist of precisely the following sections. Note that the hand-in should be self-contained: although you are required to master your code for the oral exam. Your 10 minute oral presentation should correspond to the structure of your write-up.

1. **Introduction.** Here you provide the context for the problem and re-state the brief.
2. **Methods.** Here you define and describe your methods, with precise mathematics where applicable.
3. **Experiments.** Here you describe your data source and provide the numerical the results of your method over the data. The results refer to numerical performance evaluation that you need to carry out.

4. **Discussion.** Here you reflect and discuss the results against the original questions setting. Here you also discuss short-comings of your methodology/data.

5. **Conclusions and future work.** Here you provide a couple of sentences summarising the results of the project and indicating how the methods/data could be improved.

A. **Disclosure statement.** Here (appendix) you may state if there were any serious unequal workloads among group members.

   References. This is a numbered reference list of the works you cite in the report, of the key methods referred. This section is not counted in the 3-page-limit.

In Sections 1.-5. above, you must only report scientific considerations, not matters related to group dynamics.

References

[1] D. Anguita, A. Ghio, L. Oneto, X. Parra, and J. L. Reyes-Ortiz. Energy efficient smartphone-based activity recognition using fixed-point arithmetic. *Journal of Universal Computer Science, Special Issue in Ambient Assisted Living: Home Care*, 19(9), 2013.

[2] D. Anguita, A. Ghio, Luca Oneto, X. Parra, and J. L. Reyes-Ortiz. Human activity recognition on smartphones using a multiclass hardware-friendly support vector machine. In *Proc. 4th International Workshop of Ambient Assited Living, IWAAL 201*, pages 216–223, Vitoria-Gasteiz, Spain, December 2012.

[3] J. L. Reyes-Ortiz, A. Ghio, X. Parra-Llanas, D. Anguita, J. Cabestany, and A. Catal. Human activity and motion disorder recognition: Towards smarter interactive cognitive environments. In *Proc. 21th European Symposium on Artificial Neural Networks, Computational Intelligence and Machine Learning, ESANN 2013*, pages 24–26, Bruges, Belgium, April 2013.