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Signature-Based Disaggregation of Electricity Demand

Several applications need access to detailed knowledge of the electricity consumption patterns of individual consumers. Therefore, there is an increasingly pressing need for analyzing detailed smart meter data, which collect sequences (or time series) of electricity consumption data, aggregated at the level of households. There is also a strong need to decompose the global consumption recorded by these smart meters into the different usages of electricity (e.g., heating, water heating, washing machine, refrigerator, etc.). This is what is called *disaggregation*, which can be defined as several problems from the prediction of the presence of a specific equipment in the premises, to the extraction of the consumption of each equipment.
In this work, we will design scalable and robust techniques for disaggregating the smart meter data, in order to identify the signatures, namely, the characteristic usage patterns, of different appliances. Existing techniques are focused on the definition of these signatures, e.g., using appliance profiling and machine learning (and deep learning) techniques [1][2][3]. In addition to this, we will also focus on the detection of known signatures of varying length in large historical and fast live data [4], as well as in the extraction of previously unknown candidate signatures [5]. Due to their inherent computational complexity, both these operations are now very expensive, and limited to comparably small sets of sequences. One of the key foci of this proposal will therefore lie on the development of efficient, scalable algorithms to detect and extract such signatures.

This work will be conducted in close collaboration with the Électricité de France (EDF), which will also provide access to real data from smart meters.

Internship:
Apply by emailing Prof. Themis Palpanas your CV. Accepting this project will make you part of diNo (LIPADE, Paris Descartes University), an enthusiastic team working on real, challenging problems! The internship will last between 3-6 months, and is fully funded.
Prerequisites: experience with machine learning, file and data structures, excellent programming skills (Python, C).

References:

[1] Faustine, Anthony, et al. "A Survey on Non-Intrusive Load Monitoring Methodologies and Techniques for Energy Disaggregation Problem." arXiv preprint arXiv:1703.00785 (2017).

[2] Agyeman, Kofi Afrifa, Sekyung Han, and Soohee Han. "Real-time recognition non-intrusive electrical appliance monitoring algorithm for a residential building energy management system." Energies 8.9 (2015): 9029-9048.

[3] Ebeid, Emad, Rune Heick, and Rune Hylsberg Jacobsen. "Deducing Energy Consumer Behavior from Smart Meter Data." Future Internet 9.3 (2017): 29.

[4] Michele Linardi, Themis Palpanas. ULISSE: ULtra compact Index for Variable-Length Similarity SEarch in Data Series. IEEE International Conference on Data Engineering (ICDE), Paris, France, April 2018.

[5] Chin-Chia Michael Yeh, Yan Zhu, Liudmila Ulanova, Nurjahan Begum, Yifei Ding, Hoang Anh Dau, Diego Furtado Silva, Abdullah Mueen, Eamonn J. Keogh: Matrix Profile I: All Pairs Similarity Joins for Time Series: A Unifying View That Includes Motifs, Discords and Shapelets. ICDM 2016: 1317-1322.