Meet-up 2019 | Doctorants & Industrie

DEEP LEARNING APPLIED TO ENERGY CONSUMPTION

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Abstract

Artificial intelligence has initiated new opportunities for the development of various areas. The energy management systems with the obligation of the best use of energies are with the first who should benefit from these technologies.

In this paper, we propose a dual deep neural network architecture. We are trying to highlight the potential of Deep neural networks typically Long Short Term Memory(LSTM) on making accurate time-series predictions we are also using categorization methods to classify time series.

1 CONTEXT

Climate issues are in the heart of various fields of researches. In this theme, the demand for electricity and renewable energies (solar, wind turbine, hydro, geothermal, ...) plays a leading role. Because of the uncertainty of renewable energy production, we need to make accurate management between the generated energy and consumed.
=> The efficient management of these resources relies on forecasting the habits of energy consumption.

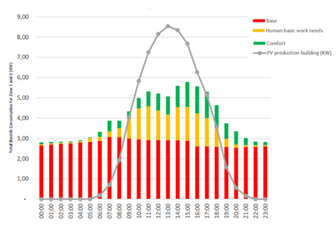


Figure 1: Energy consumption and production for one day

2 OBJECTIVES

Considering a Micro-grid composed of photovoltaic panels, wind turbines, and other renewable energy sources, various buildings (energy consumers), storage capacities and access to the utility grid.

Since energy consumption depends on several factors such as user's habit, external temperature, occupancy and so on, likewise for the production of renewable energy because of their irregular and uncertain nature we need to use advanced methods for predicting the future energy consumption and production to meet the adequate balance between them.

Our chief objective is to elaborate a smart Energy Management System(EMS) that will consider the different actors of a micro-grid and manage it in an efficient way.

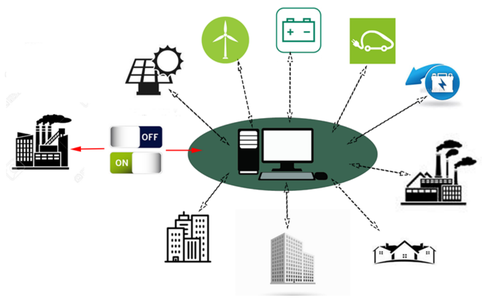


Figure 2: Micro-grid Architecture

3 PROPOSED METHOD

In the first step, since there are many buildings and diverse kinds of energy consumptions for each one. We need to do classification. After making comparisons our choice went to Multi-Layer Perceptron (MLP).

At a second step, we used Long Short Term Memory to do Time Series Predictions.

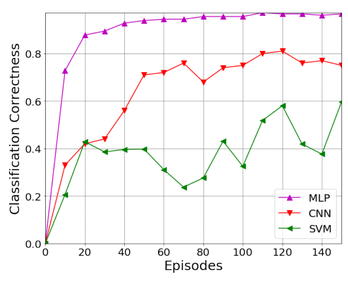


Figure 3: Comparaison SVM CNN and MLP

4 CASE STUDY

We are treating energy consumption data collected from two buildings. The first one is The DrahiX Novation Center located at Ecole Polytechnique, and the second one is The student Dorm "Maisel" located at Evry.

(a) Building with 7 different Zone

(b) student dorm

Figure 4: Working Environment

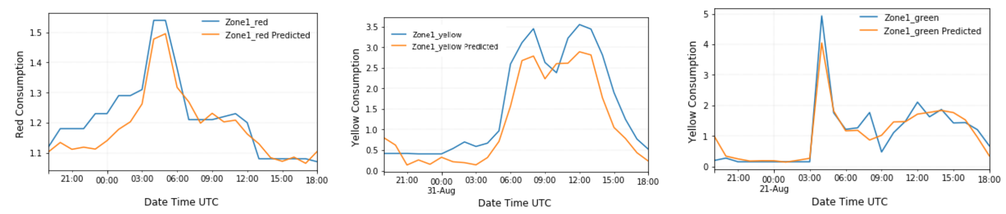
5 RESULTS

Using MLP to classify the various kind of energy consumption gave us an accuracy of 0.96. We started by comparing Long Short Term Memory(LSTM) and Gated Recurrent Unit (GRU) to determine which one gave better results on the baseis of Mean Square Error (MSE), Root MSE and R^2.

Table 1: Efficiency of deep prediction algorithms

KPI \ Approach	GRU	LSTM
MSE	0,007	0.006
$RMSE$	0.076	0.063
R^2	0.911	0.918

Results show that LSTM outperform GRU. In the next figures we will show predictions of the three kinds of energy consumption for the first zone.



(a) Critic Energy Consumption **(b)** Programmale Energy Consumption **(c)** Confort Energy Consumption

Figure 5: Forecasting different kinds of Energy consumption

6 FUTURE WORK

After starting by categorizing the kind of energy consumption and the type of building, we trained a Deep Neural Network on historical data collected from two distinct buildings to forecast one day-ahead energy consumption and photovoltaic panel production.

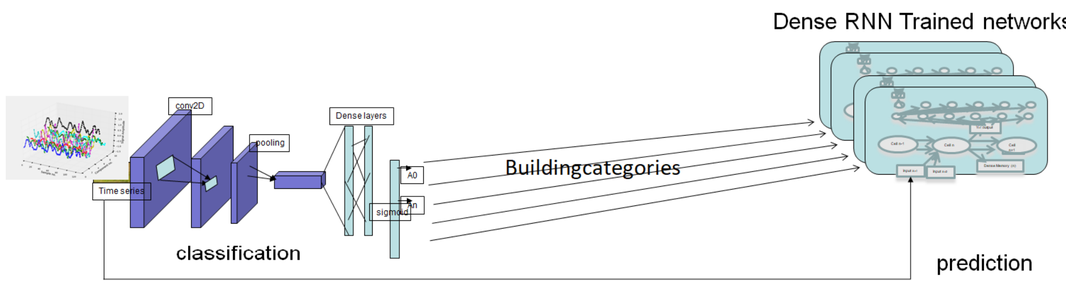


Figure 6: Classification and Prediction

The next step is to develop the model using either optimization methods or Reinforcement learning.

References

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