First Exercise session of Smart Distribution Systems

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1 Introduction

This exercise session will familiarize the students with basic machine learning concepts and teach them how these concepts can be used within power systems. The exercises will mainly focus on forecasting.

Two exercise sessions are planned for this course. During these sessions students will learn to:

- set up a machine learning environment, using state-of-the-art tools, such as Keras and Tensorflow in Python;
- implement and train a neural network using Keras;
- use this neural network to make prediction about the electricity price according to the data set which is provided for them.

2 Installation procedure

During the first two sessions you will use Python. The computers at ESAT have Python installed, but you will need to install several packages yourself. You can find the necessary instructions on Toledo ⇒ Smart Distribution Systems ⇒ course documents ⇒ Exercises.

Although the computers at ESAT have Python installed, you can also work on your own computer. All installation instruction are on the same page on Toledo.

3 Practical information

During the first exercise session, once you have created your Anaconda environment and installed all necessary packages, please follow these steps:

To open the exercises:

1. Go to this link: https://github.com/thijsp/Machine-Learning-in-Power-Systems
2. Download all the contents (download button in the upper right corner)
3. Open the Anaconda Navigator
4. In the 'Home' tab, select after 'Applications on ...' the environment you just created.
5. Launch 'jupyterlab'
6. Navigate to where you downloaded the exercise sessions contents

To start the exercises:

1. open *exercise_session_1.ipynb*. The goal of this part is to familiarize the students with Python programming, regression and Neural networks while using Keras.
2. Read the whole document and go through the referred extra contents. Solve the asked questions by writing small pieces of code in the empty cells. You can always ask questions when necessary.

3. When finished with the first notebook, open *data.ipynb*. This notebook shows how you can use the DataFetcher that we have implemented for you. The DataFetcher allows you to download real-time energy market and Elia (Belgian TSO) data. During the exercise we will only use the cached data. Downloading the recent data would be too slow.

4. If you have still time remaining open *machine_learning.ipynb*. Here you will again implement a Neural Network, but now you will use the real data (from the DataFetcher) to train your network to predict electricity prices. Remember there is a second exercise session in April, you will still have time to go through this notebook and ask questions then.

4 Final report

As a final proof that you understood the content and are able to implement a reasonable forecasting tool, using neural networks, you should predict day-ahead electricity prices. All of the teams will compete in a forecasting competition. For this competition, you should predict the Belgian day-ahead electricity price for the 27th of April 2018. You will have to send in your predictions the day before (26 April 2018) before the actual day-ahead prices have been published. Together with your predictions you should send in your final report. The report should contain basic information about your methodology and assumptions made. It should at least contain an explanation about:

- The data you used and the preprocessing you performed.
- The architecture of the neural network and the reason why you chose this architecture (explain the experiments you performed to make your decision).
- The final results and performance of the model, e.g. what is the test-set performance.

In summary, you should:

- team up and form groups of 2 students
- submit a CSV file indicating the hourly predicted electricity price (thus, 24 predictions) for the 27th of April
- submit a report of no more than 5 pages (including plots) explaining the earlier mentioned items.

The deadline for submission (of both report and predictions) is **26 April 2018 at 2 p.m**.