# Exercise Session: Machine Learning in Power Systems

Smart Distribution Systems (B-KUL-H00P3A)
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**Description**

This exercise session will familiarize the students with basic concepts from machine learning and teach the students how these concepts can be used within power systems for *forecasting*.

The students will learn to:

- set up a machine learning environment, using state-of-the-art tools, such as keras and theano in Python;
- implement and train a neural network using Keras;
- use this neural network to make prediction about the electricity price.

# 1 Setting up a machine learning environment

*A virtual environment has been created and can be accessed from all PC rooms at ESAT.* For students that want to use their own computer, see the Appendix for installation instructions.

For the assignment, see the IPython notebook on: https://github.com/frederikruelens/Machine-Learning-in-Power-Systems

# 2 Final report

The students need to improve the naive implementation (step 7) in the Jupyter notebook file on GitHub.

The students have to:

- team up and form groups of maximum 4 students

- submit a report of no more than 5 pages (including plots) explaining their forecasting strategy and visualization of the data set. It is recommended that students use the Ipython notebook document for their final report.

- submit the report to a dropbox link on Toledo (B-KUL-H00P3A). The final day for submission is

  - **12 April 2017**.

# A    Installation procedure

A prerequisite is that you have Python installed. Most Linux distributions come with Python installed.

The commands described below can be executed by opening a terminal (try the shortcut ctrl-alt-T)

## A.1    Cloning the repository

We clone the GitHub repository of this exercise session to get all the files we need. 'Cloning' simply copies a given repository to a local folder. This is done by executing the following command, which will copy the repository to your desktop.

```
git clone <INSERT GITHUB URL> ~/Desktop
```

## A.2    Installation

First, we will create a virtualenv. Virtualenv provides you with a virtual environment for Python, allowing you to install the exact dependencies you want for a certain application. The following commands install virtualenv, create a virtual environment named 'sds' and activate this environment.

```
sudo apt-get install python-pip
    python-dev python-virtualenv
virtualenv --system-site-packages ~/sds
source ~/sds/bin/activate
```

Next, we install tensorflow, a library created by Google for numerical computations in the context of machine learning [Ten].

```
pip install --upgrade tensorflow
```

Furthermore, we install keras, a high-level neural networks library [Ker]. This library runs on top of tensorflow, which we installed before.

```
sudo pip install keras
```

Finally, we install jupyter [Jup].

```
sudo pip install jupyter
```

# References

[Jup] Jupyter Notebook iPython. A simple way to share jupyter notebooks. https://nbviewer.jupyter.org/github/ipython/ipython/blob/4.0.x/examples/IPython

[Ker] Keras. Deep learning library for theano and tensorflow. https://keras.io/.

[Ten] TensorFlow. An open-source software library for machine intelligence. https://www.tensorflow.org/.