

Weather forecasts with deep learning (30 ECTS credits)

The professional service division at SMHI is looking for one or possibly two students to a master thesis project. The master thesis project will explore the possibility to apply deep learning techniques to generate weather forecasts based on analysis data as initial time step.

1 Background

A physics based model together with a numerical solver is the predominate method for weather forecasting. This method suffers from being computationally heavy. Another approach that is substantially lighter is statistics based methods such as linear regression models and shallow neural networks. The statistics based method suffers from rapidly deteriorating forecast quality as the forecast time is progressing. The forecasts quality is typically only acceptable during the first 6 - 12 hours which is too short for most applications. The statistics based methods are usually point-based. This means that the forecasts only are valid for one point in space and that all input data to the model are from that point. To increase the usability beyond the first 12 hours it is probably necessary to include weather patterns on a larger scale. This can be achieved by using an analysis field as input. An analysis field describes the current weather for a larger area with a regular grid. A statistics based method that uses analysis fields as input must be able to handle both high volume and high dimensional data. It can therefore be interesting to examine how well a deep neural network with analysis data as input performs for longer forecast times.

2 Goal

The goal is to implement and test a couple of deep learning architectures for generating forecasts for longer forecast times, at least 24 hours but preferably 48 hours.

3 Task description

- Suggest a couple of deep learning architectures based on literature studies and maybe some small scale experimenting. Could be convolution neural networks, LSTM, etc.
- Implement the suggested architectures (preferably in some Python framework such as Keras or Lasagne)
- Evaluate the forecasts produced by the suggested architectures. Both forecast quality and computational efficiency should be evaluated.

4 Requirements

- Solid programming skills (preferably in Python)
- Solid skills in Linux CLI
- Solid applied math skills, especially in optimization
- Basic skills in machine learning algorithms

5 Contact information

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