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Intelligent Networks: using convolutional LSTM models to estimate network traffic

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The Large Hadron Collider experiments at CERN produce a large amount of data which are analyzed by the High Energy Physics (HEP) community in hundreds of institutes around the world.
Both efficient transport and distribution of data across HEP centres are, therefore, crucial.
The HEP community has thus established high-performance interconnects for data transport—notably the Large Hadron Collider Optical Private Network (LHCOPN) [1] linking the sites with data curation responsibility and LHCONE [1], a global overlay network linking over 150 collaborating sites. Efficient data transport over these networks is managed by the File Transfer Service (FTS) [2] which manages transfers on behalf of the end users.
Although these networks are well designed—and evolve to meet the changing long-term requirements—short term bottlenecks nevertheless occur. End-user needs would therefore be better met if these networks could be reconfigured dynamically to meet short-term demands, for example by load-sharing across multiple paths or through the temporary commissioning of an additional point-to-point link.
This work is aimed at detecting link saturation in order to provide a solid basis for formulating sensible network re-configuration plans. We analyse data provided by FTS and use LSTM-based models (CNN-LSTM and Conv-LSTM) to effectively forecast network traffic along different network links.
While convolutional layers are used to extract correlations across multiple features, LSTMs interpret network data as time sequences so that a combination of CNN and LSTM layers becomes the natural architectural choice.
Our work shows that CNN-LSTM [3] and Conv-LSTM [4] architectures can indeed detect network saturation and provide great forecasting accuracy even over long time periods (up to 30 minutes). In addition, we provide a detailed performance comparison among different models, high-lighting their strengths and flaws according to the specific task at hand. Our future research will focus on further optimising the DNN architecture, in particular in terms of the relative strength between the CNN and LSTM components in the hybrid models. In addition, a systematic investigation of their capability to generalise to different data sets will not only, improve their usability for this specific application, but also contribute to DNN interpretability and the understanding of the learning process.

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Summary

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