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## Using NLP for Hardware Quality Control by predicting Alert Signals from Particle Accelerator Detectors

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### Abstract.

Particle physics data consists of patterns in measurements that can be separated into hot topics and more mundane data. This approach is analogous to looking for keywords or topics in huge text data by separating more specific words and phrases from the generalities of text through the application of NLP. This will be done using DCS alarm data. The NLP models that were constructed or fine-tuned for text classification included SVM, BERT- base-cased, RoBERTa-base, as well as stacked LSTM and bi-LSTM. This was done on Google Colab using Pytorch and Python libraries, and the hyperparameters were optimised using the WandB platform, in which an extensive Bayes' optimisation search was performed. The idea is to use the best-performing models i.e., BERT or RoBERTa and train them by fine-tuning their hyperparameters in order to classify the alarms, as well as predict future alarm signals, and then follow the same procedure for an LSTM model and compare the results. The inputs would contain information about the date and time the alarm was received, the physical variable involved, the type of error as well as the particular system, component or sub- component affected. Since this data provides information about the detector components as well as the abnormal values of the physical variables of their constituent parts during a hardware malfunction, as well as the length of time that is taken until the issue is resolved, this data can be used as a correlator for the status of other sub-detector components during a hardware malfunction of another component. Moreover, the predictive power of this algorithm could avoid fatal errors in the functioning of the hardware and electronic systems especially during testing periods and upgrades and allow for faster and more effective management and advancement of the hardware and electronic systems towards greater technological capabilities.

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