BERLINER HOCHSCHULE FÜR TECHNIK

Predicting Patient Admission to Discharge

> *"Using cloud-based hardware poses high administrative hurdles in an academic environment in Germany. With our own NVIDIA DGX A100 systems we can act quickly and stay competitive in research."*
>
> **— Alexander Löser,** Professor and Head of Data Science Research Center

On the front lines at any hospital, medical professionals have to make time-critical decisions. Available patient information is often unstructured in the form of clinical notes, usually written by other time-pressed medical personnel.

Berliner Hochschule für Technik University (BHT) developed a Clinical Decision Support system, which can help in these situations by directing doctors to related cases or certain risks, predicting a patient's development based on data from their Electronic Health Record. Outcome prediction can also help doctors avoid overlooking possible risks, and can help hospitals to plan capacities.

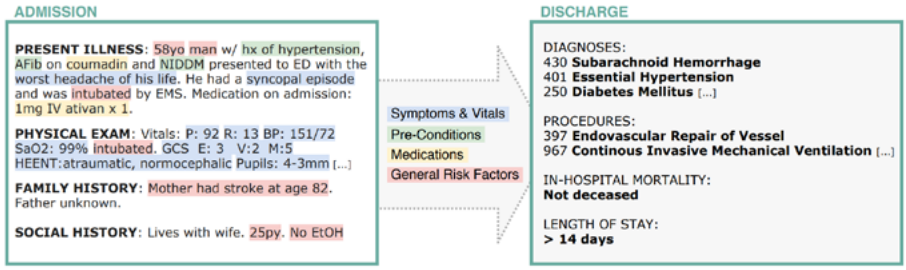
The CORe (Clinical Outcome Representations) model, based on BioBERT, is pre-trained on 10K case reports from PubMed, 32K discharge summaries, 5K medical transcriptions, 5K clinical notes and a few thousand articles about diseases and medical research from Wikipedia and NIH websites.

NVIDIA Platform

Seeking fast performance, the team turned to NVIDIA DGX A100, the universal system for all AI workloads - from analytics to training to inference - offering unprecedented compute density, performance, and flexibility, with 5 petaFLOPS of AI performance.

The DGX system enabled fast training, debugging and error analysis of the very large models, which meant BHT were able to optimise and fine-tune the design of the neural networks early on in the process.

Using Natural Language Processing (NLP), the model can extract information from the patient's admission data to predict key measures.



An admission to discharge example demonstrating an outcome prediction. The model extracts patient variables, and using NLP learns complex relations between the data to predict a clinical outcome.

BHT Berliner Hochschule für Technik

Clinical outcome predictions from admission notes using self-supervised knowledge integration

INDUSTRY

- Healthcare

NVIDIA PRODUCTS USED

- NVIDIA® DGX™ A100

BUSINESS CHALLENGE

- Decision-making times are very limited when patients are admitted to hospital
- Patient information comes from various, unstructured sources

RESULTS

- Using NLP, the patient data can all be analysed against training data to make predictions
- The system can predict 1200 diagnosis and 700 procedures at admission time, in-hospital mortality and length-of-stay
- Diagnosis Predictions achieved 83% AUROC, Procedure Prediction even 88% AUROC.

Results

By analysing simulated patients at time of admission - when decision support is needed most - BHT's system can predict results across four common measures; diagnosis at discharge, procedures performed, in-hospital mortality and length-of-stay. These predictions are inferred using patient information like symptoms upon admission, pre-conditions and risk factors.

So far, BHT University is able to classify at admission time 1,200 diagnoses and 700 procedures in the form of International Classification of Diseases (ICD-9) codes, as well as predicting mortality and length-of-stay with ~83% AUROC (area under the receiver operating characteristic) for diagnoses, and 88% for procedures.

Initially, fine-tuning the BERT-based CORe model on the diagnosis prediction task took around 7 hours on a server with two NVIDIA V100 GPUs.

Moving the training to two A100 GPUs on the DGX system sped up the process almost by twice, which resulted in training times under 4 hours. This enabled us to run a larger number of training iterations to optimise hyperparameters, the pre-training order and the data selection process.

DATEXIS Research Group

The Data Science and Text-based Information Systems (DATEXIS) research group at BHT conducts research in managing text-based and structured data. Their focus is on basic research in Natural Language Processing (NLP) and Deep Learning, explaining and benchmarking Deep Learning, and applying NLP in Healthcare and other domains.

Berliner Hochschule für Technik, Data Science Research Center

BHT is one of Germany's largest state universities of applied sciences, founded in 1971. With a wide range of forward-looking degree courses and a staff of highly qualified specialists, BHT encourages the career opportunities of all prospective and 13,000 current students, regardless of their social background.

During the last years BHT became a major academic player in Berlin's AI landscape with its internationally well recognized Data Science Master Class. The Data Science Research Center with 13 Professors in AI and more than 30 PhD students is one of the larger academic organizations working on AI in Berlin. Our basic research includes application areas such as health, education or engineering.

The EACL'21 Paper and the model are available
at huggingface.co/bvanaken/CORe-clinical-outcome-biobert-v1

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