

COMENIUS UNIVERSITY IN BRATISLAVA
FACULTY OF MATHEMATICS PHYSICS AND INFORMATICS



PREDICTION OF HEALTH STATUS DETERIORATION

Master thesis

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Master thesis

Study program: Applied informatics
Branch of study: Applied informatics
Department: Department of Applied Informatics
Supervisor: MSc. František Dráček
Consultant:



ZADANIE ZÁVEREČNEJ PRÁCE

Typ záverečnéj práce: diplomová
Jazyk záverečnéj práce: slovenský
Sekundárny jazyk: anglický

Názov: Predikcia zhoršenia zdravotného stavu
Prediction of Health Status Deterioration

Anotácia: V súčasnosti sa sektor zdravotníctva na Slovensku vyznačuje nízkou mierou využitia dostupných zdravotníckych dát. V rámci tejto práce je cieľom ukázať, že z existujúcich dát je možné predikovať vývoj ďalšieho zdravotného stavu pacienta, poprípade odhadnúť vývoj budúcich nákladov za účelom lepšieho plánovania prerozdelenia financií v rámci sektoru.

Cieľ: Práca bude rozdelená na dve časti, v prvej študent urobí teoretické zhnutie existujúcich metód spracovania dát a metód strojového učenia, ktoré sa budú dať potenciálne aplikovať na daný problém. V druhej časti navrhne a aplikuje predikčný model.

Literatúra: T. Sk, L. M. G, L. R. K and R. R. J, "Health Status Prediction using ML Techniques," 2022 6th International Conference on Computing Methodologies and Communication (ICCMC), Erode, India, 2022, pp. 1191-1196, doi: 10.1109/ICCMC53470.2022.9753766.

Jödicke, A.M., Zellweger, U., Tomka, I.T. et al. Prediction of health care expenditure increase: how does pharmacotherapy contribute?. BMC Health Serv Res 19, 953 (2019). <https://doi.org/10.1186/s12913-019-4616-x>

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garant študijného programu

.....
študent

.....
vedúci práce

I hereby declare that I have written this thesis by myself, only with help of referenced literature, under the careful supervision of my thesis advisor.

Bratislava, 2025

.....
Bc. Marián Kravec

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Abstract

ABSTRACT EN

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Terminology

Terms

Abbreviations

- **CPT** - Current Procedural Terminology.
- **EHR** - Electronic Health Records.
- **LaBSE** - Language-agnostic BERT sentence embedding model.

Motivation

Chapter 1

Introduction

Chapter 2

Similar studies

One of sub-task for prediction of patient future is to group medical procedures into clusters because there are many procedures that even though have different codes they are essentially same or similar enough that leaving them separate would only cause issue for predicting model.

For this task Lorenzi et al. from Duke University in Durham developed novel algorithm called Predictive Hierarchical Clustering [4]. This algorithm was developed for agglomerative clustering of surgical CPT codes. This algorithm uses one-pass bottom-up approach where they utilize EHR, more precisely using 317 predictors like lab values and patients history, excluding CPT information for 3,723,252 patients and 3,132 CPT codes where each patient have one main surgical CPT code. For each CPT code then they create tree containing patients with that code. Then at each iteration, the algorithm considers merging all pairs of existing trees. To compare two trees they utilize two hypothesis, first hypothesis say that data in both trees are generated from same model, while second say data in each tree is generated from models with different parameters. Final value is weighted average of probabilities of these two hypothesis considering data in trees, where weight is probability of first hypothesis 2.1.

$$p(D_k|T_k) = p(H_1^k)p(D_k|H_1^k) + (1 - p(H_1^k))p(D_i|T_i)p(D_j|T_j) \quad (2.1)$$

Where D_k is set of data in merged tree (merged T_i and T_j), T_k is merged tree, H_1^k is first hypothesis, D_i and D_j are data in trees T_i and T_j .

Chapter 3

Medical data

Chapter 4

Proposed method

Chapter 5

Software design

Chapter 6

Implementation

Chapter 7

Research

Chapter 8

Results

Conclusion

REFERENCE SHOWCASE: 3

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