



UNDERGRADUATE THESIS

OPTIMIZATION OF CATEGORICAL BOOSTING MODEL USING OPTUNA FOR HYPERTENSION RISK PREDICTION BASED ON LIFESTYLE PATTERNS

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2026**

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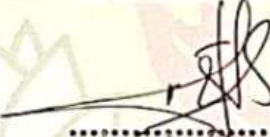
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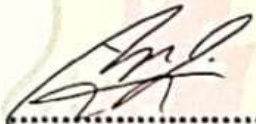
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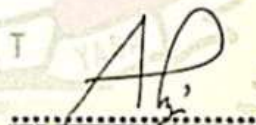
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ABSTRACT

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Thesis Title: Hyperparameter Optimization of the Categorical Boosting Model Using Optuna for Hypertension Risk Prediction Based on Lifestyle Factors
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Hypertension is one of the most prevalent non-communicable diseases and often remains undetected in its early stages due to the lack of noticeable symptoms. This condition can lead to serious complications, including heart disease, stroke, and kidney disorders. Therefore, a data-driven approach is needed to support faster and more accurate hypertension risk prediction. This study aims to analyze the performance of the CatBoost model in predicting hypertension risk based on lifestyle factors and to examine the effect of hyperparameter optimization using Optuna on the model's performance. This study utilized the Hypertension Risk Dataset consisting of 1,985 records. The research stages included data preprocessing, data splitting using Stratified Train-Test Split, CatBoost model development, hyperparameter optimization using Optuna based on the Tree-structured Parzen Estimator (TPE), and model evaluation using Stratified 5-Fold Cross Validation along with accuracy, precision, recall, and F1-score metrics. The results showed that, before optimization, the CatBoost model achieved an accuracy ranging from 68.84% to 98.32% and an F1-score ranging from 60.26% to 98.38%. After hyperparameter optimization using Optuna, the model performance improved, achieving an accuracy of 99.16%–99.83%, precision of 98.72%–100%, recall of 99.03%–99.68%, and F1-score of 99.20%–99.84%. These results indicate that hyperparameter optimization using Optuna effectively improved the performance of the CatBoost model for hypertension risk prediction. The optimized model was then implemented as a web-based application using Streamlit.

Keywords: *Hypertension, Machine Learning, CatBoost, Optuna, Lifestyle Factors.*

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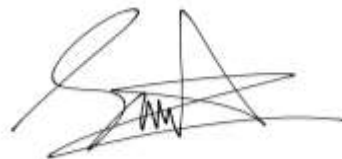
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LIST OF ABBREVIATIONS

AG	: <i>Age</i> (Variabel)
SI	: <i>Salt_Intake</i> (Variabel)
SS	: <i>Stress_Score</i> (Variabel)
BPH	: <i>BP_History</i> (Variabel)
SD	: <i>Sleep_Duration</i> (Variabel)
BMI	: <i>Body Mass Index</i> (Variabel)
MD	: <i>Medication</i> (Variabel)
FH	: <i>Family_History</i> (Variabel)
EL	: <i>Exercise_Level</i> (Variabel)
SMS	: <i>Smoking_Status</i> (Variabel)
HH	: <i>Has_Hypertension</i> (Variabel)
N	: <i>No</i>
P	: <i>Prehypertension</i>
H	: <i>Hypertension</i>
Nn	: <i>None</i>
AI	: <i>ACE Inhibitor</i>
O	: <i>Other</i>
BB	: <i>Beta Blocker</i>
Y	: <i>Yes</i>
L	: <i>Low</i>
M	: <i>Moderate</i>
HI	: <i>High</i>
NS	: <i>None_Smoking</i>
S	: <i>Smoking</i>