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Mental Health Risk Prediction in Tech Workers Using Random Forests and SHAP Explainability

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Abstract: *Mental health challenges in the technology sector have become increasingly prevalent, demanding robust predictive solutions that not only forecast risk but also offer transparent insights into the driving factors. This study introduces a machine learning-based framework utilizing a Random Forest Classifier, optimized through hyperparameter tuning, to predict mental health risks among tech professionals. The model was trained and validated on an industry-standard survey dataset, ensuring both reliability and real-world applicability. Beyond mere prediction, this research integrates SHAP (SHapley Additive exPlanations) to interpret model decisions, enabling stakeholders to comprehend the significance of various demographic and workplace factors contributing to mental health vulnerabilities. Extensive Exploratory Data Analysis (EDA) was conducted to uncover critical trends and distributions within the data. The final model achieved an accuracy exceeding 83%, with a threshold-tuned recall-oriented design to minimize false negatives—an essential consideration in healthcare-oriented predictions. A user-friendly Streamlit application was deployed, allowing users to input personal data and receive immediate, explainable predictions. This paper details the full lifecycle of the project—from data preprocessing and model training to explainability analysis and deployment—providing a replicable blueprint for future work in mental health prediction frameworks. The inclusion of model performance visualizations, SHAP-based feature importance plots, and an accessible web application underscores the practical utility of the proposed solution*

Keywords: Machine Learning, Mental Health Prediction, Random Forest, SHAP, Explainable AI, Streamlit, Data Preprocessing, Classification

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