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PREDICTING MENTAL HEALTH SEVERITY AMONG U.S. COLLEGE STUDENTS WHO USE FACEBOOK

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Background

- Mental health disorders are rising in the U.S., particularly among young adults. Globally, anxiety and depression affect over 500 million people, with U.S. prevalence rates reaching 1 in 5 adults and 44% of adolescents.¹⁻⁵
- Over 97% of young adults use social media, and Facebook is one of the most used platforms.^{6,7,8,9,10}
- Excessive Facebook use has been linked to depression, anxiety, stress, poor sleep, and suicidality.¹⁻¹¹ College students face additional risks like cyberbullying and social comparison, worsening emotional distress.²⁻⁹
- Although many studies link social media use to mental health issues, few have examined specific demographic and health-related predictors of anxiety severity in Facebook-using college students.³⁻⁸

Study Goal: To address this gap, the present study investigates how individual demographics and prior mental health history relate to anxiety severity among U.S. college students who use Facebook. Supervised machine learning algorithms are applied to identify individuals at elevated risk and inform early intervention strategies.

Methods

Data Source & Sample:

Survey data were collected from 579 U.S. college students (2021-2022) who reported active Facebook use and completed PHQ-9 and GAD-7 assessments.¹² Additional data included demographics, general health, emotional distress symptoms, and mental health history.

Feature Selection & EDA:

13 predictors were selected based on EDA results, statistical significance, and clinical relevance.¹⁴ The binary outcome, Anxiety_Severity (0 = minimal, 1 = mild to severe), was derived from GAD-7 scores. Chi-square, ANOVA ($p < 0.05$), confidence intervals, and correlation matrices guided variable selection. Visualizations (boxplots, violin plots, pie charts) were created using Python (pandas, seaborn, matplotlib).¹⁴

Model Development:

Seven supervised ML models (Logistic Regression, SVM, Random Forest, XGBoost, Decision Tree, KNN, ANN) were trained to classify anxiety severity.¹⁵⁻¹⁹ Class imbalance was addressed using SMOTE on the training set only.^{15,16} Hyperparameters were tuned using GridSearchCV and Keras Tuner, optimizing for weighted F1 score.^{18,19}

Evaluation:

Model performance was evaluated on the test set using accuracy, precision, recall, F1 score, and ROC-AUC metrics.²⁰ Among all models, the K-Nearest Neighbors (KNN) classifier achieved the best overall performance and was selected as the final predictive model.^{20,21} To enhance interpretability, permutation feature importance was applied to identify the most influential predictors in the model's decision-making process.²¹

Deployment:

The final KNN model was deployed as an interactive Streamlit app, titled Anxiety Screener for Facebook Users, allowing personalized anxiety severity predictions based on user input²².

App Link: <https://anxiety-screener-app.streamlit.app/>

Table 1: ANOVA Results for Numerical Variables (Age, General Health)

Variable	P-value	Significant(<0.05)	Mean(±95%CI)
Age	0.618836	False	23.56(22.77-24.35)
General_Health	0.984618	False	3.17(3.07-3.26)

Table 2: Chi-Square Test Results for Categorical Variables Associated with Anxiety Severity

Variable	P-Value	Significant (<0.05)
Depressed - hard to function*	2.675725e-47	True
Very sad*	1.140630e-41	True
Exhausted (not physical)*	1.484494e-38	True
Hopeless*	5.617337e-37	True
Overwhelmed*	3.403522e-34	True
Total_Health_Issues_Score*	4.244773e-20	True
Seriously considered suicide*	4.971903e-13	True
Sex*	2.559304e-10	True
Previously_Diagnosed_Depression*	8.383576e-08	True
In_Therapy_for_Depression*	2.329720e-03	True
Attempted suicide*	1.702317e-02	True
Race	6.173724e-02	False
Depression_Severity_Score	1.829259e-01	False

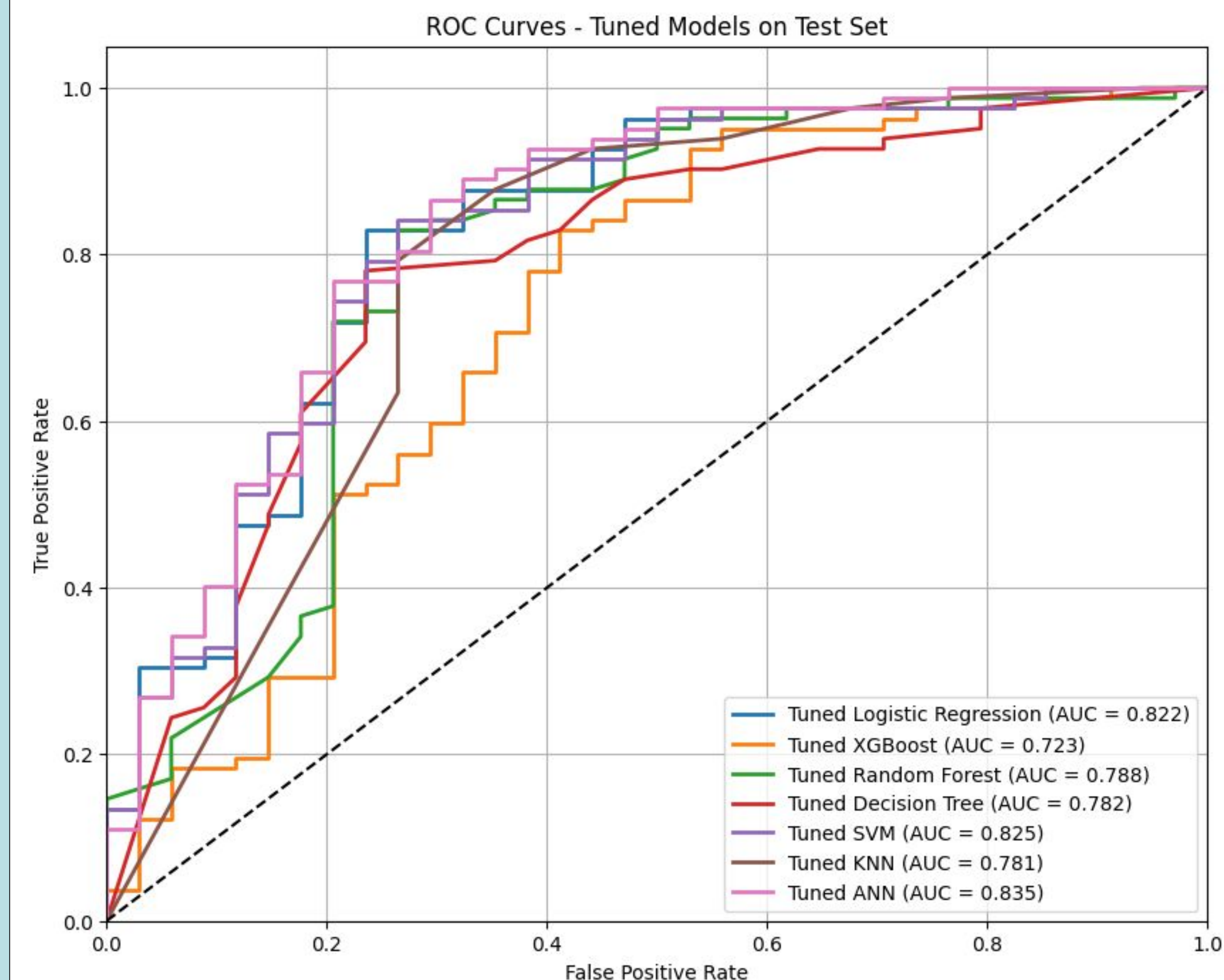
* Indicates statistical significance at $p < 0.05$.

Table 3: Model Performance After Hyperparameter Tuning

Tuned Models Performance Comparison Table:						
	Model	Accuracy	Precision	Recall	F1 Score	AUC
5	Tuned KNN	0.8190	0.8352	0.9268	0.8786	0.7807
6	Tuned ANN	0.8190	0.8588	0.8902	0.8743	0.8350
2	Tuned Random Forest	0.7931	0.8372	0.8780	0.8571	0.7884
3	Tuned Decision Tree	0.7845	0.8202	0.8902	0.8538	0.7816
0	Tuned Logistic Regression	0.7931	0.8718	0.8293	0.8500	0.8225
4	Tuned SVM	0.7845	0.8800	0.8049	0.8408	0.8250
1	Tuned XGBoost	0.7500	0.7978	0.8659	0.8304	0.7231

Results

Figure 1: Displays ROC curves for all models after hyperparameter tuning



Based on evaluation KNN achieved the highest F1 score (0.879), recall (92.7%), and accuracy (81.9%), making it the most reliable model for classifying anxiety severity. Although ANN had the highest AUC (0.835), KNN outperformed in minimizing false negatives-critical for mental health screening. Logistic Regression and SVM performed consistently well; XGBoost underperformed despite its popularity.

Conclusion

Emotional distress indicators-especially “Exhausted,” “Hopeless,” and “Very sad”-were the strongest predictors of anxiety severity. The tuned KNN model achieved the best overall performance (F1 = 0.879, Recall = 92.7%, AUC = 0.781), offering high interpretability and minimizing false negatives-key for mental health screening. While ANN had a higher AUC (0.835), KNN’s recall makes it better suited for early detection. These results support using interpretable, symptom-focused models in digital tools for anxiety screening among students.

References

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22. [Additional References](#)