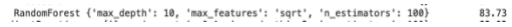
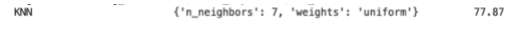
Model Optimization and Tuning Phase Report

Date	20 June 2025
Team ID	SWTID1749622322
Project Title	Mental Health Prediction
Maximum Marks	10 Marks

Model Optimization and Tuning Phase

The Model Optimization and Tuning Phase involves refining machine learning models for peak performance. It includes optimized model code, fine-tuning hyperparameters, comparing performance metrics, and justifying the final model selection for enhanced predictive accuracy and efficiency.

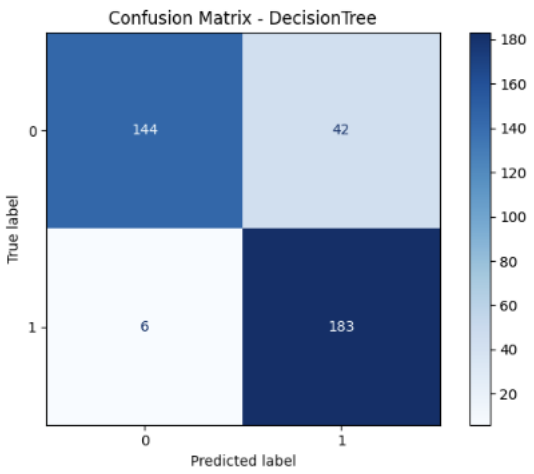
Hyperparameter Tuning Documentation (6 Marks):

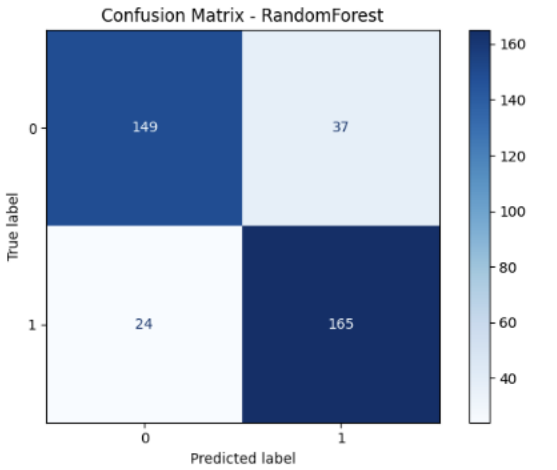
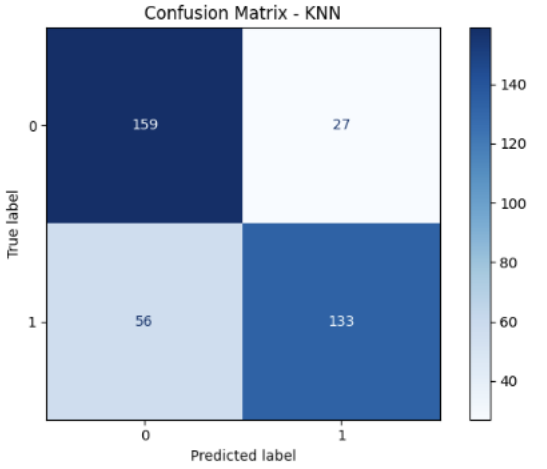
Model	Tuned Hyperparameters	Optimal Values
Decision Tree		
Random Forest		
KNN		

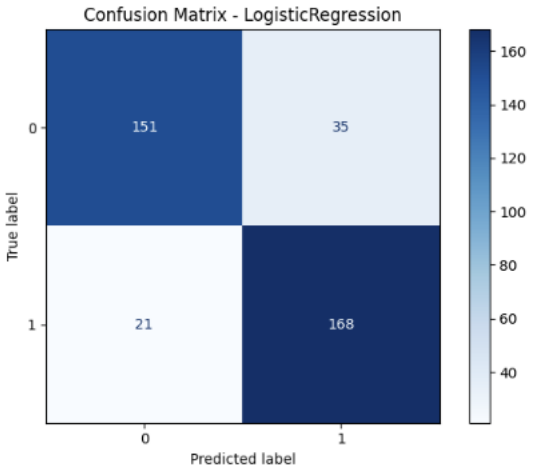
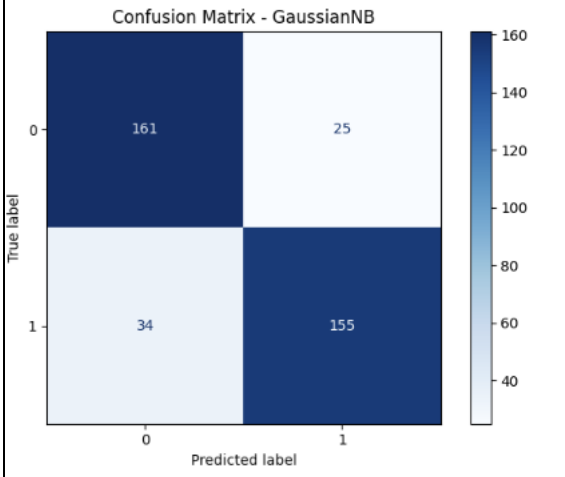
Logistic Regression	'LogisticRegression': { 'model': LogisticRegression(max_iter=1000), 'params': {'C': [0.1, 1, 10]} },	LogisticRegression {'C': 0.1} 85.07
Gaussian NB	'GaussianNB': { 'model': GaussianNB(), 'params': {} # No tuning needed },	GaussianNB {} 84.27
SVC	'SVC': { 'model': SVC(), 'params': {'C': [0.1, 1, 10], 'kernel': ['linear', 'rbf']} },	SVC {'C': 1, 'kernel': 'linear'} 85.60
AdaBoost	'AdaBoost': { 'model': AdaBoostClassifier(), 'params': {'n_estimators': [50, 100, 200], 'learning_rate': [0.01, 0.1, 1]} },	AdaBoost {'learning_rate': 1, 'n_estimators': 50} 87.20
Gradient Boosting	'GradientBoosting': { 'model': GradientBoostingClassifier(), 'params': {'n_estimators': [100, 200], 'learning_rate': [0.05, 0.1], 'max_depth': [3, 5]} },	GradientBoosting {'learning_rate': 0.1, 'max_depth': 3, 'n_estimators': 100} 82.93

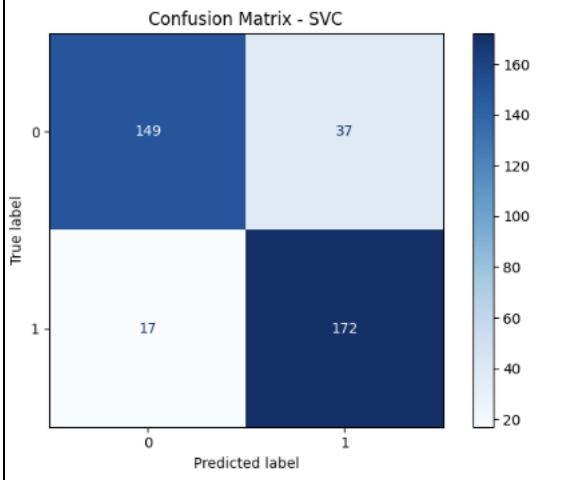
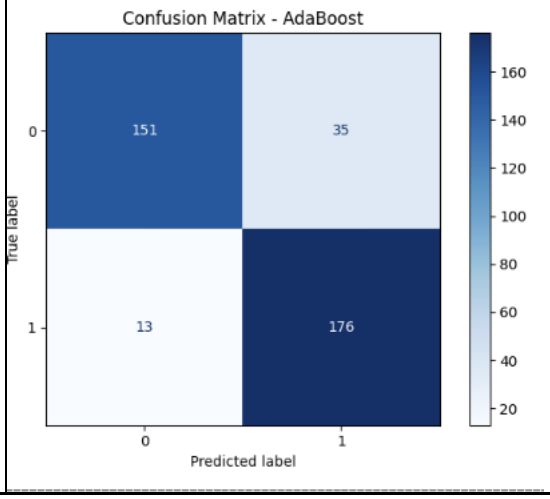
XG Boost	'XGBoost': {
	'model': XGBClassifier(eval_metric='logloss', use_label_encoder=False),
	'params': {'n_estimators': [100, 200], 'learning_rate': [0.05, 0.1], 'max_depth': [3, 5]}
	}
		XGBoost {'learning_rate': 0.05, 'max_depth': 3, 'n_estimators': 200} 85.07

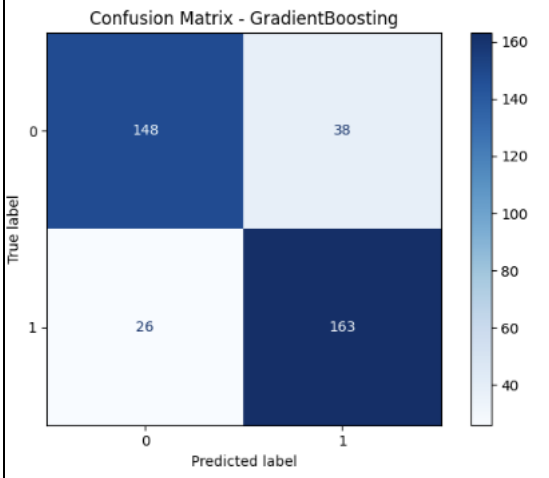
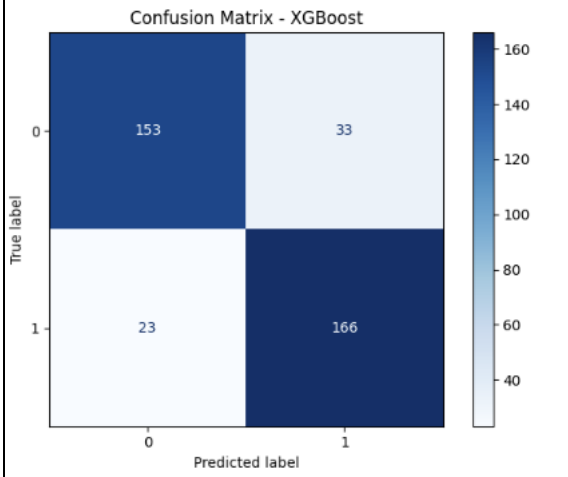
Performance Metrics Comparison Report (2 Marks):

Model	Optimized Metric
Decision Tree	Classification Report for DecisionTree: precision recall f1-score support 0 0.96 0.77 0.86 186 1 0.81 0.97 0.88 189 accuracy 0.87 375 macro avg 0.89 0.87 0.87 375 weighted avg 0.89 0.87 0.87 375 

Random Forest	Classification Report for RandomForest: precision recall f1-score support 0 0.86 0.80 0.83 186 1 0.82 0.87 0.84 189 accuracy 0.84 375 macro avg 0.84 0.84 0.84 375 weighted avg 0.84 0.84 0.84 375 
KNN	Classification Report for KNN: precision recall f1-score support 0 0.74 0.85 0.79 186 1 0.83 0.70 0.76 189 accuracy 0.78 375 macro avg 0.79 0.78 0.78 375 weighted avg 0.79 0.78 0.78 375 

Logistic Regression	Classification Report for LogisticRegression: precision recall f1-score support 0 0.88 0.81 0.84 186 1 0.83 0.89 0.86 189 accuracy 0.85 375 macro avg 0.85 0.85 0.85 375 weighted avg 0.85 0.85 0.85 375 
Gaussian NB	Classification Report for GaussianNB: precision recall f1-score support 0 0.83 0.87 0.85 186 1 0.86 0.82 0.84 189 accuracy 0.84 375 macro avg 0.84 0.84 0.84 375 weighted avg 0.84 0.84 0.84 375 

SVC	Classification Report for SVC: precision recall f1-score support 0 0.90 0.80 0.85 186 1 0.82 0.91 0.86 189 accuracy 0.86 375 macro avg 0.86 0.86 0.86 375 weighted avg 0.86 0.86 0.86 375 
Ada Boost	Classification Report for AdaBoost: precision recall f1-score support 0 0.92 0.81 0.86 186 1 0.83 0.93 0.88 189 accuracy 0.87 375 macro avg 0.88 0.87 0.87 375 weighted avg 0.88 0.87 0.87 375 

Gradient Boosting	Classification Report for GradientBoosting: precision recall f1-score support 0 0.85 0.80 0.82 186 1 0.81 0.86 0.84 189 accuracy 0.83 375 macro avg 0.83 0.83 0.83 375 weighted avg 0.83 0.83 0.83 375 
XG Boost	Classification Report for XGBoost: precision recall f1-score support 0 0.87 0.82 0.85 186 1 0.83 0.88 0.86 189 accuracy 0.85 375 macro avg 0.85 0.85 0.85 375 weighted avg 0.85 0.85 0.85 375 

Final Model Selection Justification (2 Marks):

Final Model	Reasoning
Ada Boost	The Ada Boost model was selected for its superior performance, exhibiting high accuracy during hyperparameter tuning. Its ability to handle complex relationships, minimize overfitting, and optimize predictive accuracy aligns with project objectives, justifying its selection as the final model.