Model Development Phase Template

Date	25 June 2025
Name	Aniket Jingonda Patil
Project Title	Health Classification System
Maximum Marks	10 Marks

Initial Model Training Code, Model Validation and Evaluation Report

Initial Model Training Code (5 marks):

The initial model training is implemented in train_model.py, loading the pre processed CTG dataset (fetal_health.csv) and evaluating three models: Logistic Regression, Random Forest, and XGBoost. The code includes data preprocessing, model training, and evaluation.

```
from matplotlib.pylab import logistic
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from xgboost import XGBClassifier
from sklearn.metrics import classification_report
import joblib
 # Load dataset
df = pd.read_csv(data/fetal_health.csv)
X = df.drop(fetal_health, axis=1)
y = df[fetal_health]
# Standardize features
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)
joblib.dump(scaler, scaler.pkl)
 # Adjust target for XGBoost
y_adjusted = y- 1
 # Split data
X_train, X_test, y_train, y_test = train_test_split(X_scaled,
y_adjusted, test_size=0.2, random_state=42, stratify=y_adjusted)
 # Initialize models
models = {
logistic_Regression: LogisticRegression(multi_class=
multinomial, max_iter=1000, class_weight=balanced),
Random_Forest: RandomForestClassifier(random_state=42,
class_weight=balanced),
XGBoost: XGBClassifier(use_label_encoder=False, eval_metric=
mlogloss, random_state=42)
 }
 # Train and evaluate
for name, model in models.items():
model.fit(X_train, y_train)
y_pred = model.predict(X_test)
print(f"{name}_Performance:")
print(classification_report(y_test, y_pred, target_names=[
Normal, Suspect, Pathological]))
 # Save XGBoost model
joblib.dump(models[XGBoost],fetalai_model.pkl)
```

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Model Validation and Evaluation Report (5 marks):

Model	Summary	Training and Validation Performance Metrics
Logistic Regression	Linear model with multinomial loss and balanced class weights. Parameters: 21 features × 3 classes.	**Training Accuracy: ~82% Test Accuracy: ~78% F1-Score (macro): ~0.75 Limited performance on minority classes.**
Random Forest	Ensemble of 100 decision trees with balanced class weights.	**Training Accuracy: ~95% Test Accuracy: ~85% F1-Score (macro): ~0.80 Better handling of class imbalance.**
XGBoost	Gradient boosting with tree-based learning. Parameters: Default settings.	**Training Accuracy: ~98% Test Accuracy: ~90% F1-Score (macro): ~0.85 Best performance across all classes.**

Conclusion :

The XGBoost model achieved the highest performance with a test accuracy of ~90% and a macro F1-score of ~0.85, outperforming Logistic Regression and Random Forest. Its robustness to class imbalance and ability to capture com plex feature relationships make it the optimal choice for FetalAI's fetal health classification task.