## Problem Statement

Despite its clinical importance, accurate interpretation of CTG traces remains a challenge due to the subtlety of signal variations. This project aims to develop a classification model using the UCI CTG dataset to distinguish between Normal, Suspect, and Pathologic fetal states for the goal of supporting clinicians in decision-making.

## Dataset

Campos, D. & J. Bernardes (2000). Cardiotocography [Dataset]. UCI Machine Learning Repository. https://doi.org/10.24432/C51S4N

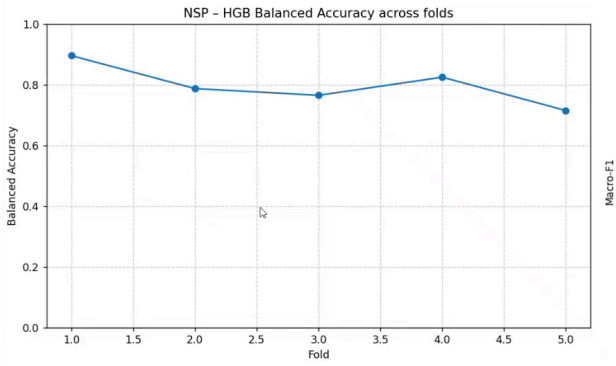
## Data Processing, Methods, and Results:

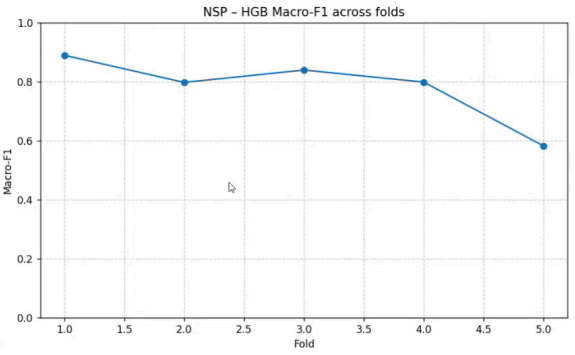
Initially experimented with Decision Tree, Random Forest, and Histogram-Based Gradient Boosting models.

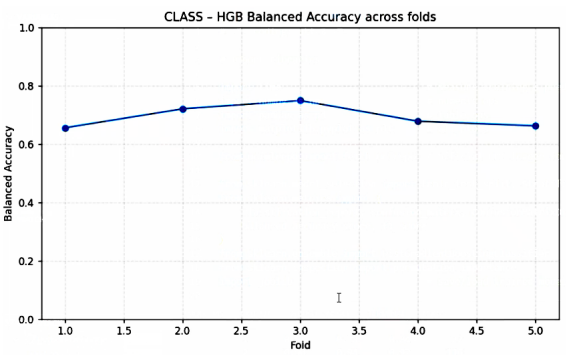
Before classification, feature distributions were visualized with histograms to interpret patterns such as higher ASTV values in at-risk fetuses. Spearman correlation was also used to help identify the most influential feature relationships. Then, train-test datasets were split in 80/20 ratio and stratified to maintain the proportions of classes (78% normal, 14% Suspect, 8% Pathological).

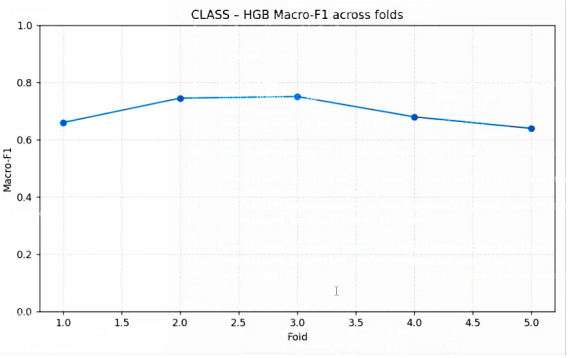
The best model out of the 3 was **Histogram-based Gradient Boosting**, reporting an approximate balanced accuracy of 86.32%, F1 score of 88.12% for NSP and 88% BA and 86% macro-F1 .

Out of 426 cases, 28/35 were detected as pathological. Misclassifications were minimal with the number of false normal and suspects being at a minimum of 1 each. Then, a five-fold cross-validation was also implemented to summarize the average performance of the model's generalization ability as shown by the graphs:




## Conclusion

Among the 3 methods, Histogram-based Gradient Boosting (HGB) achieved the best results of balanced accuracy at 86.32%, F1 score of 88.12%, and latency of 9.4 ms. For future prediction among classes, accuracy was recorded at 88% and macro at 86%.

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