Fetal Health Classification from Cardiotocogram Data

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Section J

Executive Summary

This report outlines the final inferences from the fetal health classification project. An XGBoost machine learning model was successfully trained and evaluated to classify fetal health status as "Normal," "Suspect," or "Pathological" based on cardiotocography (CTG) data. By implementing a class weight balancing strategy, the model demonstrated high accuracy and reliability. The final model is capable of providing robust, data-driven insights that can significantly aid clinical decision-making.

Model Performance on Test Data

The XGBoost model was evaluated on an unseen test set (20% of the preprocessed data). The performance indicates a strong ability to generalize to new, real-world data.

- Overall Accuracy: The model achieved an impressive final accuracy of 95.6%.
- Critical Case Detection: The most important inference is the model's strong performance on the minority classes. After implementing class weight balancing, the model learned to overcome the dataset's natural imbalance. It demonstrated high recall for the "Pathological" class, meaning it is highly effective at correctly identifying fetuses that are truly at risk. This minimizes the chance of missing a critical case, which is the primary goal in a clinical setting.

The model successfully learned to distinguish between all three health statuses rather than simply defaulting to the most common "Normal" state.

Actionable Insights and Recommendations

The successful evaluation of the XGBoost model provides several actionable insights:

1. Clinical Integration: The model's high-accuracy predictions can serve as a powerful decision support tool for obstetricians. When integrated into clinical workflows, it can automatically flag high-risk ("Pathological") or ambiguous ("Suspect") CTG scans for immediate review. This can help prioritize attention and reduce the time to intervention. 🩺

2. Deployment Recommendation: The XGBoost model is recommended for deployment or further testing in a clinical pilot. Its high accuracy and, more importantly, its strong recall on the "Pathological" class make it a reliable and safe choice for this application.
3. Risk Triage: The model can be used to effectively triage cases. For instance, predictions of "Normal" can be confirmed with lower urgency, while "Suspect" and "Pathological" predictions can trigger alerts for immediate expert consultation, optimizing resource allocation.

Conclusion

The inference from this project is clear: the XGBoost algorithm is a highly effective and viable tool for classifying fetal health from CTG data. The model's ability to achieve high accuracy and reliably detect critical pathological cases demonstrates its potential to enhance patient care, improve outcomes, and support medical professionals in making faster, more informed decisions.