AUTOMOTIVE VEHICLES ENGINE HEALTH PREDICTION

GROUP D

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BACKGROUND

Predictive car repair with machine learning is gaining traction.

Advanced sensors in modern cars generate data for health monitoring.

Machine learning models analyze data to predict problems accurately.

This can optimizes resource allocation and minimizes downtime.

CASE STUDY

- Objective: Develop a robust model for predicting automotive engine health using supervised learning.
- Model: Utilizes a feedforward neural network with multilayer perceptron (MLP) architecture and backpropagation.
- Dataset: Includes critical sensor measurements (RPM, oil pressure, fuel pressure, etc.).
- Preprocessing: Precise normalization and scaling for maximum efficiency.
- Training/testing: 70% for training, 30% for testing predictive capabilities.
- Advantages: Pre-emptive identification of engine problems, real-time monitoring, understanding sensor impact.

Software Detail

Data Acquisition Module

Data Preprocessing Module

Machine Learning Model Module

Alerts and Notifications Module

Dashboard and Reporting Module

AIPM Detail

Initiating Processes

- Project Objectives Definition
- Business Case and Project Charter
- Stakeholder Identification and Analysis
- Risk Assessment and Mitigation Planning

Planning Processes

- Scope Definition and Requirement Gathering
- Work Breakdown Structure (WBS) Creation
- Task Scheduling and Timeline Establishment
- Resource Planning and Allocation
- Budgeting and Cost Estimation

Executing processes

- Dataset Acquisition
- Data Preprocessing
- Model Development
- Training and Validation

AIPM Detail

Monitoring and controlling processes

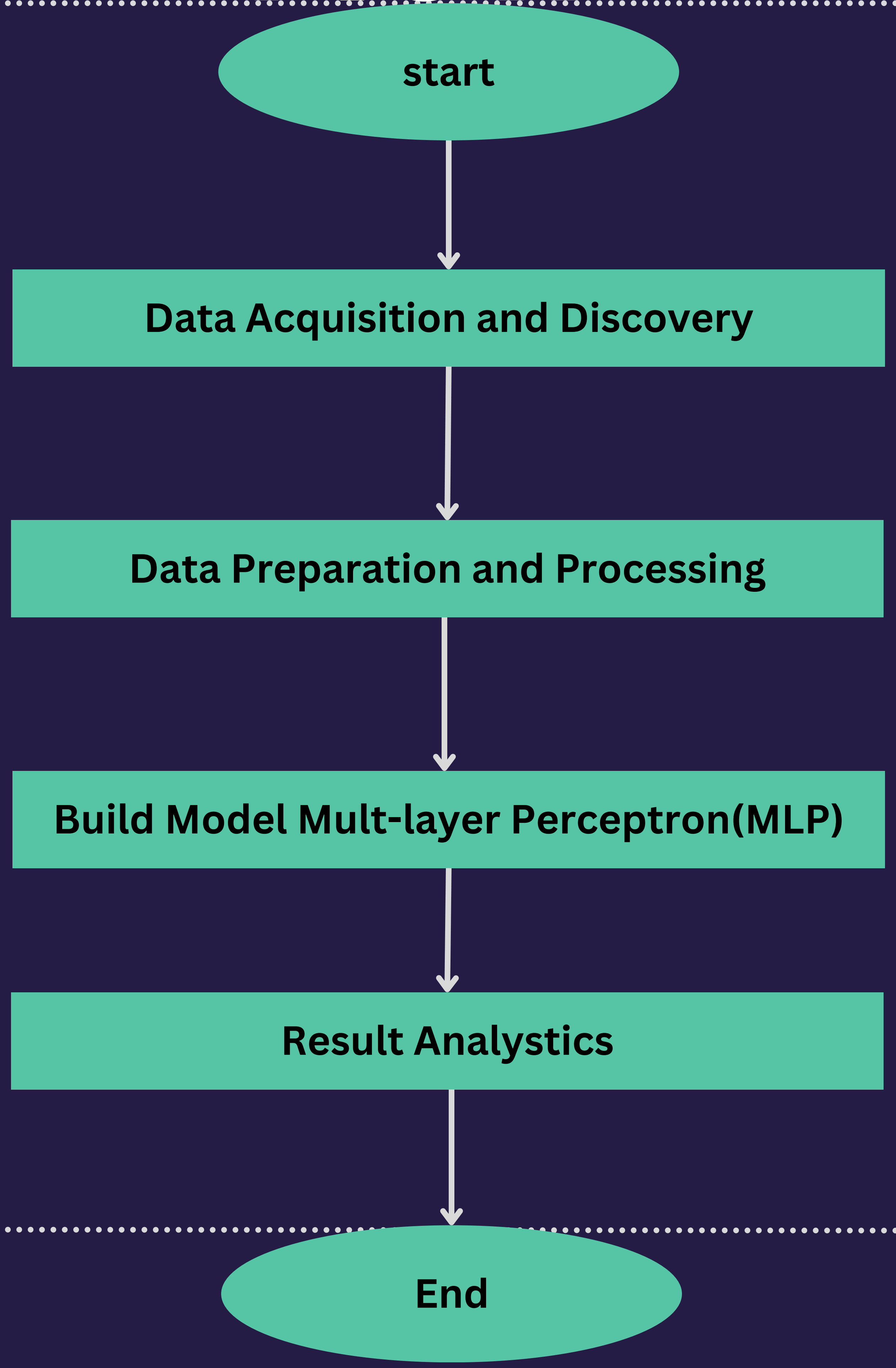
- Model Performance Assessment
- Iterative Improvement Strategies
- Progress Tracking and Reporting
- Quality Assurance Measures
- Risk Management and Mitigation

Closing processes

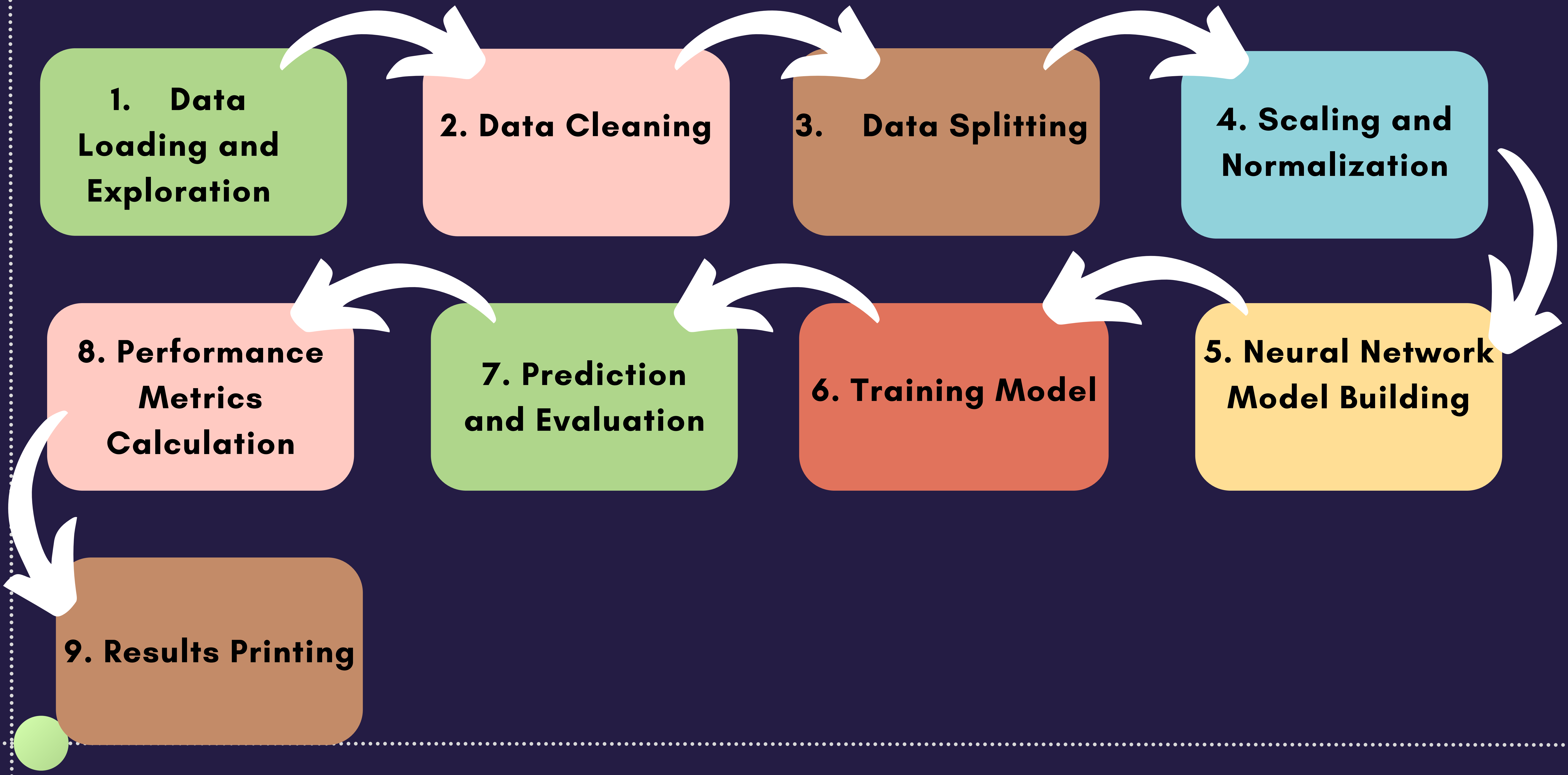
- Comprehensive Documentation
- Knowledge Transfer Sessions
- Project Review and Lessons Learned
- Project Deliverables and Recommendations

Flow, Algorithm and Problem Solving

Flow


start
Data Acquisition and Discovery
Data Preparation and Processing
Build Model Mult-layer Perceptron(MLP)
Result Analystics
End

Algorithm


1. Data Loading and Exploration
2. Data Cleaning
3. Data Splitting
4. Scaling and Normalization
5. Neural Network Model Building
6. Training Model
7. Prediction and Evaluation
8. Performance Metrics Calculation
9. Results Printing

Problem Solving

1. Understanding the problem

- Understand each attribute in the dataset

2. Data Exploration

- understand its structures and features

3. Data Cleaning and Preprocessing

- Replace or remove the missing value if present

4. Scaling and Normalization

- Decide which scaling and normalization techniques want to be applied

5. Model Selection

- Choose a suitable neural networks architecture for the project.

6. Model Evaluation

- Evaluate the model's performance using metrics such as accuracy, recall, precision, and F1-score.

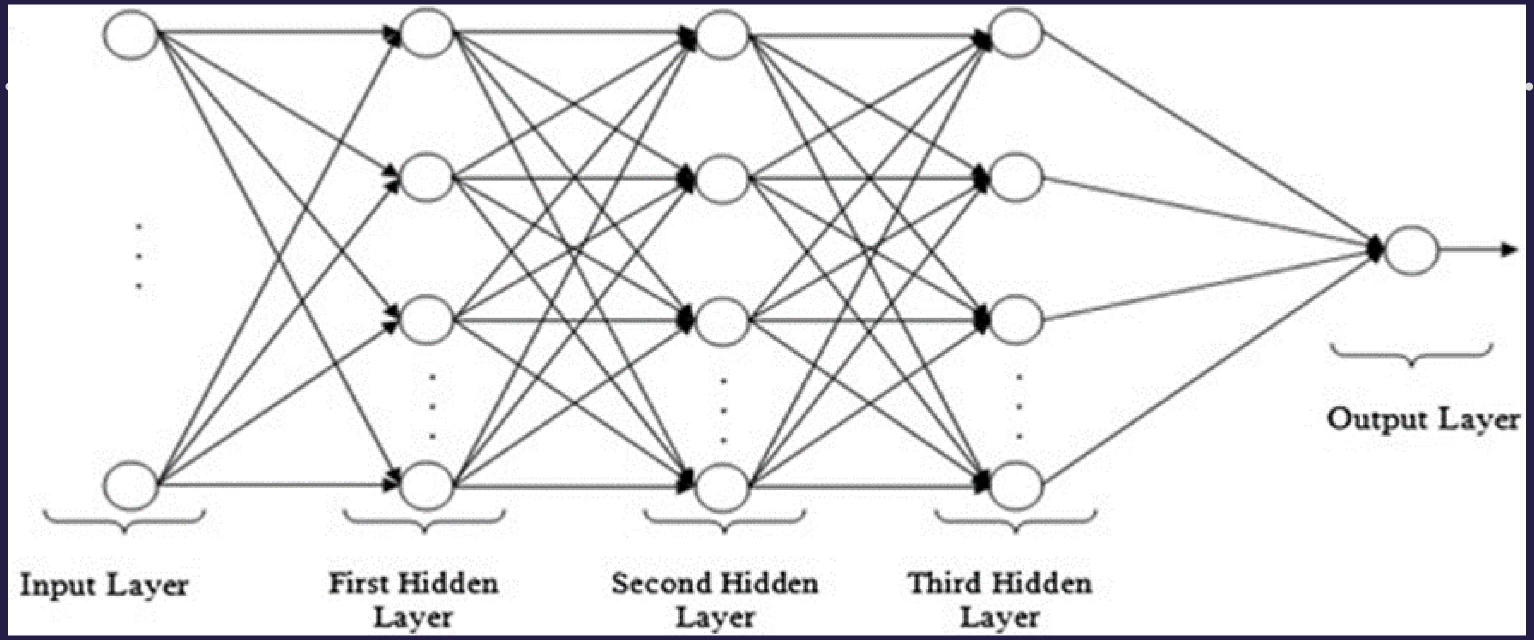
7. Improvement

- Adjusting hyperparameters such as learning rate or number of layers.
- Exploring different neural networks architecture.

8. Communication

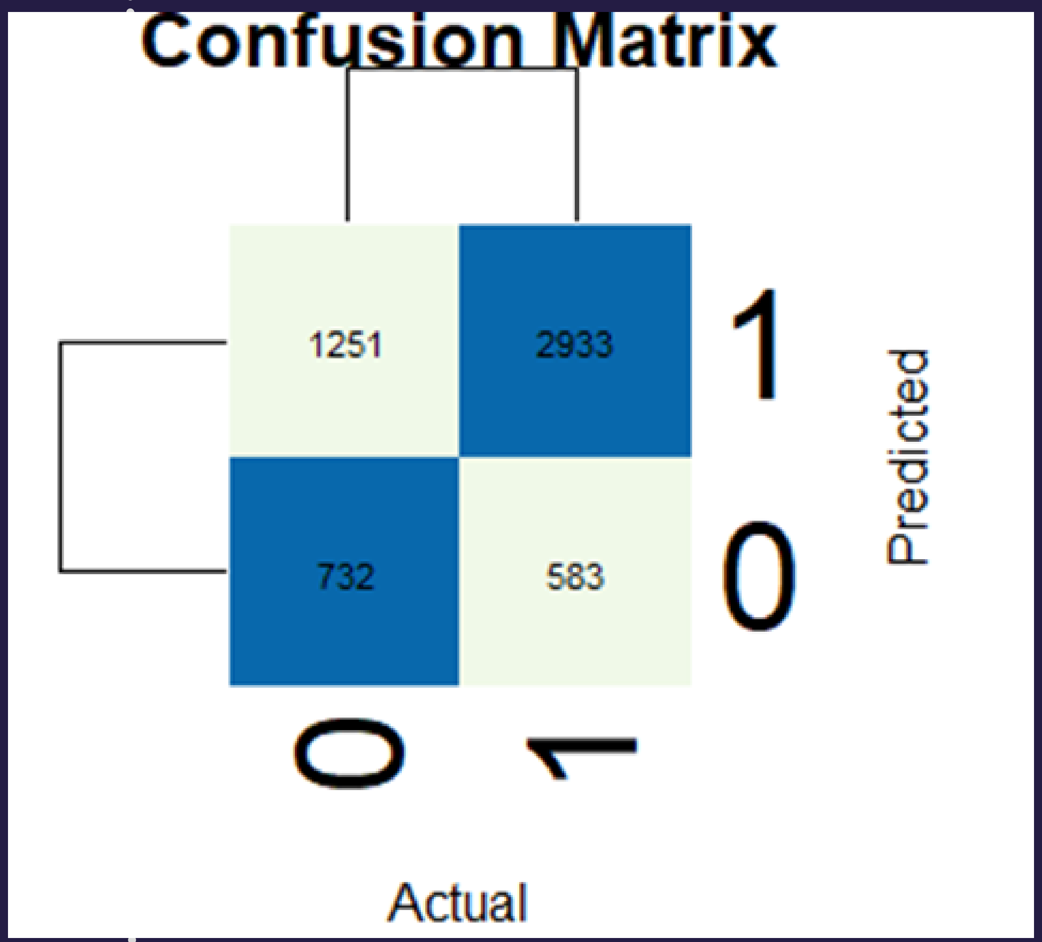
- Effectively communicate the whole decision to stakeholder or project members

Project Implementation and Output



Training size	70%
Testing size	30%
Optimizer	Adam

	Input layer	First hidden layer	Second hidden layer	Third hidden layer	Output layer
Activation Function	-	ReLU	ReLU	Sigmoid	-
Nodes of layers	128	128	64	32	1



0 represent bad condition.
1 represent good condition.

False Negatives (FN): The model failed to identify 1251 engines that were actually in bad condition.

True Negatives (TN): The model correctly identified 2933 engines in good condition.

True Positives (TP): The model correctly identified 732 engines in bad condition.

False Positives (FP): The model incorrectly identified 583 engines as being in bad condition when they were actually in good condition.

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Accuracy: 0.6664848
 Recall: 0.8341866
 F1-score: 0.7618182
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The model's accuracy is around 66.65%, indicating that it correctly predicts engine condition in about two-thirds of cases.

The recall (true positive rate) is approximately 83.41%, showing that the model captures over 83% of actual engine failures.

The F1-score, a balance of precision and recall, is 0.7618182, suggesting a reasonably balanced performance overall.

In summary, the model is moderately accurate, excelling in identifying engine failures (high recall), and providing a balanced precision-recall trade-off (moderate F1-score). The specific requirements and context of the engine health prediction problem should be considered to evaluate its suitability for the intended application.

Conclusion

Predictive Maintenance Software for the automotive industry, utilizing machine learning, proactively addresses vehicle breakdowns. Key features include data analysis, real-time alerts, and a user-friendly dashboard. Integration with existing systems, scalability, and performance optimization are priorities. The AIPM framework guides the project with a focus on documentation, knowledge transfer, and continuous improvement, ensuring effectiveness, reliability, and adaptability for the evolving automotive industry needs.

Thank you!