

A close-up, artistic photograph of a glass pipette tip dispensing a small amount of liquid onto a surface that displays a colorful, multi-lane gel electrophoresis pattern. The pattern consists of numerous horizontal bands of various colors (red, orange, yellow, green, blue, purple) arranged in lanes. The background is blurred, focusing attention on the pipette and the gel.

# Capstone Research Progress & Planning

Predictive Maintenance using  
AI on Fleet Data

**Presented by:** Dang, Dale,  
Sadman, Barsat

- Refining the model
- GUI and deployment
- API integration and Backend
- Frontend integration
- Live data integration

## Refining the

- In Progress
- Not completed

10. *Journal of the American Medical Association*, 2000; 284: 2689-2695.

[illegible]

# Solution & AI Model Research

## **Goals:**

- Identify suitable Machine / Deep Learning models for time-series predictive maintenance.
- Evaluate models based on requirements

## **Explored Models:**

- LSTM / GRU (deep learning, time-series)
- Random Forest, XGBoost
- Autoencoders for anomaly detection

## **Early Findings:**

- Experiment with external datasets (from various sources and manufacturers) shows XGBoost the highest accuracy.
- Combining LSTM and an autoencoder will benefit from large datasets and complexity, but interpretability can be an issue

# Architecture Research

## Research Phase

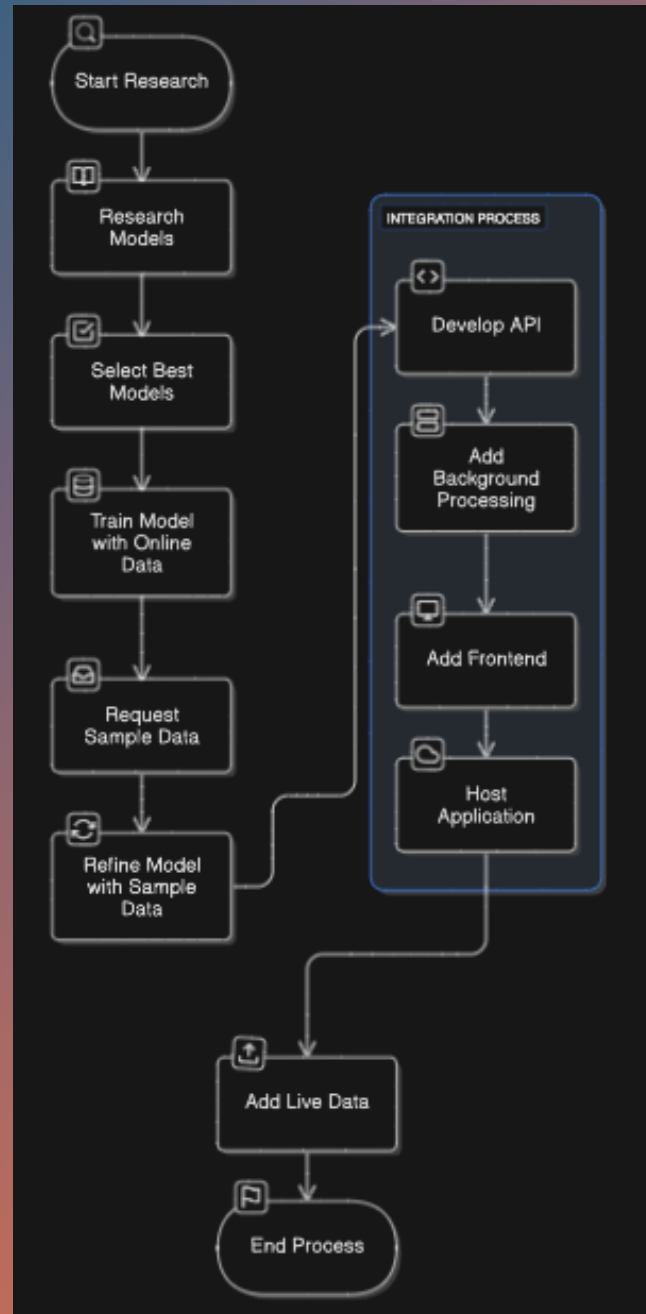
- Investigate existing models and technologies
- Select the best-suited models for the task Model Training Phase
- Train initial models using online data
- Request real-world sample data
- Refine model accuracy using sample datasets

## Integration Process

- Develop backend API
- Add background processing functionality
- Build and integrate frontend
- Host the application

## Final Steps

- Integrate live data streams
- Complete and finalize the process



# External Dataset Research

## Why External Datasets?

- To train/test models while live data is being collected.
- Examine key features that has highest likelihood to vehicle degradation (strongest correlation)

## Sources Researched:

- Kaggle OBD-II datasets [1][2]
- Hyundai Vehicle data [3]
- SCANIA Component X [4]
- UCI Machine Learning Repository [5]
- Ford Challenge Dataset (Sensor data) [6]

## Status:

- 4 datasets experimented and conduct reflection on model selection + feature correlations.
- 2 potential datasets shortlisted.
- Need to ensure similarity to our sensor input format.

[1] C. Dulaj, "Vehicle Maintenance Data," *Kaggle*, 2020. Available: <https://www.kaggle.com/datasets/chavindudulaj/vehiclemaintenance-data>.  
[2] P. Modi, "Automotive Vehicles Engine Health Dataset," *Kaggle*, 2021. Available: <https://www.kaggle.com/datasets/pavmodi/automotive-vehicles-engine-health-data>.  
[3] Hyundai, "Hyundai Vehicle Telematics and Sensor Dataset," *Hyundai AutoEver Research*, Internal Dataset.  
[4] SCANIA, "Component Faults Dataset," *UCI Machine Learning Repository*, 2016. Available: <https://archive.ics.uci.edu/ml/datasets/Scania+Truck+Dataset>.  
[5] UCI Machine Learning Repository, "Various Datasets," *University of California, Irvine*. Available: <https://archive.ics.uci.edu/ml/index.php>.  
[6] Ford Research, "Ford Challenge Vehicle Sensor Data," *Ford Motor Company Research Challenge*. Available: <https://www.kaggle.com/competitions/ford-challenge/datasets>.



# What Does Statistics Say?

## Key Features Predicting Maintenance Need

### 1. Issue & Condition Logs (Top Overall Predictor)

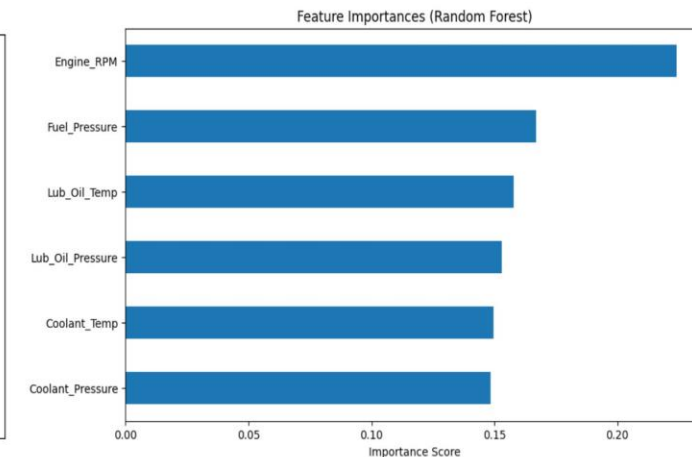
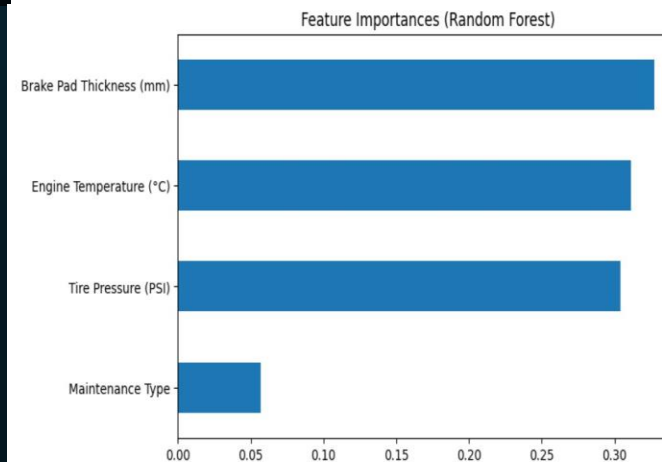
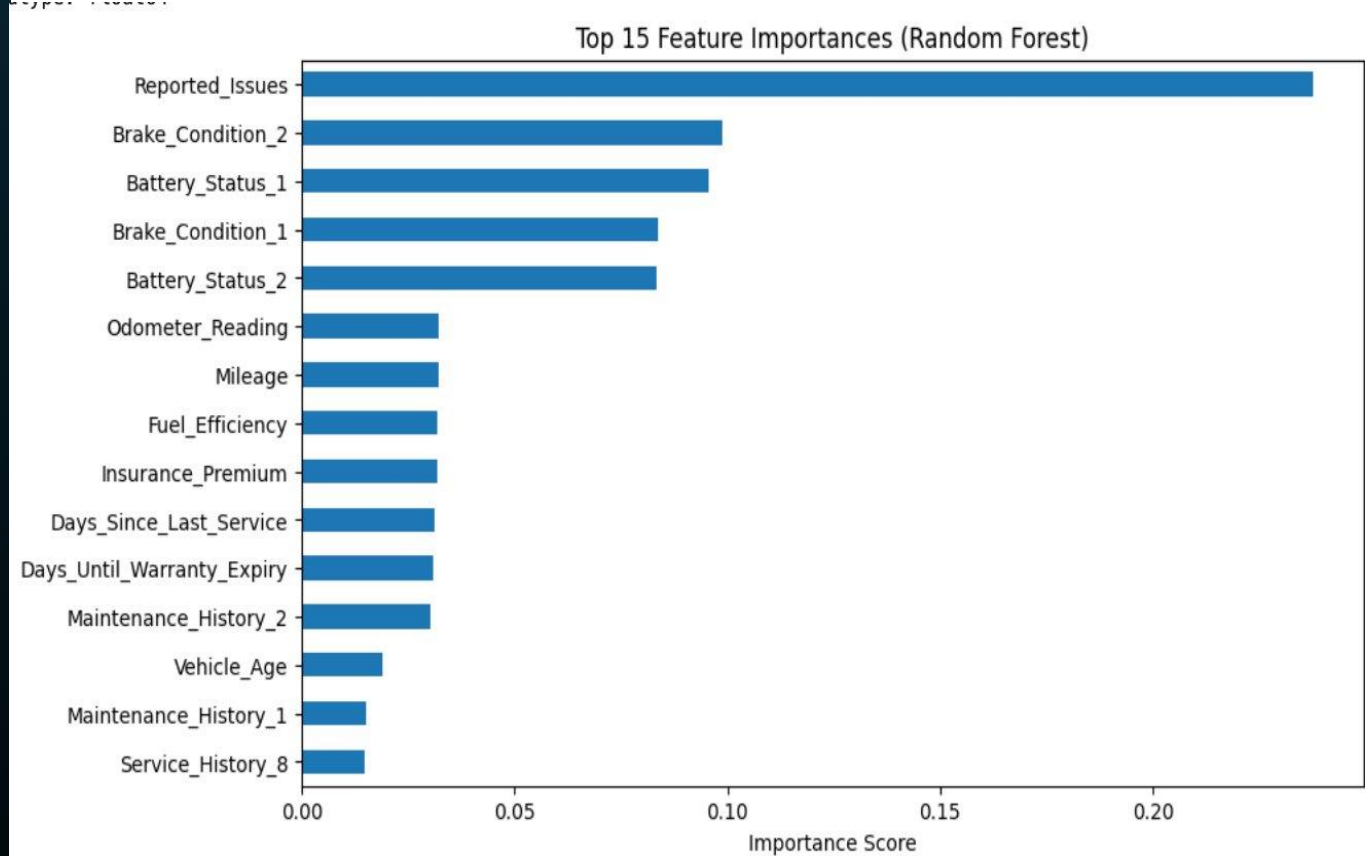
- **Reported Issues:** Most influential feature (Importance  $\approx 0.23$ )
- **Brake\_Condition\_1 & 2:** Importance  $\sim 0.10$
- **Battery\_Status\_1 & 2:** Importance  $\sim 0.09$

### 2. Sensor & Mechanical Metrics (Hyundai Dataset)

- **Engine RPM:** Highest importance at **0.23**
- **Fuel Pressure:** Importance  $\approx 0.17$
- **Lubricant Oil Temp/Pressure:** Importance  $\sim 0.15$
- **Coolant Temp/Pressure:** Also scored  $\sim 0.15$

### 3. Tire & Brake Sensor Data (Fleet Maintenance Dataset)

- **Brake Pad Thickness:** Highest scoring at **0.32**
- **Engine Temperature ( $^{\circ}\text{C}$ ):** Importance **0.31**
- **Tire Pressure (PSI):** Importance **0.30**



# Constraints Investigation



DATA AVAILABILITY



ACCESS TO REAL TIME DATA



OTHER TRAITS NOT AVAILABLE  
THROUGH OBD-II PORT  
(TIRES, BRAKES ETC.)

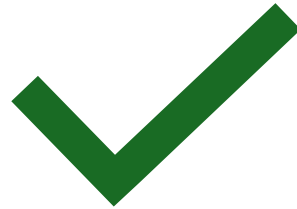


BUDGET

# Next Steps



Finalize architecture  
blueprint



Shortlist datasets and  
begin pretraining



Prepare for physical data  
collection (start Week 7)



# Why Real-World Data Matter?



**Improves Model Accuracy**



**Enhances Anomaly Detection**



**Ensures Operational Relevance**



**Enables Continuous Improvement**



**Supports Business Decisions**



**Reduces Maintenance Costs & Downtime**

# Budget Proposal

Item	Quantity	Unit Price (AUD)	Total Cost (AUD)	Source
ELM327 Bluetooth OBD-II Adapter	1	\$26.99	\$26.99	Amazon Australia
Google Colab Pro Subscription	3 month	\$45.00	\$45.00	Google Colab Pricing
Contingency Fund (10% of total)	-	-	\$7.20	-
Raspberry Pi 4 and hardware integration	1	108.65	108.65	Core Electronics
Micro-HDMI to Standard HDMI Cable (1m)	1	\$9.95	\$9.95	Core Electronics
Total Estimated Cost			\$79.19	

# Budget Proposal

## Hardware Components:

- **ELM327 Bluetooth OBD-II Adapter:** Essential for accessing vehicle diagnostics data. The selected model is cost-effective and compatible with our project requirements [1].
- **Optional Hardware:** Raspberry Pi 4 Model B (4GB RAM) [2] Official Raspberry Pi 4 Power Supply [3] Micro-HDMI to Standard HDMI Cable [4], Raspberry Pi 4 Official Case [5] if the existing system can handle data collection and processing

## Software and Cloud Services:

- **Google Colab Pro Subscription:** Provides enhanced computational resources for model training and data analysis. The subscription is on a monthly basis, allowing flexibility in usage [6].

## Contingency Fund:

- Allocated <10% of the total estimated cost to cover unforeseen expenses or price fluctuations.

## Financial Planning Considerations

- **Remaining Budget:** After the initial expenditure of **\$79.19 AUD**, approximately **\$320.81 AUD** remains for the duration of the project.
- **Monthly Budget:** 7 x \$11 AUD per month.
- **Future Expenses:** Google Colab Pro subscription (plus pay-as-you-go), cloud services for hosting, database, additional computational resources beyond this period.

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[1] Amazon Australia, "OBD2 ELM327 Bluetooth Scanner," *Amazon AU*, [Online]. Available: <https://www.amazon.com.au/elm327-bluetooth/s?k=elm327+bluetooth>. [Accessed: 05-Apr-2025].

[2] Core Electronics, "Raspberry Pi 4 Model B (4GB RAM)," *Core Electronics*, [Online]. Available: <https://core-electronics.com.au/raspberry-pi-4-model-b-4gb.html>. [Accessed: 05-Apr-2025].

[3] Core Electronics, "Raspberry Pi 4 Power Supply USB-C," *Core Electronics*, [Online]. Available: <https://core-electronics.com.au/raspberry-pi-4-power-supply-usb-c-5-1v-15-3w-white.html>. [Accessed: 05-Apr-2025].

[4] Core Electronics, "Micro HDMI to Standard HDMI (1m) Cable," *Core Electronics*, [Online]. Available: <https://core-electronics.com.au/micro-hdmi-to-standard-hdmi-1m-cable.html>. [Accessed: 05-Apr-2025].

[5] Core Electronics, "Raspberry Pi 4 Case - Red/White (Official)," *Core Electronics*, [Online]. Available: <https://core-electronics.com.au/raspberry-pi-4-case-red-white-official.html>. [Accessed: 05-Apr-2025].

[6] Google, "Colaboratory: Pro and Pro+," *Google Colab*, [Online]. Available: <https://colab.research.google.com/signup>. [Accessed: 05-Apr-2025].