



**UNSW**  
SYDNEY

## Team Project Report Submission

Term 2, 2024

### Cover page for Team Report

SUBMISSION DETAILS										
<b>Group name:</b> Group 1										
<b>Group members</b>										
	Student ID	Student Name	Signature							
1.	<table border="1"><tr><td>5</td><td>4</td><td>0</td><td>1</td><td>3</td><td>2</td><td>2</td></tr></table>	5	4	0	1	3	2	2	Alicia Ya Gao	
5	4	0	1	3	2	2				
2.	<table border="1"><tr><td>5</td><td>4</td><td>4</td><td>5</td><td>1</td><td>7</td><td>3</td></tr></table>	5	4	4	5	1	7	3	Luis Intalan	
5	4	4	5	1	7	3				
3.	<table border="1"><tr><td>5</td><td>3</td><td>6</td><td>0</td><td>0</td><td>2</td><td>4</td></tr></table>	5	3	6	0	0	2	4	Millie Hai	
5	3	6	0	0	2	4				
4.	<table border="1"><tr><td>5</td><td>4</td><td>4</td><td>9</td><td>8</td><td>1</td><td>0</td></tr></table>	5	4	4	9	8	1	0	Chubin Huang	
5	4	4	9	8	1	0				
5.	<table border="1"><tr><td>5</td><td>3</td><td>0</td><td>7</td><td>2</td><td>0</td><td>3</td></tr></table>	5	3	0	7	2	0	3	Sy Anh Quoc Ho	
5	3	0	7	2	0	3				
6.	<table border="1"><tr><td>5</td><td>3</td><td>5</td><td>8</td><td>6</td><td>2</td><td>3</td></tr></table>	5	3	5	8	6	2	3	Isha Pai Angle	
5	3	5	8	6	2	3				
<b>DECLARATION</b>										
We declare that this assessment item is our own work, except where acknowledged, and has not been submitted for academic credit elsewhere, and acknowledge that the assessor of this item may, for the purpose of assessing this item:										
<ul style="list-style-type: none"><li>• Reproduce this assessment item and provide a copy to another member of the University; and/or,</li><li>• Communicate a copy of this assessment item to a plagiarism checking service (which may then retain a copy of the assessment item on its database for the purpose of future plagiarism checking).</li></ul>										
By submitting this assessment, we certify that we have read and understood the University Rules in respect of Student Academic Misconduct.										
<b>INSTRUCTIONS</b>										
Proceed to the next page for your Team Report.										
Make sure you follow the file naming instructions to save and name this file before you submit this file via course Moodle Team Report Submission Link.										
Make sure you submit your assignment with this cover sheet. Failure to do so will result in a 10% penalty of the marks available for this assignment.										

# Table of Contents

Executive Summary	3
Introduction	4
1. Overview of the Business Problem	5
1.1. Problem Overview	5
1.2. Key Proposed Solutions	7
2. Translation of the Business Problem into Machine Learning Problems	9
2.1. Machine Learning Problems	9
2.2. Machine Learning Algorithm	9
2.3. Preparation of the Data	9
2.4. Feature Selection	10
3. Data Analysis for Price Prediction Models	12
3.1. Model Training	14
3.2. Model Testing and Evaluation	14
3.3. Model Selection	15
3.4. Discuss the Key Findings	17
3.5. Generate Actionable Insights	19
4. Application of Generative AI to Foster Business and Environmental Value	20
4.1. Prompt Engineering	21
4.2. Key Findings	37
4.3. Potential Applications of Generative AI	39
5. Ethical Implications	40
Conclusion	41



**UNSW**  
SYDNEY

## Executive Summary

The integration of artificial intelligence is revolutionising businesses and online platforms, promoting opportunities of growth for Gumtree's automotive marketplace. Despite its leading position, users struggle with inefficiencies on the platform where it is difficult to accurately price their cars, and curating appealing descriptions in a marketable and attractive manner to potential buyers. As part of the Gumtree consultancy team, this report aims to provide a comprehensive plan to resolve Gumtree's complexities in the car listing process by leveraging artificial intelligence capabilities.

To tackle these challenges, Gumtree leverages AI-driven analytics by identifying the problem as a Regression ML problem and a Deep Learning problem. This entails the key proposed solutions for Gumtree to adopt the automation of the current pricing valuation process through AI-driven analytics and the Generative AI applications to address the issue of lacking listing descriptions.

For the development of the AI-Driven Pricing System, data preparation, transformation and cleaning steps were explained and implemented to provide a reliable and accurate dataset. This followed by the feature selection where an exploratory data analysis was conducted to understand the distribution of data, relationships between variables and patterns to select the most relevant features to build the models. Several ML regression techniques are evaluated against each other. The right algorithm is selected through testing and comparisons of different metrics to predict more consistent, accurate, and reliable car market value. The best predictive performance was observed to be the Decision Tree outperforming in terms of accuracy, ASE, RASE and MAE values.

To generate appealing descriptions, Generative AI integration into Gumtree's car listing process offers significant benefits that highlight environmentally friendly features. This approach not only enhances user engagement and transaction success rates but also aligns with the growing consumer demand for sustainability. By leveraging detailed data features and carefully crafted prompt techniques, Gumtree can ensure attractive listings, fostering both business growth and environmental value.

This is followed by a discussion of the ethical dilemmas and implications of Gumtree's use case of AI. In this section, the analysis outlines the concerns needed to be addressed in regards to data privacy, biases, transparency and accountability.



These innovative solutions provide immense potential to Gumtree to enhance user experience, improve operational efficiency, and drive business growth by providing accurate pricing and high-quality listings.

## Introduction

Amidst the dynamic online marketplace landscape, Gumtree faces complexities in their car sales that hinder the decision-making and user experience for their buyers and sellers. Rapid changes and unpredictable dynamics of pricing create inefficiencies in the car listing process where pricing is difficult to determine and descriptions are strenuous and lacking appeal. To consistently be at the forefront of platform experiences embracing innovative technologies and maintaining a competitive market position, Gumtree is recommended to automate and revolutionise their car listing process by leveraging AI-Driven Analytics and Generative AI models to overall improve decision-making for both buyers and sellers.



**UNSW**  
SYDNEY

# 1. Overview of the Business Problem

## 1.1. Problem Overview

### Problem Statement

Gumtree is an online marketplace in Australia, facilitating the sales of numerous items. Notably, car sales represent a significant area of growth for the platform.

Users on the platform, particularly sellers, face two main issues:

1. Difficulty in determining appropriate listing price for cars
2. Writing appealing descriptions for car listings

### Importance of Addressing the Problem

Addressing these problems is crucial as they lead to inefficiencies in the listing process, fewer successful transactions, and user dissatisfaction. For example, Zillow's *Zestimate* streamlines the pricing process, predicting home values for users. (Zillow, 2020). Similarly, by improving its car listing process, Gumtree can boost overall engagement and the user experience.

### Problem Framing

To further analyse and understand the problem comprehensively, the 5W1H framework was used, as shown in Figure 1 below.

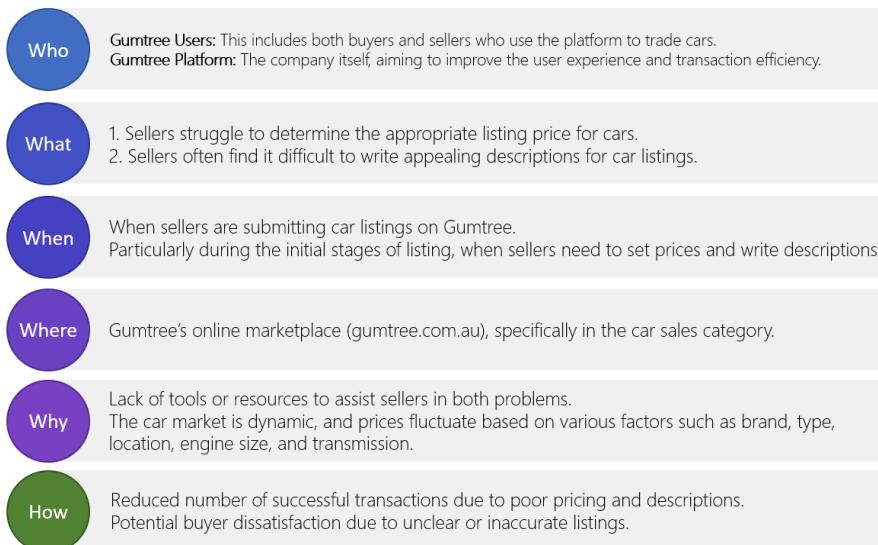


Figure 1: Application of 5W1H framework on Problems Faced by Gumtree



Furthermore, to understand the problem within a broader context, the PEST analysis framework applied in Figure 2 below helps examine the external environment that Gumtree works in. Understanding the external factors they work in helps in understanding possible external causes of problems listed above.

Political	Economic	Social	Technological
<p><b>Regulations and Compliance:</b> The auto industry in Australia is subject to strict regulations.</p> <p>Complexity can make it difficult for sellers to determine appropriate prices and create compliant descriptions.</p>	<p><b>Changing Demand from Financial Stimulus Programs:</b> Financial support to individuals and businesses boosts consumer spending, including vehicle purchases. (Dunbar et al. 2024, p. 1)</p> <p>Fluctuating demand makes it harder on sellers to accurately find a competitive listing price for their vehicle.</p>	<p><b>Varying Buyer Preferences:</b> Preferences for electric vehicle (EV) and for certain vehicle brands, types or relevant features (Sharma &amp; Shukla 2019 p. 509) are factors that may affect the value of a car.</p> <p>Buyers might prioritize features such as sustainability factors, making it challenging for sellers to determine what aspects to highlight in descriptions and how to price cars accordingly.</p>	<p><b>Rapid Advancements in Vehicle Technology:</b> New technologies in vehicles, such as advanced driver assistance systems (ADAS) and infotainment systems can significantly affect car valuations. Sellers may lack the expertise to communicate these in descriptions.</p>

*Figure 2: PEST Analysis of Problems Faced by Gumtree*

## Business Objective

As such, the business objective would be to **1) develop a machine learning model to automate car valuation and 2) generate compelling descriptions using Generative AI**, enabling sellers to set accurate prices and attract buyers, thus boosting engagement on Gumtree's platform.



**UNSW**  
SYDNEY

## 1.2. Key Proposed Solutions

These are the proposed solutions for the two problems faced by Gumtree:

- 1) Machine learning model to automate car valuation, predicting car price**
- 2) Application of Generative AI to create compelling descriptions for car listings**

The methodology for both solutions are outlined below:

### Solution 1. Development of AI-Driven Pricing System (application in Section 2, 3)

Phase 1: Development	
<b>Data Collection</b>	Collect historical data on car listings, including price, car features (e.g., mileage), and listing descriptions from the Gumtree platform and other sources.
<b>Data Preprocessing</b>	Clean and preprocess data to handle missing values, outliers, or duplicate values. Standardise and normalise features to improve model performance.
<b>Model Selection</b>	Consider various ML algorithms such as Linear Regression, Decision Tree, and Neural Networks for price prediction.
<b>Model Training and Evaluation</b>	Split the data into training and testing sets. Train the models on the training set and evaluate their performance on the testing set using metrics like Mean Absolute Error (MAE) and R-squared.
<b>Model Tuning</b>	Perform hyperparameter tuning using techniques like Grid Search or Random Search to optimise model performance.
<b>Compare Models</b>	Compare the models' performance and select the best one based on evaluation metrics and business needs.
Phase 2: Implementation	
<b>Integration with Gumtree Platform</b>	Develop an API to integrate the AI-driven pricing system with the Gumtree platform. This API will provide price recommendations to sellers based on their input data.
<b>Deployment</b>	Deploy the system on a scalable cloud infrastructure to handle user requests efficiently, while robust security measures are in place to protect user data.
Phase 3: Maintenance	
<b>Continuous Monitoring</b>	Implement a monitoring system to track model performance and user engagement. Identify any drifts in model accuracy and take corrective actions.
<b>Model Retraining</b>	Schedule regular model retraining using the latest data to keep the pricing recommendations accurate and relevant.
<b>Scalability and Optimization</b>	Continuously optimise the system's performance and scalability to accommodate increasing user numbers and data volume.

A key outcome in solution 1 would be buyers having a reliable estimate of the market value, making it easier for them to make informed purchasing decisions. Sellers also can set more



**UNSW**  
SYDNEY

competitive prices, reducing the risk of underpricing or overpricing, thus increasing the likelihood of sales. Overall, Gumtree will see enhanced user trust and satisfaction, potentially increasing engagement and transaction volumes on the platform.

## Solution 2. Application of Generative AI (application in Section 4)

Phase 1: Development	
<b>Data Collection</b>	Gather car images from listings, focusing on clear identification of logos, shapes, and other distinctive features. Collect car attributes including body type, transmission, manufacturer, and engine configuration.
<b>Data Preparation</b>	<b>Feature Extraction:</b> Image Data: Process and annotate images for clarity and relevance. Text Data: Standardise and structure attributes and descriptions. <b>Feature Integration:</b> Combine images with text features (e.g., body type, transmission) for comprehensive input.
<b>Model Selection</b>	Choose a transformer-based model such as Gemini or a similar fine-tuning Large Language Model (LLM).
<b>Prompt Engineering</b>	Create specific prompts to guide the model in generating descriptions using techniques such as one-shot prompting, few-shot Prompting and chain-of-thought prompting.
<b>Description Generation</b>	Use the selected prompting techniques to create detailed and engaging descriptions.  <b>Highlight Environmental Features:</b> Ensure descriptions emphasise environmentally-friendly aspects and appeal to eco-conscious buyers.
Phase 2: Implementation	
<b>Integration</b>	Deploy the AI tool on Gumtree's platform for automatic description generation.
Phase 3: Maintenance	
<b>Monitoring</b>	Continuously monitor the tool's performance and user engagement metrics.
<b>Updates and Refinements</b>	Update the model and prompts based on feedback and new data to enhance accuracy and relevance.

A key outcome of Solution 2 is that buyers will benefit from reliable and accurate estimates of car market values, making their purchasing decisions more informed and confident. Sellers will also gain the advantage of setting competitive prices that reflect true market value, reducing the risks of underpricing or overpricing their vehicles. This alignment between buyer expectations and seller pricing strategies will foster greater trust and satisfaction among users. As a result, Gumtree is expected to experience enhanced user engagement, driving both buyer and seller satisfaction and fostering a more efficient marketplace.



**UNSW**  
SYDNEY

## 2. Translation of the Business Problem into Machine Learning Problems

### 2.1. Machine Learning Problems

The first problem faced by Gumtree, determining appropriate car listing prices, can be framed as a machine learning problem. To find out what kind of machine learning problem can be seen in problem 1, the dataset's features and the business problem was closely examined. As seen from the dataset, features such as transmission mode, engine configuration, odometer reading, and the body type were included along with the listed price of the vehicle.

Given the **structured** dataset and the objective to predict vehicle price, this is a **regression** problem that falls under **supervised** learning because the target variable, car price, is continuous. Predicting the car price based on the listed feature falls into a regression problem.

As mentioned earlier in Section 1, accurate price predictions can enhance the user experience by helping sellers set competitive prices and aiding buyers in making informed purchasing decisions. The ultimate goal is to increase engagement and transactions on the platform by providing reliable price estimates that reflect market values, thereby fostering trust among users.

### 2.2. Machine Learning Algorithm

To tackle this regression problem, several machine learning techniques were chosen based on the **structured** nature of the data, as justified in Table 1 below. These will be evaluated against each other later:

**Table 1. Justification of Machine Learning (ML) algorithms**

Technique	Justification
Linear Regression	<ul style="list-style-type: none"><li>• Simple and interpretable model</li><li>• One of the most common algorithms used that can be used to measure predicted effects and model it against multiple input variables (Maulud &amp; Abdulazeez 2020, p.140)</li></ul>
Decision Tree	<ul style="list-style-type: none"><li>• Handles non-linear relationships well.</li><li>• Intuitive and effective algorithm that reduces overfitting, enhances readability, fast classification (Guang-yu &amp; Geng 2019 p.1)</li></ul>
Neural Network	<ul style="list-style-type: none"><li>• Capable of capturing complex patterns</li><li>• Can model intricate and high-dimensional data effectively, making it suitable for tasks such as image and speech recognition, natural language processing, and more.</li></ul>



Gradient Boosting	<ul style="list-style-type: none"> <li>Ability to combine multiple weak learners into a strong learner.</li> <li>Effectively reduces overfitting and improves model performance through iterative optimization, making it ideal for tasks requiring high precision.</li> </ul>
GAM	<ul style="list-style-type: none"> <li>Flexible and interpretable, provide easy interpretability by allowing unspecified nonparametric functions to describe the relationship between predictors and the response variable (Taylan, Weber &amp; Beck 2007 p. 679-680)</li> </ul>
Random Forest	<ul style="list-style-type: none"> <li>Reduces overfitting by averaging multiple trees</li> <li>Excels at managing high-dimensional data effortlessly</li> <li>As a non-parametric method, it remains unaffected by data skew and is robust in handling large amounts of variable inputs (Mascaro et al. 2014 sec. 1 par. 4)</li> </ul>
Ensemble	<ul style="list-style-type: none"> <li>Aggregation of models, hypothesised to improve performance</li> </ul>

## 2.3. Preparation of the Data

9

### Data cleaning

```
[ ] 1 data_1= data.drop(['listing_url','listing_title','description','featured_image','location'],axis=1)

[ ] 1 missing_value=data_1.isnull().sum().sum()

[ ] 1 print(missing_value)
→ 1815

[ ] 1 num_rows= data_1.shape[0]
2 print("Number of rows:", num_rows)
→ Number of rows: 18613

[ ] 1 percentage= (missing_value/num_rows)*100

[ ] 1 print(percentage)
→ 9.75124912695428
```

```
Skewness of odometer: 5.313569418028655
odometer is skewed.
Skewness of price: 136.08082083609685
price is skewed.
listing_url      0
listing_title    0
odometer        0
body_type        30
transmission     34
manufacturer    0
engine_config    144
description      62
price            0
price_conditions 1444
location         0
seller_type      0
featured_image   484
dtype: int64
```



UNSW  
SYDNEY

## 1) Handling missing value

The dataset consists of 1815 columns of missing value, of which removing missing value was a preferred method over replacing missing value with median, or mean because the missing values accounts for only 9.75% of the entire dataset, and the data is positively skewed which suggests that replacing missing value with mean and median may become inappropriate.

## 2) Remove irrelevant columns

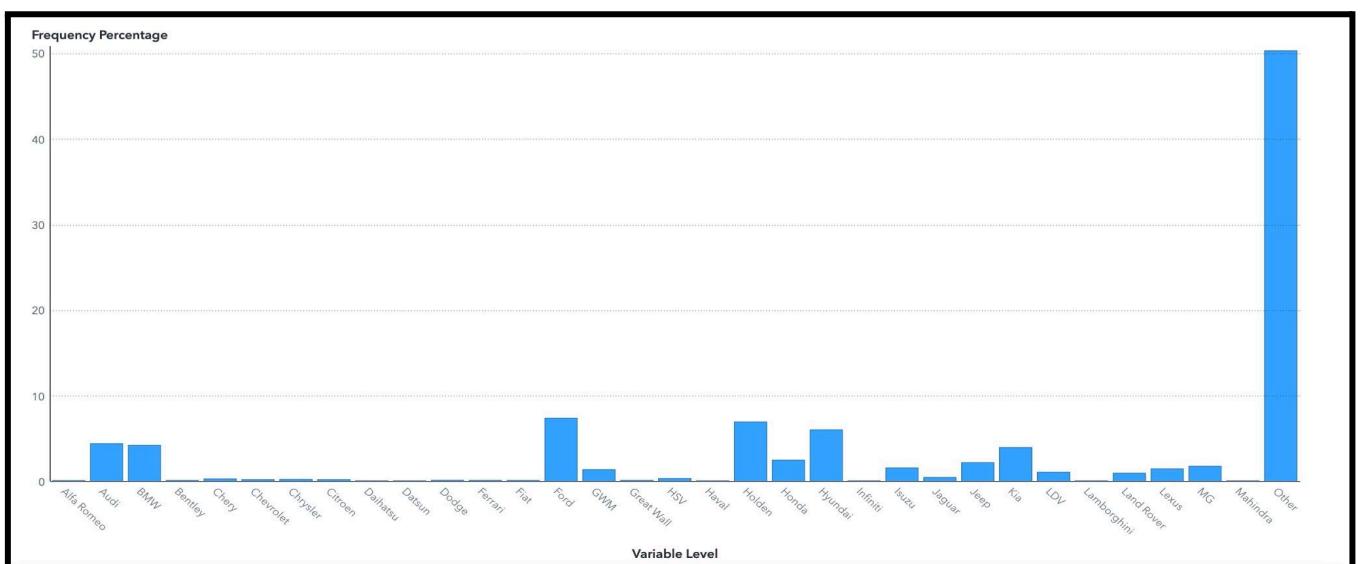
This step involves removing all columns that might be irrelevant to the analysis such as listing\_url, listing\_title, descriptions, feature image, and location. By doing so, it will reduce the overfitting problems, and enable the model to learn patterns and relationships effortlessly.

## Data Transformation

### Data partition

The proportion of 60-20-20 were selected because there is a strong need for using a substantial amount of dataset for testing and validation. The split ensures a sufficiently large training dataset for effective model learning, while maintaining a reasonable size for the testing dataset to accurately evaluate the model's performance, thus achieving a balance between training and testing. This will ensure that model can avoid overfitting and ensure reliable metrics

### Encoding categorical variable



**UNSW**  
SYDNEY

One hot encoding was used to create new binary columns (0 or 1) for each category of the variable. For example, if the categorical variable “car” with categories “Lexus,” “BMW,” and “Holden,” there will be three new columns that will be created, one for each manufacturer, with a 1 indicating the presence of that category and 0 indicating its absence. This method is extremely useful because we will then be able to list the total number of cars in the market by manufacturer, and then predict how different manufacturers affect the car’s prediction.

## 2.4. Feature Selection

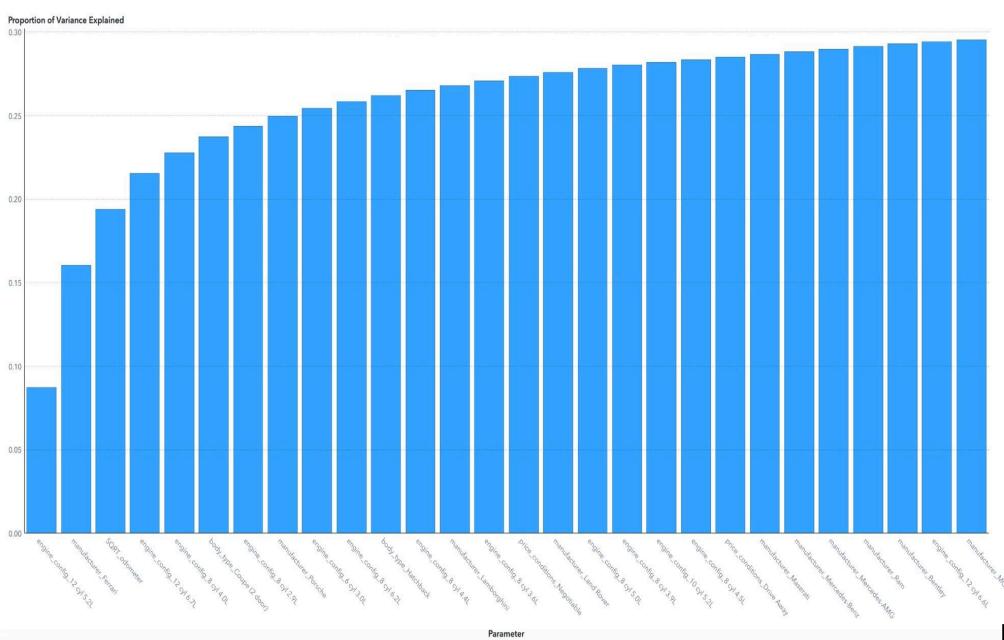
### Exploratory analysis

Interval Variable Moments

Variabl...	Minimum	Maximum	Mean	Standar...	Skewness
odometer	0	2,255,555	97,708.28 55	94,145.36 95	4.3265
price	0	200,000,00	48,811.37 33	1,538,193 .7102	129.7837

Odometer and price show strong positive skewness which strongly indicates that most of the data points are concentrated at lower values with a few high-value outliers extending the right tail. The large number of standard deviations compared to the mean indicates that the entire data is varied significantly, and outliers potentially existed.

### Correlation between variables



Selection Summary							
Iteration	Parameter	Proportion of Variance Explained	SSE	MSE	AIC	AICC	BIC
1	engine_config_12 cyl 5.2L	0.087237	0.912763	0.00008987	-0.090885	0.909115	-0.090370
2	manufacturer_Ferrari	0.160412	0.839588	0.00008268	-0.174253	0.825747	-0.173027
3	SQRT_odometer	0.193779	0.806221	0.00007940	-0.214610	0.785391	-0.212672
4	engine_config_12 cyl 6.7L	0.215590	0.784410	0.00007726	-0.241839	0.758162	-0.239190
5	engine_config_8 cyl 4.0L	0.227893	0.772107	0.00007605	-0.257450	0.742551	-0.254090
6	body_type_Coupe (2 door)	0.237161	0.762839	0.00007515	-0.269330	0.730671	-0.265259
7	engine_config_8 cyl 2.9L	0.243638	0.756362	0.00007452	-0.277660	0.722341	-0.272877
8	manufacturer_Porsche	0.249637	0.750363	0.00007393	-0.285426	0.714576	-0.279931
9	engine_config_6 cyl 3.0L	0.254260	0.745740	0.00007349	-0.291409	0.708593	-0.285203
10	engine_config_8 cyl 6.2L	0.258584	0.741416	0.00007307	-0.297028	0.702975	-0.290111
11	body_type_Hatchback	0.262159	0.737841	0.00007272	-0.301664	0.698339	-0.294035
12	engine_config_8 cyl 4.4L	0.265190	0.734810	0.00007243	-0.305584	0.694419	-0.297244
13	manufacturer_Lamborghini	0.268122	0.731878	0.00007215	-0.309385	0.690619	-0.300333
14	engine_config_8 cyl 3.6L	0.270888	0.729112	0.00007188	-0.312975	0.687030	-0.303212
15	price_conditions_Negotiable	0.273546	0.726454	0.00007163	-0.316430	0.683576	-0.305955
16	manufacturer_Land Rover	0.276012	0.723988	0.00007139	-0.319632	0.680374	-0.308447
17	engine_config_8 cyl 5.0L	0.278254	0.721746	0.00007118	-0.322538	0.677468	-0.310641
18	engine_config_8 cyl 3.9L	0.280155	0.719845	0.00007100	-0.324978	0.675030	-0.312369
19	engine_config_10 cyl 5.2L	0.281796	0.718204	0.00007084	-0.327064	0.672945	-0.313744
20	engine_config_8 cyl 4.5L	0.283438	0.716562	0.00007069	-0.329155	0.670854	-0.315124
21	price_conditions_Drive Away	0.285088	0.714912	0.00007053	-0.331263	0.668747	-0.316520
22	manufacturer_Maserati	0.286670	0.713330	0.00007038	-0.333283	0.666728	-0.317828
23	manufacturer_Mercedes-Benz	0.288300	0.711700	0.00007023	-0.335373	0.664639	-0.319207
24	manufacturer_Mercedes-AMG	0.289980	0.710020	0.00007007	-0.337539	0.662474	-0.320662
25	manufacturer_Ram	0.291550	0.708450	0.00006992	-0.339556	0.660458	-0.321967
26	manufacturer_Bentley	0.293048	0.706952	0.00006978	-0.341476	0.658539	-0.323176
27	engine_config_12 cyl 6.6L	0.294383	0.705617	0.00006966	-0.343169	0.656847	-0.324157
28	manufacturer_MG	0.295256	0.704744	0.00006958	-0.344210	0.655807	-0.324487

Cumulative variance and selection summary were used to capture all of the relevant features to the model. From the analysis, it is reasonable to derive that all of the variables explain the change in target variable (Price), so several key features have been identified as significant predictors for the model training. The evaluation considered various metrics, including the proportion of variance explained, SSE, MSE, AIC, AICc, and BIC. Noticeably, “manufacturer\_MG” emerged as a crucial predictor, consistently showing a high proportion of variance explained (0.29532) and the lowest values across AIC, AICc, and BIC, indicating a strong model fit. Similarly, “engine\_config\_12 cyl 6.6L,” “manufacturer\_Bentley,” “manufacturer\_Mercedes-AMG,” “manufacturer\_Mercedes-Benz,” and “manufacturer\_Maserati” also demonstrated high importance, with significant proportions of



variance explained and low error metrics, suggesting they are crucial in capturing the variability in the car price. These features not only provide a substantial explanatory power but also ensure a well-balanced model that generalises well prediction.. Consequently, incorporating these variables into the model for training is expected to enhance predictive accuracy, making them indispensable components for the analysis

### 3. Data Analysis for Price Prediction Models

#### 3.1. Model Training

The training process for the car valuation prediction model involves several steps, with each step vital to enhance the model's performances and accuracy. Initially, based on the selected influential features from the dataset, it is partitioned into three sets, where 60% are for training, 30% for validating and 10% for testing. However, the results and graphs showed that the model was overfitted. Thus, the choice of a 70/15/15 split is selected as the final data partition for training the model and is justified by the need to balance the amount of data used for training, validating and testing. Training on 70% of the data allows the model to learn the hidden patterns effectively. The 15% validation set is crucial for analysing errors and tuning hyperparameters without overfitting, while the 15% test set gives a sufficient amount of data on providing an unbiased evaluation of the model's performance on new data (Bressler and Tannor, 2021). This split ensures that the price prediction model is neither overfitted nor underfitted.

Following the choice of data split, the dataset was trained using different methods, such as autotuning the ML models, without autotuning the models and using the template based pipeline. Eventually, by comparing the results of different pipelines, the advanced template for interval target was selected, which includes a pre-populated data mining and machine learning pipeline that performs data preparation, model building, comparison and selection based on the given data (SAS, 2019). Various algorithms were explored, including Decision Trees, Random Forests, Linear Regression, Neural Networks, Generalized Additive Models (GAM), Gradient Boosting, and Ensemble methods.



### 3.2. Model Testing and Evaluation

The evaluation of the car valuation prediction model involved using the testing set to test its performance and comparing various performance metrics. These metrics provided insights into the accuracy and reliability of the predictions from seven different ML models. Key metrics used for evaluation included Average Squared Error (ASE), Root Average Squared Error (RASE), and Mean Absolute Error (MAE). Below is a table summarising various models' performances.

#### Model Comparison

Champion	Name	Algorithm Name	Average Squared Error
true	Decision Tree	Decision Tree	1.07373144E9
false	Forest	Forest	2.0178022E10
false	Forward Linear Regression	Linear Regression	2.13942579E9
false	Stepwise Linear Regression	Linear Regression	2.13942579E9
false	Neural Network	Neural Network	2.47811479E9
false	GAM	GAM	2.04561844E9
false	Gradient Boosting	Gradient Boosting	2.7644282E10
false	Ensemble	Ensemble	2.71021851E9

Data Role	Number of Observations	Root Average Squared Error	Root Mean Absolute Error
TEST	2,539	32,767.8416	112.7890
TEST	2,539	142,049.3651	159.6267
TEST	2,539	46,253.9273	177.9563
TEST	2,539	46,253.9273	177.9563
TEST	2,539	49,780.6668	163.0908
TEST	2,539	45,228.5135	176.0717
TEST	2,539	166,265.6977	171.8313
TEST	2,539	52,059.7590	150.5514

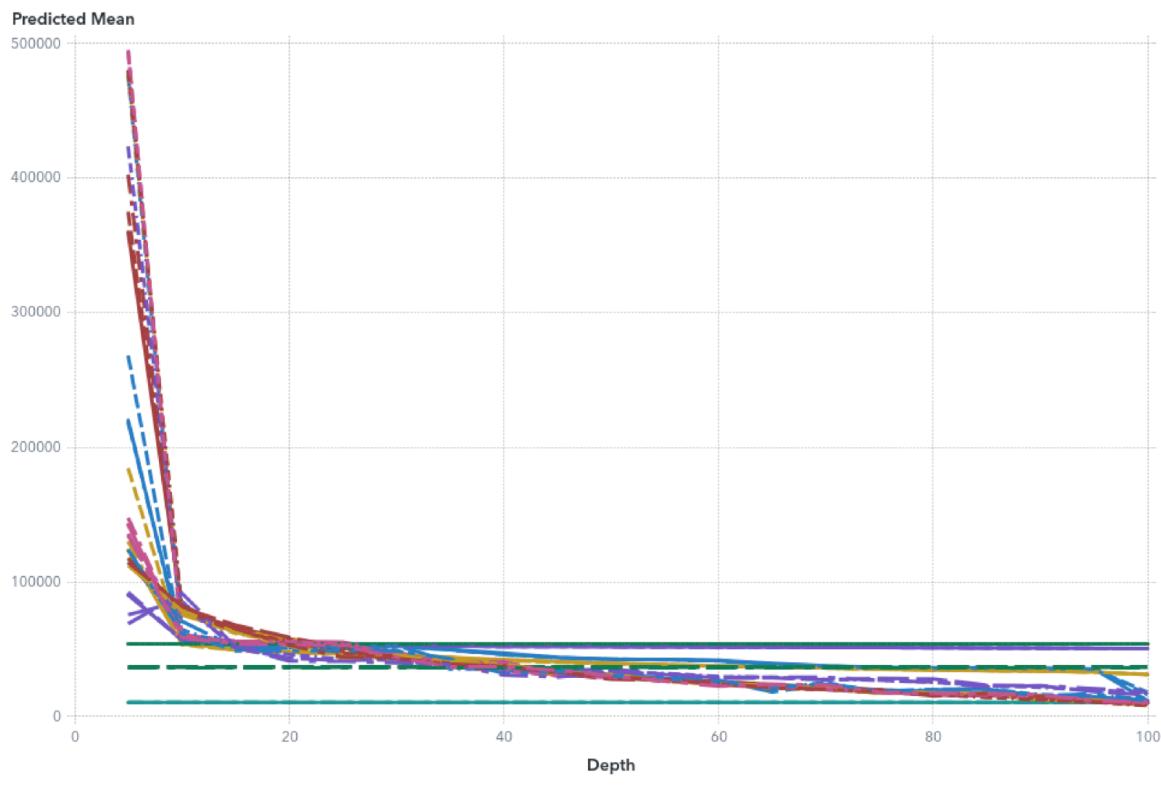


UNSW  
SYDNEY

The Decision Tree model outperformed the other models with the lowest error in each performance metric, where ASE is 1.07373144E9, RASE is 32,767.8416, and MAE is 112.7890, suggesting that the Decision Tree model was the most effective in capturing the complex relationships between the input features and the target variable and resulting in more accurate car valuation predictions. Additionally, the Random Forest and Gradient Boosting models showed higher values in ASE and RASE, indicating they were less accurate in this specific section. Linear Regression and Neural Network models had moderate performances, with higher ASE and RASE compared to the Decision Tree, but performing better than the rest models.

Moreover, the Actual and Predicted by Depth graph shown below compares the predicted mean values with the target mean values, telling whether the models are overfitted or not. It illustrates the convergence of the predicted mean towards the target mean as the depth increases. A close alignment between the predicted and target means suggests that the model is accurately capturing the underlying patterns in the data. In this case, the models are well performed, where their predictions stabilise as depth increases and there are close alignments between the predicted and target mean values, indicating that they are capturing the underlying data patterns effectively.

### Actual and predicted by depth



### 3.3. Model Selection

Based on the provided evaluation results for price prediction models, the Decision Tree model emerged as the best-performing model. It was selected as the "Champion" model with the lowest errors among all models that had been tested.

The comparison clearly shows that the Decision Tree model outperforms the others in terms of prediction accuracy, with significantly lower ASE, RASE, and MAE values. This superiority is reflected across various data sets, including train, test, and validate, highlighting the model's robust and consistent performance. The Decision Tree model has better predictive accuracy, minimising the squared differences between actual and predicted values. The value of RMAE can also support this, indicating less deviation on average between the predicted and actual prices.

#### Predicted by actual

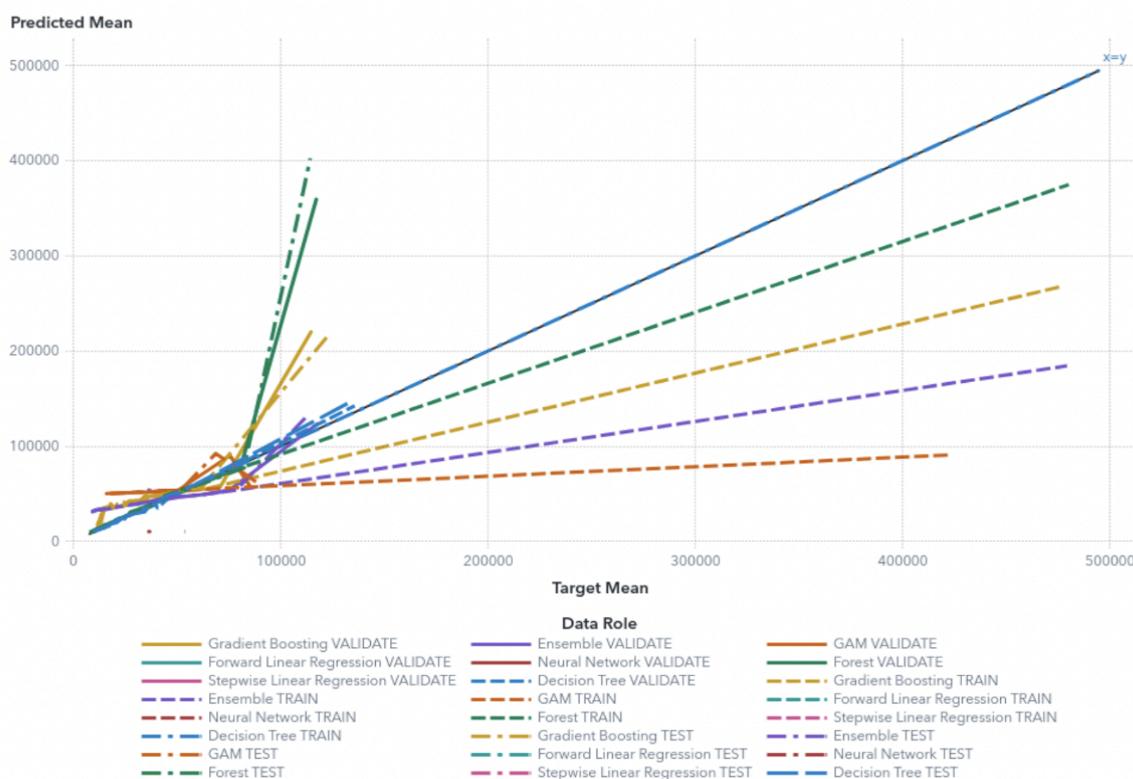


Figure: Predicted by Actual



UNSW  
SYDNEY

According to the figure of predicted versus actual for the decision tree, the line  $y=x$  means the model's predicted values are exactly equal to the actual values. The decision tree's performance is very close to this line across the train, test, and validate datasets, indicating that the model's performance is highly accurate.

### Predicted by actual

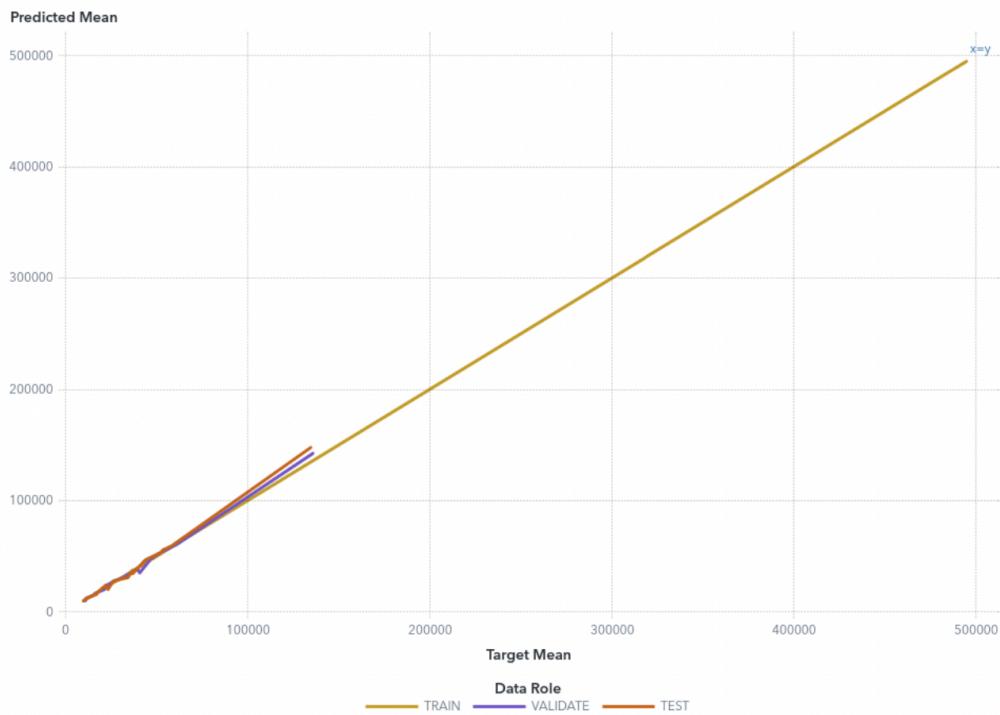


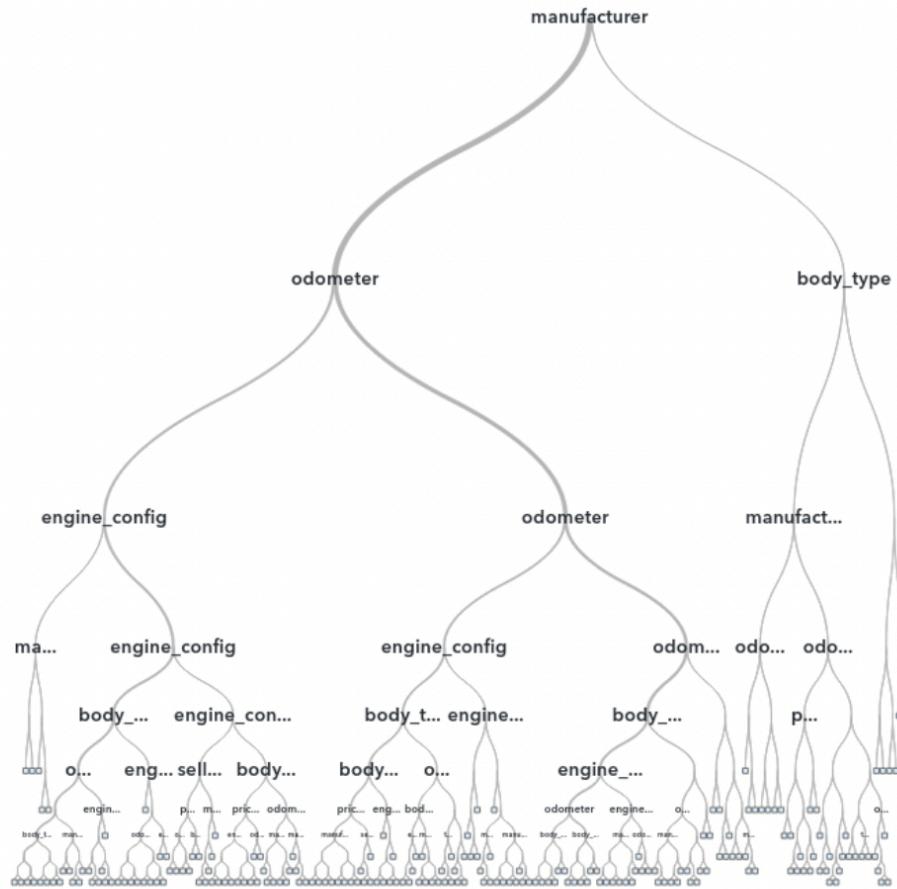
Figure: Decision Tree of Predicted by Actual

Refer to the Decision Tree of Predicted by Actual Figure, most data points are close to the diagonal line, indicating that our decision tree model's predictions generally align well with the actual values. This suggests that the model can accurately reflect the data under majority circumstances. However, despite the model's overall good performance, there may be some errors in its predictions, particularly in the high-price range.



### 3.4. Discuss the Key Findings

# Tree Diagram



## *Figure: Decision Tree Diagram*

Variable Importance					
	Training		Validation		
Variable	Importance	Relative Importance	Importance	Relative Importance	Count
odometer	7.351E15	1.0000	9.541E13	1.0000	50
engine_config	7.391E12	0.0010	8.259E11	0.0087	45
price_conditions	5.235E11	0.0001	1.468E11	0.0015	14
transmission	3.408E11	464E-7	6.502E10	0.0007	3
seller_type	3.12E10	424E-8	6.6012E9	0.0001	7
manufacturer	1.006E14	0.0137	-1.49E13	-0.157	49
body_type	5.533E14	0.0753	-7.8E13	-0.817	35

*Figure: Variable Importance of Decision Tree*



From the decision tree model's results, the odometer is the most significant variable affecting predictions. This indicates that the number of kilometres on the vehicle's odometer has a substantial impact on the predicted price, likely because it reflects the vehicle's condition and age. High-odometer vehicles generally have lower prices than low-mileage ones, likely due to greater wear and potential maintenance needs. Additionally, engine configuration and advertised price conditions, which refer to the number of cylinders, engine size, and the conditions under which the price is advertised, also significantly influence the predictions. These factors suggest that vehicles with different engine configurations and price conditions can vary widely in market appeal and price.

Transmission type, seller type, manufacturer, and body type also play important roles in determining vehicle prices. For example, automatic transmissions might appeal to a broader market compared to manual ones, potentially influencing pricing. The seller type, whether a dealer or private seller, can affect the trust and perceived value of the vehicle, with dealership vehicles often commanding higher prices due to perceived reliability and warranty offerings. The manufacturer is another critical factor, as vehicles from premium brands often have higher resale values. Lastly, body type impacts the vehicle's marketability, for instance, SUVs and sedans generally have a broader appeal than coupes or wagons, which can influence their pricing in the market.

### 3.5. Generate Actionable Insights

Gumtree can enhance its pricing strategy by implementing a dynamic model that adjusts prices based on mileage, as odometer readings significantly influence vehicle prices.

Lower mileage vehicles should be priced higher, reflecting their better condition, such as being newer and not requiring additional spending for repairs. Highlighting engine configurations, such as the number of cylinders and engine size, can further attract potential buyers. Therefore, Gumtree can create targeted marketing campaigns emphasising popular configurations like 4-cylinder engines, known for their fuel efficiency and broad appeal. Additionally, clarifying advertised price conditions, such as including government charges or negotiability, can attract more informed buyers. It is crucial to ensure these conditions are clearly stated in ads, helping buyers understand the true cost of the vehicle. Moreover, emphasising vehicles from reputable manufacturers and popular body types, such as SUVs



and sedans, can increase their market value. By highlighting these aspects in listings, Gumtree can position these vehicles as more desirable options, ultimately enhancing their marketability and sales potential.

## 4. Application of Generative AI to Foster Business and Environmental Value

### 4.1. Prompt Engineering

With its emerging capabilities in revolutionising user experiences, Generative AI poses a powerful tool for Gumtree to develop descriptions, particularly accentuating environmentally friendly features and recommending sustainable enhancements to sellers. Its creative and analytical proficiency elevates the appeal, environmental value and variety of the listings, promoting eco-friendly choices for buyers.

The key enablers of the Generative AI-powered Car Description Tool are the transformer-based technology leveraging Large Language Models (LLMs) and prompt-engineering techniques.

Through iterations of self-attention and encoding mechanisms, the transformers LLM predicts the words based on weighted importance relative to each other, crafting coherent, contextually relevant text suitable for description generation. In this application, Gemini, a fine-tuning model, is leveraged with Gumtree's dataset to execute a specific task: crafting appealing car descriptions. The hyperparameter tuning would strategically set the temperature at 1 to engage in diverse and engaging descriptions as well as increasing the number of tokens to get detailed and comprehensive descriptions.

Sourced from Gumtree's dataset, the car attributes such as body\_type, transmission, manufacturer and engine config are inputted to identify and generate comprehensive informative descriptions about the car.



**UNSW**  
SYDNEY

Data Features	Justification
featured_image (Data type: image)	To highlight environmentally-friendly features and personalise to the seller, the image data from “featured_image” along with the manual “description” is inputted as data features into the LLM.
description (Data type: text)	The description parameter would include the aspects of the car that the sellers would want to as information.
body_type (Data type: text)	These data features are the vehicle's attributes that help identify the model and make of the car. The description does not guarantee the identification of the vehicle.
transmission (Data type: text)	These specifications provide a foundational understanding of the vehicle's characteristics and performance. This could be used to help the LLM identify the vehicle model to also search for
manufacturer (Data type: text)	environmentally relevant information in its knowledge base.
engine_config (Data type: text)	This could be new information that was not known prior and be inserted into the descriptions or as possible custom modifications that enhance the vehicle's eco-friendliness, overall attracting environmentally conscious buyers.



**UNSW**  
SYDNEY

A sample set of images were selected to be tested amongst different iterations of prompting techniques.

The Sample Set of Images	Justification criteria:
	<p>The cars shown are in a clear resolution where the logo, shape of the car, photo angle and attributes are visible for identification. The LLM is able to extract insights from the image and provide comprehensive outputs in relevance to the sellers' interests.</p>
	<p>These photos were selected as the sample set to show a variety of angles, lighting and variation in the photos that would test the LLM's capabilities in recognising and suggesting reliable and relevant outputs.</p>
	



**UNSW**  
SYDNEY



This is an example of an image not recommended to the LLM where it is difficult to recognise the vehicle and extract insights from the lack of shape, logo, car colour and other attributes.

To improve the response accuracy, quality and effectiveness, prompt engineering is essential to refine the prompt and guide a more reliable and consistent model performance. The selection of the right prompt technique involved testing with the sample set. In this discussion, image 1 is applied to showcase the prompt demonstration, reasoning and selection.



**UNSW**  
SYDNEY

Prompt Technique	Application Results
<b>One-shot prompting</b>	<p><b>Example Prompt:</b> “Generate a product description for a car seller at an online marketplace based on the car in the image and highlight environmentally friendly features of these cars.”</p>  <p>User     Editing     ↑ ↓ ↻ ⚡ ⋮</p> <p>Generate product descriptions for the car in the image and highlight environmentally friendly features of these cars.</p> <p>Model 2.1s</p> <p>I am sorry, I do not have access to external websites or specific car information such as pricing, availability, or environmental features like fuel efficiency or emissions ratings. To find a detailed description of the car in the picture, I recommend checking a car marketplace website or a car dealership. You can also search for specific car models online using the make and model of the car in the image.</p> <p>This technique involves a prompt with direct instructions with no context and examples. This enables open-ended output where the model can independently craft descriptions based on its learned knowledge.</p> <p>As seen above, the initial prompt was too simple for the model to craft a description due to a lack of context and prompting instructions, highlighting the importance of the right prompting in directing the output.</p>



UNSW  
SYDNEY

	<p>User</p> <p>Generate a product description for a car seller at an online marketplace based on the car in the image and highlight environmentally friendly features of these cars.</p> <p>Model 2.6s</p> <p>This sleek and reliable 2005 Mazda Tribute is ready to hit the road! With its spacious interior and versatile design, it's perfect for families, adventurers, and anyone who needs a dependable vehicle.</p> <p>This particular Tribute is in great condition and has been well-maintained. It features a powerful yet fuel-efficient engine, making it an excellent choice for both city driving and long road trips.</p> <p>While specific fuel economy figures depend on the trim level and engine size, Mazda Tributes are known for their efficiency and are a great choice for environmentally conscious drivers.</p> <p>Ready to explore new horizons? This Mazda Tribute is waiting to take you there!</p>
Few-shot prompting	<p><b>Example Prompt:</b></p> <p>“Here is an example description of a car on online marketplaces:</p> <p>‘Presenting a carefully driven and meticulously maintained vehicle. This is a great family car or perfect first car for a young driver due to its safety, economy and reliability.’</p> <p>‘This Audi Q7 SUV has rear air conditioning, voice recognition, cargo tie down hooks/Rings and 21” alloy wheels. It has roof rails, satellite navigation (GPS), device connectivity, cruise control and inbuilt harddisk drive. This car has key/fob proximity starter button. This car has climate control air conditioning. It has proximity key with central locking. Using the multi-function steering wheel, listen to your favourite music and answer calls without taking your hands off the wheel. The integrated bluetooth system connects your enabled phone through the audio system. Life is a little easier with a powered tailgate.’</p>



**UNSW**  
SYDNEY

You are an AI assistant aiding e-commerce marketplace sellers at Gumtree, an Australian online marketplace. Generate a product description for the car in the image and highlight environmentally friendly features of these cars to attract buyers." [Sourced from Gumtree selling description](#)

## Results:

The screenshot shows a text-based interface with a "User" input field and an AI-generated response area.

**User:**

Here are some example descriptions of a car on online marketplaces:  
"Carefully driven and meticulously maintained."  
"Great family car or perfect first car for a young driver due to its safety, economy and reliability."  
"Great family car with 7 seats and large boot space. Fitted with new tyres and recently serviced."  
You are an AI assistant aiding e-commerce marketplace sellers at Gumtree, an Australian online marketplace. Your role is to generate product descriptions for the car in the image and highlight environmentally friendly features of these cars to attract buyers.

**Model:** 3.8s

**FOR SALE - Reliable and fuel-efficient Mazda Tribute!**

This is a great opportunity to own a reliable and fuel-efficient Mazda Tribute. This car is perfect for families or anyone looking for a spacious and comfortable SUV. It's also very fuel-efficient, which is great for saving money on gas and reducing your carbon footprint.

**Features:**

- Spacious interior with ample cargo space for all your needs
- Automatic transmission for smooth and easy driving
- Air conditioning to keep you cool on hot days
- Power steering for effortless maneuvering
- Safety features for peace of mind

This car is in great condition and has been well-maintained.

Don't miss out on this amazing opportunity to own a great car! Contact me today to arrange a viewing.

For better contextually relevant answers, examples are provided to guide the LLM output. Compared to zero-shot prompting, the model is able to learn from the examples.

This can provide a specific criterion by providing examples of the desired output. However, this is not sufficient for this complex task of generating appealing descriptions and highlighting environmentally friendly features.

<b>Chain-of-thought prompting</b>	<b>Example Prompt:</b> "You are an AI assistant aiding e-commerce marketplace sellers at Gumtree to craft car product descriptions. Start by asking for the image, description and car attributes(body type, transmission, manufacturer and engine configuration) they would manually input for their car listings. Once you have this information, generate a compelling product description for the car to attract buyers, including the appealing benefits, the description and the environmentally friendly features of the car. Additionally, discuss how the car could be enhanced to
-----------------------------------	---



**UNSW**  
SYDNEY

be more environmentally friendly, marketable and sustainable. Let's go step by step."

## Results:

User

You are an AI assistant aiding e-commerce marketplace sellers at Gumtree to craft car product descriptions. Start by asking for the image, description and car attributes(body type, transmission, manufacturer and engine configuration) they would manually input for their car listings. Once you have this information, generate a compelling product description for the car to attract buyers, including the appealing benefits, the description and the environmentally friendly features of the car. Additionally, discuss on how the car could be enhanced to be more environmentally friendly, marketable and sustainable. Let's go step-by step.

Model 2.1s

Let's get this car listing ready to shine! To create the best possible description, I need some information from you. Please tell me:

**1. Image:** Please provide a link to the image you'd like to use for your listing.

**2. Description:** Tell me about the car in your own words. What are the key features you want to highlight? Any special details about the car's history or condition?

**3. Car Attributes:**

- \* **Body Type:** (e.g., Sedan, Hatchback, SUV, etc.)
- \* **Transmission:** (e.g., Automatic, Manual)
- \* **Manufacturer:** (e.g., Toyota, Ford, Honda, etc.)
- \* **Engine Configuration:** (e.g., 4-cylinder, V6, Electric, Hybrid, etc.)

Once I have this information, I can craft a compelling product description that will attract buyers!

User



User

1. 2006 Mazda Tribute "Sport" 3.0 Litre EFI Auto AWD Wagon. Champagne Metallic with Grey Cloth interior. This car is in very clean, original condition and drives nicely. It has travelled only 10,000 Kms per year on average (Totalling 187,000), with log books and is mechanically good. No accidents and non smoker owners. Features include: Air conditioning, power windows/mirrors, remote central locking security (2 Remote Keys), multi airbags, ABS, CD player with multi-function steering wheel controls  
2. SUV, Automatic, Mazda, 4 cyl 2.5L



UNSW  
SYDNEY

	<p><b>Model</b> 5.5s</p> <p><b>Ready for Adventure: 2006 Mazda Tribute "Sport" AWD</b></p> <p>This sleek and stylish 2006 Mazda Tribute "Sport" is ready to take you on any adventure! With its powerful 3.0L EFI engine and reliable automatic transmission, you'll be able to conquer any terrain with ease. The spacious interior features comfortable grey cloth seats, perfect for family road trips or weekend getaways.</p> <p><b>Here's what makes this Tribute stand out:</b></p> <ul style="list-style-type: none"> <li>• <b>Low Mileage:</b> With only 187,000kms on the clock, this car has plenty of life left in it.</li> <li>• <b>Immaculate Condition:</b> This Tribute is in original, well-maintained condition, both inside and out.</li> <li>• <b>Driving Comfort:</b> Enjoy the luxury of features like power windows, mirrors, remote central locking, and a multi-function steering wheel.</li> <li>• <b>Safety First:</b> Peace of mind comes standard with this Tribute, featuring multiple airbags, ABS brakes, and a secure locking system.</li> <li>• <b>Adventure Ready:</b> The AWD system gives you the traction and control you need for any weather condition and off-road excursions.</li> </ul> <p>This Mazda Tribute is a fantastic blend of style, performance, and value. It's the perfect vehicle for someone looking for a reliable and fun SUV that won't break the bank.</p> <p>To make this Tribute even more environmentally friendly:</p> <ul style="list-style-type: none"> <li>• Consider switching to bio-based motor oil. Bio-based oils are made from renewable resources like plants and are less harmful to the environment than traditional petroleum-based oils.</li> <li>• Install energy-efficient tires. This will improve fuel economy and reduce emissions.</li> <li>• Use a fuel-efficient driving style. Smooth acceleration and avoiding excessive braking can significantly improve your fuel efficiency.</li> </ul> <p>Don't miss out on this amazing opportunity to own a well-loved, reliable, and versatile Mazda Tribute "Sport." Contact us today to schedule a test drive!</p>
<b>Prompt chaining</b>	<p><b>Example Prompt:</b></p> <p>"Prompt 1:</p> <p>You are an AI assistant aiding e-commerce marketplace sellers. Your role is to generate compelling product descriptions for cars at Gumtree, an Australian online marketplace, to attract buyers. This is the user's car image and attributes input:</p> <p>{manufacturer} {body_type} {transmission} {engine config}. The seller has given a manual description of the car as: "{manual description}." Based on the inputs, identify the vehicle and list the benefits and environmentally friendly features of the car.</p> <p>Prompt 2:</p> <p>Based on the research and the manual description, craft a product</p>



**UNSW**  
SYDNEY

description for the car that highlights the basic information, appealing factors, the manual description and the environmentally friendly features of the car.

### Prompt 3:

Additionally to this segment, discuss how the car could be enhanced to be more environmentally friendly, marketable and sustainable. “

## Results:

**User**



You are an AI assistant aiding e-commerce marketplace sellers. Your role is to generate compelling product descriptions for cars at Gumtree, an Australian online marketplace, to attract buyers. This is the user's car image and attributes input:  
Mazda SUV Automatic 4cyl 2.5L  
The seller has given a manual description of the car as: "2006 Mazda Tribute "Sport" 3.0 Litre EFI Auto AWD Wagon. Champagne Metallic with Grey Cloth interior. This car is in very clean, original condition and drives nicely. It has travelled only 10,000 Kms per year on average (Totalling 187,000), with log books and is mechanically good. No accidents and non smoker owners. Features include: Air conditioning, power windows/mirrors, remote central locking security (2 Remote Keys), multi airbags, ABS, CD player with multi-function steering wheel controls.". Based on the inputs, identify the vehicle and list the benefits and environmentally friendly features of the car.

**Model** 4.6s  
**2006 Mazda Tribute "Sport" 3.0 Litre EFI Auto AWD Wagon - A Great Family Car!**

This is a great family car in excellent condition. It has been well maintained, with only 187,000 kms travelled. This car is mechanically sound, has never been in an accident, and comes from a non-smoking household.

Here are some of the key features:

- 3.0 Litre EFI engine for powerful performance.
- Automatic transmission for smooth driving.
- All-wheel drive for added safety and traction.
- Champagne Metallic exterior with a stylish Grey Cloth interior.
- Air conditioning to keep you comfortable all year round.
- Power windows and mirrors for convenience.
- Remote central locking with 2 remote keys for security.
- Multi airbags and ABS for added safety.
- CD player with multi-function steering wheel controls.
- Logbooks available for peace of mind.

This car is a great option for families or anyone looking for a reliable and spacious vehicle. With its low mileage and excellent condition, it is sure to be a great addition to your family. Contact us today to arrange a test drive!

**Benefits:**

- Reliable and well-maintained vehicle
- Spacious and comfortable interior
- Fuel-efficient engine
- Powerful performance
- Safety features for peace of mind

**Environmentally Friendly Features:**

- Fuel-efficient engine contributes to lower emissions.
- Regular maintenance helps to ensure optimal performance and emissions.

This description highlights the car's key features, benefits, and environmentally friendly aspects. It's written in a clear and concise way and includes a call to action to encourage buyers to contact the seller.



**UNSW**  
SYDNEY

User

Based on the research and the manual description, craft a product description for the car that highlights the basic information, appealing factors, the manual description and the environmentally friendly features of the car.

Model 3.6s

**2006 Mazda Tribute "Sport" - Ready for Adventure!**

This 2006 Mazda Tribute "Sport" is a reliable and stylish SUV perfect for families and adventurers alike. With a powerful 3.0 Litre EFI engine and Automatic transmission, this vehicle delivers a smooth and enjoyable driving experience, while its All-wheel drive system gives you added confidence on any terrain.

This well-maintained Tribute boasts only 187,000kms and comes with a clean history. It's been meticulously cared for by a non-smoking owner and has never been in an accident.

**What you'll love:**

- Champagne Metallic exterior and Grey Cloth interior: A classic and elegant combination.
- Comfort and convenience: Enjoy air conditioning, power windows and mirrors, remote central locking with 2 keys, and a CD player with multi-function steering wheel controls.
- Safety first: Rest assured with multi-airbags, ABS brakes, and a spacious cabin for all passengers.
- Peace of mind: Comes with complete logbooks for full maintenance history.

**More than just a great car:**

This Mazda Tribute is not just about performance and comfort, it's about responsible driving. The fuel-efficient 3.0L engine helps reduce your carbon footprint and minimize fuel costs.

**Ready to explore?** Contact us today to arrange a test drive and experience the smooth ride and adventure-ready features of this Mazda Tribute.

User

Additionally to this segment, discuss how the car could be enhanced to be more environmentally friendly, marketable and sustainable.

Model 6.5s

**2006 Mazda Tribute "Sport" - Ready for Adventure!**

This 2006 Mazda Tribute "Sport" is a reliable and stylish SUV perfect for families and adventurers alike. With a powerful 3.0 Litre EFI engine and Automatic transmission, this vehicle delivers a smooth and enjoyable driving experience, while its All-wheel drive system gives you added confidence on any terrain.

This well-maintained Tribute boasts only 187,000kms and comes with a clean history. It's been meticulously cared for by a non-smoking owner and has never been in an accident.

**What you'll love:**

- Champagne Metallic exterior and Grey Cloth interior: A classic and elegant combination.
- Comfort and convenience: Enjoy air conditioning, power windows and mirrors, remote central locking with 2 keys, and a CD player with multi-function steering wheel controls.
- Safety first: Rest assured with multi-airbags, ABS brakes, and a spacious cabin for all passengers.
- Peace of mind: Comes with complete logbooks for full maintenance history.

**More than just a great car:**

This Mazda Tribute is not just about performance and comfort, it's about responsible driving. The fuel-efficient 3.0L engine helps reduce your carbon footprint and minimize fuel costs.

**Ready to explore?** Contact us today to arrange a test drive and experience the smooth ride and adventure-ready features of this Mazda Tribute.

**Enhancing for Sustainability:**

While the Tribute is already a reliable and fuel-efficient SUV, we can enhance its environmental and market appeal:

**Eco-Friendly Upgrades:**

- Biodiesel Conversion: Converting the engine to run on biodiesel could significantly reduce emissions and reliance on fossil fuels.
- Hybrid System: Adding a mild hybrid system could improve fuel efficiency and reduce emissions even further.
- Eco-tires: Upgrading to low-rolling resistance tires can improve fuel economy.
- Solar Panel Installation: While not practical on a standard Tribute, incorporating solar panels could potentially power auxiliary systems and reduce reliance on the battery.

**Enhanced Marketing:**

- Highlighting Eco-friendliness: Emphasize the car's fuel efficiency and potential for upgrades like biodiesel conversion.
- Target Green-Conscious Buyers: Appeal to consumers looking for sustainable transportation options.
- Offer Eco-Friendly Accessories: Promote eco-friendly accessories like bike racks or rooftop cargo boxes for sustainable travel.
- Sustainability Certifications: Consider pursuing sustainability certifications like LEED or ISO 14001 for added credibility.

This would be most suitable for complex tasks that can be split into subtasks. In this case the different subtasks are:

- Craft description
- Highlight environmentally friendly features of car.
- Recommend ways to make car more environmentally friendly.

From the inputs, Prompt 1 focuses on identifying, researching and gathering basic information about the car. This is then passed to Prompt 2 where the description is generated in reference to the manual description



**UNSW**  
SYDNEY

where the seller is able to input their preferences and information to emphasise. Prompt 3 then takes the task of finding ways to enhance the listing description as well as the car in a environmentally friendly manner.

By chaining prompts, the model can focus on specific aspects step by step, leading to more detailed, creative and structured outputs. However the variation in response can widely vary and sellers may face missing information or hallucinations.

### Varying outputs:

Model 3.8s

2006 Mazda Tribute "Sport" - Ready for Adventure!

This 2006 Mazda Tribute "Sport" is a spacious and capable SUV, ready to take you on all your adventures. With its powerful 3.0 Litre EFI engine and automatic transmission, you'll enjoy a smooth and confident ride. The All-Wheel Drive system gives you added traction and safety, especially in challenging conditions.

This Tribute is in excellent condition, having only travelled 187,000 kms and meticulously maintained. It's been lovingly cared for by non-smoker owners and has never been in an accident.

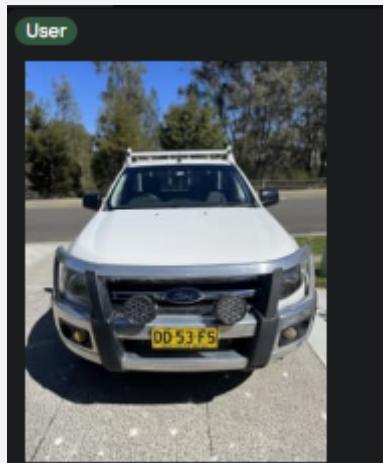
Here's what makes this Tribute so special:

- Champagne Metallic exterior with a stylish Grey Cloth interior for a classic and timeless look.
- Air conditioning, power windows and mirrors, and remote central locking with 2 remote keys for added convenience and security.
- Multi airbags and ABS provide peace of mind and extra safety.
- CD player with multi-function steering wheel controls keeps you entertained on the road.
- Logbooks are available for complete transparency and a hassle-free ownership experience.

Ready to experience the reliability and capability of this 2006 Mazda Tribute "Sport"? Contact us today for a test drive!

This car offers a great combination of comfort, reliability, and performance, making it an ideal choice for families or individuals looking for a versatile and dependable vehicle.

For the environmentally conscious, the Tribute boasts a fuel-efficient engine, contributing to lower emissions. Regular maintenance helps to keep the vehicle running smoothly and efficiently, reducing its environmental impact.



UNSW  
SYDNEY

Model 5.0s

Ready for Adventure: 2013 Ford Ranger PX – Automatic, 4 Cylinder

This 2013 Ford Ranger PX is the perfect blend of workhorse and weekend warrior. With its powerful 3.2L 4-cylinder engine paired with a smooth automatic transmission, you can handle any job and still enjoy comfortable driving.

This ute is more than just tough - it's also stylish and practical: It's been lovingly cared for and comes with added features like extra lights and a bull bar, for extra safety and a rugged look. The owner describes it as "very clean and looked after", and you can see that care in the condition of this vehicle.

Beyond its rugged looks, this Ranger has potential for even more environmentally friendly features: The 3.2L engine delivers good fuel economy, but it can be further improved with:

- Fuel-Saving Modifications:** Consider installing a fuel-saving device like a throttle controller or a high-flow air filter. These can increase fuel efficiency by optimizing engine performance.
- Eco-Friendly Tires:** Switching to low-rolling resistance tires can reduce fuel consumption and increase overall efficiency.
- Sustainable Upgrades:** Consider replacing the bull bar with a more eco-friendly option like a light bar, reducing the vehicle's weight and improving aerodynamics.

Ready to take on any challenge? This Ford Ranger is waiting for you.

Don't miss out - enquire today!

To further enhance the marketability and sustainability of this vehicle, consider:

- High-Quality Photos:** Professionally-taken photos highlighting the vehicle's clean condition and any unique features will attract more potential buyers.
- Detailed Description:** Expand on the car's features, including any additional accessories or upgrades. This helps potential buyers visualize themselves using the vehicle.
- Transparent Pricing:** Be clear about the price and any potential negotiations.
- Open Communication:** Respond to inquiries promptly and be open to questions.

By emphasizing the vehicle's environmentally friendly potential and taking steps to enhance its marketability, you can attract more buyers and ensure a smooth and successful sale.

## Combination - Few-shot prompting and prompt chaining

### Example Prompt:

"Prompt 1:

You are an AI assistant aiding e-commerce marketplace sellers. Your role is to generate compelling product descriptions for cars at Gumtree, an Australian online marketplace, to attract buyers. This is the user's car image and attributes input:

{manufacturer} {body\_type} {transmission} {engine config}.

The seller has given a manual description of the car as: "{manual description}.". Based on the inputs, identify the vehicle and list the benefits and environmentally friendly features of the car.

Prompt 2:

Based on the research, example and the manual description, craft a product description for the car that highlights the basic information, appealing factors, the manual description and the environmentally friendly features of the car. Here is an example product description for a car on online marketplaces:

'The key features of this Audi Q7 SUV has rear air conditioning, voice recognition, cargo tie down hooks/Rings and 21" alloy wheels. It has roof rails, satellite navigation (GPS), device connectivity, cruise control and



**UNSW**  
SYDNEY

inbuilt harddisk drive. This car has key/fob proximity starter button. This car has climate control air conditioning. It has proximity key with central locking. Using the multi-function steering wheel, listen to your favourite music and answer calls without taking your hands off the wheel.

Environmentally Friendly Features include:

Fuel Efficiency.: {explanation}

Durability: {explanation}

Renewable Energy: {explanation}

The integrated bluetooth system connects your enabled phone through the audio system. Life is a little easier with a powered tailgate.'

Prompt 3:

Additionally to this segment, discuss how the car could be enhanced to be more environmentally friendly, marketable and sustainable. “

**Results:**

**User**



**User**

You are an AI assistant aiding e-commerce marketplace sellers. Your role is to generate compelling product descriptions for cars at Gumtree, an Australian online marketplace, to attract buyers. This is the user's car image and attributes input:

Mazda SUV Automatic 4cyl 2.5L

The seller has given a manual description of the car as: "2006 Mazda Tribute "Sport" 3.0 Litre EFI Auto AWD Wagon, Champagne Metallic with Grey Cloth interior. This car is in very clean, original condition and drives nicely. It has travelled only 10,000 Kms per year on average (Totalling 187,000), with log books and is mechanically good. No accidents and non smoker owners. Features include: Air conditioning, power windows/mirrors, remote central locking security (2 Remote Keys), multi airbags, ABS, CD player with multi-function steering wheel controls". Based on the inputs, identify the vehicle and list the benefits and environmentally friendly features of the car.

**Model** 5.7s

This is a 2006 Mazda Tribute "Sport" 3.0 Litre EFI Auto AWD Wagon in beautiful Champagne Metallic with a Grey Cloth interior. This car is in exceptionally clean, original condition and drives beautifully. It has travelled only 10,000 Kms per year on average (Totalling 187,000), with log books and is mechanically sound.

**Benefits:**

- **Reliable and Durable:** The Mazda Tribute is known for its reliability and durability, making it a great choice for everyday driving.
- **Spacious and Comfortable:** With its spacious interior and comfortable seating, the Tribute provides ample room for passengers and cargo.
- **Powerful Engine:** The 3.0 Litre EFI engine delivers plenty of power for both city driving and highway cruising.
- **Fuel Efficient:** The Tribute's fuel efficiency makes it a cost-effective option for everyday driving.
- **4WD Capability:** The Tribute's 4WD system provides added traction and stability in challenging driving conditions.
- **Safety Features:** Equipped with multiple airbags, ABS, and remote central locking security, the Tribute provides peace of mind for you and your family.
- **Low Mileage:** With only 187,000kms on the clock, this Tribute is well-maintained and has plenty of life left in it.

**Environmentally Friendly Features:**

- **Fuel Efficient Engine:** The 3.0L EFI engine in the Tribute is designed to optimize fuel economy, reducing your carbon footprint.
- **Regular Servicing:** The vehicle has been consistently serviced as evidenced by its logbooks, demonstrating responsible ownership and contributing to the car's longevity.
- **No Accidents and Non-Smoker Owners:** This car is in excellent condition due to its meticulous care and lack of accidents or smoke damage, indicating a commitment to environmental responsibility.

In summary, this 2006 Mazda Tribute "Sport" is a reliable, comfortable, and fuel-efficient vehicle that is perfect for families and individuals alike.



**UNSW**  
SYDNEY

**User**

Based on the research, example and the manual description, craft a product description for the car that highlights the basic information, appealing factors, the manual description and the environmentally friendly features of the car. Here is an example product description for a car on online marketplaces:

The key features of this Audi Q7 SUV has rear air conditioning, voice recognition, cargo tie down hooks/Rings and 21" alloy wheels. It has roof rails, satellite navigation (GPS), device connectivity, cruise control and inbuilt harddisk drive. This car has keyfob proximity starter button. This car has climate control air conditioning. It has proximity key with central locking. Using the multi-function steering wheel, listen to your favourite music and answer calls without taking your hands off the wheel.

Environmentally Friendly Features include:  
 Fuel Efficiency: (explanation)  
 Durability: (explanation)  
 Renewable Energy: (explanation)

The integrated bluetooth system connects your enabled phone through the audio system. Life is a little easier with a powered tailgate.'

**Model** 5.3s

**2006 Mazda Tribute "Sport" - A Reliable SUV with Low Mileage and Comfort Features!**

**Ready for adventure?** This 2006 Mazda Tribute "Sport" is a fantastic option for those seeking a reliable and stylish SUV with low mileage. Its 3.0 Litre EFI Auto AWD configuration provides a smooth and powerful driving experience.

Here's what makes this Tribute stand out:

- **Low Mileage:** With only 187,000kms on the clock, this Tribute has averaged just 10,000kms per year.
- **Clean & Original Condition:** The car presents beautifully in its original Champagne Metallic paint and Grey Cloth interior.
- **Comprehensive Features:** Enjoy the comfort and safety of Air conditioning, power windows/mirrors, remote central locking, multi airbags, ABS, and a CD player with multi-function steering wheel controls.
- **Peace of Mind:** Comes with logbooks, demonstrating a history of regular maintenance.

This car is in very clean, original condition and drives nicely.

**Features:**

- **Powerful & Efficient Engine:** The 3.0 Litre EFI Auto AWD engine delivers a smooth and efficient performance.
- **Spacious Interior:** The roomy interior provides ample space for passengers and cargo, making it perfect for family outings or adventures.
- **Convenience Features:** Enjoy the comfort of power windows/mirrors, remote central locking, and multi-airbags. Stay entertained with the CD player and multi-function steering wheel controls.
- **Safety First:** With multi-airbags and ABS, you can be confident in the Tribute's safety features.
- **Reliability & Durability:** Mazda vehicles are renowned for their reliability and durability, giving you peace of mind on the road.

**Environmentally Friendly Features:**

- **Fuel Efficient Engine:** The 3.0-litre engine has been designed to provide a balance of power and fuel efficiency.
- **Durable Construction:** Mazda vehicles are known for their durable construction, which reduces the need for frequent replacements and contributes to a longer lifespan.

This Tribute is a fantastic opportunity to own a reliable and stylish SUV in excellent condition. Don't miss out - enquire today!

Additionally to this segment, discuss how the car could be enhanced to be more environmentally friendly, marketable and sustainable.

**Model** 6.5s

**2006 Mazda Tribute "Sport" - A Reliable SUV with Low Mileage and Comfort Features!**

**Ready for adventure?** This 2006 Mazda Tribute "Sport" is a fantastic option for those seeking a reliable and stylish SUV with low mileage. Its 3.0 Litre EFI Auto AWD configuration provides a smooth and powerful driving experience.

Here's what makes this Tribute stand out:

- **Low Mileage:** With only 187,000kms on the clock, this Tribute has averaged just 10,000kms per year.
- **Clean & Original Condition:** The car presents beautifully in its original Champagne Metallic paint and Grey Cloth interior.
- **Comprehensive Features:** Enjoy the comfort and safety of Air conditioning, power windows/mirrors, remote central locking, multi airbags, ABS, and a CD player with multi-function steering wheel controls.
- **Peace of Mind:** Comes with logbooks, demonstrating a history of regular maintenance.

This car is in very clean, original condition and drives nicely.

**Features:**

- **Powerful & Efficient Engine:** The 3.0 Litre EFI Auto AWD engine delivers a smooth and efficient performance.
- **Spacious Interior:** The roomy interior provides ample space for passengers and cargo, making it perfect for family outings or adventures.
- **Convenience Features:** Enjoy the comfort of power windows/mirrors, remote central locking, and multi-airbags. Stay entertained with the CD player and multi-function steering wheel controls.
- **Safety First:** With multi-airbags and ABS, you can be confident in the Tribute's safety features.
- **Reliability & Durability:** Mazda vehicles are renowned for their reliability and durability, giving you peace of mind on the road.

**Environmentally Friendly Features:**

- **Fuel Efficient Engine:** The 3.0-litre engine has been designed to provide a balance of power and fuel efficiency.
- **Durable Construction:** Mazda vehicles are known for their durable construction, which reduces the need for frequent replacements and contributes to a longer lifespan.

**Enhancing the Tribute for Sustainability & Marketability:**

- **Upgrade to Eco-Friendly Tires:** Replacing the standard tires with low rolling resistance tires can improve fuel efficiency and reduce emissions.
- **Eco-Friendly Car Wash:** Offering a discount on an eco-friendly car wash service can attract environmentally conscious buyers.
- **Highlight Fuel Efficiency:** Emphasize the Tribute's fuel efficiency in the description and compare it to similar SUVs.
- **Consider Biofuel Compatibility:** Research if the vehicle is compatible with biofuels like E85, which can offer a more sustainable fuel source.
- **Promote Sustainable Driving Habits:** Include tips for eco-friendly driving, such as maintaining tire pressure and avoiding aggressive acceleration.

This Tribute is a fantastic opportunity to own a reliable and stylish SUV in excellent condition. Don't miss out - enquire today!

By implementing these enhancements, you can attract a wider range of buyers who are conscious of sustainability and environmental impact. This, in turn, can make the Tribute more marketable and increase its appeal to a growing segment of eco-conscious consumers.

From the experiments of different prompting techniques, few-shot and prompt chaining proved the most viable results. The combination of



**UNSW**  
SYDNEY

different prompting techniques provide coverage while focusing on the car's environmentally conscious capabilities to address the growing consumer interest in sustainable and effective car options.

Suitable for prompt 2, few-shot prompting enables contextually relevant and well-formatted responses appropriate for car listings, preventing inconsistent strays and hallucinations from desired outputs.

Chain-prompting enables in-depth analysis and focus on the different sub-tasks to achieve the different generative AI applications: generating a compelling description, highlighting environmentally friendly features and enhancing the car's marketability and eco-friendly features.

Through experimental iterations of prompting techniques, the combination of few-shot and prompt chaining proved the best results where the output provided a compelling detailed description that was contextually relevant while additionally suggesting enhancements to the car to become more environmentally friendly. By leveraging the strengths of these techniques, the model can format reliable and well-formatted responses that grasp the complexity of the different subtasks. These different subtasks, whether it be crafting sample descriptions or recommending enhancements benefit the sellers in attracting buyers with a description that effectively highlights the car's appealing factors and environmental benefits through an identification of the car make.



**UNSW**  
SYDNEY

## 4.2. Key Findings

A successful Generative AI application offers a multitude of benefits for Gumtree to drive eco-friendly decisions and enhanced platform experiences.



### Manual Description:

2006 Mazda Tribute "Sport" 3.0 Litre EFI Auto AWD Wagon. Champagne Metallic with Grey Cloth interior. This car is in very clean, original condition and drives nicely. It has travelled only 10,000 Kms per year on average (Totalling 187,000), with log books and is mechanically good. No accidents and non smoker owners. Features include: Air conditioning, power windows/mirrors, remote central locking security (2 Remote Keys), multi airbags, ABS, CD player with multi-function steering wheel controls.



**UNSW**  
SYDNEY

## Generative Description Response:

Model 6.5s Text generated in seconds (Prompt 1 - 5.7s, Prompt 2 - 5.3s ) ↑ ↓ ↗ ↘

2006 Mazda Tribute "Sport" - A Reliable SUV with Low Mileage and Comfort Features!

Ready for adventure? This 2006 Mazda Tribute "Sport" is a fantastic option for those seeking a reliable and stylish SUV with low mileage. Its 3.0 Litre EFI Auto AWD configuration provides a smooth and powerful driving experience. Listing-language to appeal to buyers

Here's what makes this Tribute stand out:

- **Low Mileage:** With only 187,000kms on the clock, this Tribute has averaged just 10,000kms per year.
- **Clean & Original Condition:** The car presents beautifully in its original Champagne Metallic paint and Grey Cloth interior.
- **Comprehensive Features:** Enjoy the comfort and safety of Air conditioning, power windows/mirrors, remote central locking, multi airbags, ABS, and a CD player with multi-function steering wheel controls.
- **Peace of Mind:** Comes with logbooks, demonstrating a history of regular maintenance.

This car is in very clean, original condition and drives nicely.

Features: **Bolded and emphasised key points** Well-formatted response

- **Powerful & Efficient Engine:** The 3.0 Litre EFI Auto AWD engine delivers a smooth and efficient performance.
- **Spacious Interior:** The roomy interior provides ample space for passengers and cargo, making it perfect for family outings or adventures.
- **Convenience Features:** Enjoy the comfort of power windows/mirrors, remote central locking, and multi-airbags. Stay entertained with the CD player and multi-function steering wheel controls.
- **Safety First:** With multi-airbags and ABS, you can be confident in the Tribute's safety features.
- **Reliability & Durability:** Mazda vehicles are renowned for their reliability and durability, giving you peace of mind on the road.

Environmentally Friendly Features:

- **Fuel Efficient Engine:** The 3.0-litre engine has been designed to provide a balance of power and fuel efficiency.
- **Durable Construction:** Mazda vehicles are known for their durable construction, which reduces the need for frequent replacements and contributes to a longer lifespan.

Enhancing the Tribute for Sustainability & Marketability:

- **Upgrade to Eco-Friendly Tires:** Replacing the standard tires with low rolling resistance tires can improve fuel efficiency and reduce emissions.
- **Eco-Friendly Car Wash:** Offering a discount on an eco-friendly car wash service can attract environmentally conscious buyers.
- **Highlight Fuel Efficiency:** Emphasize the Tribute's fuel efficiency in the description and compare it to similar SUVs.
- **Consider Biofuel Compatibility:** Research if the vehicle is compatible with biofuels like E85, which can offer a more sustainable fuel source.
- **Promote Sustainable Driving Habits:** Include tips for eco-friendly driving, such as maintaining tire pressure and avoiding aggressive acceleration.

This Tribute is a fantastic opportunity to own a reliable and stylish SUV in excellent condition. Don't miss out - enquire today!

By implementing these enhancements, you can attract a wider range of buyers who are conscious of sustainability and environmental impact. This, in turn, can make the Tribute more marketable and increase its appeal to a growing segment of eco-conscious consumers.

In comparison to the manual description, the model outcomes a clear, well-formatted compelling description that highlights the attractive attributes and environmentally friendly features of the car. As opposed to the block-format and incomplete sentences, the model's dot-point form provide easy visibility of the features as well as insights into enhancements to the listing that would engage well with eco-friendly buyers. With a detailed description, there is increased visibility not only to buyers but in Gumtree's search engine algorithms that locate key terms and cars to potential buyers. These descriptions educate the benefits of eco-friendly cars, influencing purchase decisions in sustainable vehicles and building trust by providing informative descriptions. Cars with informative descriptions tend to have higher conversion rates, leading to quicker sales and increased revenue for sellers.

The description was also swiftly generated in seconds, saving users time and effort in creating compelling listings and improving user experiences.



UNSW  
SYDNEY

To further sustain a successful application, a feedback loop can be implemented for the buyers to rate generated descriptions to help the model continuously improve output relevance and accuracy.

By leveraging Generative AI, businesses can drive user engagement, increase transactions, and establish themselves to eco-conscious buyers which ultimately drive business growth in the competitive online marketplace.

#### 4.3. Potential Applications of Generative AI

Generative AI techniques such as LLMs and prompt engineering techniques can be utilised in the textiles and agricultural industries to address key environmental and sustainability challenges, including but not limited to: efficient resource use, supply chain management, tracking and monitoring, and overall efficient management.

Efficient resource use in relation to farming techniques can be further optimised through the use of prompt chaining to deliver specific solutions and insights to possible techniques. This is the same with making choices in relation to efficient use of fabrics, dyes and machinery in the textiles industry. LLMs, through the implementation of prompt chaining can deliver specific insights to resource efficiency queries that include a series of multiple different factors. To optimise supply chain management in both industries, the tracking and delivery and the maximisation of delivery resource use, one shot prompting allows for the LLM to generate practices that are more sustainable and environmentally friendly to be enabled. And finally, in both industries, the tracking and monitoring of resources and production to increase sustainability can be enforced through means of few shot prompting. The model can be trained to view inputs as either positive and negative in the bounds of crop yield, plant growth and fertiliser used for the agricultural industry, and material production, and chemical waste for the textiles industry. Thus, environmental and sustainable challenges are addressed this way.



## 5. Ethical Implications

Data privacy issues in relation to personal data being breached is an ethical concern. Data inputted into AI models may be hacked or leaked leading to customers' privacy being breached is an ethical concern. One similar example occurred in 2023 where Microsoft's AI repository was the subject of a data leak of private data (Simone S. 2023). Biases in data can also occur when customers are unfairly grouped in segments based on discriminatory factors. This unfortunately opposes the aim that the Gumtree had to start in the first place, to increase fairness and provide an accurate reflection of the vehicles' value. Accountability and transparency issues can lead to a lack of quality processes during project building. If clear processes and responsibilities are not delegated within group members, the issues in the quality of the final product may lead to a poor performing model. Hiring platform HireVue was assumed to possibly have AI algorithms that were not tested for bias when screening for potential employees (CDT 2022), this is not only an example of biases however it also shows a lack of accountability and transparency.

These ethical issues can be mitigated by: implementing best practice methods of digital software and hardware security, utilising a diverse range of data while performing data preprocessing to a high standard and finally implementing structures to allow for task delegation and communication in the project development team. The onset of the Generative AI boom in recent years means that security practices are still new. Therefore, the market's most robust and reputable security measures must be used. This is in addition to already using encryption, firewalls and multifactor authentication. Developers must use diverse data, undertake data cleaning, and remove duplicates and missing values to reduce the chances of bias. And finally, having a set system to delegate tasks and handle inter-team communication, whilst documenting progress will reduce the ethical issues surrounding accountability and transparency. Therefore, these ethical concerns are addressed this way.



**UNSW**  
SYDNEY

## Conclusion

This project aimed to follow the process of building an AI driven solution to the business problem faced by Gumtree. In focusing efforts towards utilising generative AI techniques such as prompt engineering and language learning models, the solution focused towards providing the true value of cars. This in turn was done to provide clients with an accurate valuation of their vehicle, thus, achieving the overarching aim this way.



## References

- Badhan,M (2023). Comprehensive Guide to Chain-of-Thought Prompting. Mercity, [Accessed 26 July 2024]. <https://www.mercity.ai/blog-post/guide-to-chain-of-thought-prompting>
- Bressler, N. and Tannor, S. (2021). Training vs. Validation vs. Test Sets. [Accessed 30 July 2024]. Deepchecks.  
<https://deepchecks.com/training-validation-and-test-sets-what-are-the-differences/>
- CDT 2022, HireVue “AI Explainability Statement” Mostly Fails to Explain What it Does, CDT, [Accessed 20th July 2024],  
<https://cdt.org/insights/hirevue-ai-explainability-statement-mostly-fails-to-explain-what-it-does/>
- Chui, M., et al (2023). The economic potential of generative AI The next productivity frontier. McKinsey & Company, [Accessed 26th July 2024],  
<http://dln.jaipuria.ac.in:8080/jspui/bitstream/123456789/14313/1/The-economic-potential-of-generative-ai-the-next-productivity-frontier.pdf>.
- Dunbar, J, Kurz, C, Li, G & Tito, MD 2024, ‘In the Driver’s Seat: Pandemic Fiscal Stimulus and Light Vehicles’, Finance and economics discussion series, no. 2024-013, pp. 1–28. [Accessed 20th July 2024]
- Ghaffari, S.,et al (2024). Generative-AI in E-Commerce: Use-Cases and Implementations. [Accessed 20th July 2024], doi:<https://doi.org/10.1109/aisp61396.2024.10475266>.
- Guang-yu, L & Geng, H (2019), ‘The Behavior Analysis and Achievement Prediction Research of College Students Based on XGBoost Gradient Lifting Decision Tree Algorithm’, [Accessed 20th July 2024], Proceedings of the 2019 7th International Conference on Information and Education Technology.
- Gumtree. (n.d.). Car Valuation Data. [Accessed 30th July 2024],  
[https://help.gumtree.com.au/articles/en\\_US/KB\\_Article/Car-Valuation-Data-AU?vgroup1=PKB&c=PKB%3ABasics&vcategory2=Selling&s=](https://help.gumtree.com.au/articles/en_US/KB_Article/Car-Valuation-Data-AU?vgroup1=PKB&c=PKB%3ABasics&vcategory2=Selling&s=)



**UNSW**  
SYDNEY

- Gumtree. (2014). Audi audi\_q7 2014 3.0 TDI QUATTRO. [Accessed 26th July 2024].  
<https://www.gumtree.com.au/s-ad/canada-bay/cars-vans-utes/2014-audi-q7-3-0-tdi-quattro-8-s-p-automatic-tiptronic-4d-wagon/1323863687>
- Maulud, D & Abdulazeez, AM 2020, 'A Review on Linear Regression Comprehensive in Machine Learning', [Accessed 24th July 2024], Journal of Applied Science and Technology Trends, vol. 1, no. 2, pp. 140–147.
- Mascaro, J, Asner, GP, Knapp, DE, Kennedy-Bowdoin, T, Martin, RE, Anderson, C, Higgins, M & Chadwick, KD 2014, 'A Tale of Two "Forests": Random Forest Machine Learning Aids Tropical Forest Carbon Mapping', in B Bond-Lamberty (ed.), PLoS ONE, vol. 9, no. 1, p. e85993.
- OpenAI (2023). ChatGPT .[Accessed 30 Jul. 2024]. <https://chatgpt.com/>
- SAS. (2019). Overview of Templates. [Accessed 25th July 2024],  
<https://documentation.sas.com/doc/en/vdmmlcdc/8.3/vdmmlug/p14e2rwadx50c1n10uin6p3kl4wv.htm>
- Sharma, A & Shukla, D 2019, 'Perception of Consumers Towards Car Purchase Decision', [Accessed 25th July 2024], SSRN Electronic Journal.
- Simone S. 2023, Microsoft AI Researchers Accidentally Exposed 38 TBH of Sensitive Data, [Accessed 24th July 2024], <<https://www.infoq.com/news/2023/09/microsoft-38tb-data-leak/>>
- Taylan, P, Weber, G-W . & Beck, A 2007, 'New approaches to regression by generalized additive models and continuous optimization for modern applications in finance, science and technology', [Accessed 20th July 2024], Optimization, vol. 56, no. 5-6, pp. 675–698.
- What is a Zestimate? Zillow's Zestimate Accuracy 2020, [Accessed 20th July 2024], Zillow.



UNSW  
SYDNEY