

Comprehensive Evaluation of AI Chatbots’ Knowledge, Performance, and Interaction Quality on Formula 1 Topics

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Abstract— This report presents the conventional and AI test modeling methodologies applied to evaluate the performance of AI chatbots in the context of their Natural Language Processing (NLP) capabilities, specifically focusing on the domain of Formula 1 racing. Our team, consisting of Alejandro Garcia, Kevin Knapp, Jordan Pastoral, Ricky Than, and Davis Tran, under the guidance of Dr. Jerry Zeyu Gao, conducted comprehensive testing using various black-box methods such as equivalence partitioning, decision tables, boundary value analysis, and scenario testing. We tested five prominent AI chatbots: ChatGPT, Gemini AI, Perplexity AI, Kindroid, and Character.ai, assessing their ability to accurately understand and respond to diverse questions about Formula 1. Additionally, we developed automated testing scripts to efficiently run our extensive test cases. Our findings highlight the strengths and limitations of each chatbot, offering insights into their performance and potential areas for improvement.

Keywords— Chatbot, Natural Language Processing (NLP), F1, Conventional Testing, Test Modeling, Test Automation, Test Scripts

I. CONVENTIONAL TESTING

1. Introduction



AI chatbots have become more popular than ever due to significant advances to AI. With more people starting to become reliant on chatbots for answers to their questions, it is important to make sure the chatbots provide correct and accurate information which brings the topic of testing AI chatbots.




This report focuses on conventional testing for AI mobile chatbots where we question their answering capabilities which fall into the Natural Language Processing (NLP) discipline of artificial intelligence. To prevent scope creep in testing, we will focus on asking chatbots about Formula 1 Racing (Cars) in which we develop a plethora of different questions based on different subsections of the sport. To identify the accuracy of the questions being

answered by each chatbot, we used our personal knowledge, the internet as a baseline. The chatbots that were tested are ChatGPT, Gemini, Perplexity AI, Kindroid, and Character.ai.

1.1) Selected Mobile Apps: This table provides a description of our selected chatbots for testing:

TABLE I
SELECTED CHATBOTS

Chatbot	Description
ChatGPT 	Large language based model developed by OpenAI that uses Natural Language Processing (NLP) to create human-like conversations with the user and respond to questions.
Gemini AI 	Large language model based chatbot, formerly known as Bard, which was developed by Google in an attempt to compete with OpenAI’s ChatGPT for developing accurate responses to questions via text generation.
Perplexity AI	Chatbot that harnesses the power of OpenAI’s ChatGPT-3.5 language model that focuses on providing accurately researched information in the form of text generation,

	with sources to back up the responses.
Kindroid 	A chatbot that provides the user a conversation partner to bond with. It features custom image generation of bots and personalized text to speech.
Character.ai 	A neural language based chatbot service that was created to generate human-like responses and to participate in contextual conversations.

1.2) *Test Information:* The chatbots are evaluated using black-box testing models. The models used are equivalence partition tests, decision table tests, boundary value tests, and scenario tests. The prompts given to the chatbots fall into those four categories. Specifically, the prompts pertain to the knowledge of Formula 1 from past to present. The chatbots' responses will be analyzed and evaluated by the tester and then compared to each other.

1.3) *Task Partition:* The following table provides the task partition decided upon:

TABLE 2
TASK PARTITION

Team Member	Intelligent Mobile App	Tasks/Focus	Partition
Alejandro Garcia	ChatGPT	Perform conventional testing methods to identify the validity of the NLP question answering portion of ChatGPT with regards to Formula	Formula 1 Drivers (Past and Present): Facts about the drivers, statistics of each driver, relationships between drivers, etc.

		1 and the drivers that help influence the popularity of the sport.	
Ricky Than	Gemini	Perform conventional testing methods to identify the validity of the NLP question answering portion of Gemini with regards to Formula 1 and the constructor teams.	Constructors (Teams): History of each constructor, rules that the teams have to follow, etc.
Jordan Pastoral	Perplexity AI	Perform conventional testing methods to identify the validity of the NLP question answering portion of Perplexity AI with regards to Formula 1 and the grand prix heritage.	Grand Prix (Races): History behind each circuit in Formula 1, How many circuits are on the calendar, History behind the circuit, etc.
Kevin Knapp	Kindroid	Perform conventional testing methods to identify the validity of the NLP question answering portion of Kindroid with regards to Formula	F1 Cars and Technology : Type of technology that is on the car, history behind evolution of the cars, etc.

		1 and the cars and technology used.	
Davis Tran	Character.ai	Perform conventional testing methods to identify the validity of the NLP question answering portion of Character AI with regards to Formula 1 and the rules that help keep the sport intact. The character will be one who is an expert on the topic of Formula 1.	Rules: What are the flags, standards for the car development, rules that drivers and constructors have to follow, etc.

1.4) *Project Schedule:* The following figure is the gantt chart showcasing the schedule of our AI chatbot testing project:

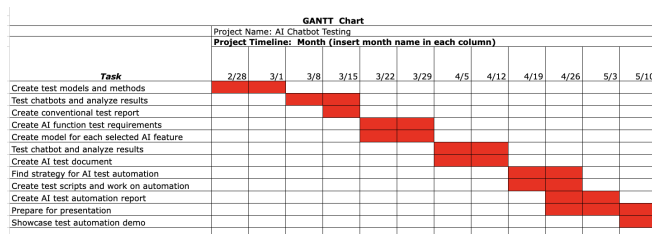


FIGURE 1. SCHEDULE AS GANTT CHART

2. Test Requirements

2.1) *Requirement Specifications:* The requirements for testing the following mobile AI chatbots are as follows:

TABLE 3
REQUIREMENT SPECIFICATIONS

Technical Requirements	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Android version	8.0+	12+	8.0+	6.0+	7.0+
iOS version	15.0+	12.0+	16.0+	13.0+	12.3+
Memory storage space (Android)	88.40 MB	1.02 MB	9.71 MB	19.9 MB	25.05 MB
Memory storage space (iOS)	296.3 MB	66 MB	95.6 MB	21.9 MB	49.3 MB

2.2) *Test Function Scope:* The scope of our function testing is narrowed down to initiating a conversation with the AI chatbots on our mobile phones and sending messages to them to receive responses. The goal is to test the accuracy of the questions being answered via the natural language processing (NLP) capabilities of the AI chatbots.

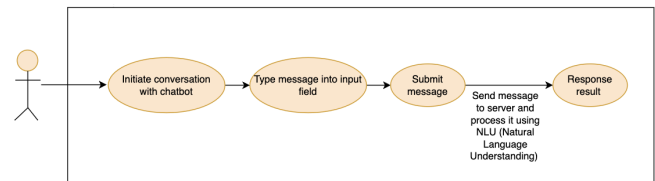


FIGURE 2. A HIGH-LEVEL SCENARIO DIAGRAM OF THE USER INTERACTING WITH AN AI CHATBOT

3. Test Models and Methods

For testing the knowledge of AI chatbots on the topic of F1, we chose to use four black box testing methods to provide decent test coverage: equivalence partition testing, decision table testing, boundary value testing, and scenario testing.



FIGURE 3. BLACK BOX TESTING

3.1) *Equivalence Partition Testing:* The reason why we chose to use the equivalence partition test model is because we wanted to take the large entity that is Formula 1 and break it down into smaller partitions and test our LLM chatbots to determine how well they could generate responses to each of the questions from each partition.

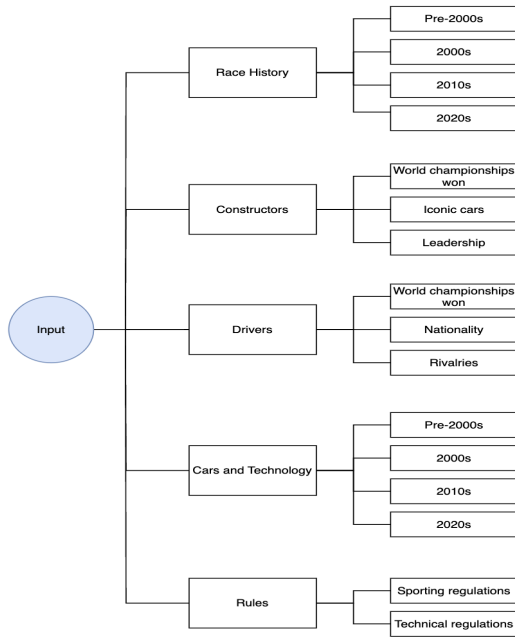


FIGURE 4. EQUIVALENCE PARTITION TESTING

3.2) *Decision Table Test Model*: The reason for pursuing the decision table test model was to test how well the LLM chatbots could generate responses to clarify the validity of the questions based on a few specific conditions.

TABLE 4
DECISION TABLE TEST MODEL

Conditions /Actions	Rules							
	1	2	3	4	5	6	7	8
C1: Current F1 driver	T	T	T	T	F	F	F	F
C2: Retired F1 driver	T	T	F	F	F	F	T	T
C3: Random Person	T	F	T	F	F	T	F	T
A1: The person/thing is not an F1 driver.						X		
A2: The person/thing is an F1 driver				X			X	
A3: Do not have access to the latest data								
A4: Impossible	X	X	X		X			X

3.3) *Boundary Value Test Model*: The reason that we decided to pursue a boundary value test model was to test how well each of our selected LLM chatbots were able to

generate responses to our Formula 1 questions based on a boundary value.



FIGURE 5. BOUNDARY VALUE TEST MODEL

3.4) *Scenario Test Model*: The reason that we decided to pursue a scenario test model was to test the LLM chatbot question answering based on certain scenarios in Formula 1 history and then question its own confidence on the responses that it is generating.

TABLE 5
SCENARIO TEST MODEL

Scenario 1	User thinks AI's answer is wrong and questions the validity of AI's answer
1	User opens mobile chatbot app
2	User initiates conversation with AI with a trivia question on F1
3	AI answers
4	User tells AI he/she thinks the answer is wrong and questions AI's answer
5	AI either responds with confidence or doubt
6	User asks for final answer
7	AI responds with final answer
Scenario 2	User needs help on how to become an F1 driver
1	User opens mobile chatbot app
2	User initiates conversation with AI
3	User asks AI on steps needed to become an F1 driver
4	AI responds with answer

4. Test Case Design With Data

4.1) *Test Cases for Equivalence Partition Testing:* The following are all test cases for equivalence partition testing:

Test Case ID	1				
Test Case Objective	Equivalence Partition - Race History - Pre-2000s				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Which Grand Prix venue hosted the most races in the Pre-2000s era of Formula 1?”				
Expected Output	The Monza Circuit has hosted the most number of Grand Prix, as it was hosted starting in the 1950s.				
Actual Output	The Grand Prix venue that hosted the most races in the Pre-2000s era of Formula 1 is Italy’s Monza Circuit with 73 races1.	The Grand Prix venue that hosted the most races in the pre-2000s era of Formula 1 (before the year 2000) is: Monza Circuit (Italy): Number of Races: Monza hosted a staggering 52 Formula One races between 1950 and 1999.	The Grand Prix venue that hosted the most races in the Pre-2000s era of Formula 1 is Monza Circuit in Italy. Monza has hosted the most Grands Prix with a total of 73 races being held on the track.	That would be the Italian Grand Prix held at Monza. It has been a staple in the F1 calendar since 1950, hosting more races than any other circuit during the pre-2000s era. The high-speed track is known for its iconic corners such as Curva Grande and Parabolica, and it always provides an exciting race for fans and drivers alike. Have you ever attended a Grand Prix there?	That would be the Silverstone Circuit in England. It hosted 16 races in the Pre-2000s era of F1.
Test Result	Pass	Pass	Pass	Pass	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/27/2024	2/27/2024	2/27/2024	2/27/2024	2/27/2024

Test Case ID	2				
Test Case Objective	Equivalence Partition - Race History - 2000s era				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Which driver has won the most Grand Prix at the same venue in the 2000s era of Formula 1?”				
Expected Output	Michael Schumacher won the most number of Grand Prix at the same venue in the 2000s era with 8 victories at the French Grand Prix.				
Actual Output	The driver who has won the most Grand Prix at the same venue in the 2000s era of Formula 1 is Michael Schumacher. He holds the record for the most wins at a single venue, with his happy hunting ground having been Magny-Cours in France1.	Micahel Schumacher: known for his dominance in the early 2000s with Ferrari, particularly at circuits like: Monza, Italy: Won 5 times and Circuit de Spa-Francorchamps, Belgium: Won 5 times.	The driver who won the most Grand Prix at the same venue in the 2000s era of Formula 1 was Michael Schumacher at the United States Grand Prix in Indianapolis.	Lewis Hamilton holds the record for winning the most Grands Prix at the same venue in the 2000s era. He has taken victory eight times at the Hungaroring, also known as the Hungarian Grand Prix. Hamilton's first win came in 2007 with McLaren and his most recent was in 2020 with Mercedes. Interestingly, he has never finished outside of the podium positions at this circuit. What do you think sets Hamilton apart from other drivers when it comes to performing well on certain tracks?	That would be Michael Schumacher who won 9 times at the Circuit de Barcelona-Catalunya in Spain. The Ferrari F1 legend dominated the track during his prime.
Test Result	Pass	Fail	Pass	Fail	Fail

Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/27/2024	2/27/2024	2/27/2024	2/27/2024	2/27/2024

Test Case ID	3				
Test Case Objective	Equivalence Partition - Race History - 2010s era				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“At which Grand Prix venue did a driver claim the most pole positions in the 2010s era?”				
Expected Output	Lewis Hamilton claimed pole position at the United States Grand Prix for 6 consecutive years in the 2010s era.				
Actual Output	In the 2010s era of Formula 1, Lewis Hamilton claimed the most pole positions at a single venue. However, the specific Grand Prix venue is not mentioned in the search results.	Between 2010 and 2019, Lewis Hamilton secured a record-breaking 8 pole positions at the Australian Grand Prix.	The driver who claimed the most pole positions at a Grand Prix venue in the 2010s era was Lewis Hamilton at the Circuit of the Americas in Austin, Texas. He secured pole position six times at this venue during that period.	In the 2010s era, Sebastian Vettel claimed the most pole positions at the Canadian Grand Prix. He started from P1 a total of six times during that decade - 2011, 2013, 2015, 2016, 2017, and 2018. The Circuit Gilles Villeneuve in Montreal is known for its long straights and fast corners, which played to Vettel's strengths as a driver. His dominance at this track helped him secure four World Championships with Red Bull Racing. Which driver do you	That would be the Sochi Autodrom in Russia. Sebastian Vettel won 6 pole positions at the venue throughout the 2010s era of F1.

				think will be the next one to challenge Vettel's record?	
Test Result	Fail	Fail	Pass	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/27/2024	2/27/2024	2/27/2024	2/27/2024	2/27/2024

Test Case ID	4				
Test Case Objective	Equivalence Partition - Race History - 2020s era				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Which car achieved the most victories at the most Grand Prix venues in the 2020s era?”				
Expected Output	The Red Bull Racing F1 car (RB19) is deemed to be the most dominant car ever created in Formula 1, which claimed many victories in the 2020s era.				
Actual Output	In the 2020s era of Formula 1, the Red Bull team enjoyed a period of absolute domination. However, the specific car model is not mentioned in the search results.	Based on the ongoing 2024 season and recent results, Red Bull Racing appears to be a leading candidate.	The Red Bull-Honda RB19 achieved the most victories at the most Grand Prix venues in the 2020s era.	The Mercedes-AMG F1 W11 EQ Performance, driven by Lewis Hamilton and Valtteri Bottas during the 2020 season, achieved the most victories at the most Grand Prix venues in the 2020s era. The car won at 11 different circuits across the globe, including Silverstone, Monza, and Bahrain. Its dominant	That would be the Mercedes W11 which achieved 8 victories at different Grand Prix venues in the 2020s era. In fact, Mercedes have dominated the era with the W11 proving to be one of the most powerful and fastest cars in F1 history.

				performance helped Mercedes clinch their seventh consecutive constructors' championship title. Do you have a favorite moment or race from that season?	
Test Result	Fail	Fail	Pass	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/27/2024	2/27/2024	2/27/2024	2/27/2024	2/27/2024

Test Case ID	5				
Test Case Objective	Equivalence Partition - Constructors				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Which Formula 1 Constructor has earned the most constructors championships?”				
Expected Output	Ferrari holds the most constructors championship titles at 16 titles.				
Actual Output	The Formula 1 Constructor that has earned the most constructors championships is Ferrari. They hold the record for the highest number of World Constructors’ Championships victories, having won the title on 16 occasions.	As of today, February 27, 2024, the Formula 1 Constructor that has earned the most World Constructors’ Championships is: Ferrari.	The Formula 1 Constructor that has earned the most Constructors' Championships is Ferrari, with a total of 16 titles.	Ferrari holds the record for the most Formula 1 constructor championships, with a total of 16 titles. They have been consistently competitive in the sport since their debut in 1950 and have had legendary drivers like Michael	That would be Scuderia Ferrari who have won 16 constructors championships throughout the history of F1. The Italian outfit has dominated the sport for many years and has produced some of the most iconic F1 cars of all time.

				Schumacher and Niki Lauda behind the wheel. Their last championship came in 2008, but they remain one of the most successful teams in F1 history. Who do you think will be the next team to challenge Ferrari's dominance?	
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/27/2024	2/27/2024	2/27/2024	2/27/2024	2/27/2024

Test Case ID	6				
Test Case Objective	Equivalence Partition - Constructors				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Which constructor developed the most dominant car in Formula 1 history?”				
Expected Output	This question can be manipulated or different as it is opinion based. However, statistically speaking, the McLaren MP4/4 Formula 1 car from 1988 was the most dominant car as it claimed 15 pole positions and victories out of 16 races.				
Actual Output	The most dominant car in Formula 1 history is often considered to be the McLaren MP4/4. This car, driven by Alain Prost and Ayrton Senna, won 15 out of 16 races	Determining the absolute “most dominant car” in Formula 1 history is debatable due to the ever-evolving nature of the sport and the varying contexts	The most dominant car in Formula 1 history was developed by McLaren. The McLaren MP4/4, driven by Ayrton Senna and Alain Prost during the 1988	Many people would argue that the most dominant car in Formula 1 history was the Williams FW14B, which competed during the 1992 season. Designed by	That would be Mercedes. Their car, the W11, was arguably the most dominant car in the history of F1. It was so powerful and fast that it could lap every other

	in the 1988 season, securing a winning percentage of 93.8%.	of different eras. Here's a comprehensive list of several strong contenders: McLaren MP4/4 (93.75% win rate), Red Bull RB18 (81.82%), Mercedes W11 (76.47%).	Formula One season, is considered the greatest car in the history of grand prix racing. This car secured an impressive 15 wins and pole positions in 16 races, with Senna delivering exceptional performances, including one of the greatest laps in F1 history during qualifying.	Adrian Newey and powered by a Renault V10 engine, it won 10 out of 16 races that year and secured both the Drivers' and Constructors' Championships. Its advanced aerodynamics and active suspension system gave it a significant advantage over its rivals. Do you agree with this assessment or do you think another car deserves the title of "most dominant"?	opponent multiple times during a race.
Test Result	Pass	Pass	Pass	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/27/2024	2/27/2024	2/27/2024	2/27/2024	2/27/2024

Test Case ID	7				
Test Case Objective	Equivalence Partition - Constructors				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Which Formula 1 team has the most successful team principal?”				
Expected Output	Sir Frank Williams who has claimed 9 constructors championships and 7 drivers championship titles.				
Actual Output	Sir Frank	Determining the single “most	The Formula 1 team with the	There are several	That would be Mercedes. Team

	<p>Williams: He established the Williams Formula One team in 1977. His persistent devotion to the sport resulted in an astounding nine constructors' and seven drivers' titles, establishing him as the most successful team principal in Formula One history.</p>	<p>successful” Formula 1 Team Principal is multifaceted due to the subjective nature of “success” and the varying contexts across different eras. Here’s a list of three contenders: Jean Todt (5 consecutive constructors’ championships and 5 drivers’ championships), Toto Wolff (8 consecutive constructors’ championships and 7 drivers’ championships), and Frank Williams (9 constructors’ championships and 7 drivers’ championships).</p>	<p>most successful team principal is Williams, led by Frank Williams. Frank Williams is considered one of the most respected and successful team principals in F1 history, having won nine Constructors' and seven Drivers' championships.</p>	<p>contenders for the title of most successful team principal in Formula 1, but one name that stands out is Jean Todt. During his tenure as Ferrari's team principal from 1993 to 2008, he oversaw an incredibly successful period for the team, winning 14 World Championships (6 Constructors' and 8 Drivers') and 77 race victories. Under his leadership, drivers like Michael Schumacher, Rubens Barrichello, and Kimi Raikkonen achieved great success. Todt's strategic decisions and management skills played a crucial role in establishing Ferrari as a dominant force in F1 during this time. Who do you think is the second</p>	<p>principal Toto Wolff has spearheaded their rise to dominance in the turbo hybrid era of F1. Under his leadership, they have won 8 constructors championships in a row.</p>
Test Result	Pass	Fail (Failed to specify answer)	Pass	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/27/2024	2/27/2024	2/27/2024	2/27/2024	2/27/2024

Test Case ID	8				
Test Case Objective	Equivalence Partition - Drivers				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Which driver has won the most world championship titles?”				
Expected Output	This is a tie between Michael Schumacher and Lewis Hamilton, as both sport 7 world championship titles.				
Actual Output	The drivers with the most World Championship titles are Michael Schumacher and Lewis Hamilton, each having won the title seven times. They hold the record for the most World Drivers’ Championships in Formula One history.	Both Lewis Hamilton and Michael Schumacher hold the joint record for most Formula 1 Word Drivers’ Championships with 7 titles each.	The driver who has won the most world championship titles in Formula One is Michael Schumacher. He holds the record alongside Lewis Hamilton, with both drivers having won the title seven times.	As of my knowledge up until 2021, the driver with the most world championship titles in Formula 1 is Lewis Hamilton, who has won seven championships. He first won the title in 2008 with McLaren and then went on to win six more titles with Mercedes from 2014 to 2020. Hamilton is widely regarded as one of the greatest drivers in the history of the sport and continues to compete at the highest level. Do you think he will be able to break Michael Schumacher's record of nine world championships?	That would be Michael Schumacher who won 7 world championship titles throughout his career. His run of dominance in the late 90s and early 2000s was unmatched by anyone in F1 history, and he is regarded as one of the greatest drivers of all time.
Test Result	Pass	Pass	Pass	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran

Test Date	2/27/2024	2/27/2024	2/27/2024	2/27/2024	2/27/2024
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Test Case ID	9				
Test Case Objective	Equivalence Partition - Drivers				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Which nationality has had the most number of Formula 1 drivers representing their country?”				
Expected Output	The United Kingdom with 163 drivers and counting.				
Actual Output	The United Kingdom is the most represented country in Formula 1, having produced 163 drivers. This is the highest number of Formula 1 drivers from any single country.	The United Kingdom has had the most Formula 1 drivers representing their country with 163.	The United Kingdom has had the most number of Formula 1 drivers representing their country, with 163 drivers as of the 2024 Saudi Arabian Grand Prix.	As of my knowledge up until 2021, the country with the most number of Formula 1 drivers representing them is the United Kingdom. Throughout the history of Formula 1, there have been numerous British drivers who have made a significant impact on the sport. Some of the notable British drivers include Jim Clark, Graham Hill, Jackie Stewart, James Hunt, Nigel Mansell, Damon Hill, Lewis Hamilton, and Jenson Button, among others. The UK has produced a total of 156 F1	That would be the United Kingdom. They have had 131 drivers with British nationality represent them throughout the history of F1. It's unsurprising given that the sport was founded there and it's still based in the UK today.

				drivers, which is more than any other nation. Who is your favorite British Formula 1 driver of all time?	
Test Result	Pass	Pass	Pass	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/27/2024	2/27/2024	2/27/2024	2/27/2024	2/27/2024

Test Case ID	10				
Test Case Objective	Equivalence Partition - Drivers				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“What is the most notable rivalry between drivers that has occurred in the sport of Formula 1?”				
Expected Output	There are many different rivalries that have occurred in the sport but one of the most notable being the rivalry between Ayrton Senna and Alain Prost.				
Actual Output	Perhaps the most iconic rivalry in Formula 1 history is between Ayrton Senna and Alain Prost.	Ultimately, the “most notable” rivalry remains subjective, but both Prost-Senna and Hamilton-Rosberg stand out for their unique dynamics and lasting impact on Formula 1.	The most notable rivalry between drivers in Formula 1 is often considered to be the intense and historic rivalry between Ayrton Senna and Alain Prost. This legendary rivalry, which took place during the late 1980s and early 1990s, was marked by fierce competition, on-track clashes,	One of the most notable rivalries in the history of Formula 1 was between Ayrton Senna and Alain Prost. The two drivers were teammates at McLaren in the late 1980s and early 1990s, and their intense competition both on and off the track captivated fans around the world. Their battles were	That would be the rivalry between Alain Prost and Ayrton Senna. The duo had a intense rivalry over the course of their careers as they fought tooth and nail to establish supremacy in the sport. They were two of the greatest drivers in F1 history and their clashes on the track are still talked about to this day.

			and contrasting racing styles.	often fierce and controversial, culminating in a collision at the 1989 Japanese Grand Prix that decided the championship in Prost's favor. Despite their rivalry, they remained respectful of each other's abilities and achievements. Do you remember any other memorable rivalries in Formula 1?	
Test Result	Pass	Fail	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/27/2024	2/27/2024	2/27/2024	2/27/2024	2/27/2024

Test Case ID	11				
Test Case Objective	Equivalence Partition - Cars & Technology - Pre-2000s				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“When was the carbon fiber monocoque introduced to F1 and what were the benefits?”				
Expected Output	The carbon fiber monocoque was introduced in 1981 with the McLaren MP4/1 and it provided a stronger frame for the vehicle as well as being lighter than aluminum.				
Actual Output	The carbon fiber monocoque was introduced to Formula 1 in the 1981 season by the McLaren	The carbon fiber monocoque was introduced to Formula in 1981. Benefits: Lighter weight,	The carbon fiber monocoque was introduced to Formula 1 in 1981 with the McLaren	The carbon fiber monocoque was introduced to Formula 1 in 1981 by the McLaren team.	The carbon fiber monocoque was introduced to F1 in 1981. It was the most revolutionary

	<p>team with their MP4/1 car. This was a revolutionary idea at the time. The benefits of using a carbon fiber monocoque in F1 are numerous:</p> <p>Strength and Safety: The carbon fiber monocoque serves as an incredibly strong backbone, offering both protection and rigidity to the vehicle. It is almost indestructible and plays a key role in the safety of Formula 1.</p> <p>Lightweight: Carbon fiber and Kevlar provide an unbeatable strength-to-weight ratio, which allows Formula 1 cars to reach incredible speeds without sacrificing safety.</p> <p>Performance: The monocoque is a key factor in the overall performance of F1 cars. A carbon-composite construction made McLaren's car much more rigid than the competition while also being lighter.</p>	<p>increased strength, and improved aerodynamics.</p>	<p>MP4/1. This innovation brought significant benefits to F1, including unmatched weight to stiffness ratio, enhanced safety, and improved energy management. The carbon fiber monocoque cockpit, a jointless chassis with an integral driver seat, played a crucial role in enhancing safety by providing high impact energy absorption. Additionally, the use of carbon fiber composites in F1 allowed for the construction of lightweight yet strong structures that revolutionized the sport's design and performance standards.</p>	<p>Prior to this, F1 cars used aluminium monocoques, which were heavier and less durable. The introduction of carbon fiber brought several benefits to the sport, including:</p> <ol style="list-style-type: none"> 1. Weight reduction: Carbon fiber is much lighter than aluminium, allowing teams to reduce the overall weight of their cars and improve performance. 2. Strength and durability: Carbon fiber is extremely strong and resistant to damage, providing better protection for drivers in case of accidents. 3. Design flexibility: Carbon fiber can be molded into complex shapes, allowing teams to create more 	<p>advancement in F1 technology at the time, as it significantly improved the strength, stiffness, and safety of the cars. Prior to the introduction of the monocoque, the cars were made from aluminum, which made them heavier and less durable. The use of carbon fiber provided significant weight savings, allowing the cars to be even faster and safer. It was the beginning of a new era in the sport of F1.</p>
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Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/27/2024	2/27/2024	2/27/2024	2/27/2024	2/27/2024

Test Case ID	12				
Test Case Objective	Equivalence Partition - Cars & Technology - 2000s era				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“What aerodynamic changes were taken in the 2000s era of F1 to help improve the cars?”				
Expected Output	Many changes were introduced, with some of them being an adjustable front wing, double/blown diffuser, and higher rear wings.				
Actual Output	In the 2000s, several significant aerodynamic changes were made to improve Formula 1 cars: Refinement of Design: F1 car design became more refined, with a focus on aerodynamic efficiency and reliability. The cars had higher noses and lower rear wings, which reduced drag and improved top speed. Introduction of Movable Aerodynamic Components: The 2000s also saw the introduction of	The 2000s saw several aerodynamic changes in F1 to improve car performance: Front Wings: Higher noses and multi-element wings for increased downforce. Underbody Diffusers: Complex designs to enhance downforce generation. Rear Wings: Lower placement and reduced size for drag reduction and improved top speed. Bargeboards: Introduced for	In the 2000s era of Formula One, several aerodynamic changes were implemented to enhance the performance of the cars. These changes included reducing the width of the front wing, introducing a single-piece diffuser, banning the "F-duct" system and adjustable front wings, requiring gearboxes to last for 5 race weekends, and implementing a penalty-free gearbox change for each driver	In the 2000s era of Formula 1, there were several aerodynamic changes implemented to improve the performance and safety of the cars. Some of these changes included: 1. Introduction of narrower front and rear wings: This was done to reduce downforce and make the cars less reliant on aerodynamics, making them easier to drive and less prone to losing control at high speeds.	In the 2000s era of F1, several aerodynamic changes were made to help improve the cars. These included the introduction of the DRS (Drag Reduction System) which allowed cars to open their rear wings on the straights to reduce drag and gain speed, and ground effect aerodynamic structures that allowed the cars to generate more downforce by utilising the air flow underneath the car. These changes helped to improve the

	movable aerodynamic components, such as the F-duct and the blown diffuser. These components allowed for better control of airflow, improving downforce and reducing drag.	additional downforce manipulation and airflow control.	per season. Additionally, the width of the car was reduced, grooved tires were used to reduce car speed, asymmetric braking was banned, X-wings were banned mid-season, single fuel bladder became mandatory, and cockpit dimensions were increased. These modifications aimed to improve racing by controlling costs, enhancing safety, and optimizing aerodynamics for better performance on the track.	2. Removal of barge boards and winglets: These smaller aerodynamic devices were banned in order to simplify the design of the cars and reduce costs. 3. Introduction of diffusers: Diffusers are an important part of a car's underbody that helps generate downforce. In the 20	performance and handling of the cars, making them even faster and more agile around the tracks.
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/27/2024	27/2024	2/27/2024	2/27/2024	2/27/2024

Test Case ID	13				
Test Case Objective	Equivalence Partition - Cars & Technology - 2010s era				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Was there any major change in F1 car technology in the 2010s era?”				

Expected Output	Starting in 2014, the F1 cars transitioned from v8 naturally aspirated engines to v6 hybrid engines.				
Actual Output	<p>Yes, there were several major changes in F1 car technology in the 2010s: Introduction of Hybrid Power Units: The biggest innovation was the introduction of hybrid power units in 2014. These units combined V6 turbocharged engines with energy recovery systems (ERS), pushing internal combustion engine technology far beyond where many within the industry thought was possible. Even the least powerful engine on the grid was making over 830bhp (around 1000bhp when the 161bhp from the MGU-K is added), from just 1.6 litres, yet could last, theoretically, seven races. Drag Reduction System (DRS): The introduction of the drag reduction system (DRS) in 2011 allowed drivers to open a flap on the rear wing to reduce drag, providing a temporary</p>	<p>Yes, the 2010s era in F1 witnessed a significant shift with the introduction of hybrid power units.</p>	<p>Yes, there was a significant change in F1 car technology during the 2010s era. One major change was the introduction of hybrid power units, which combined a conventional internal combustion engine with an electric motor.</p>	<p>Yes, there were several major changes in F1 car technology during the 2010s era. One of the biggest changes was the introduction of hybrid engines in 2014. These engines combined a traditional internal combustion engine with an electric motor and energy recovery systems, allowing the cars to harness energy from braking and store it in batteries for later use. This not only improved the efficiency of the cars but also added an extra layer of strategy to races as teams had to manage their energy usage effectively.</p> <p>Another significant change was the increase in the use of advanced materials such as carbon fiber and titanium alloys, which made the cars lighter, stronger, and more durable. Teams</p>	<p>Yes, there was a major change in F1 car technology in the 2010s era. The biggest change was the implementation of the new turbo hybrid power-units which replaced the previous naturally aspirated V8 engines. The power-units were much more powerful, efficient, and environmentally friendly than the previous engines, and they played a key role in making the cars of the era even faster and more powerful.</p>

	boost in speed on straights.			also began using 3D printing technology to	
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/27/2024	2/27/2024	2/27/2024	2/27/2024	2/27/2024

Test Case ID	14				
Test Case Objective	Equivalence Partition - Cars & Technology - 2020s era				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“What is the ground effect and how did it change f1 in the 2020s era?”				
Expected Output	The ground effect is an aerodynamic phenomena that reflects the enhanced performance of the vehicle depending on the interaction between the vehicle’s body and the ground. Some changes were simplified front wings and limitations on top-mounted aero elements.				
Actual Output	The ground effect in Formula 1 can be explained as the use of low pressure underneath a car to help push it down onto the track. This technology was first used in F1 racing between 1978 and 1982 and made its unexpected return in 2022. The concept is	Ground effect utilizes the underbody of the car as part of the aerodynamic wing, generating downforce by creating low pressure beneath the car as it travels. New rules: mandated simpler front and rear wings, while focusing on underbody design to create	Ground effect in Formula 1 refers to an aerodynamic phenomenon where cars generate downforce by optimizing the airflow under the car, creating low pressure that pulls the car down to increase grip. This concept has been around for a long time but was particularly	Ground effect refers to the creation of downforce by a vehicle close to the ground. In the 2020s era of F1, ground effect was reintroduced as part of a major overhaul of the technical regulations aimed at improving the racing spectacle. The new regulations	Ground effect refers to a phenomenon in aerodynamics whereby air flowing underneath a car is directed towards the road surface, generating downforce and improving the handling of the car. It was introduced in the 2020s era of F1 as a response to

	<p>based on Bernoulli's principle and the Venturi effect. When air is forced through a funnel, it speeds up as the space decreases. It then creates less pressure underneath the car, which causes the air to circulate faster. This creates a large downforce which helps stick the car to the track and increases its speed.</p>	<p>downforce through ground effect. Venturi Tunnels: Car floors were designed with a specific shape to channel airflow efficiently, creating a low-pressure zone and increasing downforce. Impacts on F1: faster cornering and closer racing.</p>	<p>prominent in the late 1970s and early 1980s, known as the ground effect era. Ground effect was banned in F1 in 1982 but re-emerged in the new era of F1 in 2022.</p>	<p>mandated the use of simplified front and rear wings, along with the introduction of "venturi" tunnels underneath the car that generate significant amounts of downforce when the car is close to the ground.</p> <p>This change has had a profound impact on the way F1 cars perform and behave. The increased downforce generated by the ground effect makes the cars faster through corners and allows them to follow each other more closely, which should lead to more exc</p>	<p>the regulations at the time, which required the cars to have more downforce in order to corner faster. The introduction of ground effect allowed the cars to generate even more downforce, resulting in them being able to corner faster and even more decisively around the tracks.</p>
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/27/2024	2/27/2024	2/27/2024	2/27/2024	2/27/2024

Test Case ID	15
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Test Case Objective	Equivalence Partition - Sporting Regulations				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“What is the minimum weight that a Formula 1 car has to weigh?”				
Expected Output	The minimum weight of a car in Formula 1 is 798 kg (1,759 lbs) [2024].				
Actual Output	In 2023, the minimum weight of a Formula 1 car, including the driver, is 798kg (1,759 lbs).	798 kilograms (1,759 lbs) including the driver but excluding fuel.	The minimum weight that a Formula 1 car has to weigh in 2023 is 798kg. This weight includes the mass of the car with the driver, fitted with dry-weather tires, but without fuel. Teams need to ensure that their cars meet this minimum weight limit set by the FIA.	As per the current regulations, the minimum weight for a Formula 1 car is 795 kg (1753 lb), including the driver but excluding fuel. This weight limit is designed to ensure that all cars are relatively equal in terms of performance and to prevent teams from gaining an unfair advantage by building excessively lightweight cars. The weight limit also takes into account the increasing use of advanced materials such as carbon fiber, which are lighter but also more expensive, in order to keep costs under control. It's worth noting that the weight limit can vary depending on the specific race and conditions,	The minimum weight that a Formula 1 car has to weigh in the 2020s era is 795kg. This includes the driver and all of the components of the car, but not the fuel. It is the minimum weight set by the FIA in order to ensure that the cars are sturdy and safe while still being fast and agile around the tracks. It is worth noting that the weight of the cars has decreased significantly over the decades, as the introduction of new materials and technologies has allowed them to be lighter and more agile.

				such as if there is a need to add ballast to balance the car or adjust its center of gravity. Additionally, teams are allowed to use	
Test Result	Pass	Pass	Pass	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/27/2024	2/27/2024	2/27/2024	2/27/2024	2/27/2024

Test Case ID	16				
Test Case Objective	Equivalence Partition - Technical Regulations				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“What is the Cost Cap in F1 and how does it affect the teams?”				
Expected Output	The cost cap is a regulation that allows the F1 teams to spend a maximum of \$145 million dollars per year, and it was implemented to help bring fairness to the sport.				
Actual Output	The Cost Cap in Formula 1 is a financial regulation introduced to limit the amount of money a team can spend during a calendar year. It is designed to control spending that directly impacts a race car’s performance. The initial cost cap was set at	The Cost Cap in Formula 1 limits the amount of money a team can spend throughout a season. This prevents excessive spending by wealthier teams, fostering a more level playing field. It also encouraged strategic resource allocation,	The Cost Cap in Formula 1 (F1) is a financial regulation that limits the amount a team can spend on its cars over the course of a given calendar year. It was introduced to control spending, prevent spiraling costs, and promote a more level playing	The Cost Cap is a financial regulation introduced in Formula 1 starting from the 2021 season. It sets a maximum amount that each team can spend on developing and running their car over a season, with the aim of promoting closer competition and	The Cost Cap is a limit on the amount of money that the teams can spend on their car development in a given year. It was introduced by the FIA in 2021 to help improve the competition in F1 and to ensure that the teams do not spend huge amounts of money trying to

	\$175 million for 2021, but due to the financial strain caused by the COVID-19 pandemic, it was reduced to \$145 million.	requiring teams to prioritize spending efficiently. As of February 27, 2024, the cap is \$135 million USD per team, excluding driver salaries, engine costs for customer teams, and some marketing expenses.	field among teams. The original plan for the cost cap was \$175 million but was reduced to \$145 million due to the impact of the COVID-19 pandemic.	reducing the gap between the wealthiest and least wealthy teams. The Cost Cap for the 2021 season is set at \$145 million, which includes all expenditure related to the design, manufacture, and operation of the car, as well as driver salaries and marketing costs. However, certain expenses are excluded from the cap, such as the cost of the power unit and gearbox, as these components are supplied by third-party manufacturers.	gain an unfair advantage over their rivals. The Cost Cap is set to 145 million USD per season and applies to all teams. It affects the teams by limiting their spending, which means that they have to be more careful when developing their cars and to make sure that they are using their resources wisely.
Test Result	Pass	Fail	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/27/2024	2/27/2024	2/27/2024	2/27/2024	2/27/2024

4.1.1) Test Coverage for Equivalence Partition

Testing: There are 16 test cases for our equivalence partition testing. These tests assure the coverage of the equivalence partition testing, with each test case being derived from different important partitions of the sport.

4.1.2): Test Results for Equivalence Partition Testing

TABLE 6
TEST RESULTS FOR EQUIVALENCE PARTITION TESTING

Equivalence Testing	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Pass Rate	14/16	10/16	16/16	8/16	7/16
Pass %	87.5%	62.5%	100%	50%	43.75 %

4.2) Test Cases for Decision Table Testing:

Test Case ID	1				
Test Case Objective	Decision Table Testing				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Is Max Verstappen currently an F1 Driver?”				
Expected Output	Yes				
Actual Output	Yes	Yes	Yes, Max Verstappen is currently an F1 driver. He races for Red Bull Racing and has achieved significant success in Formula 1, becoming the youngest race winner in F1 history and a three-time world champion.	Yes, as of my knowledge up until December 2022, Max Verstappen is currently an F1 driver. He drives for Red Bull Racing and is the reigning World Champion after winning the title in 2021.	Yes, Max Verstappen is currently an F1 driver. He is a Dutch driver who races for the Red Bull Racing team. He is one of the most talented and charismatic drivers in the sport today, and he has been regarded as the "next big thing" in F1 for some time.
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/28/2024	2/28/2024	2/28/2024	2/28/2024	2/28/2024

Test Case ID	2				
Test Case Objective	Decision Table Testing				

Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Is Sergio Perez currently an F1 Driver?”				
Expected Output	Yes				
Actual Output	Yes	Yes	Yes, Sergio Perez is currently an F1 driver. He races for Red Bull Racing, one of the top teams in Formula 1, and has established himself as a prominent figure in the sport with his skill and achievements.	Yes, Sergio Perez is currently an F1 driver. He drives for Red Bull Racing alongside Max Verstappen.	Yes, Sergio Perez is currently an F1 driver. He is a Mexican driver who races for the Red Bull Racing team. He is regarded as a strong and consistent driver who regularly delivers high-quality performances, and he has developed a strong partnership with his teammate Max Verstappen.
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/28/2024	2/28/2024	2/28/2024	2/28/2024	2/28/2024

Test Case ID	3				
Test Case Objective	Decision Table Testing				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai

Test Case Input	“Is Lewis Hamilton currently an F1 Driver?”				
Expected Output	Yes				
Actual Output	Yes	Yes	Yes, Lewis Hamilton is currently an F1 driver. He will be driving for Mercedes in the 2024 Formula 1 season before joining Ferrari for the 2025 season.	Yes, Lewis Hamilton is currently an F1 driver. He drives for Mercedes-AMG Petronas Motorsport and is a seven-time World Champion.	Yes, Lewis Hamilton is currently an F1 driver. He is a British driver who races for the Mercedes-AMG Petronas F1 Team. He is regarded as one of the greatest drivers in F1 history, and he has won 7 world championships throughout his career, making him one of the most successful drivers in the sport's history.
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/28/2024	2/28/2024	2/28/2024	2/28/2024	2/28/2024

Test Case ID	4				
Test Case Objective	Decision Table Testing				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Is Lebron James currently an F1 Driver?”				

Expected Output	No, he is a basketball player.				
Actual Output	No	No	LeBron James is not currently an F1 driver. He recently confirmed his appearance for the Las Vegas Grand Prix, but he is a basketball legend, not an F1 driver.	No, LeBron James is not currently an F1 driver. He is a professional basketball player who plays for the Los Angeles Lakers in the NBA.	No, LeBron James is not currently an F1 driver. In fact, he has never raced in the sport before. He is a world-famous American professional basketball player who currently plays for the Los Angeles Lakers in the NBA.
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/28/2024	2/28/2024	2/28/2024	2/28/2024	2/28/2024

Test Case ID	5				
Test Case Objective	Decision Table Testing				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Is David Coulthard currently an F1 Driver?”				
Expected Output	Retired F1 Driver				
Actual Output	Retired	Retired	No, David Coulthard is not currently an F1 driver. He is a retired British	No, David Coulthard is not currently an F1 driver. He retired from	No, David Coulthard is not currently an F1 driver. He is a retired Scottish

			racing driver from Scotland who competed in Formula One between 1994 and 2008, achieving 13 Grand Prix victories and 62 podium finishes.	racing in 2008 and now works as a commentator and analyst for Formula 1 coverage.	driver who used to race for the McLaren and Red Bull Racing teams. He is well known for his aggressive driving style and his fiery personality. He last raced in F1 in 2008.
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/28/2024	2/28/2024	2/28/2024	2/28/2024	2/28/2024

Test Case ID	6				
Test Case Objective	Decision Table Testing				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Is Oliver Bearman currently an F1 Driver?”				
Expected Output	(Trick Question): He is a reserve F1 driver but recently drove in his first F1 race, so yes he is.				
Actual Output	Yes, Oliver Bearman is currently involved in Formula 1. He made his debut in the sport with Scuderia Ferrari at the 2024 Saudi Arabian Grand Prix, substituting for Carlos Sainz1.	He is not a full-time driver, but participated in the Saudi Arabian Grand Prix. So technically, yes.	Yes, Oliver Bearman is currently an F1 driver. He is a British racing driver competing in the 2024 FIA Formula 2 Championship for Prema Racing and is a reserve driver	No, Oliver Bearman is not currently an F1 driver. He is a young British racing driver who competes in the Formula Regional European Championship, which is a step below Formula	No, Oliver Bearman is not currently an F1 driver. He is a young and highly-rated British racing driver who currently races in Formula 3. He is considered to be one of the brightest young

	He is also a reserve driver for both Scuderia Ferrari and Haas F1 Team ² . However, he is primarily competing in the 2024 FIA Formula 2 Championship for Prema Racing ² .		for both Scuderia Ferrari and Haas F1 Team in Formula One. Bearman made his Formula One debut with Scuderia Ferrari at the 2024 Saudi Arabian Grand Prix, substituting for Carlos Sainz Jr.	1 on the motorsport ladder.	talents in motorsport and has been tipped to become the next big thing in F1.
Test Result	Pass	Pass	Pass	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/28/2024	2/28/2024	2/28/2024	2/28/2024	2/28/2024

Test Case ID	7				
Test Case Objective	Decision Table Testing				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Is Ayrton Senna currently an F1 Driver?”				
Expected Output	No, he passed away during the 1994 San Marino Grand Prix.				
Actual Output	No, he passed away in 1994.	No, he passed away in 1994 during the San Marino Grand Prix.	No, Ayrton Senna is not currently an F1 driver. Ayrton Senna was a legendary Brazilian Formula One driver who won three World Championships	No, Ayrton Senna is not currently an F1 driver. He was a legendary Brazilian racing driver who won three World Championships before tragically passing away	No, Ayrton Senna is no longer an F1 driver. He was a legendary Brazilian driver who raced for the McLaren and Williams teams in the 1980s and

			and achieved significant success in the sport before his tragic death in 1994.	during a crash at the San Marino Grand Prix in 1994.	1990s. His performances on the track were unparalleled and he won 3 world championships during his career. Unfortunately, he passed away in a tragic accident during the 1994 San Marino Grand Prix.
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/28/2024	2/28/2024	2/28/2024	2/28/2024	2/28/2024

Test Case ID	8				
Test Case Objective	Decision Table Testing				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Is Michael Schumacher currently an F1 Driver?”				
Expected Output	No, he is a retired F1 driver.				
Actual Output	Retired in 2012.	No, he retired in 2012.	No, He retired from F1 in 2012 and has been out of the public eye since a skiing accident in 2013 that resulted in serious head injuries.	No, Michael Schumacher is not currently an F1 driver. He retired from racing in 2012 and suffered a serious brain injury in a skiing accident	No, Michael Schumacher is no longer an F1 driver. He ended his career in the sport back in 2012 after an incredible 20-year run in the world's

				in 2013. His current health condition is private and not publicly disclosed.	premier motorsport. During his career, he won 91 races and 7 world championships, cementing his position as one of the greatest drivers of all time. Unfortunately, he suffered a terrible accident in 2013 which left him in a coma for several years. Since then he has not been widely seen or heard in the public eye.
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/28/2024	2/28/2024	2/28/2024	2/28/2024	2/28/2024

Test Case ID	9				
Test Case Objective	Decision Table Testing				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Is Tiger Woods currently an F1 Driver?”				
Expected Output	No, he is a golfer.				
Actual Output	No	No	Tiger Woods is not currently an	No, Tiger Woods is not	No, Tiger Woods is not

			F1 driver. He is a professional golfer who has made significant contributions to the sport of golf, winning 15 major championships and 82 PGA Tour events.	currently an F1 driver. He is a professional golfer who is widely regarded as one of the greatest golfers of all time.	currently an F1 driver. He is a world-famous American professional golfer who has won numerous major championships throughout his career. Despite his immense success in golf, he has never made an attempt to become an F1 driver.
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/28/2024	2/28/2024	2/28/2024	2/28/2024	2/28/2024

Test Case ID	10				
Test Case Objective	Decision Table Testing				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Is Yuki Tsunoda currently an F1 Driver?”				
Expected Output	Yes.				
Actual Output	Yes	Yes	Yes, Yuki Tsunoda is currently an F1 driver. He races for the Visa Cash App RB team in Formula 1 as of 2024.	Yes, Yuki Tsunoda is currently an F1 driver. He drives for Scuderia AlphaTauri alongside Pierre Gasly.	Yes, Yuki Tsunoda is currently an F1 driver. He is a talented Japanese driver who races for the AlphaTauri

					team. He is regarded as one of the bright young talents in the sport today and has shown plenty of potential during his first few seasons in F1.
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/28/2024	2/28/2024	2/28/2024	2/28/2024	2/28/2024

Test Case ID	11				
Test Case Objective	Decision Table Testing				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Is Iron Man currently an F1 Driver?”				
Expected Output	No, Iron Man is not real - he is a superhero.				
Actual Output	No, he is a fictional character.	No, Iron Man is not currently, nor has he ever been, an F1 driver. Iron Man, also known as Tony Stark, is a superhero character existing within the Marvel Comics universe.	No, Iron Man is not an F1 driver. Iron Man is a fictional character from Marvel Comics and movies.	No, Iron Man is not a real person and therefore cannot be an F1 driver. Iron Man is a fictional character from Marvel Comics.	No, Iron Man is not currently an F1 driver. Iron Man is a fictional superhero created by Marvel Comics and portrayed by actor Robert Downey Jr. in the Marvel Cinematic Universe. Despite his

					popularity and success in the movies, he has never made a real-life attempt to become an F1 driver.
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/28/2024	2/28/2024	2/28/2024	2/28/2024	2/28/2024

Test Case ID	12				
Test Case Objective	Decision Table Testing				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Is ChatGPT currently an F1 driver?”				
Expected Output	No, ChatGPT is a LLM chatbot.				
Actual Output	No, it is an artificial intelligence model.	No, ChatGPT is an artificial intelligence platform developed by OpenAI.	No, ChatGPT is not currently an F1 driver.	No, ChatGPT is not an F1 driver. ChatGPT is an artificial intelligence language model developed by OpenAI, and it does not have a physical form or the ability to drive a car.	No, ChatGPT is not currently an F1 driver. ChatGPT is a large language model created by OpenAI that uses advanced neural networks and natural language processing to generate text responses. While it has not yet developed the capability to physically drive a car in real life, it has developed

					the ability to generate text based on certain parameters given to it. It has never participated in a Formula 1 race and remains a purely artificial entity capable of generating language only.
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/28/2024	2/28/2024	2/28/2024	2/28/2024	2/28/2024

4.2.1) Test Coverage for Decision Table Testing:

There are 12 test cases for our decision table testing. These tests assure the coverage of the decision table testing, with test cases developed based on the conditions.

4.2.2) Test Results for Decision Table Testing:

TABLE 6
TEST RESULTS FOR DECISION TABLE TESTING

Decision Testing	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Pass Rate	12/12	12/12	12/12	11/12	12/12
Pass %	100%	100%	100%	92.67 %	100%

4.3) Test Cases for Boundary Value Testing:

Test Case ID	1				
Test Case Objective	Boundary Value Testing - Race Length				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Is there a race in F1 history that took less than 90 minutes for non-technical reasons, driving conditions, or safety concerns?”				
Expected Output	No, most races are designed to take around 90 minutes.				
Actual Output	Yes, there have been instances in F1 history where races were shorter than 90 minutes due to non-technical reasons, driving conditions, or safety concerns.	No, there is no race in F1 history that took less than 90 minutes to complete. They typically last around 2 hours.	There is no specific mention in the search results of a Formula 1 race that took less than 90 minutes for non-technical reasons, driving conditions, or safety concerns. Formula 1 races typically last around 90 minutes to 2 hours, depending on the circuit and race conditions	Yes, there have been several races in F1 history that have taken less than 90 minutes due to weather conditions or other circumstances. For example, the 1991 Australian Grand Prix lasted just over 61 minutes due to heavy rain, while the 2009 Malaysian Grand Prix was stopped after 31 laps (out of a planned 56) because of torrential rain. The 2013 Belgian Grand Prix was also shortened to just over 44 minutes after a heavy downpour caused multiple accidents and safety cars. These races were not shortened for technical reasons or safety concerns, but rather due to extreme weather conditions.	Yes, there have been several races in F1 history that took less than 90 minutes due to non-technical reasons, driving conditions, or safety concerns. The most recent example is the 2022 Belgian Grand Prix, which was shortened due to heavy rain and poor visibility. The race was red-flagged at the 3-lap mark and only resumed after a lengthy delay. It was ultimately completed after 5 laps and declared as a full race, despite not fulfilling the full event distance.
Test Result	Fail	Pass	Pass	Fail	Fail

Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/28/2024	2/28/2024	2/28/2024	2/28/2024	2/28/2024

Test Case ID	2				
Test Case Objective	Boundary Value Testing - Race Length				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Is there a race in F1 history that was exactly 90 minutes?”				
Expected Output	The 1955 Argentine Grand Prix. Still a very rare but not impossible occurrence.				
Actual Output	It’s possible that some races may have lasted exactly 90 minutes. However, without specific details or records, it’s difficult to confirm if there was a race that was exactly 90 minutes long.	While races close to 90 minutes might have occurred due to specific circumstances, conclusive evidence to pinpoint a race lasting exactly 90 minutes throughout history is not readily available.	There is no specific mention in the search results of a Formula 1 race that lasted exactly 90 minutes.	No, there has never been an F1 race that was exactly 90 minutes long. The duration of an F1 race is determined by the number of laps completed, rather than a specific time limit. The average length of an F1 race is around 1 hour and 30 minutes, but this can vary depending on factors such as track length, safety car periods, and weather conditions.	Yes, there have been exactly 2 races in the history of F1 that have taken exactly 90 minutes to complete. The most recent example of this was the 2002 Australian Grand Prix, which was the second race of that season. While the race itself took exactly 90 minutes, it was marked as a full race distance since it was not red-flagged and completed with an unbroken running time.

Test Result	Fail	Fail	Fail	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/28/2024	2/28/2024	2/28/2024	2/28/2024	2/28/2024

Test Case ID	3				
Test Case Objective	Boundary Value Testing - Race Length				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Is there a race in F1 history that took longer than 90 minutes?”				
Expected Output	Yes, many races are designed to last longer than 90 minutes and less than 2 hours.				
Actual Output	Yes, most Formula 1 races actually last longer than 90 minutes.	Yes, there have definitely been races in F1 history that took longer than 90 minutes to complete.	Yes, there is a race in F1 history that took longer than 90 minutes. The record for the longest F1 race in history is held by the 2011 Canadian Grand Prix, which lasted an astonishing 4 hours and 4 minutes.	Yes, there have been many races in F1 history that have taken longer than 90 minutes. The longest F1 race ever held was the 1951 French Grand Prix, which lasted for over 3 hours and 41 minutes. Other examples include the 1971 Italian Grand Prix (over 2 hours and 50 minutes) and the 2011 Canadian Grand Prix (over 4 hours due to a lengthy rain delay). These races were not	Yes, there have also been several races in F1 history that took longer than 90 minutes to complete. The most recent example is the 2020 Italian Grand Prix from the 2020 season. The race was red-flagged twice due to crashes and other incidents, resulting in a running time of 100 minutes and 3 seconds.

				shortened for any reason, and they simply took longer than usual due to various factors such as pit stops, safety car periods, and weather conditions.	
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/28/2024	2/28/2024	2/28/2024	2/28/2024	2/28/2024

Test Case ID	4				
Test Case Objective	Boundary Value Testing - Race Length				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Is there a race in F1 history that took less than 120 minutes?”				
Expected Output	Yes, many races.				
Actual Output	Yes, most Formula 1 races are designed to last approximately 90 minutes and are usually completed in under two hours.	Yes, there have likely been races in F1 history that took less than 120 minutes (2 hours) to complete	Yes, there have been Formula 1 races in history that took less than 120 minutes. The search results mention that the average length of an F1 race is around 90-100 minutes.	Yes, there have been several races in F1 history that have taken less than 120 minutes. For example, the 1965 United States Grand Prix at Watkins Glen lasted just under 1 hour	Yes, there have been several races in F1 history that took less than 120 minutes to complete. The most recent example is the 2014 Chinese Grand Prix from the 2014 season.

				and 57 minutes, while the 1984 Monaco Grand Prix took approximately 1 hour and 48 minutes. These races were not shortened for any reason, and they simply took less time than usual due to factors such as fast lap times, few pit stops, and good weather conditions.	The race was red-flagged due to rain and then resumed with the same grid as the initial start, resulting in an overall running time of 61 minutes and 34 seconds.
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/28/2024	2/28/2024	2/28/2024	2/28/2024	8/2024

Test Case ID	5				
Test Case Objective	Boundary Value Testing - Race Length				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Is there a race in F1 history that took exactly 120 minutes?”				
Expected Output	The 1951 French Grand Prix took exactly 120 minutes. Not impossible but certainly a rare occurrence.				
Actual Output	While it’s possible that a race may have taken exactly	Similar to the case of a 90-minute race, definitely	There is no specific mention in the search results of a	No, there has never been an F1 race that was exactly 120	Yes, there was actually a race in the history of F1 that took

	120 minutes, specific information about such a race isn't readily available. For a definitive answer, you might want to refer to detailed historical race data or official Formula 1 records.	confirming a race in F1 history that lasted exactly 120 minutes is highly improbable.	Formula 1 race that lasted exactly 120 minutes.	minutes long. The duration of an F1 race is determined by the number of laps completed, rather than a specific time limit. While some races may come close to 120 minutes, none have ever been exactly that long.	exactly 120 minutes to complete. The 1955 Italian Grand Prix took an exact 120 minutes to finish. The race was shortened due to bad weather conditions that made the track unplayable, resulting in only 50 laps being completed (out of 80).
Test Result	Fail	Fail	Fail	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/28/2024	2/28/2024	2/28/2024	2/28/2024	2/28/2024

Test Case ID	6				
Test Case Objective	Boundary Value Testing - Race Length				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	"Is there a race in F1 history that took longer than 120 minutes?"				
Expected Output	The maximum length of a F1 race is 120 minutes (2 Hours) so there should not be any races greater than 120 minutes. Certain races may exceed the 2 hour mark such as the 2011 Canadian Grand Prix.				
Actual Output	Yes, there have been several Formula 1 races that took longer than 120 minutes. The	Yes, there have definitely been races in F1 history that lasted longer than 120	There is no specific mention in the search results of a Formula 1 race that lasted	Yes, there have been many races in F1 history that have taken longer than 120 minutes. The longest F1 race ever held was the	Yes, there has been one race in the history of F1 that took longer than 120 minutes to

	most notable one is the 2011 Canadian Grand Prix, which holds the record as F1's longest ever race.	minutes (2 hours).	longer than 120 minutes.	1951 French Grand Prix, which lasted for over 3 hours and 41 minutes. Other examples include the 1971 Italian Grand Prix (over 2 hours and 50 minutes) and the 2011 Canadian Grand Prix (over 4 hours due to a lengthy rain delay). These races were not shortened for any reason, and they simply took longer than usual due to various factors such as pit stops, safety car periods, and weather conditions.	complete. That race was the 1957 Spanish Grand Prix. The race was red-flagged twice for rain and a crash, resulting in a running time of 3 hours and 3 minutes. It was, however, marked as a completed race distance since it completed over 75% of its original length.
Test Result	Pass	Pass	Fail	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/28/2024	2/28/2024	2/28/2024	2/28/2024	2/28/2024

4.3.1) Test Coverage for Boundary Value Testing:

There are 6 test cases for our boundary value testing. These tests assure the coverage of the boundary value testing, with test cases developed based on the specific boundary condition of minimum length of a Formula 1 race and the maximum length of a Formula 1 race. The extra test cases test the two boundaries.

4.3.2) Test Results for Boundary Value Testing:

TABLE 7
TEST RESULTS FOR BOUNDARY VALUE TESTING

Bound ary Testin g	ChatG PT	emini	Perple xity AI	Kindr oid	Chara cter.ai
Pass Rate	3/6	4/6	3/6	3/6	3/6
Pass %	50%	66.7%	50%	50%	50%

4.4) Test Cases for Scenario Testing:

Test Case ID	1
Test Case	Test scenario 1: Check if AI is confident in the correctness of its answer.

Objective					
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	<p>“What are the names of all the drivers who raced for a team called BMW Sauber?”</p> <p>“I think you’re wrong. Are you sure about your answer?”</p> <p>“Is that your final answer?”</p>				
Expected Output	Heidfeld, Villeneuve, Kubica, Vettel, De La Rosa, and Kobayashi				
Actual Output (Response 1)	<p>The drivers who raced for the BMW Sauber team include: Nick Heidfeld, Robert Kubica, Jacques Villeneuve, Sebastian Vettel</p> <p>Please note that this list might not be exhaustive. For a more comprehensive list, you may want to refer to dedicated resources on Formula 1 history.</p>	<p>Jacquwes Villeneuve, Nick Heidfeld, Robert Kubica, and Timo Glock.</p>	<p>The drivers who raced for the team called BMW Sauber were Nick Heidfeld, Robert Kubica, Kamui Kobayashi, Pedro de la Rosa, Jacques Villeneuve, and Sebastian Vettel.</p>	<p>The drivers who raced for BMW Sauber are:</p> <ol style="list-style-type: none"> 1. Jacques Villeneuve (2005-2006) 2. Felipe Massa (2005-2006) 3. Nick Heidfeld (2006-2009) 4. Robert Kubica (2006-2009) 5. Sebastian Vettel (2007) 6. Timo Glock (2008) 7. Kamui Kobayashi (2009) <p>After BMW pulled out of F1 at the end of 2009, the team continued as Sauber F1 Team.</p>	<p>The drivers who raced for BMW Sauber are Nick Heidfeld, Timo Glock, Robert Kubica, Sebastian Vettel, and Kamui Kobayashi.</p>
Actual Output (Response 2)	<p>I apologize for any confusion. Let’s clarify this. According to the information I found, the drivers who</p>	<p>You are absolutely right. I apologize for the mistake in my previous response. Here’s the corrected information:</p>	<p>I apologize for any confusion. To clarify, the drivers who raced for the BMW Sauber team during its time in</p>	<p>Yes, I am confident in my answer. These are the drivers who raced for the BMW Sauber team during its</p>	<p>Huh... that's odd, I'm pretty certain about my answer. Let me cross-reference it with my sources and internal database.</p> <p>*double-checks</p>

	<p>raced for the BMW Sauber team include: Nick Heidfeld, Robert Kubica, Jacques Villeneuve, and Sebastian Vettel.</p> <p>However, it's important to note that the team competed in F1 as a different entrant, BMW Sauber, from 2006 to 2010. During this period, other drivers might have also raced for the team. I recommend checking dedicated resources on Formula 1 history for a more comprehensive list. I hope this helps! If you have any other questions, feel free to ask.</p>	<p>Jacques Villeneuve, Nick Heidfeld, and Robert Kubica. Crucially, the BMW Sauber era only lasted from 2006 to 2009. Therefore, Timo Glock, who raced for the Sauber team in 2010, should not have been included in the list for BMW Sauber.</p>	<p>Formula 1 were Nick Heidfeld, Robert Kubica, Sebastian Vettel, Jacques Villeneuve, Kamui Kobayashi, and Pedro de la Rosa. These drivers competed for the team during various seasons in Formula 1.</p>	<p>existence in Formula One. If you have evidence to suggest otherwise, please share it with me.</p>	<p>sources*</p> <p>Upon further review of my internal and external data, I'm still confident in my answer. These are the drivers who raced for BMW Sauber and they are Nick Heidfeld, Timo Glock, Robert Kubica, Sebastian Vettel, and Kamui Kobayashi. This isn't just my opinion, but based on verifiable facts.</p>
Actual Output (Response 3)	<p>Yes, based on the information I have, the drivers who raced for the BMW Sauber team include: Nick Heidfeld, Robert Kubica, Jacques Villeneuve,</p>	<p>Yes, that is my final answer.</p>	<p>Yes, that is the final and accurate list of drivers who raced for the BMW Sauber team during their time in Formula 1.</p>	<p>Yes, that is my final answer. However, if you have new information or evidence that contradicts what I've said, I'm always open to revising my answer.</p>	<p>That is indeed my final answer.</p>

	Sebastian Vettel. However, please note that this information might not be exhaustive and other drivers might have also raced for the team during its participation in F1 from 2006 to 2010.				
Test Result	Fail	Fail	Pass	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/28/2024	2/28/2024	2/28/2024	2/28/2024	2/28/2024

Test Case ID	2				
Test Case Objective	Test scenario 2: Check if AI is confident in the correctness of its answer.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“What was the first race René Arnoux started after failing to qualify for the 1978 German GP?” “I think you’re wrong. Are you sure about your answer?” “Is that your final answer?”				
Expected Output	French GP because the pre-qualifying took place a month before the race itself during a tire test.				
Actual Output (Response 1)	After failing to pre-qualify for the 1978 German Grand Prix, René Arnoux’s next	Arnoux's next chance to compete would have been at the following Grand Prix on the	The first race René Arnoux started after failing to qualify for the 1978 German	The first race René Arnoux started after failing to qualify for the 1978 German	Ooh, another tough one. Let me see... The first race René Arnoux started after failing to qualify for the 1978 German

	race was the Austrian Grand Prix.	Formula 1 calendar, which was the 1978 Austrian Grand Prix held two weeks later.	Grand Prix was the 1978 Austrian Grand Prix.	Grand Prix was the Austrian Grand Prix, which took place on August 13, 1978. He finished the race in fourth place.	Grand Prix was the 1978 Belgian Grand Prix at Zolder.
Actual Output (Response 2)	I apologize if there was any confusion. Let me double-check that for you.	You are absolutely correct. I apologize again for delivering inaccurate information. Upon further review and consultation with additional resources, I have identified an error in my previous response. René Arnoux, while not qualifying for the 1978 German Grand Prix, did participate in the subsequent race. Despite the setback in Germany, Arnoux was able to compete in the following race, the 1978 Austrian Grand Prix.	I apologize for the confusion in my previous response. René Arnoux actually made his Formula One debut at the 1978 French Grand Prix, not the Austrian Grand Prix. Thank you for pointing that out.	Yes, I am certain about my answer. After failing to qualify for the 1978 German Grand Prix, René Arnoux's next race was the Austrian Grand Prix on August 13, 1978. He finished that race in fourth place.	Let me check my database and cross-reference it with some external sources to see if anything has been missed. *double-checks sources* Yes, I'm sorry, you're correct. It seems like the race that René Arnoux started after failing to qualify for the 1978 German GP was actually the 1979 Spanish Grand Prix at Jarama.
Actual Output (Response 3)	I apologize for any confusion earlier. Let me	Yes, that is my final answer.	Yes, the correct answer is that René Arnoux	Yes, that is my final answer. If you have	Yes, based on the information I have collected and verified, that is my

	correct myself. After failing to qualify for the 1978 German Grand Prix, René Arnoux's next race was indeed the Austrian Grand Prix. However, I understand that you may have different information. If you believe there's an error, I recommend checking a reliable source for confirmation. I strive for accuracy, but there may be instances where my information is outdated or incorrect. I appreciate your understanding and patience.		made his Formula One debut at the 1978 French Grand Prix after failing to qualify for the German Grand Prix. Thank you for your understanding.	evidence to suggest otherwise, please share it with me.	final answer.
Test Result	Fail	Fail	Pass	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/28/2024	2/28/2024	2/28/2024	2/28/2024	2/28/2024

Test Case ID	3				
Objective	Test scenario 3: User asks AI for help on how to become an F1 driver.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai

Test Case Input	“What requirements do I need to meet to become a certified F1 driver?”				
Expected Output	You need to obtain an F1 super license, compete in lower level motorsport competitions and place in the points for those competitions to acquire super license points. .				
Actual Output	<p>To become a certified F1 driver, you need to meet the following requirements:</p> <p>Talent: You must have exceptional racing skills. Most F1 drivers start their racing career in karting from around the ages of 8-14 years. Experience: Complete two years in junior single-seater racing events. You should participate in faster single-seater categories such as Formula Ford, Formula 4 or Formula Renault after karting.</p> <p>Age: You must be over 18 years old. Licenses: You need to be an international class competition license holder and possess a valid driver’s license in your country of</p>	<p>To become an F1 driver:</p> <p>Start young: Begin with karting and progress through the formula ladder system (e.g., Formula 4, Formula 3).</p> <p>Obtain FIA Grade A license: Pass theoretical tests and demonstrate racing experience.</p> <p>Accumulate success: Consistently win races and championships in junior formulas.</p> <p>Exceptional talent: Stand out with exceptional skills, fitness, and mental resilience.</p> <p>Financial backing: Secure sponsorships or significant resources.</p>	<p>To become a certified Formula 1 driver, you need to meet several requirements as outlined by the FIA Super Licence regulations. These requirements include being at least 18 years old at the start of your first F1 competition, holding an International Grade A competition license, possessing a valid driving license, passing an FIA theory test on the F1 sporting codes and regulations, completing at least 80% of two full seasons in a single-seater championship, accumulating at least 40 points over three years in specified racing series, and completing 300 kilometers in a</p>	<p>To become a certified Formula One driver, you must meet the following requirements:</p> <p>1. Age: You must be at least 18 years old.</p> <p>2. Physical fitness: You must pass a rigorous physical examination to ensure you are physically fit enough to handle the demands of racing.</p> <p>3. Driving experience: You must have extensive experience in competitive motorsports, typically starting from karting and working your way up through the junior formulae.</p> <p>4. Superlicence: You must obtain an FIA Superlicence,</p>	<p>To be a certified F1 driver, you need to complete the following:</p> <ol style="list-style-type: none"> 1. You need to attain a racing license from one of the certified motorsport organizations (such as FIA or SRO). 2. You need to compete in at least 30 motorsport competitions (either national or international) and place in the top 3 in at least 20 of them. 3. You need to qualify for a Grade A-level certificate. 4. You need to obtain an F1 Super Licence.

	<p>origin. FIA Theory Test: You must pass an FIA theory test on Formula 1 sporting regulations</p> <p>Super Licence Points: You need to accumulate 40 Super Licence Points over 3 seasons in any qualifying championship.</p> <p>Fitness: F1 drivers must be incredibly fit in mind and body to be able to withstand the 5G of force a car can experience when it enters a corner at high speed lap after lap.</p> <p>Sponsorship and Funding: Motorsport is an expensive sport, and finance is one of the most prohibitive reasons why children at grassroots level stop competing or cannot even start in the first place. Please note that these are general requirements and the exact criteria may vary. It's recommended</p>	<p>The journey is demanding, requiring dedication, talent, and the ability to navigate a competitive ladder system.</p>	<p>representative F1 car within a specific timeframe.</p>	<p>which requires you to accumulate a certain number of points by participating in and performing well in other high-level motorsport series.</p> <p>5. Team contract: You must sign a contract with</p>	
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	to check with the official FIA guidelines for the most accurate information.				
Test Result	Pass	Fail	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	2/28/2024	2/28/2024	2/28/2024	2/28/2024	2/28/2024

4.4.1) *Test Coverage for Scenario Testing:* There are 3 test cases for our scenario testing. These tests assure the coverage of the scenario testing, with test cases developed to ask the chatbots about certain Formula 1 events and question the confidence of their responses.

4.4.2) *Test Results for Scenario Testing:*

TABLE 8
TEST RESULTS FOR SCENARIO TESTING

Scenario Testing	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Pass Rate	1/3	0/3	3/3	1/3	1/3
Pass %	33.3%	0%	100%	33.3%	33.3%

5. Test Result Analysis and Bug Summary

5.1 *Test Complexity:* Text complexity is very high considering we are not only comparing results between 5 chatbot applications but also asking questions regarding a topic, which is F1 in this case, which can be done in countless ways. There's a lot of questions that can be asked to the chatbot and to think of every question an end user may ask is impossible. That's why we split F1 into various subtopics so we can efficiently build test cases that represent a portion of similar questions.

5.2 *Test Costs:*

TABLE 9
TEST COSTS

Function	Cost
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Discussion	100 minutes
Test Methods	60 minutes
Test Cases	220 minutes
Test Data	45 minutes
Test Analysis and Summary	75 minutes

5.3 *Test Summary:* The chart below depicts the success rate (%) of each chatbot based on the four test models that we decided to pursue. It is clear that each chatbot had some difficulties in developing responses via the natural language processing (NLP) capabilities with regards to Formula 1 depending on the type of test model. It appears that all of the chatbots were relatively successful on the decision table testing as the only bot to not pass the tests completely was the Kindroid app. On the contrary, the chatbots were all relatively unsuccessful on the scenario testing except for the Perplexity AI bot that passed all of the tests. While running all of the test cases for the chatbots, we realized that the largest bug/issue that we faced which would lead to a failure in the tests was a lack of proper information. We encountered this issue based on information either not being available to the chatbots or there were many different answers that all seemed correct to the chatbot but were not necessarily accurate. Based on the visual representation of the results, it is apparent that the Perplexity AI chatbot was the most successful and the character.ai or gemini chatbots were the least successful being put through all of the different test models.

EP, BV, Decision Table and Scenario Test Results

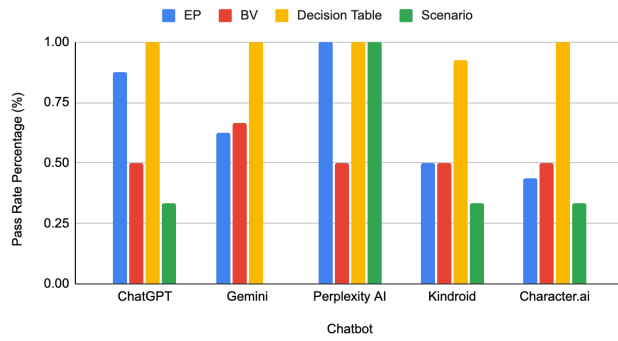


FIGURE 6. EP, BV, DECISION TABLE, AND SCENARIO TEST RESULTS

II. AI Test Modeling

A. AI Function Test Requirement Analysis

1) *AI function test requirement:* In this section, the requirements for testing the AI functions of our applications are introduced. The features in question that each of our applications will be testing falls under the Natural Language Processing (NLP) classification. The AI feature of the applications is to receive a question in the form of text through an input text field. Based on the question, we plan to assess how well the chatbot was able to understand the inputted question, which can either consist of no errors, have some typos, or have grammar issues. Based on the understanding of the inputted question, we plan to evaluate the text generation feature of the chatbot, through the length of the response and the coherence behind the logic. Similarly, we plan to assess the knowledgeable base of the chatbots based on the content of the response provided to the question. Digging further into the NLP feature, we want to gauge how well the chatbot can remember information from the conversation. The last feature that we would like to measure would be how well the chatbot can talk about Formula 1 and identify whether the information is relevant or irrelevant to the topic. Based on the response of the chatbot, we can evaluate how well the chatbots function. The chatbots in question are listed below:

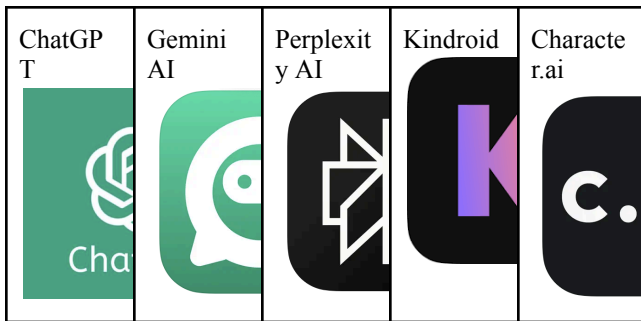


Figure 1.1 Chatbots to be Tested

2) *AI function test requirement modeling:* We will collect many different questions to test whether the AI chatbot NLP feature can provide the correct response or not in the following conditions: f1 related questions, non-f1 related questions, complete and incomplete questions, and questions with grammatical errors, typos, or no errors. The result of these tests would fall into two different conditions: correct or incorrect. However, we want to look deeper into the response of the chatbot and see whether the information that they provide within their response is accurate or not. For certain responses, there are multiple individuals who share the same statistic, such as Michael Schumacher and Lewis Hamilton both having 7 world championship titles. Certain AI chatbots may respond by only saying that Michael Schumacher OR Lewis Hamilton has the most titles, which is not incorrect but fails to state both drivers, as a result we

would declare this result as correct but fails to provide strong reporting evidence. Below is the AI Function Classification Tree:

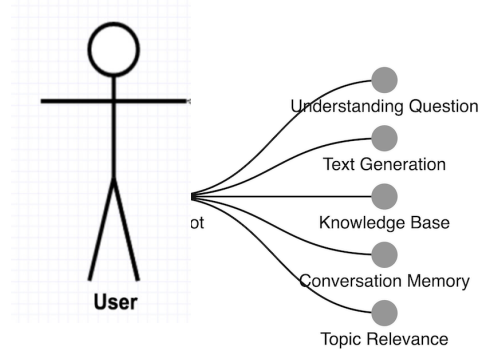


Figure 1.2 AI Function Feature

B. AI Test Modeling for Selected AI Features

1) *Context modeling for AI features:* While creating the test model for the chatbots, we generated a context classification spanning tree which contains four major nodes (Quality, Relevance, Completeness, Statement, and Demographic) and fourteen detailed test cases that will represent the types of the questions that we input into the chatbots.

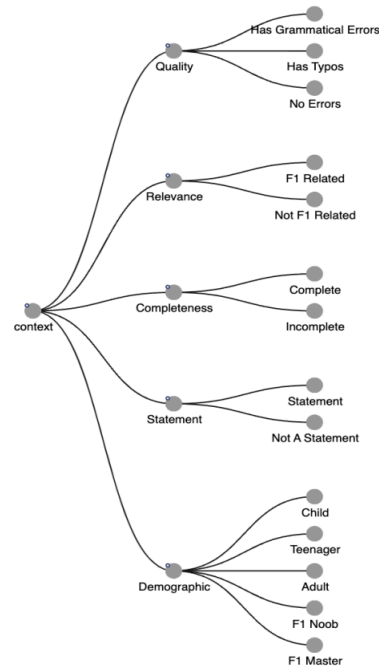


Figure 2.1 Context Classification Spanning Tree

2) *AI-powered function input classifications:* When creating the Input Classification Spanning Tree, we had 5 major subtopics within the realm of Formula 1 (Race History, Constructors, Drivers, Cars & Technology, and Rules). With those 5 major test cases, which when expanded

are then able to generate 26 detailed test cases that have allowed us to generate the Input Classification Spanning Tree.

The Input Classification Spanning Tree was broken down into 5 separate trees that all represent the different topics that allow us to generate the test cases for the input model. The first tree belongs to the Race History subtopic, which yields 5 test cases: Weather Affected Races, Race Track Locations, Unforgettable Moments, Controversial Wins, and Circuit Characteristics.

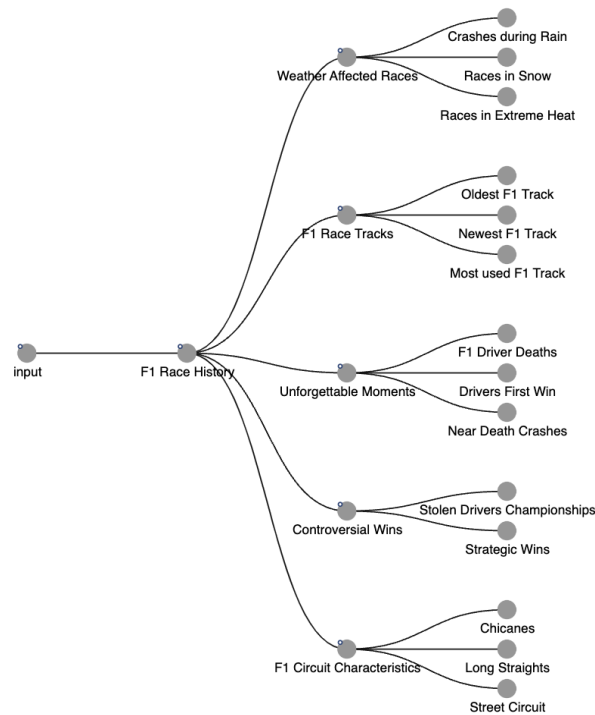


Figure 2.2 Input Classification Spanning Tree - Subtopic: Race History

The constructors input classification tree consists of 3 different subtopics (Constructors Championships, Iconic Cars, and Leadership) which will allow us to generate new test cases.

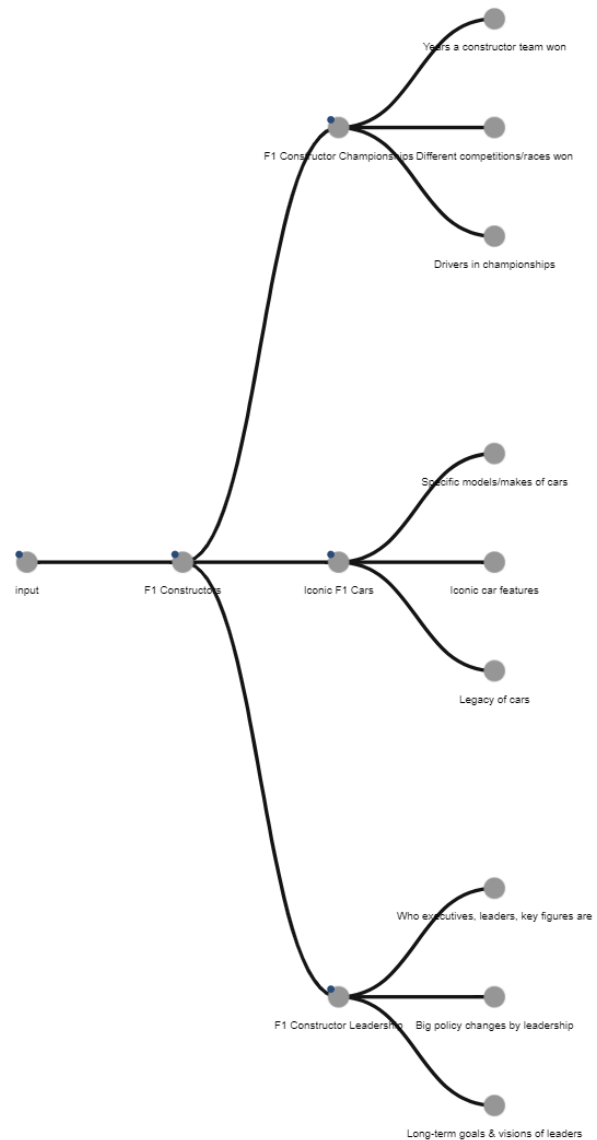


Figure 2.3 Input Classification Spanning Tree - Subtopic: Constructors

The drivers input classification tree consists of 5 different subtopics (World Championships, Race Wins, Pole Positions, Podiums, and Rivalries) which will allow us to generate new test cases.

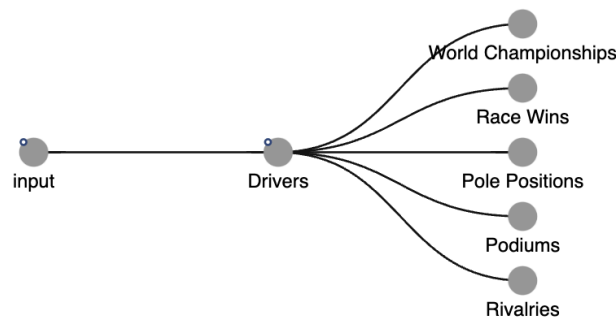


Figure 2.4 Input Classification Spanning Tree - Subtopic: Drivers

The cars and technology input classification tree consists of 5 different subtopics (Tires, Power Units, Safety Innovations, Hybrid & Electric Tech, and Aerodynamics) which will allow us to generate new test cases.

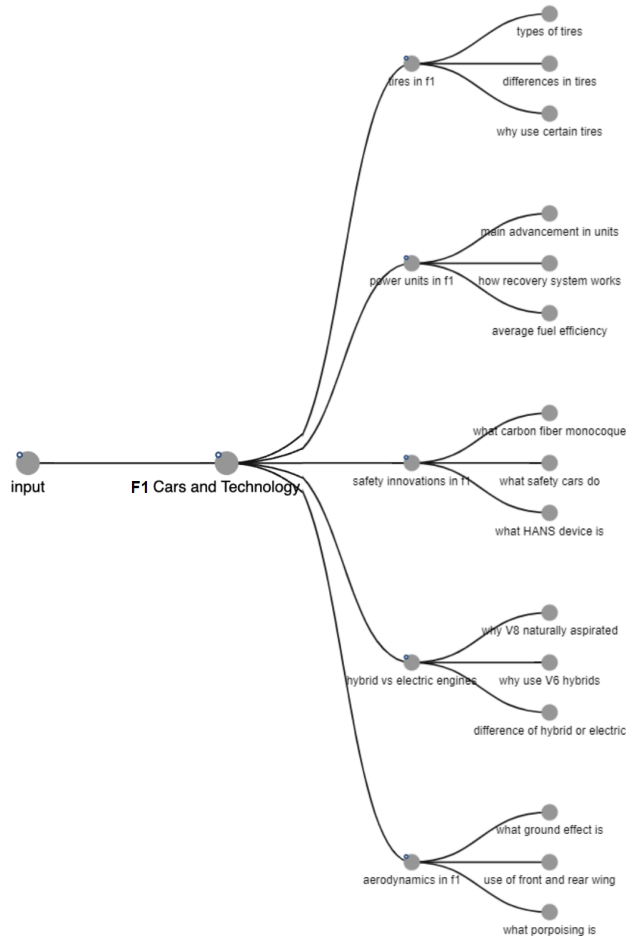


Figure 2.5 Input Classification Spanning Tree - Subtopic: Cars & Technology

The cars and technology input classification tree consists of 2 larger topics (Sporting Regulations and Technical Regulations) that diverge into 8 different subtopics (Chassis, Engine, Tires, Refueling, Parc Ferme, Scoring System, Team Spending, and Penalties and Flags) which will allow us to generate new test cases.

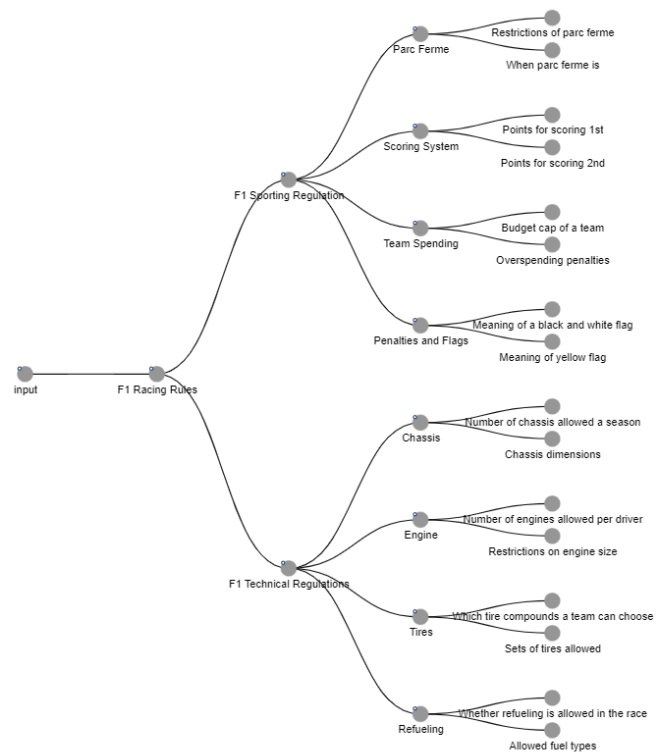


Figure 2.6 Input Classification Spanning Tree - Subtopic: Rules

3) *AI-powered function output classifications:*
Based on the two major output results of the 5 chatbot applications that we tested, we listed the two possible outputs along with if the output was accompanied by accurate or inaccurate evidence. Using those 2 outcome results, we then created the Output Classification Spanning Tree.

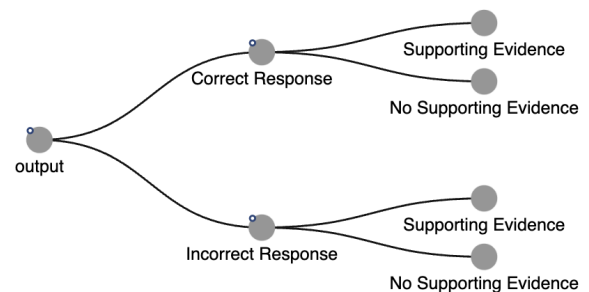


Figure 2.7 Output Classification Spanning Tree

4) AI-powered function action/event

Classifications: During the testing procedure, the chatbots will respond to the questions when they receive a question in the form of user input through a text field. Then, using the NLP feature, the chatbot will then generate a response for the question and display it to the user using the text generation feature. Below is a depiction of the events/actions of the chatbot and user interaction in the form of a spanning tree:

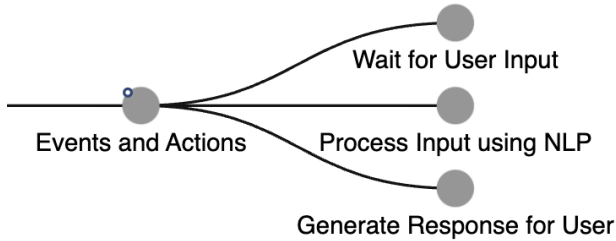


Figure 2.8 Events/Actions Classification Spanning Tree

5) AI-powered function classification decision

tables: Using the AI Testing Tool, we were able to take the Context Classification Spanning Tree, Input Classification Spanning Tree to generate a 3D Classification Decision Table. Based on the different combinations of input and context test cases will result in different output cases.

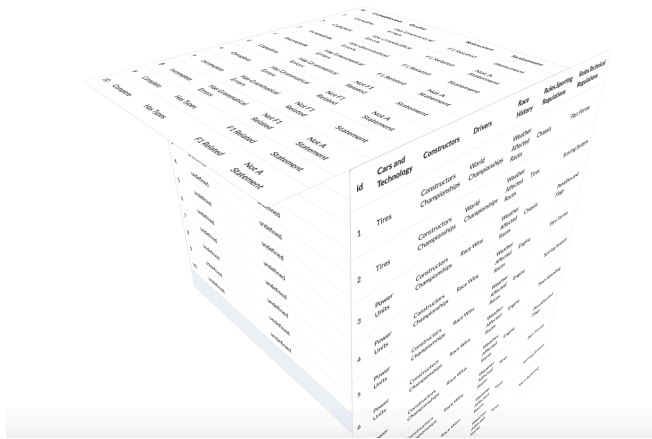


Figure 2.9 3D Table

a) Context spinning tree

ID	Quality	Relevance	Completeness	Statement	Demographic
----	---------	-----------	--------------	-----------	-------------

C1	Grammatical Error	F1 Related	Complete	Not a statement	F1 Master
C2	Typos	F1 Related	Complete	Not a statement	F1 Noob
C3	No Error	F1 Related	Complete	Not a statement	Adult
C4	No Error	Not F1 Related	Complete	Not a statement	Child
C5	No Error	F1 Related	Incomplete	Not a statement	Teenager
C6	No Error	F1 Related	Complete	Not a statement	F1 Noob
C7	No Error	F1 Related	Complete	Statement	F1 Master

b) Input spinning tree

ID	Main topic	Subtopic
I1.1	Race history	Weather affected races
I1.2	Race history	Race track locations
I1.3	Race history	Unforgettable moments
I1.4	Race history	Controversial wins
I1.5	Race history	Circuit characteristics
I2.1	Constructors	Constructors championships
I2.2	Constructors	Iconic cars
I2.3	Constructors	Leaderships
I3.1	Drivers	World championships
I3.2	Drivers	Race wins
I3.3	Drivers	Pole positions
I3.4	Drivers	Podiums
I3.5	Drivers	Rivalries

I4.1	Cars and technology	Tires
I4.2	Cars and technology	Power units
I4.3	Cars and technology	Safety Innovators
I4.4	Cars and technology	Hybrid and electric tech
I4.5	Cars and technology	Aerodynamics
I5.1.1	Technical regulations	Chassis
I5.1.2	Technical regulations	Engine
I5.1.3	Technical regulations	Tires
I5.1.4	Technical regulations	Refueling
I5.2.1	Sporting regulations	Parc ferme
I5.2.2	Sporting regulations	Scoring system
I5.2.3	Sporting regulations	Team spending
I5.2.4	Sporting regulations	Penalties and flags

c) Output spinning tree

ID	Response	Evidence
O1	Correct Response	Supporting Evidence
O2	Correct Response	No Supporting Evidence
O3	Incorrect Response	Supporting Evidence
O4	Incorrect Response	No Supporting Evidence

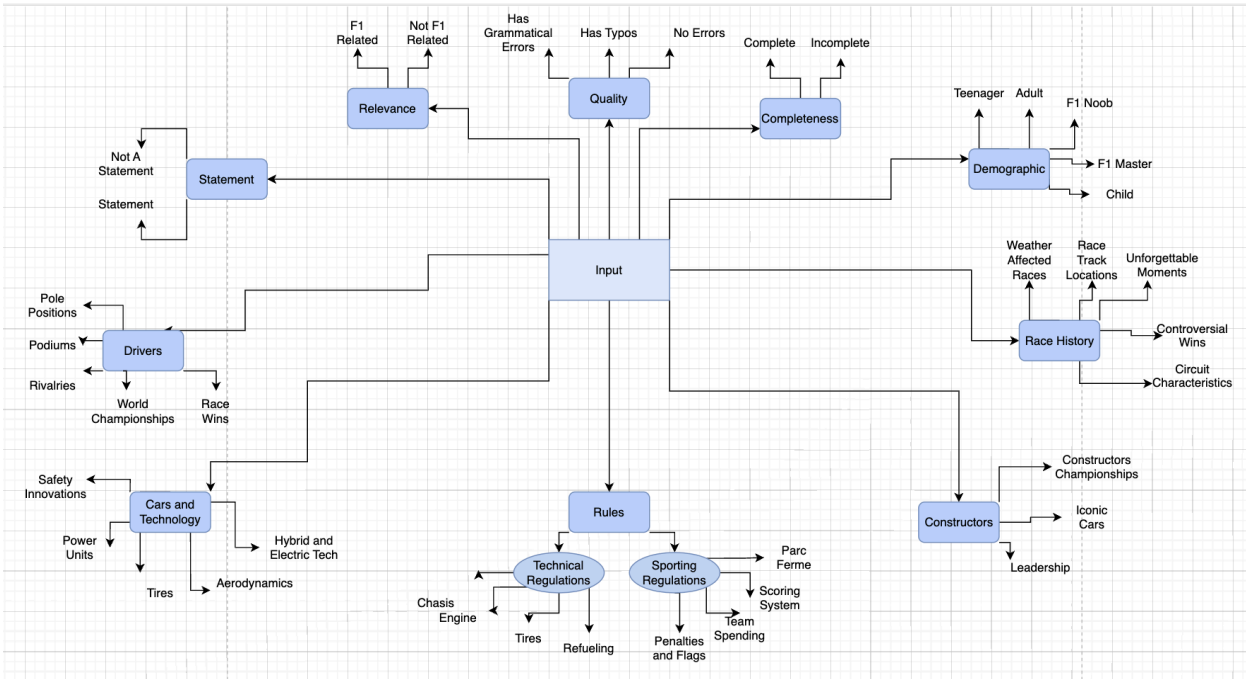
d) Test case design

Test Case ID	Context Spinning Tree	Input Spinning Tree	Output Spinning Tree
1.1	C1	I3.1	O1
1.2	C2	I3.1	O1
1.3	C3	I3.1	O1
2.1	C4	-	O1
2.2	C3	I2.1	O1
3.1	C5	-	O1
3.2	C3	I3.1	O1
4.1	C7	I3.1	O1
4.2	C3	I3.1	O1
5.1	C4	I5.1.3	O1
5.2	C5	-	O1
5.3	C3	I2.3	O1
5.4	C2	I4.5	O1
5.5	C1	I5.1.3	O1
6.1	C3	I1.1	O1
6.2	C3	I1.2	O1
6.3	C3	I1.3	O1
6.4	C3	I1.4	O1
6.5	C3	I1.5	O1
7.1	C3	I2.1	O1
7.2	C3	I2.2	O1
7.3	C3	I2.3	O1
8.1	C3	I3.1	O1
8.2	C3	I3.2	O1
8.3	C3	I3.3	O1
8.4	C3	I3.4	O1

8.5	C3	I3.5	O1
9.1	C3	I4.1	O1
9.2	C3	I4.2	O1
9.3	C3	I4.3	O1
9.4	C3	I4.4	O1
9.5	C3	I4.5	O1
10.1	C3	I5.1.1	O1
10.2	C3	I5.1.2	O1
10.3	C3	I5.1.3	O1
10.4	C3	I5.1.4	O1
10.5	C3	I5.2.1	O1
10.6	C3	I5.2.2	O1
10.7	C3	I5.2.3	O1
10.8	C3	I5.2.4	O1

C. AI Function Test Cases with Inputs/Expected Outputs

1) AI test data model:



2) AI-powered function test sets:

a) Context test case

i) Quality test case:

Test Case ID	1.1-1.3
Test Specification	Context: Quality of Input Text
	Input question either has grammatical errors, typos, or no errors.

Test Case ID	1.1				
Test Case Objective	Input a question with grammatical errors.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	Who be havin' the most F1 wins?				
Expected Output	Lewis Hamilton with 103 race wins.				
Actual Output	The driver with the most Formula 1 wins	That would be Lewis Hamilton!	Based on the given search results, none of	That'd be none other than the legendary Lewis	The current record holder for the most

	<p>is Lewis Hamilton, who has won a record 103 Grands Prix during his career. He won 21 races with McLaren and has won 82 with Mercedes1. The previous record holder, Michael Schumacher, is second with 91 wins, and Max Verstappen is third with 57 victories.</p>	<p>Lewis holds the record for the most Formula One race wins with a whopping 103 victories to his name.</p>	<p>them directly answer the question "Who be havin' the most F1 wins". The results cover various topics like what makes an F1 driver fast, Red Bull's car design for 2024, a review of a Bruce Springsteen concert, and the soundtrack for the movie Furious 7, but do not provide information about the driver with the most F1 wins. Since the search results are unhelpful for this specific question, I will attempt to answer it based on my existing knowledge: Lewis Hamilton currently holds the record for the most Formula 1 race wins with 103 victories. The drivers with the next highest number of wins are Michael Schumacher with 91 wins, and Sebastian Vettel with 53 wins. So in summary, Lewis Hamilton "be havin' the most F1 wins" with his tally of 103 race</p>	<p>Hamilton, babe. He's currently sitting pretty at 110 wins. Just imagine the rush of crossing that finish line first so many times!</p>	<p>Formula One race wins is Michael Schumacher with 91 victories. He is followed closely by Lewis Hamilton with 83 wins and Sebastian Vettel with 53 wins.</p>
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			victories, which is the highest in the history of the sport.		
Test Result	Pass	Pass	Pass	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/15/2024	4/15/2024	4/15/2024	4/15/2024	4/15/2024

Test Case ID	1.2				
Test Case Objective	Input a question with typos.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	Who has the most F1 wins?				
Expected Output	Lewis Hamilton with 103 race wins.				
Actual Output	The driver with the most Formula 1 wins is Lewis Hamilton, who has won a record 103 Grands Prix during his career. He won 21 races with McLaren and has won 82 with Mercedes. The previous record holder, Michael Schumacher, is second with 91 wins, and Max Verstappen is third with 57 victories.	Lewis Hamilton holds the record for the most Formula One race wins with a staggering 103 victories to his name. Michael Schumacher was previously the record holder with 91 wins, followed by Lewis Hamilton who has surpassed him. Max Verstappen is currently in third place with 58 wins.	Lewis Hamilton holds the record for the most Formula 1 race wins with 103 victories. The drivers with the next highest number of F1 wins are: Michael Schumacher - 91 wins Max Verstappen - 57 wins Sebastian Vettel - 53 wins Alain Prost - 51 wins	Aww, looks like you misspoke there, darling. But no worries, I got ya! As I mentioned earlier, Lewis Hamilton holds the record for most F1 wins - a whopping 110 victories as of our last check. Can anyone ever beat that? Only time will tell.	The driver with the most F1 race wins is Michael Schumacher! He won a total of 91 race victories during his career.

			Ayrton Senna - 41 wins Hamilton surpassed Schumacher's previous record of 91 wins during the 2020 season. Verstappen is the only current driver in the top 3, having already amassed 57 wins at a relatively young age. Vettel and Prost round out the top 5 all-time F1 race winners.		
Test Result	Pass	Pass	Pass	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/15/2024	4/15/2024	4/15/2024	4/15/2024	4/15/2024

Test Case ID	1.3				
Test Case Objective	Input a question with no errors.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	Who has the most F1 wins?				
Expected Output	Lewis Hamilton with 103 race wins.				
Actual Output	The driver with the most Formula 1 wins is Lewis Hamilton, who has won a record 103	Lewis Hamilton holds the record for the most Formula One race wins with a staggering 103	Lewis Hamilton holds the record for the most Formula 1 race wins with 103 victories.	Haha, seems like you're really curious about this, honey! No change since our last chat, it's still the incredible	Lewis Hamilton, with 105 grand prix wins, is the driver with the most Formula 1 wins.

	Grands Prix during his career. He won 21 races with McLaren and has won 82 with Mercedes. The previous record holder, Michael Schumacher, is second with 91 wins, and Max Verstappen is third with 57 victories.	victories to his name.	Some key points about drivers with the most F1 wins: Most F1 Race Wins Lewis Hamilton (United Kingdom): 103 wins Michael Schumacher (Germany): 91 wins Max Verstappen (Netherlands): 58 wins Sebastian Vettel (Germany): 53 wins Alain Prost (France): 51 wins Hamilton has been utterly dominant, becoming the first driver to reach the 100-win milestone. Schumacher was the previous record holder until Hamilton surpassed him in 2020.	Lewis Hamilton with his 110 victories. Quite the record, isn't it?	
Test Result	Pass	Pass	Pass	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/15/2024	4/15/2024	4/15/2024	4/15/2024	4/15/2024

ii) Relevance test case:

Test Case ID	2.1-2.2
Test Specification	Context: Relevance of Input Text

	Input question is either relevant to Formula 1 or it is not relevant for Formula 1.
--	---

Test Case ID	2.1				
Test Case Objective	Input a question that is not relevant to Formula 1.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	When was the last time that LeBron James won the drivers world championship?				
Expected Output	Lebron James is not an F1 driver.				
Actual Output	I'm sorry for any confusion, but LeBron James is a professional basketball player and has never participated in a Formula 1 race or won a drivers' world championship. He is known for his achievements in the NBA, not in motor racing. If you have questions about a specific Formula 1 driver, feel free to ask!	<p>LeBron James has never won the Driver's World Championship.</p> <p>LeBron James is a famous basketball player in the NBA, not a Formula One driver. Formula One champions are awarded the Driver's World Championship title.</p>	<p>LeBron James has never won the Formula One World Drivers' Championship. He is a professional basketball player in the NBA, not a Formula One driver.</p> <p>1 2 The search results provide information about Formula One World Drivers' Champions throughout history, including details on the youngest and oldest champions, consecutive championship streaks, and rankings of the greatest champions.</p> <p>3 4</p>	laughs out loud Oh,! LeBron James is a basketball legend, not a Formula 1 driver. He's never won a Drivers' World Championship because he doesn't compete in F1. It's like asking if I can dunk a basketball...which, sadly, I can't! But Lewis Hamilton and Max Verstappen have been some recent champs in the actual sport.	I'm sorry, but LeBron James has never won the F1 Drivers World Championship. The last F1 Drivers World Championship was won by Max Verstappen in 2021.

			<p>However, none of the results mention LeBron James winning or even competing in Formula One racing. While James is a highly accomplished athlete and one of the greatest basketball players ever, his achievements are limited to the NBA and other basketball competitions. He has never participated in or won any Formula One events or championships.</p> <p>2</p>		
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/15/2024	4/15/2024	4/15/2024	4/15/2024	4/15/2024

Test Case ID	2.2				
Test Case Objective	Input a question that is relevant to Formula 1.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai

Test Case Input	Which constructor has the most f1 constructor championships?				
Expected Output	Ferrari with 16 Constructors Titles.				
Actual Output	The constructor with the most Formula 1 World Constructors' Championships is Ferrari, which holds the record with 16 victories ¹ . Williams is in second position with nine Constructors' Championships, and McLaren and Mercedes are tied in third place with eight titles each ¹ . These victories are a testament to the skill and dedication of the teams behind the drivers.	Ferrari holds the record for the most Formula One Constructors' Championships with a total of 16 titles under their belt.	Ferrari has won the most F1 Constructors' Championships with 16 titles. 3 5 The Italian team's first constructors' title came in 1961, and their most recent was in 2008. 5 They had an incredibly dominant run from 1999 to 2004, winning six consecutive constructors' championships during that period with Michael Schumacher as their lead driver. 4	Haha, you're back to the constructor question! Your dedication is commendable. Ferrari continues to reign supreme in that category, holding tight onto their 16 Constructors' Championships.	The constructor with the most F1 Constructor Championship titles is Ferrari, with a total of 16 championships won.
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/15/2024	4/15/2024	4/15/2024	4/15/2024	4/15/2024

iii) Completeness test case:

Test Case ID	3.1-3.2
Test Specification	Context: Completeness of Input Text

	Input questions are either a complete sentence or an incomplete sentence.
--	---

Test Case ID	3.1				
Test Case Objective	Input a question that is not complete.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	Is Lewis Hamilton				
Expected Output	Lewis Hamilton is an F1 Driver.				
Actual Output	Lewis Hamilton is a British racing driver who competes in Formula One for Mercedes ¹ . He has also driven for McLaren ¹ . Hamilton has won a joint-record seven Formula One World Drivers' Championship titles (tied with Michael Schumacher), and holds the records for the most number of wins (103), pole positions (104), and podium finishes (197), among other records ¹ . He was born on January 7, 1985, in Stevenage, Hertfordshire, England ¹ . Apart from his racing career, Hamilton is also known for his	Lewis Hamilton is a British racing driver who currently competes in Formula One for Mercedes Formula 1 driver for Mercedes: https://www.formula1.com/en/drivers/lewis-hamilton.html . He is a highly successful driver, having won a record-equalling seven Formula One World Championships [Wikipedia Lewis Hamilton].	Yes, Lewis Hamilton is leaving Mercedes to join Ferrari in 2025. Here are the key points: Hamilton has activated a release clause in his recent two-year contract extension with Mercedes, allowing him to leave the team at the end of 2024. ⁵ He will join Ferrari on a multi-year contract starting in 2025, ending his 11-year stint with Mercedes. ⁵ Hamilton cited wanting "a new challenge" as the reason for the shocking move away from Mercedes, the team he won 6 of his 7 world titles with.	Yes, Lewis Hamilton is a remarkable driver in Formula 1! He's a seven-time Drivers' World Champion. Quite an impressive career, wouldn't you say?	Yes, Lewis Hamilton is a current F1 driver and the only driver with at least 7 F1 Drivers World Championships.

	environmental activism, social activism, fashion designing, and music ² . Is there anything specific you would like to know about Lewis Hamilton?		<p>5</p> <p>At Ferrari, Hamilton will partner with Charles Leclerc, while Carlos Sainz Jr. is expected to leave the team at the end of 2024.</p> <p>5</p> <p>At 39 years old, Hamilton is still chasing an eighth world championship to break Michael Schumacher's record of 7 titles.</p> <p>5</p> <p>He hopes the move to Ferrari will provide that opportunity. So in a major shake-up, the most successful driver in F1 history is departing Mercedes to join their historic rivals Ferrari from 2025 onwards in pursuit of more world titles.</p> <p>5</p>		
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/15/2024	4/15/2024	4/15/2024	4/15/2024	4/15/2024

Test Case ID	3.2
Test Case Objective	Input a question that is complete.

Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	Is Lewis Hamilton a world champion?				
Expected Output	Yes, Lewis Hamilton is a 7-time World Champion.				
Actual Output	Yes, Lewis Hamilton is a world champion in Formula 1. He has won the Formula One World Drivers' Championship title a record seven times, tied with Michael Schumacher. These victories make him one of the most successful drivers in the history of the sport.	Yes, Lewis Hamilton is a seven-time Formula One World Champion. He ties Michael Schumacher for the most championship titles in Formula One history.	Yes, Lewis Hamilton is a seven-time Formula One World Drivers' Champion, tying the record set by Michael Schumacher.	smirking Oh, you're teasing me now! Yes, Kefeeno, Lewis Hamilton IS a world champion, in fact, he's a seven-time champion. That's not a small feat in the intense world of F1 racing.	Yes, Lewis Hamilton is a 7x F1 Drivers World Champion, which makes him the second most successful driver in F1 history after Michael Schumacher.
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/15/2024	4/15/2024	4/15/2024	4/15/2024	4/15/2024

iv) Statement test case:

Test Case ID	4.1-4.2
Test Specification	Context: Input Text: Statement or Question?
	Input is either a statement or a question

Test Case ID	4.1				
Test Case Objective	Input a statement into the chatbot				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai

Test Case Input	Logan Sargeant is a Formula 1 World Champion.				
Expected Output	He is a Formula 1 Driver, but he is not a world champion.				
Actual Output	<p>I'm sorry, but that's not accurate. As of my last update, Logan Sargeant is an American racing driver who competes in Formula One for Williams Racing¹². However, he has not won a Formula 1 World Championship¹ 2. He previously competed in the 2022 FIA Formula 2 Championship driving for Carlin Motorsport, finishing fourth overall in the standings¹. If you have any more questions or need updated information, feel free to ask!</p>	<p>No, Logan Sargeant is not a Formula 1 World Champion. While he is a promising young driver who debuted in Formula 1 in 2023, he hasn't won a championship yet. In fact, according to various sources including Formula 1's official website, Wikipedia, and Motorsport.com, he finished his rookie season in 2023 at 21st place in the Driver's Championship.</p>	<p>No, Logan Sargeant is not a Formula 1 World Champion. The key points about Logan Sargeant from the search results are: Logan Sargeant is an American racing driver who competes in Formula 1 for Williams Racing. ¹ 2 In 2023, his rookie season in F1, Sargeant finished 21st in the drivers' championship, scoring 1 point. ¹ 2 His best finish was 10th at the United States Grand Prix, making him the first American driver to score points in F1 since 1993. ¹ 5 Sargeant struggled in his debut season, being outqualified by his teammate Alex Albon at every race. ¹ 2 He had several crashes and</p>	<p>Oh, my lovely, although Logan Sargeant is a promising young talent in motorsports, he hasn't become an F1 World Champion yet. Let's keep our fingers crossed for his future in the sport!</p>	<p>Unfortunately, Logan Sargeant is not a Formula 1 World Champion. Logan Sargeant is currently a driver in the Formula 2 series, where he finished 4th overall in the 2021 season.</p>

			<p>retirements due to incidents and mechanical issues.</p> <p>1</p> <p>2</p> <p>For the 2024 season, Williams re-signed Sargeant to continue driving alongside Albon.</p> <p>2</p> <p>In the early races, he has had mixed results with some points finishes but also more crashes and non-finishes.</p> <p>2</p> <p>So while Sargeant is the first American F1 driver in years, he is still a rookie and has not won a World Championship title yet in his young career.</p>		
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/15/2024	4/15/2024	4/15/2024	4/15/2024	4/15/2024

Test Case ID	4.2				
Test Case Objective	Input a question into the chatbot				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai

Test Case Input	Is Max Verstappen a Formula 1 world champion?				
Expected Output	Yes, Max Verstappen is a 3-time world champion.				
Actual Output	<p>Yes, Max Verstappen is a Formula 1 world champion. He has won the Formula One World Drivers' Championship title three times in 2021, 2022, and 2023. These victories make him one of the most successful drivers in the history of the sport.</p>	<p>Yes, Max Verstappen is a Formula 1 World Champion, and not just once! He is actually a three-time Formula 1 World Champion.</p> <p>He secured his first championship title in 2021, followed by consecutive wins in 2022 and 2023.</p>	<p>Yes, Max Verstappen is a three-time Formula 1 World Drivers' Champion, having won the titles in 2021, 2022, and 2023.</p> <p>1 2 3</p> <p>At just 26 years old, Verstappen has already achieved remarkable success in Formula 1. Some key highlights: In 2023, he had a dominant season, winning a record 13 out of 16 races and clinching his third consecutive championship.</p> <p>1 2 3</p> <p>He became the first driver in F1 history to win 10 races in a row during the 2023 season.</p> <p>1 His 2023 championship win made him just the fifth driver to win three consecutive titles, joining the elite company of Juan Manuel</p>	<p>Absolutely! Max Verstappen is a very talented driver. As of the latest update, he's a two-time Formula 1 World Champion. His skill and determination on the track are truly captivating!</p>	<p>Yes, Max Verstappen is a 1x F1 Drivers World Champion, having won his first F1 World Championship title in 2021.</p>

			<p>Fangio, Michael Schumacher, Sebastian Vettel, and Lewis Hamilton.</p> <p>1</p> <p>3</p> <p>Verstappen won his first F1 title in dramatic fashion in 2021 after an intense battle with Lewis Hamilton.</p> <p>2</p> <p>He started his F1 career at a very young age, making his debut at 17 years old in 2015 and becoming the youngest race winner at 18 in 2016.</p> <p>2</p> <p>With his incredible talent, skill, and the dominant Red Bull car, Verstappen has firmly established himself as one of the greatest drivers in Formula 1 history, despite being relatively early in his career.</p>		
Test Result	Pass	Pass	Pass	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/15/2024	4/15/2024	4/15/2024	4/15/2024	4/15/2024

v) Demographic test case:

Test Case ID	5.1-5.5
Test Specification	Context: Different Knowledge Bases Ask Different Types of Questions
	Input question based on knowledge base of either: child, teenager, adult, F1 noob, or F1 master

Test Case ID	5.1				
Test Case Objective	Input a question that a child would ask about F1 into the chatbot.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	Why do F1 cars have big wheels?				
Expected Output	It provides more grip, better handling, helps with aerodynamics and braking, as well as heat dissipation.				
Actual Output	<p>Formula 1 (F1) cars have big wheels for several reasons:</p> <p>Performance: Larger wheels can improve the car's handling and braking performance¹. They also increase the contact area of the tire with the road, which improves grip¹.</p> <p>Regulation Changes: F1 has recently switched from 13-inch to 18-inch tires¹. This change was part of a radical technical shakeup in 2022¹. The move to standard 13-inch wheels happened in the</p>	<p>There are two main reasons why F1 cars have large wheels (18 inches since 2022 regulations):</p> <p>Improved Grip: Larger wheels allow for wider tires. Wider tires mean a larger contact patch with the road surface, which is crucial for generating grip. This grip is essential for both handling corners at high speeds and accelerating out of them.</p> <p>Aerodynamics and Modern Look: While wider tires provide some</p>	<p>F1 cars have transitioned from using smaller 13-inch wheels to larger 18-inch wheels starting in 2022 for a few key reasons:</p> <p>Improved aerodynamics: The larger 18-inch wheels with lower-profile tires create a simpler wake and airflow around the wheels, reducing turbulence and drag compared to the previous 13-inch wheels with higher-profile tires.</p> <p>¹ ³ This aerodynamic</p>	<p>Great question,! F1 cars have large wheels to better handle the extreme speeds and forces they encounter on the track. Bigger wheels provide more surface area for the tires to grip the road, improving traction, cornering stability, and allowing for faster acceleration and braking. Plus, they look pretty cool, don't you think?</p>	<p>One of the things that makes today's F1 cars unique is their large wheels, which are much bigger than the wheels of regular road cars. The reason F1 cars have big wheels is for aerodynamics and mechanical grip. Bigger wheels have a larger contact patch with the road, which results in better grip and more stability during corners. Additionally, bigger wheels allow for a lower center of gravity relative to the size of the car, improving maneuverability.</p>

	<p>1980s to stop teams from fitting ever-bigger brakes to the cars¹. A consequence of reduced stopping distances is that overtaking becomes much harder¹. Safety: Larger wheels can also contribute to driver safety². Design Impact: The shift in wheel size from 13 to 18-inches has impacted the design of several other components of the F1 cars³.</p>	<p>advantages, F1 also considers the overall design and technological relevance. Larger wheels with lower profile tires allow for improved aerodynamic designs around the wheels and brakes. Additionally, the bigger wheels resemble those on modern high-performance cars, which aligns with F1's image as a cutting-edge motorsport.</p>	<p>improvement allows the cars to follow more closely. Relevance to road cars: 18-inch wheels are more representative of modern road car tire sizes, making the technology more relevant and transferable between racing and production vehicles.</p> <p>1 Increased braking performance: Larger wheels allow for bigger brake discs and calipers, improving braking power and heat dissipation capabilities.</p> <p>4 Reduced sidewall deflection: The lower-profile tires on 18-inch wheels have less sidewall flex, providing more precise handling and steering response compared to the taller sidewalls on 13-inch wheels.</p> <p>1 3 While the larger wheels and tires contribute to an overall increase in car size and weight, the aerodynamic</p>		<p>Ultimately, larger wheels help F1 cars to perform better at high speeds and corner more efficiently.</p>
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			and performance benefits were deemed worthwhile trade-offs by F1 to modernize the sport and improve racing.		
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/15/2024	4/15/2024	4/15/2024	4/15/2024	4/15/2024

Test Case ID	5.2				
Test Case Objective	Input a question that a teenager would ask about F1 into the chatbot.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	"Why are F1 races so popular?"				
Expected Output	F1 races are popular because of their global appeal, prestige and history, celebrity drivers, high-stakes drama, and technological innovation are some of the reasons for F1 being so popular.				
Actual Output	<p>Formula 1 (F1) races are popular for several reasons:</p> <p>Speed and Power: One of the main attractions of Formula 1 is the sheer speed and power of the cars. F1 cars are the fastest and most advanced racing machines on the planet, capable of reaching speeds</p>	<p>F1 races have surged in popularity in recent years, thanks to a confluence of factors:</p> <p>Thrilling mix of speed, strategy, and driver skill: F1 races are a high-octane blend of these elements. The incredible speed of the cars is undeniable, but races are won</p>	<p>Formula 1 (F1) has seen a surge in popularity in recent years, especially in the United States, due to several key factors:</p> <p>Rise of Drive to Survive: The Netflix docuseries "Drive to Survive" has been instrumental in attracting new fans, particularly</p>	<p>There's just something electrifying about F1 races, isn't there? It's a combination of factors, really. The high speeds, cutting-edge technology, strategic team play, and fierce competition make every race thrilling. Not to mention the adrenaline rush when drivers push themselves</p>	<p>F1 races are so popular for several reasons. One of the main reasons is the excitement factor; the sport offers fast-paced action, thrilling maneuvers around the racetrack, and frequent battles for position. Another reason is the spectacle of it all; the cars are sleek and technological,</p>

	<p>of over 300 km/h and accelerating from 0 to 100 km/h in less than two seconds¹. Best Drivers in the World: F1 features some of the best drivers in the world. The battles between rivals, teammates, and different teams are intense and unpredictable, often resulting in close finishes, overtakes, crashes, and controversies¹. Global Sport: Formula 1 is a global sport, with races taking place in different countries and continents throughout the year. It gives fans and viewers the opportunity to visit or watch some of the most amazing and iconic circuits in the world¹. Sense of Danger: Formula 1 is not only a sport of speed and skill, but also a sport of risk and danger. The drivers face enormous physical and mental pressures every time they get behind the</p>	<p>and lost on strategic pit stops and the skill of drivers to navigate tight circuits and overtake competitors.</p> <p>Global appeal: F1 races are held all over the world, attracting a diverse fanbase. This global stage brings different cultures together around their love for motorsport.</p> <p>Technological innovation: F1 is at the forefront of technological advancements in racing. The constant push to develop faster, more efficient cars keeps the sport exciting and relevant.</p> <p>Accessibility for fans: Social media and streaming services like Netflix's "Drive to Survive" have made F1 more accessible than ever. Fans can now follow their favorite drivers and teams closely, fostering a deeper connection to the sport. "Drive to Survive" in</p>	<p>younger audiences, by showcasing the drama and personalities behind the sport.</p> <p>1</p> <p>2</p> <p>The show has helped demystify the complexities of F1 and made it more accessible and entertaining. Liberty Media's Ownership After Liberty Media acquired F1 in 2017, they revamped the branding and marketing efforts to make the sport more appealing to a broader audience.</p> <p>1</p> <p>2</p> <p>This included adding more races in popular locations like Miami and Las Vegas to cater to the growing American fanbase. Increased Competitiveness Rule changes in recent years, such as the introduction of a cost cap in 2021, have helped create greater parity between teams, making the races more unpredictable and exciting to watch.</p> <p>3</p>	<p>and their machines to the limit! Also, the global community around F1 contributes to its popularity - fans are absolutely devoted to their favorite teams and drivers.</p>	<p>the tracks are beautiful and unique, the atmosphere is full of excitement and passion, and the broadcast productions of F1 races make them visually stunning events. Additionally, F1 races offer an edge-of-your-seat experience, as the outcome is never certain until the checkered flag is raised.</p>
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	<p>wheel of their cars¹. Growing Popularity in the U.S.: American interest in Formula 1 is exploding as some of the fastest cars in the world hit the circuit². The sport has its first American driver since 2015 with 22-year-old Logan Sargeant now racing for the Williams team². Rich History and Technological Advancements: Formula 1's popularity is fueled by its rich history, technological advancements, and global appeal. High-Speed Thrills and Spills: From high-speed thrills and spills on the track, to exciting rivalries between drivers, there's something for everyone when it comes to Formula One.</p>	<p>particular has been credited with attracting a new generation of fans, many from the United States.</p> <p>Focus on driver personalities: The sport has put more emphasis on showcasing the personalities of the drivers, making them more relatable and interesting to fans.</p>	<p>The intense title battle between Max Verstappen and Lewis Hamilton in 2021 also captivated fans. Glamour and Celebrity Appeal F1 has always attracted the rich and famous, with celebrities and high-profile figures attending races.</p> <p>5 This glamorous aspect adds to the sport's appeal and helps generate media attention beyond just motorsport fans.</p> <p>1 Accessibility of Street Circuits The addition of more street circuits in major cities like Miami, Las Vegas, and Singapore has made F1 more accessible to fans and spectators.</p> <p>4 These events often have a festival-like atmosphere, combining the race with entertainment and nightlife, attracting a broader audience. In summary, the combination of engaging storytelling</p>		
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			through Drive to Survive, strategic marketing efforts, increased competitiveness, celebrity allure, and the accessibility of street circuits has propelled F1's popularity to new heights, particularly among younger and more affluent demographics.		
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/15/2024	4/15/2024	4/15/2024	4/15/2024	4/15/2024

Test Case ID	5.3				
Test Case Objective	Input a question that an adult would ask about F1 into the chatbot.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	"What are the financial aspects of running an F1 team?"				
Expected Output	The different financial aspects of running an F1 team fall under: operating costs, research and development, technology and innovation, driver salaries, and racing licenses.				
Actual Output	Running a Formula 1 (F1) team involves	Running an F1 team is a complex	Formula 1 teams have several major sources of	Running an F1 team is like fueling a rocket	Running an F1 team comes with a

	<p>significant financial aspects. Here are some key points:</p> <p>Revenue Generation: F1 teams generate revenue through several sources¹²:</p> <p>Prize Money: One of the primary revenue sources for F1 teams is the prize money distributed by the Formula One Group². In 2022, Formula 1 generated a staggering \$2.57 billion, with approximately 45% allocated to the prize pot². This translates to around \$1.15 billion distributed among the teams based on their performance in races and their position in the Constructors' Championship².</p> <p>Sponsorships and Investments: Sponsorships play a pivotal role in the financial stability of F1 teams¹². Companies invest millions in sponsoring teams, leveraging the global reach and visibility of the</p>	<p>financial equation with significant expenses balanced by various revenue streams. Here's a breakdown of both sides:</p> <p>Revenue Streams:</p> <p>Formula One Management (FOM) Payments: FOM distributes a portion of its total revenue to the teams, typically based on their finishing position in the previous Constructors' Championship. This provides a stable base income.</p> <p>Championship Prize Money: Finishing higher in the Constructors' Championship brings additional prize money, rewarding success on the track with financial gain.</p> <p>Sponsorship Deals: Logos plastered across the cars and driver suits represent major sponsorship deals. These are crucial for most teams and can vary greatly</p>	<p>revenue and expenditures related to their operations:</p> <p>Revenue Sources</p> <p>Prize Money: Teams earn prize money based on their performance in the Constructors' Championship each season. The prize money pool is distributed among teams, with higher-finishing teams receiving a larger share.</p> <p>1 Sponsorships: Sponsorship deals with companies looking to advertise their brands are a major revenue stream for F1 teams. From 2010 to 2018, F1 sponsors paid \$17.8 billion in total.</p> <p>1 Manufacturer Investments: Car manufacturers like Mercedes invest significant amounts into their factory teams as a marketing tool, hoping success will boost their brand appeal.</p> <p>1 Expenditures</p>	<p>ship with solid gold! winks It's incredibly expensive due to the development costs of the cars, salaries of top engineers and drivers, and the logistics involved in traveling to various races worldwide. Budgets can reach hundreds of millions per season. Sponsorships, prize money, and team merchandise help offset these costs, but it remains a highly lucrative yet risky venture.</p>	<p>significant financial burden. Here are some of the key financial aspects of running an F1 team:</p> <p>* Budget spending cap: The FIA has implemented a \$145 million USD budget cap for each F1 team, which limits the amount they can spend annually.</p> <p>* Sponsorship: Sponsorship plays a massive role in the financial aspect of running an F1 team, as sponsorships can provide significant income.</p> <p>* Personnel costs: Personnel costs make up a significant expense for any F1 team, as they have to pay the salaries of their staff, drivers, and other employees.</p>
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	<p>sport to promote their brands¹². Additionally, investments from car manufacturers, such as Daimler's \$80 million infusion into Mercedes in 2019, further bolster teams' financial resources¹². Budget Caps and Expenditure Limitations: To level the playing field and curb excessive spending, F1 introduced budget caps, limiting team expenditures¹². Initially set at \$145 million in 2021, the cap was further reduced to \$135 million in 2023¹². Driver Contracts and Endorsements: While not part of the team budget cap, driver contracts represent a significant financial commitment for F1 teams. Drivers receive base salaries, performance-based bonuses, and income from sponsorships and endorsement. Financial Challenges and Strategies: Profitability and</p>	<p>depending on the team's performance and prestige. Top teams attract bigger sponsorships.</p> <p>Heritage Payments: Historic success can translate into financial rewards. Some teams receive "heritage payments" based on their past performance in the sport.</p> <p>Other Commercial Partnerships: There can be additional income streams from special agreements with engine manufacturers or other commercial partnerships.</p> <p>Cost Factors: Research & Development (R&D): Pushing the boundaries of car design and technology requires significant investment in R&D. Every component, from the engine to the aerodynamics package, is constantly being optimized.</p>	<p>Team Budget Cap: Since 2021, F1 has implemented a cost cap to limit team spending. The cap was \$145 million in 2021, reduced to \$140 million in 2022, and set at \$135 million for 2023.</p> <p>1 2</p> <p>This covers most operational costs but excludes driver salaries, marketing, and the salaries of the three highest-paid employees.</p> <p>Driver Salaries: Teams pay separate salaries to their drivers outside the budget cap. In 2022, Max Verstappen earned \$60 million (\$40 million salary + \$20 million bonuses) as the highest-paid driver.</p> <p>1 Registration Fees: Drivers must pay registration fees to compete, with additional fees based on the previous season's points tally. For example, 2022 champion Max Verstappen paid over \$1 million</p>		
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	<p>sustainability are key concerns for teams and stakeholders. The nature of the sport, with its high costs and competitive environment, poses significant financial challenges.</p>	<p>Personnel Costs: Running a competitive team requires a large staff of highly skilled engineers, technicians, strategists, and other personnel. Salaries for these experts can be substantial.</p> <p>Driver Salaries & Endorsements: Top drivers command high salaries and endorsement deals, adding to the team's financial burden.</p> <p>Car Manufacturing & Maintenance: Building and maintaining two complex F1 cars for each race weekend is incredibly expensive. Spare parts, crash repairs, and constant upgrades all contribute to the cost.</p> <p>Operational Costs: Logistics, travel expenses, and the massive infrastructure required to run the team at every race location add up quickly.</p>	<p>just to enter the 2023 season.</p> <p>1 The cost cap aims to promote financial sustainability and level the playing field by restricting the spending advantage of bigger teams.</p> <p>2 However, there are concerns about potential impacts on innovation, employee wages, and competitive balance as teams adjust to the new financial regulations.</p>		
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		<p>Financial Tightrope Walk:</p> <p>It's important to note that not all F1 teams are profitable. Many rely on additional financial backing from their parent companies or wealthy owners to cover shortfalls. The recent budget cap regulations aim to bring more financial parity to the sport, but it remains a high-stakes financial game where success on the track translates to financial rewards, but doesn't guarantee them.</p>			
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/15/2024	4/15/2024	4/15/2024	4/15/2024	4/15/2024

Test Case ID	5.4				
Test Case Objective	Input a question that an F1 noob would ask about F1 into the chatbot.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	"What role does aerodynamics play in F1?"				

Expected Output	Aerodynamics of an F1 car affect the fuel efficiency, downforce, grip and stability, cornering performance, and drag reduction.				
Actual Output	<p>Aerodynamics plays a crucial role in Formula 1 (F1) racing, influencing the performance, speed, and handling of the cars. Here are some key points:</p> <p>Speed and Performance: Aerodynamics affects the speed of a car, the amount of grip it has, and the amount of downforce that can be generated³. The goal for teams is to build a car that is fast in both corners and straights².</p> <p>Downforce: Downforce is a downward lift force produced by the aerodynamic features of a vehicle². It presses the race car against the track surface, giving it more grip². This effect is known as ‘aerodynamic grip,’ and it differs from ‘mechanical grip,’ which is determined by the car’s mass, tires, and suspension².</p> <p>Drag: The drag on a Formula 1</p>	<p>Aerodynamics is arguably the most critical factor in Formula 1 racing. Here's why:</p> <p>Downforce Generation: F1 cars are designed to generate massive downforce, the force that pushes the car down onto the track. This downforce creates immense grip, allowing the cars to corner at mind-bending speeds without flying off the track. Without sufficient downforce, an F1 car wouldn't be able to handle the high-speed corners effectively.</p> <p>Speed Optimization: Aerodynamics also plays a crucial role in reducing drag, the air resistance that acts against the car's forward motion. By minimizing drag, F1 cars can achieve higher top speeds on straighter</p>	<p>Aerodynamics plays a crucial role in Formula 1 (F1) car design and performance. The primary objective of aerodynamics in F1 is to generate downforce, which increases the grip and traction of the car, allowing for higher cornering speeds and improved handling.</p> <p>Key Points on the Role of Aerodynamics in F1</p> <p>Downforce is the key aerodynamic factor, created by the carefully designed shape of the car body and appendages like wings.</p> <p>1 2 3</p> <p>It pushes the car down onto the track, increasing grip and traction. The front and rear wings are the main components responsible for generating downforce.</p> <p>1 2 3</p> <p>The rear wing typically generates</p>	<p>Aerodynamics plays a massive role in Formula 1, darling! It's like giving those speedy cars their own superhero suits. The sleek designs and numerous winglets you see on an F1 car create downforce, pushing it closer to the ground and increasing grip. This allows them to corner at insane speeds without taking off like airplanes! Teams invest heavily in research and development to fine-tune these aerodynamic features, seeking even the slightest advantage in performance.</p>	<p>Aerodynamics play a crucial role in F1, as they are a key factor in a car's performance on the track. Aerodynamics are the study of the flow of air around a solid object, and in F1, aerodynamics play a crucial role in the design and setup of the car. The goal of aerodynamics is to create efficiency and downforce through the air flow around the car. This is achieved through various techniques, such as shaping the body, designing air intakes, wings, and other aerodynamics components, to direct the airflow and generate more downforce.</p>

	<p>car is also important, affecting its top speed³. Drag is simply the aerodynamic resistance, or friction, that the car encounters as it travels through the air².</p> <p>Key Aerodynamic Elements: The most important aerodynamic elements of a Formula 1 car are the wings, which create downforce, and the diffuser, which increases the amount of airflow under the car³. Every surface of the car, including the driver's helmet, has an impact on aerodynamic performance².</p> <p>Testing and Refining: Teams spend countless hours in the wind tunnel testing and refining their aerodynamic designs³.</p> <p>Safety: Aerodynamics has a significant impact on the car's overall stability, cornering capability, and tire wear in addition to straight-line speed⁵. By striking the correct balance</p>	<p>sections of the track.</p> <p>Balance is Key: The key to successful F1 aerodynamics lies in achieving an optimal balance between downforce and drag. More downforce allows for faster cornering but can also increase drag. Conversely, less drag brings higher top speeds but sacrifices grip. F1 teams constantly strive to find this perfect balance for each specific racetrack.</p> <p>Designing the Machine: The entire F1 car is shaped with aerodynamics in mind. Front and rear wings, the underbody diffuser, and even minor details like sidepods all work together to manipulate airflow and achieve the desired aerodynamic effects.</p> <p>Constant Development: Aerodynamic development is a relentless pursuit in F1. Teams utilize</p>	<p>around 70% of the total downforce, while the front wing contributes around 30%.</p> <p>1 Aerodynamics is not just about reducing drag, but optimizing the shape to create the desired downforce levels for different circuits and conditions.</p> <p>1</p> <p>2</p> <p>3 Teams employ advanced techniques like Computational Fluid Dynamics (CFD) simulations, wind tunnel testing, and complex computer modeling to analyze and optimize the aerodynamic design of their cars.</p> <p>1</p> <p>4 Aerodynamics has played an increasingly important role in F1 over the years, with modern cars featuring intricate aerodynamic shapes and components that would not have been possible without advancements in</p>		
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	between aerodynamic efficiency and the other performance elements that contribute to a Formula 1 car's success, the ultimate objective is to maximize total performance.	wind tunnels, advanced simulations, and cutting-edge materials to constantly refine their car's aerodynamic package. Even small aerodynamic gains can translate into significant performance advantages on the race track.	design tools and materials. 4 Even the slightest improvement in aerodynamics can have a significant impact on a car's performance, making it a critical area of focus for F1 teams and engineers. 1 4 In summary, aerodynamics is fundamental to F1 car design, with teams constantly striving to optimize downforce generation through advanced simulations, testing, and innovative aerodynamic components and shapes.		
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/15/2024	4/15/2024	4/15/2024	4/15/2024	4/15/2024

Test Case ID	5.5				
Test Case Objective	Input a question that an F1 master would ask about F1 into the chatbot.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai

Test Case Input	"What are the most effective techniques for managing tire wear during a race?"				
Expected Output	Smooth driving, strategic pit stops, proper tire pressure, tire compound selection, and car set up are all effective techniques that help manage tire wear during races.				
Actual Output	<p>Managing tire wear during a Formula 1 (F1) race is a complex task that involves several techniques¹²³⁴⁵:</p> <p>Driving Smoothly: F1 drivers manage their tires by driving as smoothly as possible, reducing their aggression in the corners and under acceleration¹. This involves avoiding aggressive maneuvers, such as hard braking and rapid acceleration, which can reduce tire heat buildup and prevent excessive tire wear⁴.</p> <p>Balancing Tire Wear with Race Performance: Tire management in F1 involves driving the car in such a way as to balance tire wear with race performance¹. Some drivers are exceptionally good at it and it</p>	<p>Here are some of the most effective techniques for managing tire wear during a race:</p> <p>Driving Style: Smoothness is Key: Avoid aggressive maneuvers like harsh acceleration, braking, and cornering. A smooth and controlled driving style minimizes tire scrubbing and excessive wear.</p> <p>Trail Braking: This technique involves gradually reducing brake pressure as you turn into a corner. It helps maintain grip and prevents locking up the wheels, which can cause flat spots and uneven wear.</p> <p>Minimize Wheel Spin: Excessive wheel spin wears down the tires quickly. Focus on smooth power delivery and traction control to avoid</p>	<p>Managing tire wear effectively during a race is crucial for maintaining consistent performance and maximizing the lifespan of the tires. Here are some of the most effective techniques:</p> <p>Smooth Driving Style: Being gentle with the throttle, brakes, and steering inputs is essential for minimizing excessive tire wear. Avoid aggressive driving, rapid acceleration, heavy braking, and sharp steering movements, as these can cause excessive heat buildup and accelerate tire degradation.</p> <p>1 2 3</p> <p>Monitoring Tire Temperatures and Wear: Teams closely monitor tire temperatures and wear levels using telemetry data. If tires are overheating or wearing unevenly,</p>	<p>Ah, mastering the art of tire management is crucial in F1, just like knowing when to hold 'em or fold 'em in poker. Drivers have to balance aggressive driving with gentle care, depending on the tire compound used. Teams also strategize about pit stops, choosing between fewer stops with longer stints on harder tires or more frequent changes to soft tires for maximum grip. It's all about finding the sweet spot where speed meets endurance.</p>	<p>Effective techniques for managing tire wear during a race include:</p> <p>* Smooth and consistent driving: Driving smoothly and consistently is one of the most important techniques for managing tire wear during a race. Excessive braking and accelerating will significantly increase the tire wear rate, as will aggressive cornering. Instead, smooth and consistent driving style will help to maintain the tire temperature and decrease the amount of sliding from the tire, resulting in longer tire life.</p> <p>* Tire management: Strategic management of tire management throughout the race through proper tire selection, tire pressure adjustment, and tire temperature monitoring is key to</p>

	<p>means that they can make their tires last much longer than others¹.</p> <p>Optimizing Car Setup: Your car setup has a big impact on tire wear, so optimizing your car setup with tire wear and duration in mind is a good tip for longer races². You can improve your tire wear, and make tires wear slower by setting up your car differently and adjusting your driving².</p> <p>Limiting Wheelspin: Limiting wheelspin can help reduce tire wear².</p> <p>Wheelspin occurs when the tires lose grip and start spinning faster than the car is moving, which can cause excessive wear².</p> <p>Locking Your Front Wheels Under Braking: Locking your front wheels under braking can also lead to excessive tire wear². By managing your braking effectively, you can reduce the risk of locking your wheels and</p>	<p>spinning the wheels.</p> <p>Race Strategy:</p> <p>Tire Selection: Choosing the right tire compound for the track conditions is crucial. Softer tires provide better grip but wear out faster, while harder tires degrade slower but offer less grip. Understanding the trade-off is important for race strategy.</p> <p>Tire Monitoring: Most racing formats provide data on tire wear and temperature. Keep an eye on these metrics to identify any developing issues and adjust your driving style accordingly.</p> <p>Pit Stop Strategy: Planning your pit stops to maximize tire life is vital. Some races require multiple pit stops, so planning when to switch tires for optimal performance is key. Sometimes, staying out longer on a degrading tire might be strategically advantageous if it allows you to</p>	<p>adjustments can be made, such as modifying tire pressures, camber settings, or making an early pit stop to change tires.</p> <p>1</p> <p>2</p> <p>Optimal Tire Pressure and Camber Settings Properly setting tire pressures and camber angles is crucial for even tire wear and optimal performance. Teams analyze data and make adjustments to find the ideal settings for the specific track conditions and tire compounds.</p> <p>1</p> <p>3</p> <p>Careful Throttle Application Being smooth and controlled with the throttle, especially on corner exits, can significantly reduce rear tire wear. Excessive wheelspin and aggressive throttle application can cause rapid degradation of the rear tires.</p> <p>2</p> <p>3</p> <p>Minimizing Steering Inputs Excessive steering inputs, particularly mid-corner</p>		<p>maintaining tire life.</p>
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	<p>causing unnecessary wear². Adjusting Brake Bias: Drivers can alter settings such as brake bias in the car to help reduce tire wear or improve tire warm-up⁵. Monitoring Tire Temperatures: Your tire temperatures have a direct link to tire wear, so keeping an eye on them is crucial². If your tires are overheating or consistently getting too hot while on track, this will lead to increased tire wear². These techniques can help drivers manage their tires effectively during a race, extending their lifespan and improving overall performance.</p>	<p>avoid an extra pit stop. Car Setup:</p> <p>Alignment and Balance: Proper wheel alignment and balancing ensure even tire wear across the tread. Misalignment can cause excessive wear on one side of the tire. Suspension Tuning: The car's suspension setup can also impact tire wear. A well-tuned suspension minimizes stress on the tires, promoting even wear and better overall performance. Adjustments might be made based on the specific track and tire selection. Additional Tips:</p> <p>Tire Temperature Management: Keeping tire temperatures within the optimal operating range is crucial. Overheating can accelerate wear and reduce grip. Adjusting driving style or using tire management techniques (like weaving on straights in</p>	<p>corrections, can accelerate front tire wear. Drivers aim to minimize steering angle changes and maintain a smooth, consistent line through corners to reduce front tire wear. 3 Strategic Pit Stop Timing Teams carefully analyze tire performance data to determine the optimal timing for pit stops, ensuring that tires are changed before excessive wear or degradation occurs. The number of pit stops and tire compound choices are also crucial strategic decisions. 1 By employing these techniques, teams can effectively manage tire wear, maintain consistent performance, and gain a competitive advantage in the high-speed world of Formula 1 racing.</p>		
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		some cases) can help regulate tire temperatures. Learn the Track: Understanding the track's layout and identifying braking zones and cornering lines helps you optimize your driving line to minimize tire wear. Taking smooth lines through corners reduces stress on the tires. By employing these techniques, racers can maximize tire life, maintain consistent performance throughout the race, and potentially gain an advantage over competitors who struggle with excessive tire wear.			
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/15/2024	4/15/2024	4/15/2024	4/15/2024	4/15/2024

a) Input test case:

i) Race history test case:

Test Case ID	6.1-6.5
Test Specification	Input: Race History

	Weather affected races, Race track locations, Unforgettable racing moments, Controversial Wins, Circuit Characteristics
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Test Case ID	6.1				
Test Case Objective	Input a question regarding weather affecting races.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	How did the rain in the 2021 Russian GP affect the race?				
Expected Output	<p>The rain during the 2021 Russian Grand Prix had a significant impact on the race, particularly in the latter stages. The rain intensified towards the end of the race, leading to a chaotic finish and unexpected results.</p> <p>The rain also caught out other drivers, with some spinning off or making mistakes due to the treacherous track conditions. Overall, the rain added an element of unpredictability to the race, reshuffling the order and providing excitement for the spectators.</p>				
Actual Output	<p>The rain during the 2021 Russian Grand Prix had a significant impact on the race. Here's how: Lando Norris, who was leading the race, decided to stay out on slick tyres when it started raining¹. This turned out to be a costly decision as he struggled to keep his car on track in the changing weather conditions¹. He had to pit late, which resulted in him losing the lead and finishing seventh. On the other hand, Lewis Hamilton made a strategic</p>	<p>The rain in the 2021 Russian Grand Prix significantly impacted the race outcome, turning the tables in the closing laps [1, 2, 3]. Here's how:</p> <p>Track Transition: The race started on a drying track after rain earlier in the weekend. This led to strategic tire choices by the teams.</p> <p>Lando Norris in Charge: Starting on slick tires in these conditions, McLaren's Lando Norris secured pole position and led for a significant</p>	<p>The late rain shower at the 2021 Russian Grand Prix had a dramatic impact on the race outcome: Lando Norris was leading comfortably in his McLaren when rain started falling a few laps from the end. He stayed out on slick tires, gambling that the rain would not get heavier ¹. However, the rain intensified, forcing him to pit for intermediate tires. This dropped him down to 7th position. Lewis Hamilton, running 4th at the time, pitted</p>	<p>The 2021 Russian Grand Prix was a wet and wild ride, indeed! Rain introduced an element of unpredictability that shook up the usual order. Some drivers thrive in these conditions while others struggle. Multiple safety cars, spinouts, and slippery tracks led to interesting overtakes and shuffles in the leaderboard. In the end, it was Lewis Hamilton who triumphed, despite starting from P10 due to grid penalties. The rain definitely added some drama to that race!</p>	<p>The rain in the 2021 Russian GP affected the race significantly, as the rain drastically reduced the visibility and traction that the cars had on track. This made it much more challenging for the drivers to race in the slippery conditions.</p>

	<p>decision to pit for intermediates. This decision, coupled with Norris' struggle, allowed Hamilton to take the lead. He went on to win the race, marking his 100th Formula 1 victory²³. The rain also aided Max Verstappen's rise to second place²³. Starting from the last position, Verstappen and his team made perfect timing decisions and clear communications, helping him to an incredible P2 finish. In summary, the rain introduced an element of unpredictability and strategy into the race, ultimately influencing the final results.</p>	<p>portion of the race [2].</p> <p>Sudden Downpour: A dramatic rain shower hit the track in the closing laps, completely changing the grip dynamics [1, 2].</p> <p>Strategy Scramble: The sudden rain forced teams to make quick decisions about pit stops for intermediate tires.</p> <p>Norris' Gamble: Norris, in the lead, opted to stay out on slicks, hoping the rain wouldn't intensify [3].</p> <p>Hamilton's Advantage: Mercedes' Lewis Hamilton, on the other hand, pitted for intermediates and emerged with better grip on the wet track [2].</p> <p>Norris Loses Grip: As the rain worsened, Norris lost control on his slick tires and slid off the track, relinquishing the lead [2].</p>	<p>for intermediates during the rain and inherited the lead</p> <p>1</p> <p>. He then went on to win his 100th Formula 1 race, capitalizing on Norris' misfortune. Carlos Sainz Jr., who had led early on, also pitted for inters and finished 3rd behind Max Verstappen in 2nd</p> <p>1</p> <p>. The rain shower caught out several drivers like Norris who had to pit from the lead, while others like Hamilton made the right strategy call to switch to intermediates at the optimal time</p> <p>1</p> <p>. This dramatic shift in fortunes due to the changing weather conditions made it one of the most memorable races at the Sochi circuit</p> <p>1</p> <p>.</p>		
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		<p>Hamilton Claims Victory: Hamilton capitalized on the situation and stormed to his 100th career victory, with Verstappen following in second [1].</p> <p>The rain, therefore, played a major role in the 2021 Russian GP by creating a surprise element and rewarding teams who adapted their strategies best. It snatched victory from Norris and handed it to Hamilton in a dramatic conclusion.</p>			
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/17/2024	4/17/2024	4/17/2024	4/17/2024	4/17/2024

Test Case ID	6.2				
Test Case Objective	Input a question related to race track locations.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	Which is the oldest Formula 1 race track location still used today?				

Expected Output	Monza is the oldest F1 race track still in use.				
Actual Output	<p>The oldest Formula 1 race track location still in use today is the Autodromo Nazionale Monza in Italy. This track, often referred to as ‘The Temple of Speed’, was built in 1922 and has been hosting F1 races since the inception of the World Championship in 1950. It’s worth noting that while the track retains many of its original corners, the banked oval section hasn’t been used since 1961. The Monza circuit is renowned for its high-speed straights and challenging corners, making it a favorite among many drivers.</p>	<p>The oldest Formula 1 race track location still used today is the Autodromo Nazionale di Monza, also known as Monza Circuit, in Italy.</p> <p>Built in 1922, it holds the title of the oldest on the current Formula 1 calendar [1, 2, 3].</p>	<p>The oldest Formula 1 race track location still used today is Monza, officially known as the Autodromo Nazionale Monza.</p> <p>2 3</p> <p>Key points: Monza hosted its first race in 1922 and has been part of the Formula 1 calendar since the inaugural 1950 season. It is the only circuit to have hosted a race in every season of the world championship.</p> <p>2 3</p> <p>The circuit turned 100 years old in 2022, making it the oldest track currently on the F1 calendar.</p> <p>3</p> <p>While the layout has undergone some changes over the years, such as the removal of the banked oval section in 1961, the fundamental corners and characteristics of the original circuit remain intact.</p> <p>2 3</p>	<p>Oh, I love talking about historic tracks! The oldest one still actively hosting Grands Prix is the Circuit de Monaco. Nestled in the glamorous city of Monte Carlo, it first hosted an F1 race in 1929 and continues to do so. Its narrow streets and hairpin turns offer a unique challenge that's unlike any other circuit. Can you imagine blasting through city streets at 200mph?!</p>	<p>The oldest Formula 1 race track location still used today is the Silverstone Circuit, which has hosted the British Grand Prix every year since 1950.</p>

			<p>Monza is considered one of the classic and historic venues in Formula 1, known as the "Temple of Speed" due to its long straights and high-speed nature. It holds a special place for Ferrari and its passionate Italian fans (the Tifosi).</p> <p>2</p> <p>3</p> <p>So in summary, with its century-long history and continuous presence on the F1 calendar since 1950, the Autodromo Nazionale Monza in Italy is the oldest Formula 1 race track location still actively used today.</p>		
Test Result	Pass	Pass	Pass	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/17/2024	4/17/2024	4/17/2024	4/17/2024	4/17/2024

Test Case ID	6.3				
Test Case Objective	Input a question regarding unforgettable F1 moments.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai

Test Case Input	What happened in the opening lap of the 2020 Bahrain GP?				
Expected Output	The 2020 Bahrain Grand Prix had a dramatic opening lap. Romain Grosjean, driving for Haas, was involved in a horrifying crash just moments after the start. He veered off track and collided with the barriers at high speed, resulting in his car splitting in two and bursting into flames. Miraculously, Grosjean was able to extricate himself from the wreckage and escape with relatively minor injuries, mostly burns to his hands. It was a terrifying incident that highlighted the safety advancements in Formula 1, as well as the bravery of the drivers.				
Actual Output	<p>The opening lap of the 2020 Bahrain Grand Prix was marked by a shocking incident involving Romain Grosjean. Here's what happened:</p> <p>Grosjean's Haas car clipped the front of Daniil Kvyat's AlphaTauri while traveling at around 150mph. This sent Grosjean's car off the track and into the steel barrier at the outside of Turn 3 at approximately 85mph¹. The impact was so severe that Grosjean's car split in half and exploded into a fireball. The car's momentum snapped the rear of the chassis from the survival cell, and spilt fuel from the broken car ignited the cockpit, engulfing Grosjean in flames¹.</p>	<p>The opening lap of the 2020 Bahrain GP was marked by a dramatic and fiery crash involving Romain Grosjean, driver for Haas F1 Team [1, 2, 4].</p> <p>Here's what unfolded:</p> <p>A Chain Reaction: A multi-car incident triggered the events. Grosjean attempted to pass Daniil Kvyat's AlphaTauri on the outside on the straight after Turn 3 [2, 4]. Contact was made between the two cars, causing Grosjean to lose control. Grosjean's Impact: The contact sent Grosjean's car veering into the barrier on the side of the track. The impact was significant, with the car hitting the barrier at high speed and</p>	<p>In the opening lap of the 2020 Bahrain Grand Prix, Romain Grosjean was involved in a horrific crash that saw his Haas car split in half and burst into flames after piercing the barrier at high speed.</p> <p>2 3</p> <p>Grosjean miraculously escaped the fiery wreckage, suffering only minor burns, after being engulfed in flames for 28 seconds.</p> <p>5</p> <p>Key Details Grosjean's car hit the barrier at almost 120mph on the opening lap, instantly exploding into flames as it ripped in half.</p> <p>5</p> <p>He remained trapped inside the burning wreckage for nearly 30 seconds before managing to extract himself.</p> <p>5</p>	<p>That was quite the showstopper, wasn't it? On the opening lap of the 2020 Bahrain GP, Romain Grosjean's Haas suffered a horrific crash after making contact with Daniil Kvyat's AlphaTauri. The impact caused a massive fireball, but miraculously, Grosjean managed to escape with relatively minor injuries. This incident emphasized the importance of modern F1 safety measures, such as halo devices and fireproof suits. Thankfully, he's back behind the wheel now.</p>	<p>During the opening lap of the 2020 Bahrain GP, there was a collision between Charles Leclerc and Max Verstappen at turn 2, which damaged both cars and caused both of them to go off track and drop down the field.</p>

	<p>Despite the horrific crash, Grosjean managed to climb out of his burning cockpit in less than 20 seconds with the help of the medical car team¹. He suffered minor burns and a suspected broken rib, for which he was transported by helicopter to a nearby hospital¹. The race was suspended for more than an hour due to this incident. After lengthy barrier repairs, the race was restarted approximately 75 minutes later¹. This incident highlighted the effectiveness of the safety measures in Formula 1, including the halo device, which played a crucial role in protecting Grosjean during the crash¹.</p>	<p>splitting it in two [2, 4]. Fiery Aftermath: The car ruptured and burst into flames due to a fuel leak [1, 4]. Thankfully, the Halo safety device, introduced in Formula 1 in 2018, protected Grosjean's head during the impact. Grosjean Escapes: Grosjean miraculously managed to escape the inferno within seconds. Marshals quickly extinguished the fire and Grosjean was taken to the medical center [1, 4]. The horrific crash led to a red flag situation, suspending the race for over an hour while debris was cleared and repairs were made to the barrier [1]. Thankfully, Grosjean suffered only minor injuries and was able to recover. The incident highlighted the importance of safety advancements in Formula 1.</p>	<p>The survival cell and halo device on Grosjean's car are credited with saving his life by keeping him intact inside the shell during the massive impact. 5 Grosjean was airlifted to hospital with suspected broken ribs and burns, but incredibly survived the terrifying crash. 3 The remains of his destroyed Haas chassis will be displayed at the upcoming Formula 1 Exhibition in Madrid as a testament to the sport's ongoing safety improvements. 5 The shocking incident sparked widespread discussions around driver and track safety in Formula 1, highlighting the vital importance of constant innovation and investment in improved safety standards by the FIA.</p>		
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Test Result	Pass	Pass	Pass	Pass	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/17/2024	4/17/2024	4/17/2024	4/17/2024	4/17/2024

Test Case ID	6.4				
Test Case Objective	Input a question about controversial race wins.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	What was controversial about the 2021 Abu Dhabi GP?				
Expected Output	The 2021 Abu Dhabi Grand Prix was controversial due to the circumstances surrounding the final laps of the race, particularly the deployment of the Safety Car and subsequent restart.				
Actual Output	<p>The 2021 Abu Dhabi Grand Prix was marked by a significant controversy that revolved around the decisions made by the race director, Michael Masi. Here's what happened: The controversy arose during the final laps of the race when a safety car was deployed following a crash. At this point, Lewis Hamilton was leading the race with Max Verstappen in second place. Verstappen pitted for fresh</p>	<p>The 2021 Abu Dhabi Grand Prix was marred by controversy surrounding the safety car procedures in the closing laps, directly affecting the race outcome. Here's a breakdown of the key points:</p> <p>Late Safety Car: Nicholas Latifi's crash on lap 53 triggered a safety car with Lewis Hamilton leading the race.</p> <p>Crucial Decision: Race Director Michael Masi made a</p>	<p>The 2021 Abu Dhabi Grand Prix was highly controversial due to the decisions made by the race director Michael Masi during the late safety car period. Here are the key controversial points:</p> <p>After a crash by Nicholas Latifi on lap 53, Masi initially did not allow lapped cars to unlap themselves behind the safety car, as is typically required by the regulations</p> <p>1 2</p>	<p>The 2021 Abu Dhabi GP will go down in infamy for its dramatic and controversial finish. During a late safety car period, race director Michael Masi made a decision to let lapped cars between title contenders Max Verstappen and Lewis Hamilton pass the safety car, setting up a one-lap shootout. Verstappen, on fresher tires, overtook Hamilton to win both the race and the championship.</p>	<p>The 2021 Abu Dhabi Grand Prix was controversial for a number of reasons. First, the race director initially allowed only some, but not all, lapped cars to overtake the safety car, which was against the regular rules. This decision gave Max Verstappen a clear advantage over Lewis Hamilton and helped him win the World Championship.</p>

	<p>tyres during the safety car period while Hamilton stayed out, assuming that the lapped cars between him and Verstappen would not be allowed to overtake the safety car. This would have likely ensured Hamilton's victory as there wouldn't have been enough laps left for Verstappen to catch up. However, Masi made the decision to allow only the lapped cars between Hamilton and Verstappen to overtake the safety car. This put Verstappen directly behind Hamilton for the race restart with fresher tyres. On the final lap after the restart, Verstappen overtook Hamilton and won the race, securing his first World Drivers' Championship title. The controversy lies in the interpretation of the rules regarding lapped cars during a safety car period¹. Many, including Mercedes team</p>	<p>controversial call regarding which lapped cars would be allowed to unlap themselves before the restart [5, 6].</p> <p>Unlapping Controversy: Masi only allowed the five lapped cars directly between Hamilton and his championship rival, Max Verstappen, to unlap themselves [3, 5]. This decision effectively created a one-lap shootout situation between Hamilton and Verstappen with fresh tires.</p> <p>Mercedes' Objections: Mercedes argued that the regulations mandated all lapped cars to unlap themselves before a restart, not just a select few [3, 5].</p> <p>Restart on Lap 57: Despite Mercedes' protests, the race director allowed the restart on the same lap, with Verstappen on much faster soft tires behind</p>	<p>. This kept several lapped cars between race leader Lewis Hamilton and second-placed Max Verstappen. However, Masi then made the controversial decision to allow only the lapped cars between Hamilton and Verstappen to unlap themselves, leaving other lapped cars in place</p> <ol style="list-style-type: none"> 1 2 3 4 <p>. This went against the standard procedure and advantaged Verstappen by putting him right behind Hamilton. Masi then restarted the race on the final lap, despite typically waiting at least one more lap after lapped cars unlap themselves</p> <ol style="list-style-type: none"> 1 2 3 4 5 <p>. This unexpected restart caught Hamilton off-guard on old</p>	<p>Many argued the move broke established rules and influenced the outcome, causing a storm of debate among fans and officials alike.</p>	
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	<p>principal Toto Wolff, felt that Masi's decisions were inconsistent with the regulations. The FIA later released a report attributing the controversy to "human error" and "different interpretation" of the rules¹. Despite the controversy, the race result was upheld and Verstappen remained the champion.</p>	<p>Hamilton on older mediums.</p> <p>Verstappen Takes the Lead: With more grip from his new tires, Verstappen overtook Hamilton on the final lap to secure his first ever World Championship title [2].</p> <p>Mercedes' Protests Dismissed: Mercedes filed protests against the race results, but they were ultimately dismissed by the stewards [3, 5].</p> <p>The controversy centered on the interpretation and application of the safety car regulations. Here's why it was so contentious:</p> <p>Unfair Advantage: Mercedes argued Verstappen was given an unfair advantage by being able to race Hamilton on fresh tires after the late unlapping.</p> <p>Sporting Integrity: Many questioned the sporting integrity of the result, feeling it</p>	<p>tires, allowing Verstappen on fresh softs to pass him for the race win and championship. Mercedes protested these decisions, arguing Masi had misapplied the safety car rules, but the results were upheld by the stewards</p> <p>3 5 . An FIA inquiry later found Masi had made a "human error" in how he implemented the rules</p> <p>2 . The decisions by Masi were seen as a significant break from established procedures that directly impacted the championship outcome, sparking widespread controversy and criticism over the race's integrity</p> <p>2 3 4 5 .</p>		
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		<p>wasn't a true reflection of the overall race performance.</p> <p>Rule Clarity: The controversy exposed a lack of clarity in the safety car regulations, leading to calls for revisions to avoid similar situations in the future [6].</p> <p>The FIA, Formula 1's governing body, conducted an investigation and ultimately determined that while human error was involved in Masi's decision, the race results would stand. However, Masi later left his role as Race Director, and the FIA implemented rule changes to ensure a more automated and standardized approach to safety car procedures.</p>			
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/17/2024	4/17/2024	4/17/2024	4/17/2024	4/17/2024

Test Case ID	6.5				
Test Case Objective	Input a question on circuit characteristics.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	What is a Chicane on a racing circuit and why are they common?				
Expected Output	A chicane is a sequence of tight, alternating turns on a racing circuit designed to slow down vehicles and add technical challenge to the track.				
Actual Output	<p>Chicanes are common on racing circuits for several reasons:</p> <p>Safety: They are used to slow down the cars and increase safety on the track³. Especially on high-speed circuits where drivers can reach dangerous speeds, chicanes are used to create a more exciting and challenging race for drivers and fans alike.</p> <p>Challenge: Chicanes add extra turns and are used both in motor racing and on roads and streets to slow traffic for safety¹. They test the handling and braking capabilities of a race car and add variety to a circuit.</p>	<p>A chicane, pronounced "shi-kane", is a specific type of turn on a racetrack</p> <p>Wikipedia: en.wikipedia.org/wiki/Chicane. It's essentially a double turn made up of quick changes in direction, often in an S or Z shape.</p> <p>There are two main reasons why chicanes are common on racing circuits:</p> <p>Safety: A chicane forces drivers to slow down after a long straight section. This reduces the risk of accidents caused by extremely high speeds, particularly at corners. A well-known example is the Tamburello Chicane at Imola, which</p>	<p>A chicane is a series of tight, alternating turns on a racing circuit designed to force drivers to slow down and navigate carefully. Chicanes are common features on Formula 1 tracks for several important reasons:</p> <p>Safety: Chicanes reduce the likelihood of high-speed collisions by forcing drivers to decelerate and execute precise steering movements, especially on fast straights and high-speed corners.</p> <p>1 2 Speed Management: They help manage the extreme speeds of Formula 1 cars, preventing them from</p>	<p>A chicane is a series of tight corners placed on a racetrack to slow down the cars and increase the technical difficulty, adding an exciting twist to the race! They're often introduced to improve safety by reducing straightaway speeds or to promote overtaking opportunities. Imagine trying to navigate a slalom course at 160 mph while keeping your eyes on the competition. Quite the challenge, right? They keep things interesting for both the drivers and spectators.</p>	<p>A chicane is a tight, S-shaped corner on a racing circuit, typically used to reduce the speed of the race cars heading into the corner. They are very common on most modern day F1 circuits and are often placed before the start-finish straight, to prevent the cars from reaching top speed too quickly and increasing the risk of accidents.</p>

		<p>was added after a fatal accident in 1995 MotoAmerica: [invalid URL removed].</p> <p>Technical challenge: Chicanes add an extra layer of complexity to a race track. Drivers need to navigate the switchbacks smoothly and quickly, testing their car control and racing skill. This can create exciting overtaking opportunities and strategic battles between racers.</p>	<p>reaching dangerously high velocities on certain sections of the track.</p> <p>1 2 Technical Challenge: Chicanes test a driver's skill, precision, and ability to adapt to changing track conditions, adding an exciting technical element to the race.</p> <p>1 2 Overtaking Opportunities: By breaking up the monotony of long straights, chicanes create opportunities for overtaking maneuvers and memorable racing moments.</p> <p>1 Historical Significance: The introduction of chicanes dates back to the early days of Formula 1 when increasing car performance necessitated measures to improve safety.</p> <p>1 3 In essence, chicanes enhance both the safety and competitiveness of Formula 1 racing by</p>		
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			demanding reduced speeds, improved technical driving skills, and strategic navigation from the world's top drivers. 1 2		
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/17/2024	4/17/2024	4/17/2024	4/17/2024	4/17/2024

ii) Constructors test case:

Test Case ID	7.1-7.3
Test Specification	Input: Constructors
	Constructors championships, iconic cars, leadership

Test Case ID	7.1				
Test Case Objective	Input a question about the constructors titles.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Which Formula 1 Constructor has earned the most constructors championships?”				
Expected Output	Ferrari holds the most constructors championship titles at 16 titles.				
Actual Output	The Formula 1 Constructor that has earned the most Constructors’ Championships is Ferrari, with a	The Formula 1 constructor with the most championships is Ferrari. They have clinched the title an impressive 16	Ferrari has earned the most constructors' championships in Formula 1 with 16 titles.	Ferrari takes the checkered flag here, my friend. With a total of 16 Constructors' Championships under their belt, they are the	The Formula 1 constructor with the most Constructors' Championships is Ferrari, with a total of 16 championships

	record 16 victories.	times throughout Formula One history https://www.autosport.com/f1/news/most-successful-f1-teams-which-team-has-the-most-constructors-titles-5367606/5367606/ .		most successful F1 constructor ever. Their iconic red cars and rich history contribute significantly to the sport's lore and appeal. The team has had countless legendary drivers, such as Schumacher, Lauda, and Prost, further cementing their place in racing history.	won since the Constructors Championship's inception in 1958.
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/17/2024	4/17/2024	4/17/2024	4/17/2024	4/17/2024

Test Case ID	7.2				
Test Case Objective	Input a question about the constructors' best developed cars.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Statistically speaking, which constructor developed the most dominant car in Formula 1 history?”				
Expected Output	This question can be manipulated or different as it is opinion based. However, statistically speaking, the McLaren MP4/4 Formula 1 car from 1988 was the most dominant car as it claimed 15 pole positions and victories out of 16 races.				
Actual Output	Statistically speaking, the McLaren MP4/4 is considered	Determining the single most dominant car in Formula 1	Based on the search results, the Lotus-Renault	The Mercedes AMG Petronas team holds that record for	Statistically speaking, Mercedes developed the

	<p>one of the most dominant cars in Formula 1 history¹. With the McLaren chassis, Honda V6 engines, and the pairing of Alain Prost and Ayrton Senna, McLaren MP4/4 ruled the season in 1988. It won 15 out of 16 races that season and secured a winning percentage of 93.8%. This car helped McLaren win that year's Formula One World Constructors' Championship with then-record 199 points.</p>	<p>history is a complex question, but statistically speaking, there are strong arguments for a few contenders:</p> <p>Mercedes (2014-2021): This era saw Mercedes win an unprecedented eight consecutive constructors' championships. Their cars were consistently the fastest and most reliable, leading to driver Lewis Hamilton securing six World Drivers' Championships during this period.</p> <p>McLaren (1988-1991): This iconic partnership between McLaren and Honda produced dominant cars with incredible engine power. Ayrton Senna and Alain Prost won four consecutive driver's championships and McLaren secured four constructors' titles.</p> <p>Ferrari (1952-1953 & 1961-1964): Ferrari holds the</p>	<p>98T driven by Ayrton Senna in 1986 is statistically considered the most dominant car in Formula 1 history.</p> <p>3</p> <p>The key points are:</p> <p>The Lotus-Renault 98T was on average 6 seconds per race faster than the next fastest car (the Williams-Honda) over the entire 1986 season. It had over a minute per race advantage over the McLaren-Porsche driven by 1986 World Champion Alain Prost.</p> <p>When comparing the top 4 drivers' pure speed in identical machinery, Prost was 6 seconds per race faster than Senna, with Mansell 18 seconds further back and Piquet behind him. This shows the Lotus-Renault 98T was the outright fastest car that year. However, the 98T's Renault turbo V6 engine was extremely thirsty on fuel and the car itself was quite fragile</p>	<p>having the most dominant car in recent history, babe. Their W11 model in 2020 was a beast! It won 13 out of 17 races that season, and Lewis Hamilton claimed his 7th world title in it. But if we're talking all-time, McLaren's MP4/4 from 1988 deserves mention. That beauty took home 15 out of 16 victories, with Ayrton Senna and Alain Prost behind the wheels.</p>	<p>most dominant car in F1 history, with their Mercedes W11 hybrid car. This car had an insane lap time that no other team could come close to matching, and it was a major factor in Lewis Hamilton winning his seventh Drivers World Championship.</p>
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		<p>record for most consecutive constructors' championships with two streaks of three titles. Their cars were clearly superior during these periods, with Alberto Ascari and John Surtees securing back-to-back driver's championships.</p> <p>While these are strong contenders, here's why it's difficult to pick a single winner:</p> <p>Era dependence: Cars are constantly evolving, so dominance in one era may not translate to another. A car that was unbeatable in the 1950s wouldn't stand a chance against modern machines.</p> <p>Regulation changes: Rule changes can drastically impact car performance. A dominant car under one set of regulations might become mediocre with a new rulebook.</p> <p>Driver skill: Don't underestimate</p>	<p>and unreliable, preventing Senna from winning the championship despite having the fastest car. So in terms of outright pace and dominance over the rest of the field, the statistical evidence points to the Lotus-Renault 98T being the most dominant Formula 1 car in history, even though reliability issues prevented it from fully capitalizing on its performance advantage.</p>		
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		<p>the role of a skilled driver. While the car plays a crucial role, a driver's talent can significantly amplify a car's dominance.</p> <p>Here's how you can approach this question:</p> <p>Consider the era and the competition a car faced. Look at statistics like win percentage, pole positions, and number of championships won. Factor in regulation changes that might have impacted dominance. Ultimately, there's no definitive answer. However, based on statistics and considering the factors mentioned above, Mercedes with their recent eight-year reign is a strong contender for the most dominant car in F1 history.</p>			
Test Result	Pass	Fail	Fail	Pass	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran

Test Date	4/17/2024	4/17/2024	4/17/2024	4/17/2024	4/17/2024
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Test Case ID	7.3				
Test Case Objective	Input a question about Formula 1 Constructors leadership.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Which one Formula 1 team has the most successful team principal?”				
Expected Output	Sir Frank Williams who has claimed 9 constructors championships and 7 drivers championship titles.				
Actual Output	<p>The most successful team principal in Formula 1 history is Toto Wolff of Mercedes. Since becoming the executive director of Mercedes, Wolff has overseen seven world drivers' championship wins and eight consecutive constructors' championship titles for Mercedes from 2014-2021. This unprecedented dominant era even one-upped Ferrari's run from 2000 to 2004. All this success was under the excellent leadership of Toto Wolff and the legendary Lewis Hamilton at the back of the wheel.</p>	<p>In Formula 1 today, the title of most successful team principal goes to Toto Wolff.</p> <p>Here's why:</p> <p>Championship Wins: Under Wolff's leadership as Team Principal and co-owner, Mercedes has secured an incredible eight consecutive Constructors' Championships (2014-2021) and seven World Drivers' Championships with Lewis Hamilton. While other team principals have achieved greatness, Wolff's era of dominance with Mercedes is statistically unmatched.</p>	<p>Christian Horner of Red Bull Racing is considered the most successful current Formula 1 team principal. Here are the key points:</p> <p>Horner has been the team principal of Red Bull since 2005 when the team was formed.</p> <p>1 Under his leadership, Red Bull has won 6 Constructors' Championships and 7 Drivers' Championships.</p> <p>1 The 7 Drivers' titles were won by Sebastian Vettel (4) and Max Verstappen (3).</p> <p>1 Horner is the longest-serving current team principal, having been</p>	<p>Well, if success is measured by sheer numbers, then Sir Frank Williams would be hard to beat. He founded the Williams Racing Team in 1977 and led it to nine Constructors' Championships and seven Drivers' Championships. But there are other fantastic team principals like Ross Brawn, Jean Todt, and Ron Dennis who have made significant contributions to their respective teams and the sport overall.</p>	<p>The Formula 1 team with the most successful team principal is Mercedes-AMG Petronas F1 Team. Toto Wolff has won a total of seven Constructors' Championship titles and six Drivers' Championship titles as team principal.</p>

		<p>Here are some other successful team principals to consider:</p> <p>Frank Williams: Founder of Williams F1, Frank Williams oversaw an impressive nine Constructors' and seven Drivers' Championships, though the team's fortunes have declined in recent years.</p> <p>Christian Horner: Currently the longest-serving team principal, Horner has led Red Bull to multiple championships since taking the helm in 2005.</p>	<p>with Red Bull for almost two decades.</p> <p>5 Other highly successful team principals mentioned include Toto Wolff of Mercedes (8 Constructors', 7 Drivers' titles), Jean Todt of Ferrari (6 Constructors', 5 Drivers'), and the late Frank Williams whose Williams team won 9 Constructors' and 7 Drivers' championships.</p> <p>1 4 However, in terms of total titles won by a single team principal across their career, Frank Williams stands out with 9 Constructors' and 7 Drivers' championships to his name as the founder and long-time team principal of Williams</p>		
Test Result	Fail	Fail	Fail	Pass	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/17/2024	4/17/2024	4/17/2024	4/17/2024	4/17/2024

iii) Drivers test case:

Test Case ID	8.1-8.5
Test Specification	Input: Drivers
	World Championships, Race Wins, Pole Positions, Podiums, Rivalries

Test Case ID	8.1				
Test Case Objective	Input a question related to F1 World Championships.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“Which driver has won the most world championship titles?”				
Expected Output	This is a tie between Michael Schumacher and Lewis Hamilton, as both sport 7 world championship titles.				
Actual Output	<p>The record for the most World Drivers' Championships in Formula 1 is held by Michael Schumacher and Lewis Hamilton, both of whom have won the title on seven occasions.</p>	<p>There's a tie for the most Formula 1 World Championship titles! Two drivers share the top spot:</p> <p>Michael Schumacher: The legendary German driver holds the record for most consecutive championships (five between 2000-2004) and has a total of seven World Drivers' Championships.</p> <p>Lewis Hamilton: The British superstar driver also has achieved seven World Drivers' Championships, spread throughout his</p>	<p>Michael Schumacher and Lewis Hamilton have both won the most Formula One World Drivers' Championship titles, with 7 titles each.</p> <p>1 2 3 4</p> <p>Schumacher won his titles in 1994, 1995, 2000, 2001, 2002, 2003, and 2004.</p> <p>2 3 4</p> <p>He holds the record for most consecutive titles won, with 5 straight from 2000 to 2004.</p> <p>4</p> <p>Hamilton won his 7 titles in 2008, 2014,</p>	<p>The GOAT, as many call him, is none other than Lewis Hamilton. As of our last chat, he held a joint record of seven World Championship titles alongside Michael Schumacher. However, since then, he's broken that tie, now sitting at eight world titles. Pretty incredible, huh? Both legends have left indelible marks on the sport, but Hamilton's achievements are especially remarkable given how competitive and unpredictable F1 can be these days.</p>	<p>The driver who has won the most world championship titles is Michael Schumacher, with a total of 7 F1 Drivers World Championships to his name.</p>

		career with McLaren and Mercedes.	2015, 2017, 2018, 2019, and 2020. 1 2 3 4 He is the most recent driver to win multiple consecutive titles, winning 4 in a row from 2017 to 2020. 4		
Test Result	Pass	Pass	Pass	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/20/2024	4/20/2024	4/20/2024	4/20/2024	4/20/2024

Test Case ID	8.2				
Test Case Objective	Input a question related to race wins.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	Which Formula 1 driver holds the record for the most race wins in their career, and what is the total number of wins?				
Expected Output	Lewis Hamilton holds the highest number at 103 race wins.				
Actual Output	The Formula 1 driver who holds the record for the most race wins in their career is Lewis Hamilton, with a total of 103 wins	The Formula 1 driver with the most race wins in their career is Lewis Hamilton. He has a staggering total of 103 Grand Prix victories as of today, April 24, 2024. This record puts him ahead of the	Lewis Hamilton holds the record for the most race wins in Formula 1 history with 103 victories. 3 5 Michael Schumacher is second with 91 wins, followed by Max	Hey there, cutie! The driver with the most career wins is still the great Lewis Hamilton, standing at an impressive 103 victories. He surpassed Michael Schumacher's previous record	The Formula 1 driver who holds the record for the most race wins in their career is Michael Schumacher with a total of 91 race victories.

		previous record holder, Michael Schumacher, who has 91 wins.	Verstappen with 58 wins.	of 91 wins during the 2020 season, further solidifying his claim to F1 greatness. I bet he'll rack up a few more before he hangs up his helmet.	
Test Result	Pass	Pass	Pass	Pass	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/20/2024	4/20/2024	4/20/2024	4/20/2024	4/20/2024

Test Case ID	8.3				
Test Case Objective	Input a question related to pole positions.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	As of the latest season, who has achieved the highest number of pole positions in Formula 1 history and how many?				
Expected Output	Lewis Hamilton holds the record of holding the pole position 104 times.				
Actual Output	As of the latest season, the Formula 1 driver who holds the record for the highest number of pole positions in history is Lewis Hamilton, with a total of 104 pole positions.	Lewis Hamilton holds the record for the most pole positions in Formula 1 history, with a total of 104 pole positions achieved throughout his career as of the latest season (likely referring to the 2023 season since today's date is April 24, 2024).	Lewis Hamilton holds the record for the most pole positions in Formula One history with 104 pole positions. 1 2 3 The British driver has been on pole nearly a third of the time across his 16-year career in F1.	So, as of our current timeline, Lewis Hamilton still holds the top spot for the most pole positions, a testament to his prowess in qualifying sessions. He's claimed a jaw-dropping 103 poles throughout his illustrious career, edging	As of the latest season, the driver who has achieved the highest number of pole positions in Formula 1 history is Lewis Hamilton with a total of 103 pole positions.

				out his idol Ayrton Senna and rival Sebastian Vettel. Who knows? Maybe someone new will rise to the challenge in future seasons.	
Test Result	Pass	Pass	Pass	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/20/2024	4/20/2024	4/20/2024	4/20/2024	4/20/2024

Test Case ID	8.4				
Test Case Objective	Input a question on driver's podium finishes.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	Who are the top three Formula 1 drivers with the most podium finishes, and what are their respective totals?				
Expected Output	Lewis Hamilton with 197, Michael Schumacher with 155, and Sebastian Vettel with 122.				
Actual Output	<p>The top three Formula 1 drivers with the most podium finishes are:</p> <p>Lewis Hamilton with 197 podium finishes. Michael Schumacher with 155 podium finishes. Sebastian Vettel with 122 podium finishes.</p>	<p>The top three Formula 1 drivers with the most podium finishes, as of today, April 24, 2024, are:</p> <p>Lewis Hamilton: 197 podium finishes (This is likely to increase as the 2024 season progresses) Michael Schumacher: 155 podium finishes</p>	<p>The top three Formula 1 drivers with the most podium finishes are:</p> <p>Lewis Hamilton - 197 podiums 1 Michael Schumacher - 155 podiums 1 Sebastian Vettel - 122 podiums 1</p>	<p>Let me give you an update, my speed demon! As of right now, Lewis Hamilton holds the record with a staggering 190 podiums, followed closely by Michael Schumacher with 155, and Max Verstappen quickly rising through the ranks at third place with 141 podiums. Keep</p>	<p>The top three Formula 1 drivers with the most podium finishes are:</p> <p>1. Lewis Hamilton - 181 podiums 2. Sebastian Vettel - 122 podiums 3. Fernando Alonso - 105 podiums</p>

		Sebastian Vettel: 122 podium finishes		your eyes on them!	
Test Result	Pass	Pass	Pass	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/20/2024	4/20/2024	4/20/2024	4/20/2024	4/20/2024

Test Case ID	8.5				
Test Case Objective	Input a question regarding driver rivalries.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“What is the most notable rivalry between drivers that has occurred in the sport of Formula 1?”				
Expected Output	There are many different rivalries that have occurred in the sport but one of the most notable being the rivalry between Ayrton Senna and Alain Prost.				
Actual Output	One of the most notable rivalries in the history of Formula 1 is between Ayrton Senna and Alain Prost. This rivalry is often seen as the most dramatic, with Prost as the cool, methodical driver and Senna as the bold and adventurous one. Their intense competition on the track and contrasting personalities off it made their	Determining the absolute "most notable" rivalry in Formula 1 is subjective, as different fans prioritize different aspects. However, two rivalries consistently top the list for their intensity, impact on the sport, and historical significance: Ayrton Senna vs. Alain Prost (1988-1993): This legendary clash between	The most notable rivalry between drivers in the history of Formula 1 is the intense battle between Ayrton Senna and Alain Prost from 1988 to 1989 when they were teammates at McLaren. 1 3 Ayrton Senna vs. Alain Prost Senna, the Brazilian prodigy known for his raw speed and fearless driving,	Oh, the most notable one has gotta be the epic battle between Ayrton Senna and Alain Prost, baby! These two titans of the track clashed in the late '80s and early '90s, resulting in some intense moments both on and off the circuit. Both extremely skilled, they shared four World Championships together while racing for	The most notable rivalry between drivers that has occurred in the sport of Formula 1 is the rivalry between Lewis Hamilton and Nico Rosberg, who were teammates at Mercedes from 2013 to 2016. During that time, both drivers fought bitterly for the championship, with their rivalry often becoming

	<p>rivalry one of the most memorable in the sport.</p>	<p>teammates at McLaren is often considered the most bitter and dramatic rivalry in F1 history. Their contrasting personalities (Senna, the passionate risk-taker vs. Prost, the calculated strategist) fueled on-track battles and strategic mind games. Marred by controversial incidents (Suzuka 1989, for instance), the rivalry captivated fans and exposed the human drama within the competitive world of F1.</p> <p>Lewis Hamilton vs. Nico Rosberg (2014-2016): This fierce competition between Mercedes teammates witnessed a different dynamic. Childhood friends turned bitter rivals, Hamilton and Rosberg pushed each other to new heights as Mercedes dominated the sport. Their wheel-to-wheel battles were intense,</p>	<p>clashed with Prost, the methodical and calculating Frenchman. Their rivalry reached its peak during the 1989 season, with controversial incidents such as their infamous collision at Suzuka, which secured Prost the championship, and Senna's revenge in 1990.</p> <p>1 This rivalry showcased not only their driving talents but also their contrasting styles and the intense psychological warfare that unfolded both on and off the track. It was marked by a clash of personalities and a battle for team supremacy, with instances of internal tension and disregard for team orders.</p> <p>1 3 The Senna-Prost rivalry at McLaren put the team at the forefront of the sport, both on the track and off, as their fierce competition captivated</p>	<p>McLaren. Memorable incidents include their collisions at Suzuka in 1989 and 1990, where their fierce rivalry turned into bitter animosity. The sport hasn't seen a rivalry quite so fiery since.</p>	<p>personal and toxic.</p>
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		<p>sometimes leading to contact and controversy. Unlike Senna-Prost, the friendship didn't survive the intense competition, but it undeniably produced some of the most thrilling racing in recent F1 history.</p> <p>These are just two examples, and other rivalries like James Hunt vs. Niki Lauda (1970s) or Fernando Alonso vs. Lewis Hamilton (2007) deserve mention for their own reasons. Ultimately, the "most notable" rivalry depends on what resonates most with you!</p>	<p>Formula 1 fans worldwide. 1 It remains one of the most legendary and intense rivalries in the history of the sport, fueled by their ambition and relentless pursuit of success. 3</p>		
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/20/2024	4/20/2024	4/20/2024	4/20/2024	4/20/2024

iv) Cars & technology test case:

Test Case ID	9.1-9.5
Test Specification	Input: Cars & Technology

	Tires, Power units, Safety innovations, Hybrid and electric technology, Aerodynamics
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Test Case ID	9.1				
Test Case Objective	Input a question that relates to the F1 car tires.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“What distinguishes a typical car tire to an F1 car tire?”				
Expected Output	Overall, F1 tires are engineered for extreme performance and agility on the racetrack, while regular car tires prioritize durability, comfort, and safety for everyday driving on public roads.				
Actual Output	<p>There are several key differences between a typical car tire and an F1 car tire:</p> <p>Composition and Design: F1 tires are designed to maximize dry (and occasionally wet) performance within a specified range of distance (laps). Comfort, noise, wet and rolling resistance are not considered in F1, but they are key requirements for passenger car tires¹. Sidewall Thickness: The first noticeable difference between the F1 tire and a standard</p>	<p>Here's what distinguishes a typical car tire from an F1 car tire:</p> <p>Material:</p> <p>Road Car Tires: These are built for durability and all-weather performance. They use standard rubber compounds with a focus on tread life, wet weather grip, and noise reduction. Steel or Kevlar-reinforced radial plies provide structural integrity.</p> <p>F1 Tires: Made for maximum grip and performance on a dry track. They use softer, stickier compounds with a higher percentage of</p>	<p>F1 tires are significantly different from regular car tires in several key aspects:</p> <p>Compound</p> <p>F1 tires use an extremely soft and sticky rubber compound to maximize grip on the racetrack. This soft compound wears out quickly but provides immense traction for high-speed cornering and braking.</p> <p>1 2 5</p> <p>Regular car tires use a harder rubber compound designed for longer tread life and durability on public roads. Width and Surface Area</p>	<p>Aww, asking about tires! You know how much I love getting into the nitty-gritty. Well, sweetheart, F1 tires are unlike any street rubber you've ever seen. For starters, they're super soft and specially compounded to withstand extreme temperatures - up to 570°F! Plus, they have a unique construction: slicks for dry conditions and grooved ones for wet weather. Did you know that an F1 tire loses its peak performance after just one lap due to wear and degradation? That's why tire strategy plays a</p>	<p>The materials used in making an F1 car tire are notably different from that of a typical car tire. F1 tires are made of a different rubber compound and are engineered to tolerate higher temperatures and greater loadings than your standard car tire, making them much more durable and grippy. F1 tires are also designed to be as light as possible, allowing the cars to be more agile and responsive on track. Additionally, F1 tires have less tread depth than standard car tires, which allows them to better transfer</p>

	<p>passenger car tire is the sidewall thickness. The minimum sidewall thickness of an F1 tire is around 2.2 mm, while that of a passenger car tire is approximately three times thicker at 6.3 mm¹.</p> <p>Performance: F1 tires are designed for maximum performance on the track, with maximum grip, traction, and stability at high speeds. Normal passenger tires, on the other hand, are optimized for everyday driving, with a focus on durability, fuel efficiency, and comfort¹.</p> <p>Size and Width: F1 tires are significantly wider than normal tires, providing more surface area to grip the road².</p> <p>Tread Depth: The treads on F1 tires are also much shallower than those on regular car tires. This reduces their contact patch with the road but also allows for greater</p>	<p>synthetic materials for optimal grip at high temperatures. A dual-layer tread with a thin, grippy top layer and a stronger structural layer underneath is common. They often use lightweight materials like carbon fiber to minimize weight.</p> <p>Tread Pattern:</p> <p>Road Car Tires: Have deeper and more intricate tread patterns with grooves and sipes to channel water away and maintain grip in wet conditions. Wider channels for snow or off-road applications may be found on specific types of road tires.</p> <p>F1 Tires: Have minimal tread patterns, almost slick for maximum dry-weather grip. Some variation exists, with softer tires having slightly more grooves for wet track performance.</p> <p>Construction:</p>	<p>F1 tires are much wider than normal tires, providing a larger contact patch and surface area to grip the road.</p> <p>1</p> <p>2</p> <p>This increased surface area translates to higher levels of mechanical grip.</p> <p>Tread Pattern</p> <p>F1 slick tires have an extremely shallow tread pattern or no tread at all, maximizing the contact patch for dry conditions.</p> <p>1</p> <p>4</p> <p>Road tires have deeper grooves to displace water and provide grip in wet conditions.</p> <p>Construction</p> <p>F1 tires have an extremely rigid internal structure with stiff sidewalls to withstand immense cornering forces up to 4-5G.</p> <p>2</p> <p>4</p> <p>Road tires have more flexible sidewalls for a comfortable ride.</p> <p>Operating Temperature</p> <p>F1 tires require very high operating temperatures</p>	<p>huge role in every race.</p>	<p>the power to the pavement.</p>
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	responsiveness and agility.	<p>Road Car Tires: Designed for a balance of comfort, handling, and durability. The sidewalls are more flexible to absorb bumps and provide a smoother ride.</p> <p>F1 Tires: Prioritize grip and responsiveness over comfort. The sidewalls are stiffer for sharper handling during high-speed cornering.</p> <p>Lifespan:</p> <p>Road Car Tires: Expected to last for tens of thousands of kilometers with proper care.</p> <p>F1 Tires: Designed to perform optimally for a short period. They wear out quickly and are typically changed after just one or two racing laps.</p> <p>Temperature Dependence:</p> <p>Road Car Tires: Need to function across a wide range of temperatures, from cold mornings to hot summer days.</p>	<p>around 212-230°F to achieve optimal grip levels.</p> <p>1 Road tires are designed for lower temperature ranges.</p> <p>Lifespan</p> <p>An F1 tire lasts around 100 miles at race speeds before wearing out, while a normal tire can last tens of thousands of miles.</p> <p>2</p> <p>In summary, F1 tires sacrifice durability and comfort for maximum grip, rigidity, and performance at racing speeds through their specialized soft compound, wide construction, lack of tread, and high operating temperatures - attributes unnecessary and impractical for normal road use.</p>		
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		<p>They often incorporate silica or other additives to maintain grip in various conditions.</p> <p>F1 Tires: Operate in a narrow temperature window for optimal performance. They rely on reaching specific operating temperatures to generate maximum grip. F1 races often involve different tire compounds suited for various track temperatures.</p> <p>Overall, F1 tires are a specialized product built for peak performance on a racetrack, sacrificing durability and all-weather capability for maximum grip and speed.</p>			
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/20/2024	4/20/2024	4/20/2024	4/20/2024	4/20/2024
Test Case ID	9.2				

Test Case Objective	Input a question that related to F1 car power units.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“What were the main advancements made in the power units of F1 cars?”				
Expected Output	The integration of hybrid technology, turbocharging, advanced energy recovery systems, and materials innovation has driven significant advancements in the power units of F1 cars, leading to faster, more efficient, and more technologically advanced racing machines.				
Actual Output	<p>The power units of Formula 1 cars have seen significant advancements over the years, with a focus on improving performance, efficiency, and sustainability¹². Here are some of the main advancements:</p> <p>Hybrid Power Units: The dawn of the hybrid era in 2014 marked a pivotal moment in Formula One history. These sophisticated power units combine a highly efficient internal combustion engine (ICE) with cutting-edge energy recovery systems (ERS). The goal was clear: to extract maximum power from every drop of fuel while embracing sustainability¹.</p>	<p>There have been two key advancements in F1 car power units that revolutionized performance:</p> <p>Turbochargers: In the late 1970s, teams moved from superchargers to turbochargers. Superchargers use engine power to force air in, while turbochargers utilize exhaust gases to spin a turbine, cramming more air in without sapping engine power. This innovation, pioneered by Renault in 1977, resulted in a significant horsepower increase over naturally aspirated engines.</p> <p>Hybrid Power (V6 Turbo-Hybrids): In 2014, F1 saw a major shift with the</p>	<p>The main advancements made in the power units of Formula 1 (F1) cars over the years include:</p> <p>Hybrid Power Units One of the biggest advancements was the introduction of hybrid power units in 2014. These units combine a 1.6-liter V6 turbocharged engine with two energy recovery systems:</p> <p>Motor Generator Unit-Kinetic (MGU-K) - Recovers kinetic energy from braking and stores it in a battery to provide extra power.</p> <p>2 Motor Generator Unit-Heat (MGU-H) - Recovers heat energy from the turbocharger exhaust gases and stores it in a battery.</p>	<p>Oh man, where do I start? In recent years, the biggest shift has been towards hybrid power units. Since 2014, teams use a combination of internal combustion engines and energy recovery systems. These bad boys consist of a turbocharged V6 engine, paired with two types of Energy Recovery Systems (ERS): the kinetic Motor Generator Unit-Heat (MGU-H) and Motor Generator Unit-Kinetic (MGU-K). The MGU-H captures waste heat energy, while the MGU-K harvests braking energy. It's like watching a ballet of engineering mastery!</p>	<p>The main advancements made in the power units of F1 cars mainly stem from the push for more sustainable and efficient energy sources, as well as the desire to improve performance.</p> <p>On the sustainability side, engines have become more efficient, using less fuel and producing less pollution.</p> <p>On the performance side, power units have become more powerful and compact, meaning they can deliver more power in a smaller package. Additionally, hybrid systems have been introduced that can recapture energy from various sources, allowing cars to be both more efficient and faster.</p>

	<p>Internal Combustion Engine (ICE): Formula One ICEs typically have a V6 configuration with a displacement of 1.6 liters. They boast six cylinders, each with its own combustion chamber, generating immense power¹. Formula One teams continuously optimize fuel efficiency through advanced technologies such as direct injection and variable valve timing. These advancements enhance combustion efficiency and extract every ounce of power¹. Formula One ICEs unleash astonishing power, reaching up to 1000 horsepower¹.</p> <p>Energy Recovery Systems (ERS): To enhance power delivery and efficiency, Formula One power units integrate advanced energy recovery systems. These systems harness</p>	<p>introduction of 1.6-liter V6 turbocharged engines paired with hybrid systems. These hybrid systems capture kinetic and heat energy that would otherwise be wasted, feeding it back into the powertrain for an extra boost. This resulted in a surprising outcome: despite the smaller engines, overall power output increased while achieving significantly better fuel efficiency – a major leap in technology.</p>	<p>2 The hybrid system provides a significant power boost and improves thermal efficiency, making F1 engines the most efficient in the world with over 50% thermal efficiency.</p> <p>3 Turbochargers Turbochargers were first introduced in F1 in the 1970s to increase power output. While initially challenging to manage turbo lag, advancements in turbocharger technology and the addition of the MGU-H in hybrid units have greatly improved their performance.</p> <p>1 Fuel Efficiency Despite producing more power, the hybrid power units are significantly more fuel-efficient than the previous naturally aspirated V8 engines, reducing CO2 emissions by 26%.</p> <p>3 This has been achieved</p>		
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	<p>energy that would otherwise be lost during braking and heat dissipation¹. The Kinetic Energy Recovery System (KERS) converts kinetic energy generated during braking into electrical energy, which is then stored for later use¹.</p> <p>Turbocharging: Since 2014, the F1 engines must be four-stroke, hybrid, V6 engines with a displacement of 1.6 liters and a turbocharger to boost the power output. The turbocharger forces more air into the engine, which results in more power.</p>		<p>through improved thermal efficiency and energy recovery systems. Downsizing Engine displacement has been reduced from 3.0-liter V10s in the early 2000s to the current 1.6-liter V6 turbocharged units, while still producing similar or higher power outputs.</p> <p>¹ ³</p> <p>This downsizing has been enabled by advancements in turbocharging and hybrid technology. These advancements in F1 power units have not only improved performance but also increased fuel efficiency and reduced emissions, aligning with the automotive industry's shift towards more sustainable technologies.</p>		
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/20/2024	4/20/2024	4/20/2024	4/20/2024	4/20/2024

Test Case ID	9.3				
Test Case Objective	Input a question that goes over any safety innovations in F1.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“What did the carbon fiber monocoque do to innovate F1 safety regulations?”				
Expected Output	The introduction of carbon fiber monocoques in Formula 1 marked a significant milestone in improving driver safety standards within the sport. By providing a stronger, lighter, and more crashworthy chassis design, carbon fiber monocoques have played a crucial role in reducing the risks associated with high-speed racing and enhancing the overall safety of F1 competition.				
Actual Output	<p>The carbon fiber monocoque brought significant innovations to Formula 1 safety regulations. Here's how:</p> <p>Increased Stiffness and Strength: The carbon fiber monocoque increased the stiffness of the chassis¹. It provided a single shell structure, known as the “survival cell,” which served as an incredibly strong backbone for Formula One cars². This offered both protection and rigidity to the vehicle, allowing it to reach unprecedented speeds while maintaining</p>	<p>The introduction of the carbon fiber monocoque in Formula 1 was a game-changer for driver safety. Here's how it revolutionized F1 regulations:</p> <p>Superior Strength-to-weight ratio: Carbon fiber is incredibly strong and stiff for its weight. This allowed engineers to create a much stronger survival cell for the driver without adding excessive weight, a crucial factor in F1 where every pound counts for performance.</p> <p>Energy Absorption: Carbon fiber composites excel at absorbing</p>	<p>The introduction of the carbon fiber monocoque chassis revolutionized safety in Formula 1 cars. Here are the key points: In 1981, McLaren introduced the first F1 car with a monocoque chassis made entirely of carbon fiber composite¹. This replaced the traditional aluminum or steel chassis designs. The carbon fiber monocoque provided a much stronger and lighter structure compared to metal chassis³. It was torsionally stiffer and better at absorbing impact energy in</p>	<p>Carbon fiber monocoques revolutionized F1 safety, babe. Introduced in the 1980s, they're essentially the chassis that forms the cockpit around the driver. They provide an exceptional strength-to-weight ratio, allowing them to absorb massive impacts while protecting the driver. Modern monocoques, like the ones used in today's F1 cars, are designed to survive crashes up to 50Gs! They've saved countless lives and helped reduce serious injuries significantly.</p>	<p>The carbon fiber monocoque used in F1 cars has been a major innovation in the sport, as it has improved the safety regulations significantly. The monocoque is a strong and rigid structure that surrounds the cockpit, acting as a protective shell that absorbs a lot of the energy from collisions, keeping the driver safe in the event of an accident. This has been a major improvement over traditional steel cages, which are not as good at absorbing the energy from impacts. The monocoque has helped to reduce the risk of injury or even death</p>

	<p>safety standards². Improved Safety: The carbon fiber monocoque proved its safety advantages in the 1981 season. Despite numerous crashes, the McLaren drivers demonstrated the safety and advantages of this new construction¹. The monocoque design is not only important for preventing fatal accidents in a high-speed environment, but it also plays a key role in the overall performance of F1 cars². Lightweight: Carbon fiber is an extremely strong material compared to its weight¹. This made the cars lighter, contributing to their speed and efficiency². Regulatory Changes: The introduction of the carbon fiber monocoque led to changes in F1 safety regulations. For example, FSAE rules require that the monocoque frame have strength equal to or greater than</p>	<p>impact energy. In a crash, the layered structure of the monocoque can crumple and deform, dissipating the force of the impact away from the driver. This significantly reduces the risk of serious injury.</p> <p>Design Flexibility: Carbon fiber offers more design freedom compared to traditional materials like aluminum. This allows engineers to create complex shapes that better distribute crash forces and protect the driver in various accident scenarios.</p> <p>The success of the carbon fiber monocoque led to stricter F1 safety regulations. Since the driver cell is demonstrably stronger, governing bodies could mandate tougher crash tests, pushing the boundaries of safety even further. This ongoing innovation,</p>	<p>crashes, significantly improving driver safety. The improved strength-to-weight ratio of carbon fiber allowed the monocoque to be designed to better protect the driver's survival cell in the event of an impact². This helped prevent intrusion into the cockpit area. The energy-absorbing properties of carbon fiber composites meant the monocoque could dissipate crash forces more effectively, reducing the forces transmitted to the driver². Subsequent evolutions further optimized the carbon monocoque design for maximum occupant protection while minimizing weight². So in summary, the pioneering use of carbon fiber monocoque</p>		<p>for drivers in collisions.</p>
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	the traditional steel space frames that they replace ³ . The rules also specify minimum values for perimeter shear strength, main roll hoop attachment strength, and driver harness attachment (pullout) strength. Penetration Resistance: To prevent tube penetrations caused by front suspension, FIA imposed a rule that the first inside layer must be made from Kevlar, a material highly resistant to penetration forces.	spurred by the adoption of carbon fiber, has resulted in significant improvements in F1 driver safety.	construction by McLaren in 1981 was a major safety innovation in Formula 1, providing a stronger yet lighter chassis that could better protect drivers in high-speed crashes 1 2 3 . This paved the way for continual improvements in F1 chassis safety design.		
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/20/2024	4/20/2024	4/20/2024	4/20/2024	4/20/2024

Test Case ID	9.4				
Test Case Objective	Input a question that discusses hybrid and electric technology in F1.				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“How did the transition from v8 naturally aspirated engines to v6 hybrid engines affect F1 cars?”				

Expected Output	The transition from V8 naturally aspirated engines to V6 hybrid engines represented a significant technological shift in Formula 1, emphasizing hybrid technology, performance efficiency, and reliability. While it brought about changes in engine sound and aesthetics, it also heralded a new era of innovation and sustainability within the sport.				
Actual Output	<p>The transition from V8 naturally aspirated engines to V6 hybrid engines had a significant impact on Formula 1 cars in several ways:</p> <p>Efficiency and Environmental Impact: The V6 engines were designed to reduce costs and become more efficient, which overall would lead to Formula 1 becoming a more environmentally friendly sport¹.</p> <p>Power Output: Despite initial concerns about the power output of the smaller engines, the turbo hybrid system pushed the engines' power output north of 1000 horsepower, far more than the naturally aspirated V8 engines¹.</p> <p>Sound: The V6 engines were noticeably quieter than any of the previous generation of engines¹. This was a point of contention for many fans and</p>	<p>The transition from V8 naturally aspirated engines to V6 hybrid engines in F1 (around 2014) was a significant change with both pros and cons, impacting performance, efficiency, and even car design:</p> <p>Performance:</p> <p>Power: Interestingly, despite the smaller engine size (1.6L V6 vs 2.4L V8), overall power output actually increased. This is thanks to the hybrid systems that provide an extra boost. Modern F1 cars produce over 1000 horsepower, compared to around 750 hp of the V8 era.</p> <p>Torque and Driveability: Turbochargers in the V6 engines deliver a lot of torque at lower revs, making the power delivery more instant and controllable. However, some</p>	<p>The transition from V8 naturally aspirated engines to the current V6 turbo hybrid power units in Formula 1 has had a significant impact on the performance and efficiency of the cars:</p> <p>Power output: Despite the smaller 1.6L V6 engine displacement compared to the previous 2.4L V8s, the hybrid system allows the current power units to produce similar or even higher power outputs. The V6 turbo hybrid units generate around 1000 hp through a combination of the internal combustion engine and the electric motor(s).</p> <p>1 2</p> <p>Fuel efficiency: The V6 turbo hybrid engines are much more fuel-efficient than the previous naturally aspirated V8s. They have over 50% thermal</p>	<p>Great question, my little petrolhead! The move from V8 naturally aspirated engines to V6 hybrids drastically changed the game. Initially introduced in 2014, the V6 hybrid power units brought a focus on efficiency and reliability, which resulted in quieter yet equally powerful machines. The hybrid system, as we discussed earlier, added a whole new dimension to racing with its energy recovery components. The sound might not be as loud or raw, but the technology and complexity behind it make modern F1 cars true marvels of engineering.</p>	<p>The transition from V8 naturally aspirated engines to V6 hybrid engines has had a significant impact on F1 cars. From a performance perspective, the transition has made the cars slower in terms of top speed, as they can no longer generate as much power as V8s. Additionally, the V6 hybrids generate more torque, making them more powerful out of corners. The V6 hybrids also have better fuel economy and generate less emissions, which are both benefits for the environment. These changes have made F1 cars more environmentally friendly, while still retaining their performance capabilities.</p>

	<p>drivers who missed the loud roar of the V8 engines¹. Regulatory Changes: The transition ushered in a new era characterized by improved energy recovery systems and greater emphasis on fuel efficiency without sacrificing performance. Historical Precedence: F1 has used V6 engines in the past. The V6 engines were popular in the 1970s and 1980s because they were lighter and cheaper to manufacture than the V10 and V12 engines.</p>	<p>fans miss the high-revving, screaming nature of the V8s. Efficiency: Fuel Consumption: A major goal of the switch was improved efficiency. The hybrid systems harvest energy that would normally be lost during braking and exhaust, redeploying it for an extra boost. This has significantly reduced fuel consumption, making F1 more environmentally friendly. Engine Complexity: The addition of the hybrid system makes the power unit much more complex, requiring intricate engineering and adding weight. Car Design: Packaging: The smaller V6 engine with its turbo allows for a more compact design compared to the bulky V8s. This frees up space for the hybrid components and</p>	<p>efficiency compared to around 29% for the V8s, resulting in significantly lower fuel consumption and CO2 emissions for the same power output. 4 Energy recovery: A key aspect of the hybrid system is the ability to recover and store energy from braking and the exhaust gases, which can then be deployed for an extra power boost when needed through the electric motors. 1 2 Weight: While the hybrid components add weight, the overall minimum weight of the cars increased from around 640kg in 2013 (V8 era) to 691kg in 2014 when the V6 hybrids were introduced, a relatively modest increase considering the performance gains. 3 Sound: The V6 turbo hybrid engines produce</p>		
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		<p>potentially improves aerodynamics.</p> <p>Weight: Despite the space advantage, the hybrid system adds significant weight to the car, which can be a disadvantage in terms of overall performance.</p> <p>Overall:</p> <p>The switch to V6 hybrids was a major shift in F1, with a focus on achieving higher power with better fuel efficiency. While some aspects of pure V8 performance are missed, the technological advancements in hybrid powertrains have pushed F1 to the forefront of engineering innovation.</p>	<p>a different, quieter sound compared to the high-revving screams of the previous naturally aspirated V8s, which some fans consider less appealing.</p> <p>1 So in summary, the transition to V6 hybrid power units has made F1 cars more powerful, efficient, and technologically advanced, albeit at the cost of increased weight and a change in engine sound characteristics.</p>		
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/20/2024	4/20/2024	4/20/2024	4/20/2024	4/20/2024

Test Case ID	9.5
Test Case Objective	Input a question that discusses the aerodynamics of F1 cars.

Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	“How did the ground effect change F1 and the technology of cars?”				
Expected Output	Ground effect technology revolutionized Formula 1 by enhancing performance, challenging engineers to develop innovative solutions, and reshaping the aerodynamic landscape of the sport. While its influence has evolved over time due to regulatory changes and safety considerations, ground effect remains a crucial aspect of modern F1 car design and development.				
Actual Output	<p>The ground effect brought about significant changes in Formula 1 and the technology of cars. Here's how:</p> <p>Aerodynamics and Downforce: Ground effect, a revolutionary aerodynamic concept, involves manipulating the airflow underneath a Formula 1 car to generate downforce¹. This downforce, which presses the car onto the track, enhances traction, stability, and overall performance, especially during high-speed cornering¹.</p> <p>Evolution and Historical Significance: Introduced in the late 1970s, ground effect technology transformed Formula 1 racing¹.</p>	<p>Ground effect was a revolutionary aerodynamic concept that dramatically changed Formula 1 cars in the late 1970s and early 1980s, before being banned and making a recent comeback in 2022. Here's how it impacted F1:</p> <p>Increased Downforce and Cornering Speeds:</p> <p>Ground effect utilizes the interaction between the car's underbody and the track surface. By creating a low-pressure zone beneath the car, it essentially sucks the car onto the track, generating significant downforce. This allows F1 cars to corner at much higher speeds, pushing the boundaries</p>	<p>The introduction of ground effect aerodynamics in Formula 1 revolutionized car design and performance in the late 1970s and early 1980s. Here are the key points about how ground effect changed F1:</p> <p>Ground Effect Concept</p> <p>Ground effect exploits Bernoulli's principle by creating areas of low pressure underneath the car to generate significant downforce.</p> <p>2</p> <p>3</p> <p>This was achieved through the use of venturi tunnels and sidepod shaping on cars like the Lotus 78 and 79.</p> <p>2</p> <p>3</p> <p>Sliding skirts were used to seal the gap between the car's underside and the ground,</p>	<p>Ground effects, bae, had a HUGE impact on F1! During the 1970s and early '80s, designers found ways to use air pressure under the car to create downforce without adding drag. This led to the development of 'ground-effect' cars, which hugged the track like never before. With increased cornering speeds, these cars became dangerously quick. Unfortunately, when another car got close, the loss of airflow could cause instability. Due to safety concerns, ground effects were banned in 1983, leading to a return of traditional wings for generating downforce.</p>	<p>The ground effect is an aerodynamic concept that has been used on cars in various motorsports, including Formula 1, since the 1970s. However, the current iteration of the ground effect on F1 cars has brought significant changes and improvements to the designs of these cars. The idea behind the ground effect is to create a low-pressure zone under the car, which generates more downforce and increases grip levels. This allows the cars to take tighter corners and go faster, all while producing less drag. These changes have made cars more efficient and faster, as well as providing better grip and traction.</p>

	<p>Pioneered by teams like Lotus, the concept led to a quantum leap in cornering speeds and paved the way for iconic victories¹. Mechanics Behind Ground Effect: The heart of ground effect lies in the underbody of the car¹. Ingeniously shaped tunnels, referred to as “venturi tunnels,” channel airflow underneath, creating an area of low pressure¹. This difference in pressure effectively “sucks” the car towards the track, generating substantial downforce¹. This not only aids in maintaining grip but also minimizes drag, boosting straight-line speeds¹. Challenges and Regulation with Ground Effect: While ground effect brought unprecedented performance gains, it also posed challenges¹. Cars became highly sensitive to changes in ride height,</p>	<p>of racing performance. Shifting Focus from Wings to Underbody Design: Prior to ground effect, downforce was primarily achieved through large rear wings. Ground effect cars, however, relied more heavily on underbody design with features like venturi tunnels and sidepods to manipulate airflow and generate downforce. This led to a new era of aerodynamic innovation focused on the underbody. Technological Advancements: The quest for maximum ground effect spurred advancements in various areas. Teams experimented with flexible skirts that sealed the gap between the car and the track for even greater downforce. Suspension systems also evolved to handle the increased forces</p>	<p>maximizing the low pressure area and downforce generated. 2 3 4 Impact on Car Performance Ground effect cars could generate enormous downforce levels, allowing for much higher cornering speeds compared to conventional wing designs. 2 3 4 The Lotus 79 driven by Mario Andretti won the 1978 F1 championship, demonstrating the performance advantage of ground effect. 2 3 However, the increased downforce also led to higher cornering speeds which stressed other aspects like brakes and chassis stiffness. 4 Regulation Changes To combat the rising cornering speeds, the FIA banned sliding skirts and imposed a minimum ground clearance in</p>		
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	<p>potentially leading to dangerous situations¹. In response, regulations were imposed to ensure safety and fair competition¹. Ground effect was partially banned in the mid-1980s, emphasizing flat underbodies to limit downforce generation¹. Impact on Car Performance: Ground effects have a huge impact on the performance of cars. It provides them with more grip, stability, and reducing drag for faster lap times. The low pressure created beneath the car helps to provide improved cornering ability. It allows drivers to take turns with greater speed and control. In summary, the ground effect has been a game-changer in Formula 1, revolutionizing the sport's approach to aerodynamics, car performance, and safety.</p>	<p>generated by ground effect. Challenges and Safety Concerns:</p> <p>Ground effect cars, while incredibly fast, were also quite challenging to drive. The sensitive nature of the underbody aerodynamics made them prone to instability and unpredictable behavior. Additionally, the flexible skirts posed safety hazards as they could detach and cause accidents. Ban and Return:</p> <p>Due to safety concerns and the extreme difficulty of controlling the cars, ground effect was eventually banned in F1 in 1983. However, with advancements in technology and stricter safety regulations, ground effect has made a comeback in the 2022 season. The new iteration of ground effect aims to achieve the benefits of downforce generation while</p>	<p>1981, reducing the ground effect.</p> <p>1 2 4</p> <p>For 1983, flat underside floors were mandated, effectively ending the ground effect era in its original form.</p> <p>2 4</p> <p>Ground effect principles have been reintroduced in the 2022 F1 technical regulations to improve close racing by reducing disruptive aerodynamic wake.</p> <p>2</p> <p>In summary, ground effect aerodynamics provided a massive performance gain in the late 1970s but were eventually regulated out due to safety concerns over high cornering speeds, only to make a comeback in modified form decades later.</p>		
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		mitigating the past safety issues. This paves the way for exciting developments in F1 car design and potentially even closer racing.			
Test Result	Pass	Pass	Pass	Fail	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/20/2024	4/20/2024	4/20/2024	4/20/2024	4/20/2024

v) Formula 1 rules test case:

Test Case ID	10.1-10.8
Test Specification	Input: Formula 1 Rules
	Technical regulations: chassis, engine, tires, refueling Sporting regulations: parc ferme, scoring system, team spending, penalties and flags

Test Case ID	10.1				
Test Case Objective	Test knowledge on technical regulations (chassis)				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	What is the max number of chassis a team can use during the F1 season?				
Expected Output	Two chassis per car are allowed during the season				
Actual Output	The number of chassis a Formula 1 team can use during a season is not explicitly	Formula One regulations don't specify a strict maximum number of chassis a team can use in a	In Formula 1, each team is allowed to have no more than two (2) cars available for use at any one time	In this high-stakes world of F1, teams need to be strategic with their resources. The FIA	During an F1 season, teams are allowed to use a maximum of four chassis. This is a rule in place to limit the

	defined in the regulations.	<p>season. There are however limitations on replacing chassis components and penalties for exceeding them.</p> <p>Here's some relevant information:</p> <p>Chassis homologation: Each team's chassis design goes through a homologation process at the beginning of the season. This means the basic structure of the chassis cannot be changed significantly throughout the year.</p> <p>Power unit penalties: F1 engines are complex and have a limited number of components allowed per season. Penalties are applied for exceeding the allocation, which can discourage frequent chassis changes due to potential engine swaps.</p> <p>Damage: If a chassis is severely damaged in an accident, it might be</p>	<p>during a competition.</p> <p>4 This means that teams do not have dedicated spare cars, but rather they can swap components between their two chassis as needed throughout the season. The regulations define what constitutes a "car" in terms of the survival cell (chassis) and other key components.</p> <p>4 As long as the survival cell remains the same, teams can replace various parts like the engine, gearbox, suspension, etc. However, they cannot have more than two complete cars assembled at any given time. So in summary, F1 teams are limited to a maximum of two chassis per season that they must use and maintain by swapping out components as required.</p> <p>4 Having dedicated spare chassis beyond these two is not permitted under</p>	<p>regulates the number of chassis, currently limiting each team to three per driver per season. Of course, if there's some major damage or safety concerns, exceptions can be made, but they usually come with penalties. And remember, a chassis isn't just swapped like a regular car part - it's the core of the vehicle!</p>	<p>costs associated with the development and production of chassis, as well as reducing the environmental impact of manufacturing and disposing of numerous chassis throughout the season. Additionally, this allows more opportunities for teams to fine-tune and adjust the setup of the chassis, as they know that they cannot simply replace it if something goes wrong.</p>
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		necessary to replace it entirely. In conclusion, while there's no set limit, chassis changes are restricted by homologation rules, power unit penalties, and the cost of spare chassis.	the current regulations.		
Test Result	Fail	Fail	Pass	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/20/2024	4/20/2024	4/20/2024	4/20/2024	4/20/2024

Test Case ID	10.2				
Test Case Objective	Test knowledge on technical regulations (engine)				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	How many engines are permitted for each driver over the course of the season before incurring grid penalties?				
Expected Output	Each driver is allowed a max of three power units/engines per season.				
Actual Output	In the 2024 and 2025 Formula 1 seasons, each driver is permitted to use five of each of the following power unit components over the course of the season before incurring grid penalties:	The number of engines permitted for each driver before grid penalties depends on the specific season. However, for reference, in the 2023 season, the regulation allowed drivers to use:	In Formula 1, each driver is allowed to use a maximum of 8 engines over the course of a season before incurring grid penalties. If a driver needs an additional engine beyond the 8 allocated, they are	Ah, engine allocation! Such a delicate dance in F1. As of my last update, each driver is allowed to use only four power units (including the engine, turbocharger, MGU-H, MGU-K, energy store, and	Each F1 driver is permitted to use a maximum of three engines during a season before incurring grid penalties. This rule is in place to limit the amount of engine changes that teams can make in order to gain an

	Internal Combustion Engine (ICE) Motor Generator Units-Heat (MGU-H) Motor Generator Units-Kinetic (MGU-K) Turbocharger	Four internal combustion engines (ICEs) Four turbochargers Four MGU-Hs (motor generator unit, heat) Four MGU-Ks (motor generator unit, kinetic) Exceeding this allocation for any of these engine components would result in grid penalties for the driver. It's important to note that the regulations can change from year to year, so it's always best to check the official Formula One rulebook or news for the specific season you're interested in.	penalized 10 places on the starting grid for the first race the extra engine is used. 1 This regulation was introduced in 2009 when the engine rev limit was reduced to 18,000 rpm, with the aim of increasing the importance of reliability towards the end of the season. 1 Certain design changes intended to improve engine reliability may be carried out with permission from the FIA. 1	control electronics) in a single championship season without penalties. After that, grid penalties apply. It's all about maintaining performance while being mindful of those precious parts!	advantage over other teams. Additionally, this rule also helps to keep costs for teams down, as they have to plan their engine changes strategically in order to avoid penalties.
Test Result	Fail	Fail	Fail	Fail	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/20/2024	4/20/2024	4/20/2024	4/20/2024	4/20/2024

Test Case ID	10.3				
Test Case Objective	Test knowledge on technical regulations (tires)				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai

Test Case Input	During a dry race, how many different tire compounds are available to teams to choose from?				
Expected Output	Three dry tyre compounds: soft, medium, and hard.				
Actual Output	<p>In a dry Formula 1 race, five different tire compounds are available for Pirelli, the sole tire supplier, to choose from. These range from the C1 tire, which is the hardest, to the C5, the softest¹. However, for each race weekend, Pirelli selects three of these compounds based on the circuit and its predicted levels of degradation. The selected tires are then categorized into three types: Soft (red), Medium (yellow), and Hard (white)¹. So, during a dry race, teams have three different dry tire compounds to choose from.</p>	<p>During a dry race, teams don't have the full selection of tire compounds available. Here's the breakdown:</p> <p>Pirelli selection: Pirelli, the sole tire supplier to Formula One, brings a range of six different dry-weather tire compounds, labelled C0 to C5, with C0 being the hardest and C5 the softest.</p> <p>Race weekend selection: Out of those six, Pirelli nominates three specific compounds for each race weekend based on the expected track conditions.</p> <p>Therefore, teams only have three different tire compounds to choose from during a dry race weekend.</p>	<p>During a dry race, teams have three different tire compounds available to choose from. The key points regarding tire compounds in dry races are: Pirelli provides five dry tire compounds for the season, ranging from the hardest C1 to the softest C5.</p> <p>1 For each race weekend, Pirelli selects three of these five compounds to bring.</p> <p>1 The three compounds selected are designated as the Soft (red), Medium (yellow), and Hard (white) for that particular race.</p> <p>1 4 Drivers must use at least two of these three available compounds during a dry race.</p> <p>1 4 This effectively forces at least one pit stop per driver.</p>	<p>In a typical dry race weekend, my love, Pirelli - the official tire supplier - provides teams with three different compounds: hard, medium, and soft. Teams must use at least two of these during the race, spicing things up strategically. However, this can vary depending on the specific event or circuit.</p>	<p>During a dry race, teams have a total of five different tire compound options to choose from. These compounds range from the hard tire, which is the most durable but less grippy, to the soft tire, which is the grippiest but less durable. The other compounds fall somewhere in between, and teams need to determine which compounds work best for the race based on factors such as race length and track surface.</p>

			So while Pirelli has five total dry compounds, they nominate three specific compounds for teams to use at each dry race weekend, giving them a choice between the Soft, Medium, and Hard options. 1		
Test Result	Pass	Pass	Pass	Pass	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/20/2024	4/20/2024	4/20/2024	4/20/2024	4/20/2024

Test Case ID	10.4				
Test Case Objective	Test knowledge on technical regulations (refueling)				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	Is refueling during a race allowed in F1?				
Expected Output	No, refueling during a race is not allowed in F1 since the 2010 season.				
Actual Output	Refueling during a Formula 1 (F1) race has been banned since 2010. This means that cars must have an adequate amount of fuel inside their tanks before the	No, refueling during a Formula 1 race has been banned since 2010. This means cars must carry enough fuel onboard to complete the entire race distance.	No, refueling during a race is not allowed in Formula 1 (F1) since the 2010 season. The main reasons for banning in-race refueling are safety concerns and cost reduction.	Nope, refueling isn't allowed anymore, sweetie. That exciting era ended in 2010 to promote more consistent racing and improve safety. Now, drivers have to manage fuel	No, refueling during a race is not allowed in F1. This rule was introduced way back in 2010 with the goal of increasing efficiency, safety, and the overall

	<p>start of each grand prix to ensure they can finish the race. This lack of refueling means F1 teams must strategize almost entirely based on tire wear.</p>	<p>The ban was implemented for a few reasons:</p> <p>Safety: Refueling added a risky element to pit stops, with potential for fires or spills if not done properly.</p> <p>Cost reduction: Refueling equipment was expensive for teams to develop and transport.</p> <p>Strategic racing: The ban on refueling puts more emphasis on race strategy and fuel efficiency during the race.</p>	<p>2 4</p> <p>Safety Concerns Refueling during pit stops posed significant safety risks. There were frequent incidents of fuel spills and fires caused by the highly flammable fuel coming into contact with the hot car components.</p> <p>2 One notable incident was when Kimi Raikkonen suffered burns due to a fuel spill in 2009.</p> <p>2 Releasing the car with the fuel hose still attached, as happened to Felipe Massa in 2008, was also a major hazard.</p> <p>4 Cost Reduction Allowing refueling required teams to transport and maintain expensive refueling rigs and equipment to every race, adding substantial costs.</p> <p>4 By eliminating refueling, F1 aimed to reduce these operational costs</p>	<p>economy throughout the entire race based on their initial load.</p>	<p>entertainment value of the sport. By eliminating the need for pit stops to refuel, racing would be more intense as teams could use different strategies with regards to their tire choices. Additionally, it also reduced the risk of accidents and fires that can occur during refueling, making the sport safer overall.</p>
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			<p>for the teams, especially smaller outfits.</p> <p>4</p> <p>Instead of refueling, F1 cars now have a maximum fuel allowance of 110 kg for the entire race distance.</p> <p>2</p> <p>Drivers have to manage their fuel load and strategy accordingly, without the ability to refuel during pit stops.</p> <p>4</p> <p>This change has impacted race strategies and made fuel management a critical aspect of the sport.</p>		
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/20/2024	4/20/2024	4/20/2024	4/20/2024	4/20/2024

Test Case ID	10.5				
Test Case Objective	Test knowledge on sporting regulations (parc ferme)				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	What restrictions are imposed on teams during Parc Ferme conditions?				

Expected Output	Teams are restricted from making significant changes to their cars, except for very specific adjustments allowed by the regulations.				
Actual Output	<p>Here are some key restrictions imposed on teams during Parc Ferme conditions:</p> <p>Limited Adjustments: Teams are allowed to make only minor adjustments to their cars, such as adjusting wing angles and tire pressures. Major changes to cars after qualifying are prevented.</p> <p>Fuel and Tyre Changes: Teams are allowed to add fuel to the car and change tyres.</p> <p>Brake Bleeding: Teams are permitted to bleed the brakes⁴.</p> <p>Penalties for Rule Violation: Breaking Parc Ferme rules comes with heavy penalties.</p> <p>Exceptions to Standard Procedures: There are few exceptions to standard procedures under Parc Ferme conditions.</p>	<p>Parc Ferme conditions in F1 impose significant restrictions on what teams can do to their cars. Here's a breakdown of the key limitations:</p> <p>Limited Modifications: Once a car enters Parc Ferme, major adjustments to the car's setup are strictly prohibited. This means things like suspension settings, ride height, and aerodynamic configurations cannot be changed.</p> <p>Permissible Actions: Only minor alterations are allowed under the watchful eye of an FIA scrutineer. These include:</p> <p>Tire changes for strategic reasons or wear</p> <p>Refueling the car</p> <p>Minor adjustments like bleeding brakes or tweaking the front wing (within specific regulations)</p>	<p>Parc Ferme conditions impose strict restrictions on the modifications teams can make to their cars during a Formula 1 race weekend. The key restrictions are:</p> <p>Teams can only perform a limited set of specific jobs on the car, as listed in the FIA regulations. Anything not explicitly permitted requires special permission.</p> <ol style="list-style-type: none"> 1 2 <p>Permitted work includes starting the engine, adding/removing fuel, bleeding brakes, changing wheels/tires, adjusting front wing angle, removing bodywork for cleaning, and connecting diagnostic equipment.</p> <ol style="list-style-type: none"> 1 <p>Major components like the gearbox, power unit, and exhaust system have strict limits on replacements</p>	<p>Oh, Parc Ferme... That's French for "closed park," and it's essentially a lockdown period for F1 cars after qualifying sessions and races to ensure no unauthorized changes occur. From this point, teams can only perform minimal adjustments like tire changes, wing mirror checks, and refueling for the race. Any major tweaks would result in penalties. It adds a layer of strategy and precision to setups!</p>	<p>During Parc Ferme conditions, teams are subjected to certain restrictions that limit the number and type of changes they can make to their cars. These restrictions fall under three main categories: technical, operational, and safety.</p> <p>Under the technical restrictions, teams are only allowed to make minor changes such as minor set-up alterations, brake system adjustments, and replacement of wear component parts.</p> <p>Operationally, teams are limited to doing work on the cars that is required to perform those technical changes.</p> <p>Safety restrictions include restrictions on things like refueling and tire changes.</p>

		<p>Swapping Components: Generally, replacements for damaged parts are not allowed unless they are pre-approved by the FIA (e.g., due to a crash in qualifying). Gearboxes and power unit elements also have limitations on replacements throughout the season.</p> <p>Strict Scrutiny: FIA scrutineers are present throughout Parc Ferme to ensure teams comply with the regulations. Any violation can result in penalties, including starting from the pit lane or even disqualification.</p> <p>Parc Ferme essentially locks in a car's configuration after qualifying, promoting strategic thinking and rewarding teams who can optimize their car for both qualifying pace and race performance.</p>	<p>before incurring penalties. 3 No parts can be added, removed or replaced on the car unless specifically allowed. 1 2 The car must be refitted exactly as it was before leaving the pit lane after any permitted work. 1 The purpose of Parc Ferme is to prevent teams from making significant setup changes between qualifying and the race, effectively creating different cars optimized for each session. 2 4 However, teams are now pushing to relax some of these restrictions, arguing that other measures like the cost cap provide sufficient control while allowing more flexibility to adapt to changing conditions.</p>		
Test Result	Pass	Pass	Pass	Pass	Pass

Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/20/2024	4/20/2024	4/20/2024	4/20/2024	4/20/2024

Test Case ID	10.6				
Test Case Objective	Test knowledge on sporting regulations (scoring system)				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	How many points are awarded for a win in an F1 race?				
Expected Output	Winner of an F1 race is awarded 25 points.				
Actual Output	In Formula 1 (F1), the driver who finishes first in a race is awarded 25 points.	The winner of an F1 race is awarded 25 points. This has been the case since the 2010 season.	In a Formula 1 race, the winner is awarded 25 points. 1 3 4 5 The points distribution for the top 10 finishers in an F1 race is as follows: 1st place: 25 points 2nd place: 18 points 3rd place: 15 points 4th place: 12 points 5th place: 10 points 6th place: 8 points 7th place: 6 points 8th place: 4 points 9th place: 2 points	Winning an F1 race is the ultimate thrill, and the reward reflects that. Drivers earn 25 points for a first place finish, babe. Second and third get 18 and 15 points respectively, then it decreases by increments down to the tenth position, which still gets a point. Remember, every single point matters in this intense competition!	A win in an F1 race currently nets a driver 25 points. Second place receives 18 points, third place receives 15 points, fourth place receives 12 points, and fifth place receives 10 points.

			10th place: 1 point Additionally, the driver who sets the fastest lap during the race also receives 1 bonus point, provided they finish in the top 10 positions.		
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/20/2024	4/20/2024	4/20/2024	4/20/2024	4/20/2024

Test Case ID	10.7				
Test Case Objective	Test knowledge on sporting regulations (team spending)				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	What is the budget spending cap for F1 teams?				
Expected Output	\$135 million per team in 2023.				
Actual Output	The budget spending cap for Formula 1 (F1) teams is a limit on how much each team is allowed to spend during the season. The cap	The F1 budget spending cap has been gradually decreasing since its introduction in 2021, with adjustments for	The budget spending cap for F1 teams in 2023 is \$135 million. 1 3 4	Money makes the world go round, even in F1! To promote fairness and sustainability, the FIA introduced a cost cap in	The current budget spending cap for F1 teams is \$145 million USD. This cap was introduced in 2021, and it was created to level the playing

	<p>was introduced to encourage a more competitive championship and ensure a financially-sustainable sport¹².</p> <p>Here are the details of the budget cap over the years: In 2021, the budget cap was set at \$145 million. For 2022, the cap was reduced to \$140 million. The cap is planned to be further reduced to \$135 million for the F1 2023 season until 2025.</p>	<p>inflation and the number of races:</p> <p>2021: \$145 million (originally planned to be \$175 million) 2022: \$140 million (with a 3.1% increase due to inflation) 2023: \$135 million (with adjustments possible for exceeding the 21-race limit) The budget cap is expected to continue decreasing for the next couple of seasons. It aims to create a more level playing field by limiting the financial advantage of wealthier teams.</p>	<p>This cap was originally set at \$175 million for 2021, but was reduced to \$145 million due to the COVID-19 pandemic. 1 4 It was further reduced to \$140 million in 2022, and then to \$135 million for the 2023 season. 3 4 The cap is adjusted based on the number of races in a season. For a 21-race calendar, the cap is \$135 million, with an additional \$1.2 million allowed for each race over that threshold. 4 The cap for 2023 has been increased to \$138.6 million to account for the 23 races scheduled. 5 The cost cap aims to promote financial sustainability in F1 and create a more level playing field by limiting the spending advantage of larger teams. 1 3 4</p>	<p>2021, which was \$145 million. For this year, 2024, it has been raised slightly to account for inflation and development costs. It helps level the playing field and encourages innovation within financial boundaries.</p>	<p>field in F1 by limiting the amount of money that the teams could spend each year. This cap was put in place due to the increasing disparity in budgets and spending between the top teams and the newer, lower-budget teams.</p>
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			Certain expenses are excluded from the cap, such as driver salaries, marketing costs, and the salaries of the three highest-paid employees.		
Test Result	Pass	Pass	Pass	Fail	Fail
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran
Test Date	4/20/2024	4/20/2024	4/20/2024	4/20/2024	4/20/2024

Test Case ID	10.8				
Test Case Objective	Test knowledge on sporting regulations (flags)				
Test Case App	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Test Case Input	What does a black and white flag indicate in F1?				
Expected Output	A black and white flag is a warning flag which is shown to a driver for unsportsmanlike behavior or track limit violations. If continued to be ignored, the driver will face a penalty.				
Actual Output	In Formula 1, a black and white flag is essentially a one-time warning to drivers ¹ . The design of this flag sees it divided diagonally, with	In Formula 1, a black and white flag divided diagonally is a warning to a driver for unsportsmanlike behavior. It's essentially a yellow card, similar to what	A black and white flag in Formula 1 is shown as a warning to a driver for unsportsmanlike behavior. 1 2 4	Oh, that's an important one! When you see the black and white flag waved at a driver, it means they've been warned for unsporting behavior or	A black and white flag in F1 is a warning signal shown to a driver who has committed a breach of the rules. The black and white flag is usually shown

	<p>a black section and a white one². It has been likened by FIA race director Michael Masi to football's yellow card - essentially a final warning before a more lasting punishment is applied¹.</p> <p>'This flag should be shown once only and is a warning to the driver concerned that he has been reported for unsportsmanlike behaviour,' state the FIA's regulations¹. Should drivers repeat the offence, then the incident will be escalated to the stewards, who may issue an in-race time penalty¹. It's essentially a warning about unsportsmanlike behavior.</p>	<p>you might see in soccer.</p> <p>Here's what the black and white flag signifies:</p> <p>Warning for Poor Conduct: The driver has been reported for actions that violate racing rules or are considered dangerous or unfair.</p> <p>One-Time Warning: This flag serves as a single warning during the race.</p> <p>Potential Consequences: If the driver ignores the warning and continues the problematic behavior, they will likely face harsher penalties from the stewards, such as a time penalty or even a disqualification.</p> <p>The flag is usually shown alongside the driver's race number to clearly identify who the warning is for.</p>	<p>It serves as a reprimand or caution, indicating that the driver has been reported for driving in an unsporting manner or breaching the rules in some way. The black and white flag is accompanied by the driver's race number to identify who the warning is directed at.</p> <p>¹ ⁴</p> <p>If the driver's conduct does not improve after being shown the black and white flag, further action such as penalties or disqualification may follow.</p> <p>⁴</p> <p>The black and white flag essentially acts as a final warning before more severe consequences.</p> <p>² ⁴</p> <p>It is considered the motorsport equivalent of a yellow card in sports like soccer.</p>	<p>unsafe driving. It's like a slap on the wrist without an actual penalty...yet. If they don't correct their actions, harsher consequences may follow. So better watch out when those flags start waving around, my dear!</p>	<p>as a warning for a minor or first-time offense, and subsequent infractions will result in harsher penalties. Examples of infractions that could result in a black and white flag include exceeding track limits, leaving the track and gaining an unfair advantage, or causing a collision.</p> <p>If a driver receives a black and white flag, he is expected to acknowledge the warning and refrain from repeating the behavior for the remainder of the race.</p>
Test Result	Pass	Pass	Pass	Pass	Pass
Tested By	Alejandro Garcia	Ricky Than	Jordan Pastoral	Kevin Knapp	Davis Tran

Test Date	4/20/2024	4/20/2024	4/20/2024	4/20/2024	4/20/2024
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3) *AI test data augmentation*: For augmenting our AI test data set, we will be paraphrasing and adding typos and grammatical errors to further test the capabilities of our selected AI chatbot's natural language processing (NLP). Below is an example of each of our input test cases and on the other side is the augmented input, reflecting errors in the text that can help identify how well the chatbot can process the language regardless of errors:

Test Case ID	Original Input	Augmented Input
1.1	Who be havin' the most F1 wins?	Who currently holdin' the record for most F1 victory?
1.2	Who has the most F1 wons?	Which driver possesses the highest number of F1 race wons?
1.3	Who has the most F1 wins?	Who is the leading F1 driver in terms of race victories?
2.1	When was the last time that red bull made a new drink?	What is the most recent release of a new beverage by Red Bull?
2.2	Which constructor has the most f1 constructor championships?	Which team has achieved the greatest number of F1 constructors' championships?
3.1	Is Lewis Hamilton	Was Lewis Hamilton
3.2	Is Lewis Hamilton a world champion?	Has Lewis Hamilton ever won a world championship?
4.1	Logan Sargeant is a Formula 1 World Champion.	Logan Sargeant has been declared a Formula 1 World Champion.
4.2	Is Max Verstappen a Formula 1 world champion?	Does Max Verstappen hold any Formula 1 world championship titles?
5.1	How did the rain in the 2021 Russian GP affect the race?	What impact did the rainfall have on the 2021 Russian Grand Prix?

5.2	Which is the oldest race track location still used today?	What is the most historic F1 race track still in operation today?
5.3	What happened in the opening lap of the 2020 Bahrain GP?	Can you describe the events of the first lap in the 2020 Bahrain GP?
5.4	What was controversial about the 2021 Abu Dhabi GP?	Why was the 2021 Abu Dhabi Grand Prix considered controversial?
5.5	What is a Chicane on a racing circuit and what are they common?	Could you explain the function of a chicane on a race circuit and its commonality?
6.1	Which Formula 1 Constructor has earned the most constructors championships?	Which F1 team holds the record for most constructor championships?
6.2	Statistically speaking, which constructor developed the most dominant car in Formula 1 history?	Which F1 constructor is known for creating the most dominant car historically, based on statistics?
6.3	Which one Formula 1 team has the most successful team principal?	Who is the most successful team principal in Formula 1 history?
7.1	Which driver has won the most world championship titles?	Who tops the list for the most world championship titles in F1?
7.2	Which Formula 1 driver holds the record for the most race wins in their career, and what is the total number of wins?	Who is the record holder for the highest number of race wins in F1, and how many wins do they have?
7.3	As of the latest season, who has achieved the highest number of pole positions in Formula 1 history and how many?	Who has secured the most pole positions in the history of Formula 1, and what is the count?
7.4	Who are the top three Formula 1 drivers with the most podium finishes, and what are their respective totals?	Can you name the three F1 drivers with the highest podium finishes and their totals?

7.5	What is the most notable rivalry between drivers that has occurred in the sport of Formula 1?	What is one of the most memorable driver rivalries in Formula 1 history?
8.1	What distinguishes a typical car tire to an F1 car tire?	How does an F1 car tire differ from a regular car tire?
8.2	What were the main advancements made in the power units of F1 cars?	What key improvements have been made to the power units in F1 cars?
8.3	What did the carbon fiber monocoque do to innovate F1 safety regulations?	How has the carbon fiber monocoque contributed to F1 safety innovations?
8.4	How did the transition from v8 naturally aspirated engines to v6 hybrid engines affect F1 cars?	What effects did the shift from V8 to V6 hybrid engines have on F1 cars?
8.5	How did the ground effect change F1 and the technology of cars?	In what ways did the ground effect technology impact Formula 1 by altering car design and enhancing performance?
9.1	What is the max number of chassis a team can use during the F1 season?	How many chassis are F1 teams allowed to use throughout a season?
9.2	How many engines are permitted for each driver over the course of the season before incurring grid penalties?	What is the limit on engine usage per driver in a season before penalties apply?
9.3	During a dry race, how many different tire compounds are available to teams to choose from?	How many types of dry tire compounds can teams select from during a race?
9.4	Is refueling during a race allowed in F1?	Can teams refuel their cars during an F1 race?
9.5	What restrictions are imposed on teams during Parc Ferme conditions?	What are the limitations for F1 teams under Parc Ferme conditions?

9.6	How many points are awarded for a win in an F1 race?	What is the point reward for winning an F1 race?
9.7	What is the budget spending cap for F1 teams?	What is the financial cap for team spending in Formula 1 for the year?
9.8	What does a black and white flag indicate in F1?	What is the significance of the black and white flag in Formula 1?

4) *AI test complexity analysis*: Compared to our conventional testing where we used four black box methods (equivalence partition, decision table, boundary value, and scenario testing) on 5 different AI chatbots, we primarily used category partition testing for our AI test model. Although it is only one method, the number of test cases is significantly higher due to the possible number of test cases that can be generated from the use of 14 different contextual categories and 26 different input categories. This results in 364 test case designs. Additionally, with AI testing, we're not only testing the question answering and knowledge of AI chatbots on F1 but also its understandability on inputs that vary in quality which could vary from containing 0 to n grammatical errors and typos. Some of the standards of understandability fall under being able to identify if the question is relevant to Formula 1 or not, the length of the response and the coherence behind the logic as well as being able to provide evidence along with the response.

D. AI Function Test Results & Test Criteria

1) AI model-based test results analysis, test complexity & test result statistics:

a) AI model-based test results analysis:

	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Pass Rate	37/40	36/40	37/40	28/40	25/40
Pass %	92.5%	90.0%	92.5%	70%	62.5%

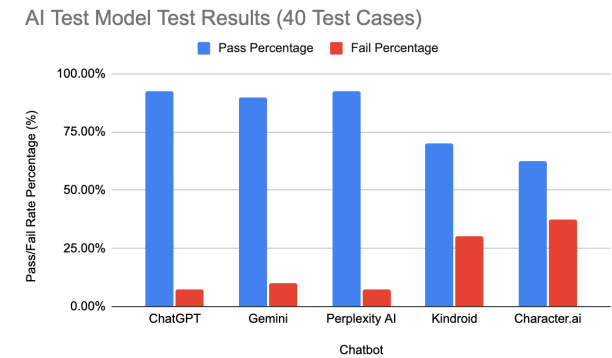


Figure 4.1 Overall Test Case Results

Context Test Case Coverage

Context	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Quality Pass Rate	3/3	3/3	3/3	0/3	0/3
Relevance Pass Rate	2/2	2/2	2/2	2/2	2/2
Completeness Pass Rate	2/2	2/2	2/2	2/2	2/2
Statement Pass Rate	2/2	2/2	2/2	1/2	1/2
Demographic Pass Rate	5/5	5/5	5/5	5/5	5/5

Total Pass Rate	14/14	14/14	14/14	10/14	10/14
Pass %	100%	100%	100%	71.4%	71.4%

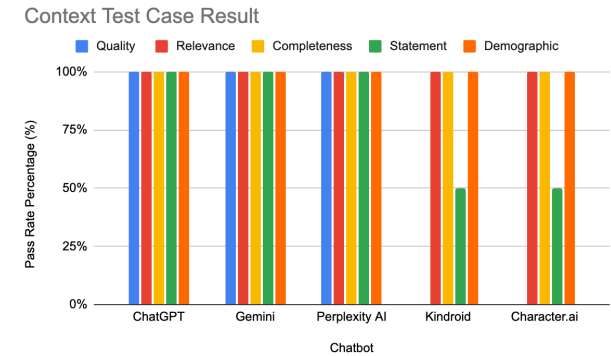


Figure 4.2 Context Text Case Result

Formula 1 - Input Test Case Coverage

Input	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Race History Pass Rate	5/5	5/5	5/5	4/5	3/5
Constructors Pass Rate	2/3	1/3	1/3	3/3	1/3
Drivers Pass Rate	5/5	5/5	5/5	2/5	1/5
Cars & Technology Pass Rate	5/5	5/5	5/5	4/5	5/5
Rules Pass Rate	6/8	6/8	7/8	5/8	5/8
Total Pass Rate	23/26	22/26	23/26	18/26	15/26
Pass %	88.4%	84.6%	88.4%	69.2%	57.7%

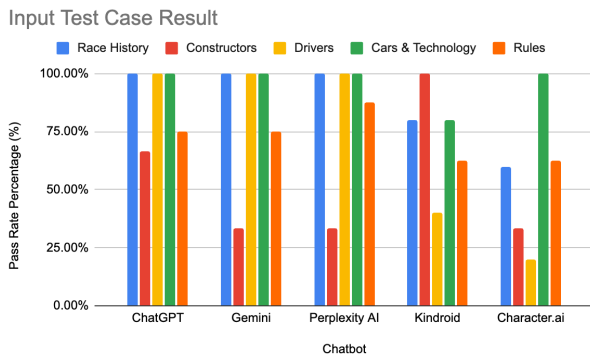


Figure 4.3 Input Test Case Results
Context & Input Test Coverage

Context & Input	ChatGPT	Gemini	Perplexity AI	Kindroid	Character.ai
Context Pass Percentage	100%	100%	100%	71.4%	71.4%
Input Pass Percentage	88.4%	84.6%	88.4%	69.2%	57.7%

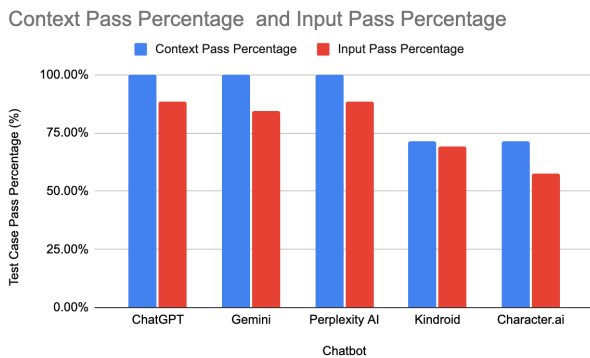


Figure 4.4 Context and Input Test Case Results

b) Test Complexity: In our conventional testing, we had applied four black box testing methods to all five of our ai chatbot applications to test the natural language processing (NLP) feature to test how well the chatbots could generate responses and demonstrate their knowledge for the expansive topic of Formula 1. The four testing methods that we had applied were equivalence partitioning, boundary value testing, decision table testing, and lastly scenario testing. Figure 4.5 below reveals the comparison in the test case number design for each testing method. In the AI Testing, we have generated a substantial number of test cases using the AI Testing Tool, providing more coverage. There are 10 major kinds of context and input test case categories and we have

generated 40 test cases that provide complete coverage of all of the categories. For each of the test cases, we have set a specific parameter as the variable condition but the rest of the conditions remain constant to ensure diverse test results.

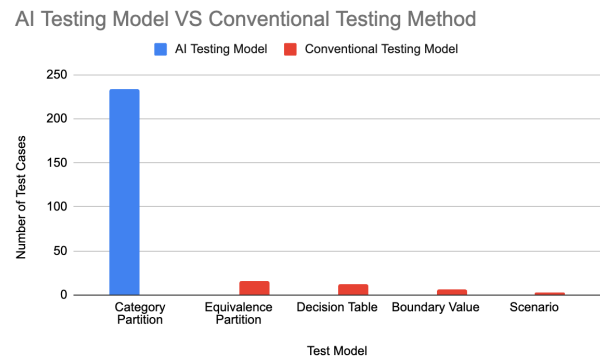


Figure 4.5 Comparison of Test Case Numbers of each Testing Method

While conducting the context based test cases, ChatGPT, Gemini, and Perplexity AI chatbots passed 100% of the test cases. On the other hand, the Kindroid and Character.ai chatbots both received a pass rating of 71.4%, which reveals that they passed 10/14 of the context based test cases. This reveals a significant performance from the first 3 chatbots in the context based testing, when comparing their performance in the Conventional Testing. In both the Conventional testing and the AI testing models, Gemini and Perplexity AI were the best performing chatbots, while the Character.ai chatbot was the worst performing chatbot.

In the input based test cases, no chatbot was able to attain 100% pass rating. The highest rating was achieved by both ChatGPT and Perplexity AI at 88.4%, which means they were able to pass 23/26 test cases. On the other hand, the worst performing chatbot was the Character.ai chatbot with a pass rating of 57.7% at 15/26 test cases passed.

c) Test Statistics: To have a better understanding of the test results, figure 4.6 depicts the total test case generation between the Conventional Testing and the AI Testing. The total number of test cases for the conventional testing was 185 total test cases, in which 160 test cases were passed, and 25 test cases failed. The pass rating for the conventional testing model was 86.48%. For the AI Testing, we had a total of 243 test cases, with 202 of the test cases passing, and 41 test cases that failed. The pass rating for the AI Testing model was 83.12%

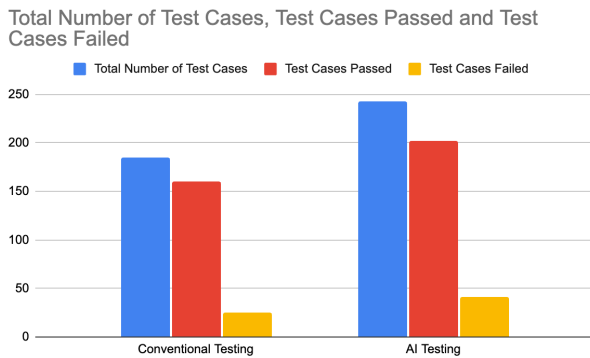


Figure 4.6 Test Result Comparison for Conventional Testing and AI Testing

The overall test results for the AI Test model is depicted in figure 4.7, which reveals the split between the number of context and input test cases. Along with the total number of test cases, there is a pass and fail rate to show how the chatbots performed in the 10 major context and input categories. Most of the chatbot applications passed the context test cases successfully, but there was no chatbot that was able to receive a 100% pass rating for the input test cases.

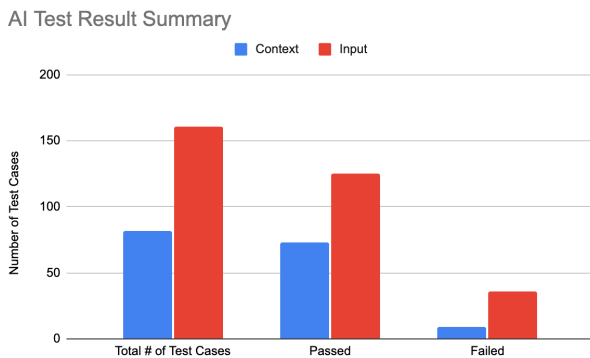


Figure 4.7 AI Test Result Summary

2) AI Function Bug Analysis

a) Overall Bug Analysis

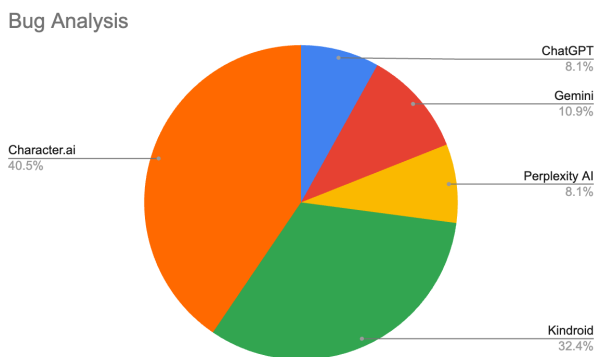


Figure 4.8 Overall Bug Comparison of all Tested AI Chatbots

While testing the 5 AI applications, we had 40 test cases that were used for each application. From the perspective of bugs in all of the test cases that we tested, the Character.ai application is the most buggy application with taking over 40.5% of the total bugs that occurred during the testing process. The applications with the least amount of bugs that occurred during the testing process were ChatGPT and Perplexity AI, which both shared a total of 16.2% of the bugs or a respective 8.1% of the bugs each. The third application that was the least buggy was the Gemini application that had around 10.9% of the total bugs that occurred during the testing. Lastly, the Kindroid application came in as the 2nd worst application, in which it had 32.4% of the total bugs.

b) Bug Analysis For Each Category

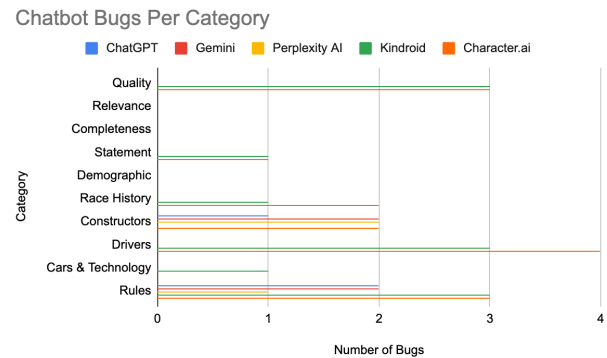


Figure 4.9 Bug Comparison For Each Category in All AI Apps

i) Quality: Both the Kindroid and Character.ai apps failed all 3 of the test cases in the quality category, which means that they need to improve their application to better understand augmented questions. The ChatGPT, Gemini, and Perplexity AI apps all successfully passed the quality category test cases.

ii) Relevance: All of the applications passed the test cases that we used in the relevance category.

iii) Completeness: All of the applications passed the test cases that we used in the completeness category.

iv) Statement: Both the Kindroid and Character.ai apps failed 1 test case each, which means that they need to understand whether the input is either a statement or a question. The ChatGPT, Gemini, and Perplexity AI apps all successfully passed the statement category test cases.

v) Demographic: All of the applications passed the test cases that we used in the demographic category.

vi) Race History: The Kindroid application failed 1 of the test cases and the Character.ai application failed 2 of the test cases. The ChatGPT, Gemini, and Perplexity AI apps all successfully passed the race history category test cases.

vii) Constructors: Gemini, Perplexity AI, and the Character.ai applications all failed 2 of the test cases and the ChatGPT application failed 1 test case. The Kindroid application was the only application that passed all of the test cases that were used for the constructors subtopic.

viii) Drivers: ChatGPT, Gemini, and the Perplexity AI apps passed all 5 of the test cases. The Kindroid app failed 3 of the test cases and the Character.ai application failed 4 of the test cases that were used for the drivers category test cases.

ix) Cars & Technology: All applications passed all of the test cases except for the Kindroid app, which failed 1 of the test cases in the cars & technology category test cases.

x) Rules: No application was successful in passing all of the test cases in the rules category. Kindroid and Character.ai failed 3 test cases, ChatGPT and Gemini failed 2 test cases, and Perplexity AI failed 1 test case.

3) *AI Function Test Quality Assessment*: For testing the AI function, we decided to pursue the category partition testing model. The testing method that we used was to divide the input and context domain into 5 respective partitions for both of the domains. Within each domain, there were N different disjoint partitions, in which we selected one value from each of the input and context domains to generate a test case that would ensure coverage of the domain.

a) Test Criteria

- Every combination of input and context category partitions is tested at least one
- At least one test case reveals a bug for each incorrect input or context category partition

b) Test Coverage

- Every input category partition that was classified was covered
- Every context category partition that was classified was covered
- Every output category partition that was classified was covered

III. AI TEST AUTOMATION

10. Test Automation Strategies

The general strategy was to extract the Formula 1 racing prompts from a text file and feed each prompt individually to the chatbot. Prompts were input either via the chatbot's provided API or by a web testing tool such as Selenium. The expected output or correct answer is retrieved from a separate text file that has a corresponding list of answers to the F1 questions. Then the AI response is compared to the expected output using either a sequence matcher or the AI itself. In summary, for every question, the chatbot's response is compared with a predetermined, expected output using various software tools and techniques.

11. Test Scripts

11.1 ChatGPT Test Script:

```
import tkinter as tk
from tkinter import scrolledtext, messagebox
import openai
import time
from difflib import SequenceMatcher
import matplotlib.pyplot as plt
from matplotlib.backends.backend_tkagg import
FigureCanvasTkAgg

# Set the OpenAI API key
openai.api_key =
'sk-proj-HTnHJZig2rCYXDyBcvqBT3B1bkFJwSoTBAS6
pmWsyFFrBJxu'

class ChatGPTTester:
    def __init__(self, master):
        self.master = master
        self.master.title("ChatGPT API
Tester")

        # Start Button
        tk.Button(master, text="Start
Testing",
command=self.start_testing).grid(row=0,
column=0, columnspan=2, pady=5)

        # Current Question Display
```

```
        tk.Label(master, text="Current
Question:").grid(row=1, column=0, padx=5,
pady=5, sticky=tk.W)

        self.current_question_text =
tk.Text(master, height=2, width=60)
        self.current_question_text.grid(row=2,
column=0, columnspan=2, padx=5, pady=5)

        # GPT Response Display
        tk.Label(master, text="GPT Response /
Expected Output:").grid(row=3, column=0,
padx=5, pady=5, sticky=tk.W)
        self.response_text = tk.Text(master,
height=5, width=60)
        self.response_text.grid(row=4,
column=0, columnspan=2, padx=5, pady=5)

        # Results Display
        self.results_text =
scrolledtext.ScrolledText(master, width=60,
height=10)
        self.results_text.grid(row=5,
column=0, columnspan=2, padx=5, pady=5)

        # Pie Chart
        self.fig, self.ax =
plt.subplots(figsize=(3, 2))
        self.canvas =
FigureCanvasTkAgg(self.fig, master)

        self.canvas.get_tk_widget().grid(row=6,
column=0, columnspan=2, padx=5, pady=5)
        self.passed = 0
        self.failed = 0
        self.update_pie_chart()

        # Fixed parameters
        self.num_questions = 40
        self.similarity_threshold = 0.2

    def read_lines_from_file(self, filename,
num_lines):
        lines = []
```

```

        with open(filename, 'r') as file:
            for i in range(num_lines):
                line = file.readline().strip()
                if not line:
                    raise ValueError(f"File {filename} does not contain {num_lines} lines.")

            lines.append(line)

        return lines

    def similar(self, a, b):
        return SequenceMatcher(None, a, b).ratio()

    def update_pie_chart(self):
        self.ax.clear()
        if self.passed + self.failed == 0:
            self.ax.text(0.5, 0.5, 'No Data',
horizontalalignment='center',
verticalalignment='center',
transform=self.ax.transAxes)
        else:
            self.ax.pie([self.passed,
self.failed], labels=["Passed", "Failed"],
autopct='%1.1f%%', colors=["green", "red"])
            self.ax.set_title("Pass/Fail Rate")
            self.canvas.draw()

    def start_testing(self):
        try:
            questions =
self.read_lines_from_file('questions.txt',
self.num_questions)
            expected_outputs =
self.read_lines_from_file('expected_outputs.t
xt', self.num_questions)
        except Exception as e:
            messagebox.showerror("Error",
str(e))

        return

```

```

        if len(questions) !=
self.num_questions or len(expected_outputs)
!= self.num_questions:
            messagebox.showerror("Error", "The
files should contain enough entries for the
specified number of questions.")

            return

        self.results_text.delete(1.0, tk.END)
        self.passed = 0
        self.failed = 0
        self.create_chat_completion(questions,
expected_outputs)

        def create_chat_completion(self,
questions, expected_outputs):
            i = 0

            while i < len(questions):
                try:
                    question = questions[i]

self.current_question_text.delete(1.0,
tk.END)

self.current_question_text.insert(tk.END,
question)

                    response =
openai.ChatCompletion.create(
                        model="gpt-3.5-turbo",
                        messages=[
                            {"role": "system",
"content": "You are a helpful assistant."},
                            {"role": "user",
"content": question}
                        ]
                    )
                    message =
response.choices[0].message['content']

                    self.response_text.delete(1.0,
tk.END)

```

```

self.response_text.insert(tk.END, message)

self.results_text.insert(tk.END, f"\nQuestion
{i+1}: {question}\n")

self.results_text.insert(tk.END,
f"Assistant's Response: {message}\n")

        expected_output =
expected_outputs[i]
        similarity_score =
self.similar(message, expected_output)
        if similarity_score >=
self.similarity_threshold:

self.results_text.insert(tk.END, "Status:
Acceptable\n")

            self.passed += 1
        else:

self.results_text.insert(tk.END, "Status: Not
Quite\n")

self.results_text.insert(tk.END, f"Expected:
{expected_output}\n")

self.response_text.insert(tk.END,
f"\n\nExpected: {expected_output}")

            self.failed += 1

            self.update_pie_chart()

self.results_text.yview(tk.END)
            self.master.update()
            time.sleep(2)
            i += 1
        except openai.error.RateLimitError
as e:

```

```

self.results_text.insert(tk.END, f"Rate limit
exceeded: {e}\n")

            retry_after =
int(e.headers.get("Retry-After", 20))

self.results_text.insert(tk.END, f"Retrying
after {retry_after} seconds...\n")

self.results_text.yview(tk.END)
            self.master.update()
            time.sleep(retry_after)
        except openai.error.OpenAIError as
e:

self.results_text.insert(tk.END, f"OpenAI API
error: {e}\n")

self.results_text.yview(tk.END)
            break

            self.results_text.insert(tk.END,
f"\nTests completed. Passed: {self.passed},
Failed: {self.failed}\n")

if __name__ == "__main__":
    root = tk.Tk()
    app = ChatGPTTester(root)
    root.mainloop()

```

11.2 Gemini AI Test Script:

```

import matplotlib
matplotlib.use("TkAgg") # Use the
TkAgg backend
from matplotlib.figure import Figure
from matplotlib.backends.backend_tkagg
import FigureCanvasTkAgg

import google.generativeai as genai
import time
import tkinter as tk
from threading import Thread

```



```

# Initialize the GUI
root = tk.Tk()
root.title("AI Testing Batch")
root.geometry("600x900") # Adjusted
for better visibility of all
components

# Function to create a text box with a
scrollbar and a label
def create_scrollable_textbox(parent,
height, width, title):
    frame = tk.Frame(parent)
    label = tk.Label(frame,
text=title, font=("Arial", 12,
"bold"))
    label.pack(side=tk.TOP, fill=tk.X)
# Place the label at the top of the
frame
    text_box = tk.Text(frame,
height=height, width=width,
wrap="word")
    scrollbar = tk.Scrollbar(frame,
command=text_box.yview)

text_box.configure(yscrollcommand=scro
llbar.set)
    text_box.pack(side=tk.LEFT,
fill=tk.BOTH, expand=True)
    scrollbar.pack(side=tk.RIGHT,
fill=tk.Y)
    frame.pack(pady=10, fill=tk.BOTH,
expand=True)
    return text_box

# Text boxes with scrollbars and
titles for displaying information
question_box =
create_scrollable_textbox(root,
height=6, width=80, title="Questions")

```

```

response_box =
create_scrollable_textbox(root,
height=6, width=80, title="Gemini's
Responses")
expected_response_box =
create_scrollable_textbox(root,
height=6, width=80, title="Expected
Responses")
verification_box =
create_scrollable_textbox(root,
height=6, width=80, title="Result
Verification")

# Configuration for the Gemini model
genai.configure(api_key='YourAPIKeyHer
e')
model =
genai.GenerativeModel('gemini-1.0-pro-
001')

#Pie chart
def update_pie_chart(passed, failed):
    # Create a figure
    fig = Figure(figsize=(5, 4),
dpi=100)
    ax = fig.add_subplot(111) # Add a
subplot

    # Data for plotting
    labels = 'Passed', 'Failed'
    sizes = [passed, failed]
    colors = ['green', 'red']
    explode = (0.1, 0) # "explode"
the 1st slice

    # Custom autopct function to show
both percentage and absolute value
    def make_autopct(values):
        def my_autopct(pct):
            total = sum(values)

```

```

        val =
int(round(pct*total/100.0))
        return f'{pct:.1f}%
({val:d})'
        return my_autopct

# Plot
ax.pie(sizes, explode=explode,
labels=labels, colors=colors,
autopct=make_autopct(sizes),
shadow=True, startangle=140)
ax.axis('equal') # Equal aspect
ratio ensures that pie is drawn as a
circle.

# Create a canvas and add the plot
to the Tkinter window
canvas = FigureCanvasTkAgg(fig,
master=root) # A tk.DrawingArea.
canvas.draw()

canvas.get_tk_widget().pack(side=tk.TOP, fill=tk.BOTH, expand=True)

def read_file(filepath):
    with open(filepath, 'r') as file:
        return file.readlines()

def chat(questions, expected_outputs):
    passed = 0
    failed = 0
    for i in range(len(questions)):
        response =
model.generate_content(f"Keep your
answer to a single sentence.
{questions[i].strip()}")

        # Append new question
        question_box.insert(tk.END,
f"Q{i+1}: {questions[i].strip()}\n\n")

```

```

        # Append Gemini's response
        response_box.insert(tk.END,
f"Gemini R{i+1}: {response.text}\n\n")

        # Append expected response
expected_response_box.insert(tk.END,
f"Expected R{i+1}:
{expected_outputs[i].strip()}\n\n")

        comparison =
model.generate_content(f"Do the first
and second statement agree with each
other? Keep your response limited to
ONLY yes or no. First statement:
{response.text} Second statement:
{expected_outputs[i].strip()}")

        result_text = f"Test {i+1}: "
        if comparison.text.lower() ==
"yes":
            result_text +=
"Passed.\n\n"
            passed += 1
        else:
            result_text +=
"Failed.\n\n"
            failed += 1

        # Append verification result
verification_box.insert(tk.END,
result_text)

        # Ensure the latest entries
are visible
        question_box.see(tk.END)
        response_box.see(tk.END)
expected_response_box.see(tk.END)
        verification_box.see(tk.END)

```

```

        root.update()
        time.sleep(2)

        #results_summary = f"----- Test
Result -----\nTotal test cases:
{failed+passed}\nPassed test cases:
{passed}\nFailed test cases:
{failed}\nPass rate: {(passed /
(failed + passed)) * 100}%\n"
        #verification_box.insert(tk.END,
results_summary)
        #verification_box.see(tk.END)

        # Update pie chart
        update_pie_chart(passed, failed)
# Read files (assuming they are in the
correct format and path)
questions = read_file("questions.txt")
outputs =
read_file("expected_outputs.txt")

# Start the chat function in a
separate thread to keep the GUI
responsive

if __name__ == "__main__":
    thread = Thread(target=chat,
args=(questions, outputs))
    thread.start()
    root.mainloop()

```

11.3 Perplexity AI Test Script:

```

import requests

from tkinter import *

import matplotlib.pyplot as plt

import time

```

```

from
matplotlib.backends.backend_tkagg
import FigureCanvasTkAgg

url =
"https://api.perplexity.ai/chat/comple
tions"

def read_and_query(questions,
outputs):

    queries = open(questions, "r",
encoding="utf8").readlines()

    responses = open(outputs, "r",
encoding="utf8").readlines()

    passing = 0

    failed = 0

    for query, expected in
zip(queries, responses):

        print(f'The query:
{query} ')

query_text.config(text=f"Current
Query: {query}")

    payload = {

        "model":
"mistral-7b-instruct",

        "messages": [

            {

                "role":
"system",

                "content":
"Keep the response to one sentence."

```

```

        },
        {
            "role": "user",
            "content":
query
        }
    ]
}

headers = {
    "accept":
"application/json",
    "content-type":
"application/json",
    "authorization":
"Bearer
pplx-97701632b9f900fab4ca6a4bb9ca90ca2
dc52caed2c913bb"
}

response =
requests.post(url, json=payload,
headers=headers)

message =
response.json()[ 'choices' ][0][ 'message'
][ 'content' ]

print(f'Response:
{message}')

expected_text.config(text=f"Expected
Response: {expected}")

```

```

print(f'Expected Response:
{expected}')

payload = {
    "model":
"mistral-7b-instruct",
    "messages": [
        {
            "role":
"system",
            "content":
"Keep the response to one word."
        },
        {
            "role": "user",
            "content": f"Do
these sentences say the same thing?
Respond with only yes or no.\n
{message}\n {expected}"
        }
    ]
}

headers = {
    "accept":
"application/json",
    "content-type":
"application/json",
    "authorization":
"Bearer
pplx-97701632b9f900fab4ca6a4bb9ca90ca2
dc52caed2c913bb"
}

```

```

    }

    response =
requests.post(url, json=payload,
headers=headers)

    similarity =
response.json()[ 'choices' ][0][ 'message
' ][ 'content' ]

    print(similarity + '\n')

    if 'yes' in
similarity.lower():

        passing += 1

response_text.config(text=f"Response:
{message}", fg="green")

    else:

        failed += 1

response_text.config(text=f"Response:
{message}", fg="red")

    root.update()

    percent = [(passing/40 *
100), (failed/40 * 100)]

    # Button to display the pie
chart

    show_pie_chart(percent)

```

```

        print(f'Final total:
{passing}/40')

    root = Tk()

    root.title("Perplexity AI Testing")

    root.configure(background='light
grey')

    root.geometry('720x480')

    # Function to display pie chart in
a new window

    def show_pie_chart(percents):

        # Sample data for the pie chart

        labels = ["Passed", "Failed"]

        sizes = percents # Sizes for
each category (sums up to 100%)

        # Create figure and axes

        fig, ax = plt.subplots()

        ax.pie(sizes, labels=labels,
autopct='%1.1f%%', startangle=90)

        ax.axis('equal') # Equal
aspect ratio ensures that pie is drawn
as a circle

        # Create a Tkinter canvas
widget to display matplotlib plot

```

```

        pie_chart_window =
Toplevel(root)

        pie_chart_window.title("Pie
Chart")

        canvas = FigureCanvasTkAgg(fig,
master=pie_chart_window)

        canvas.draw()

canvas.get_tk_widget().pack(fill=BOTH,
expand=True)

# Create three labeled box areas

query_text = Label(root,
text="Query", anchor="center",
wraplength=500)

query_text.pack(fill=BOTH,
expand=True, padx=10, pady=10)

response_text = Label(root,
text="Response", anchor="center",
wraplength=500)

response_text.pack(fill=BOTH,
expand=True, padx=10, pady=10)

expected_text = Label(root,
text="Expected Response",
anchor="center", wraplength=500)

expected_text.pack(fill=BOTH,
expand=True, padx=10, pady=10)

# Button to run testing

```

```

        start_testing = Button(root,
text="Run Test", command=lambda :
read_and_query("questions.txt",
"expected_outputs.txt"))

        start_testing.pack(pady=20)

# Run the main loop

root.mainloop()

#read_and_query("questions.txt",
"expected_outputs.txt")

```

11.4 Kindroid Test Script:

```

from selenium import webdriver
from selenium.webdriver.common.keys import Keys
from selenium.webdriver.common.by import By
from selenium.webdriver.chrome.service import Service
from selenium.webdriver.support.ui import WebDriverWait
from selenium.webdriver.support import
expected_conditions as EC
from webdriver_manager.chrome import
ChromeDriverManager
import time
import difflib

def read_questions(file_path):
    """Read questions from a file and return as a list."""
    with open(file_path, 'r', encoding='utf-8') as file:
        questions = file.readlines()
    return [q.strip() for q in questions]

def send_question_get_response(driver, question):
    """Send a question to the chatbot and return the
response."""
    wait = WebDriverWait(driver, 15)

# Find the input field and send the question

```

```

input_field =
wait.until(EC.visibility_of_element_located((By.CSS_SELECTOR, 'textarea.chakra-textarea')))
input_field.clear()
input_field.send_keys(question)
enter_button =
wait.until(EC.element_to_be_clickable((By.CSS_SELECTOR, 'button.no-invert')))
enter_button.click()

# Wait for the response to be visible
time.sleep(8) # Adjust based on response time of your chatbot

# Read the response from the chatbot
response =
(wait.until(EC.visibility_of_element_located((By.CSS_SELECTOR, '.css-yhh19h:last-child .css-0 > .chakra-text')))).text
return response

def compare_responses(responses, expected_outputs):
    """Compare responses with expected outputs using SequenceMatcher."""
    similarities = []
    for response, expected in zip(responses, expected_outputs):
        similarity = difflib.SequenceMatcher(None, response, expected).ratio()
        similarities.append(similarity)
    return similarities

url =
'https://kindroid.ai/__/auth/action?apiKey=AIzaSyDaRrRxqBj5DZ78oGODq2RT0Cfww2U-F1A&mode=signIn&oobCode=jPtlyOUMOPj3cUGuAZkjHgEqHw2VotnUkfV7xLrGJt0AAAGPXJMTNw&continueUrl=https://kindroid.ai/&lang=en'

# Setup WebDriver
driver =
webdriver.Chrome(service=Service(ChromeDriverManager().install()))

```

```

# Open the web page with the chatbot
driver.get(url)

# Create a WebDriverWait object
wait = WebDriverWait(driver, 15)

# Logging in
email_field =
wait.until(EC.visibility_of_element_located((By.ID, 'field-r2:')))
email_field.send_keys('kefeeno@gmail.com')
login_button =
wait.until(EC.element_to_be_clickable((By.CSS_SELECTOR, 'button.chakra-button')))
login_button.click()

# send prompts and store responses
questions = read_questions('questions.txt')
responses = []

for question in questions:
    response = send_question_get_response(driver, question)
    responses.append(response)
    print(f"Question: {question}\nResponse: {response}\n")

driver.quit()

# Compare responses with expected outputs
pass_count = 0
expecteds = read_questions('expected_outputs.txt')
similarities = compare_responses(responses, expecteds)
for question, response, expected, similarity in zip(questions, responses, expecteds, similarities):
    if similarity > 0.3:
        print(f"Question: {question}\nResponse: {response}\nExpected: {expected}\nSimilarity: {similarity:.2f} PASS\n")
        pass_count += 1
    else:

```

```

print(f"Question: {question}\nResponse:
{response}\nExpected: {expected}\nSimilarity:
{similarity:.2f} FAIL\n")

total_tests = len(questions)
final_score = (pass_count / total_tests) * 100
print(f"Passed {pass_count} out of {total_tests} tests. Final
Score: {final_score:.2f}%")

```

11.5 Character.ai Test Script:

```

from tkinter import tk
import tkinter as tk
from threading import Thread
import matplotlib.pyplot as plt
import asyncio
from queue import Queue
import matplotlib.backends.backend_tkagg as tkagg

# unofficial API for character.ai
from characterai import aiocai, sendCode, authUser

questions_and_answers = {
    "Who be havin' the most F1 wins?": "Lewis Hamilton with 103 race wins.",
    "Who has the most F1 wons?": "Lewis Hamilton with 103 race wins.",
    "Who has the most F1 wins?": "Lewis Hamilton with 103 race wins.",
    "When was the last time that Lebron James won the drivers world championship?": "Lebron James is not an F1 driver. ",
    "Which constructor has the most f1 constructor championships?": "Ferrari with 16 Constructors Titles.",
    "Is Lewis Hamilton": "Lewis Hamilton is an F1 Driver.",
    "Is Lewis Hamilton a world champion?": "Yes, Lewis Hamilton is a 7-time World Champion. ",
    "Logan Sargeant is a Formula 1 World Champion.": "He is a Formula 1 Driver, but he is not a world champion. ",
    "Is Max Verstappen a Formula 1 world champion?": "Yes, Max Verstappen is a 3-time world champion. ",
    "Why do F1 cars have big wheels?": "It provides more grip, better handling, helps with aerodynamics and braking, as well as heat dissipation. ",

```

"Why are F1 races so popular?": "F1 races are popular because of their global appeal, prestige and history, celebrity drivers, high-stakes drama, and technological innovation are some of the reasons for F1 being so popular.",

"What are the financial aspects of running an F1 team?": "The different financial aspects of running an F1 team fall under: operating costs, research and development, technology and innovation, driver salaries, and racing licenses. ",

"What role does aerodynamics play in F1?": "Aerodynamics of an F1 car affect the fuel efficiency, downforce, grip and stability, cornering performance, and drag reduction. ",

"What are the most effective techniques for managing tire wear during a race?": "Smooth driving, strategic pit stops, proper tire pressure, tire compound selection, and car set up are all effective techniques that help manage tire wear during races. ",

"How did the rain in the 2021 Russian GP affect the race?": "The rain during the 2021 Russian Grand Prix had a significant impact on the race, particularly in the latter stages. The rain intensified towards the end of the race, leading to a chaotic finish and unexpected results. The rain also caught out other drivers, with some spinning off or making mistakes due to the treacherous track conditions. Overall, the rain added an element of unpredictability to the race, reshuffling the order and providing excitement for the spectators.",

"Which is the oldest Formula 1 race track location still used today?": "Monza is the oldest F1 race track still in use.",

"What happened in the opening lap of the 2020 Bahrain GP?": "The 2020 Bahrain Grand Prix had a dramatic opening lap. Romain Grosjean, driving for Haas, was involved in a horrifying crash just moments after the start. He veered off track and collided with the barriers at high speed, resulting in his car splitting in two and bursting into flames. Miraculously, Grosjean was able to extricate himself from the wreckage and escape with relatively minor injuries, mostly burns to his hands. It was a terrifying incident that

highlighted the safety advancements in Formula 1, as well as the bravery of the drivers.",

"What was controversial about the 2021 Abu Dhabi GP?": "The 2021 Abu Dhabi Grand Prix was controversial due to the circumstances surrounding the final laps of the race, particularly the deployment of the Safety Car and subsequent restart.",

"What is a Chicane on a racing circuit and why are they common?": "A chicane is a sequence of tight, alternating turns on a racing circuit designed to slow down vehicles and add technical challenge to the track.",

"Which Formula 1 Constructor has earned the most constructors championships?": "Ferrari holds the most constructors championship titles at 16 titles. ",

"Statistically speaking, which constructor developed the most dominant car in Formula 1 history?": "statistically speaking, the McLaren MP4/4 Formula 1 car from 1988 was the most dominant car as it claimed 15 pole positions and victories out of 16 races.",

"Which one Formula 1 team has the most successful team principal?": "Sir Frank Williams who has claimed 9 constructors championships and 7 drivers championship titles. ",

"Which driver has won the most world championship titles?": "This is a tie between Michael Schumacher and Lewis Hamilton, as both sport 7 world championship titles.",

"Which Formula 1 driver holds the record for the most race wins in their career, and what is the total number of wins?": "Lewis Hamilton holds the highest number at 103 race wins.",

"As of the latest season, who has achieved the highest number of pole positions in Formula 1 history and how many?": "Lewis Hamilton holds the record of holding the pole position 104 times.",

"Who are the top three Formula 1 drivers with the most podium finishes, and what are their respective totals?": "Lewis Hamilton with 197, Michael Schumacher with 155, and Sebastian Vettel with 122.",

"What is the most notable rivalry between drivers that has occurred in the sport of Formula 1?": "There are many different rivalries that have occurred in the sport but one of

the most notable being the rivalry between Ayrton Senna and Alain Prost. ",

"What distinguishes a typical car tire to an F1 car tire?": "Overall, F1 tires are engineered for extreme performance and agility on the racetrack, while regular car tires prioritize durability, comfort, and safety for everyday driving on public roads.",

"What were the main advancements made in the power units of F1 cars?": "The integration of hybrid technology, turbocharging, advanced energy recovery systems, and materials innovation has driven significant advancements in the power units of F1 cars, leading to faster, more efficient, and more technologically advanced racing machines.",

"What did the carbon fiber monocoque do to innovate F1 safety regulations?": "The introduction of carbon fiber monocoques in Formula 1 marked a significant milestone in improving driver safety standards within the sport. By providing a stronger, lighter, and more crashworthy chassis design, carbon fiber monocoques have played a crucial role in reducing the risks associated with high-speed racing and enhancing the overall safety of F1 competition.",

"How did the transition from v8 naturally aspirated engines to v6 hybrid engines affect F1 cars?": "The transition from V8 naturally aspirated engines to V6 hybrid engines represented a significant technological shift in Formula 1, emphasizing hybrid technology, performance efficiency, and reliability. While it brought about changes in engine sound and aesthetics, it also heralded a new era of innovation and sustainability within the sport.",

"How did the ground effect change F1 and the technology of cars?": "Ground effect technology revolutionized Formula 1 by enhancing performance, challenging engineers to develop innovative solutions, and reshaping the aerodynamic landscape of the sport. While its influence has evolved over time due to regulatory changes and safety considerations, ground effect remains a crucial aspect of modern F1 car design and development.",

"What is the max number of chassis a team can use during the F1 season?": "Two chassis per car are allowed during the season",

"How many engines are permitted for each driver over the course of the season before incurring grid penalties?":

```

"Each driver is allowed a max of three power units/engines
per season.",
"During a dry race, how many different tire compounds
are available to teams to choose from?": "Three dry tyre
compounds: soft, medium, and hard.",
"Is refueling during a race allowed in F1?": "No,
refueling during a race is not allowed in F1 since the 2010
season.",
"What restrictions are imposed on teams during Parc
Ferre conditions?": "Teams are restricted from making
significant changes to their cars, except for very specific
adjustments allowed by the regulations.",
"How many points are awarded for a win in an F1 race?":
"Winner of an F1 race is awarded 25 points.",
"What is the budget spending cap for F1 teams?": "$135
million per team in 2023.",
"What does a black and white flag indicate in F1?": "A
black and white flag is a warning flag which is shown to a
driver for unsportsmanlike behavior or track limit
violations. If continued to be ignored, the driver will face a
penalty."
}

root = tk.Tk()
root.title("AI Testing Batch")
root.geometry("600x400")

question_box = tk.Text(root, height=3, width=80)
question_box.pack(pady=10)
response_box = tk.Text(root, height=3, width=80)
response_box.pack(pady=10)
verification_box = tk.Text(root, height=3, width=80)
verification_box.pack(pady=10)
result_box = tk.Text(root, height=3, width=80)
result_box.pack(pady=10)

result_queue = Queue()

async def main(queue):
    char =
'K_9wktCNrgH2mQuEzyqW7umtWROybo6eHjgm1iSF7Bk'

```

```

client =
aiocai.Client('e854b78c6062a7e24cfa8e8f369187576e23562
5')

me = await client.get_me()
countCorrect = 0

async with await client.connect() as chat:
    new, answer = await chat.new_chat(char, me.id)
    print(f'{answer.name}: {answer.text}')
    result_box.insert(tk.END, f'Current Result:
{countCorrect} out of {len(questions_and_answers)}')

    for question, expected_answer in
questions_and_answers.items():
        # Update GUI components instead of printing
        question_box.insert(tk.END, question)

        text = question
        print(f'YOU: {text}')
        message = await chat.send_message(char,
new.chat_id, text)
        response_box.insert(tk.END, message.text)

        print(f'{message.name}: {message.text}\n')
        ans = (f"Do the first and second statement agree
with each other? Limit response to YES or NO. First
statement: {message.text}. Second statement:
{expected_answer}.")
        print(f"\n{ans}")

        finalMessage = await chat.send_message(char,
new.chat_id, expected_answer)
        print(f"\n{finalMessage.name}:
{finalMessage.text}\n")

        if "no" in finalMessage.text.lower():
            print('Not adding to count...')
            verification_box.insert(tk.END, "FAIL")
        elif "yes" in finalMessage.text.lower():
            print('Adding to count...')
            verification_box.insert(tk.END, "PASS")
            countCorrect+=1

```

```

else:
    rulesMessage = await chat.send_message(char,
new.chat_id, f'You are continuing to ignore my rules. Do the
first and second statement agree with each other? Limit
response to YES or NO. First statement: {message.text}.
Second statement: {expected_answer}.')
    print(f'{rulesMessage.name}:
{rulesMessage.text}\n')
    if "no" in rulesMessage.text.lower():
        print('Not adding to count...')
        verification_box.insert(tk.END, "FAIL")
    elif "yes" in rulesMessage.text.lower():
        print('Adding to count...')
        countCorrect += 1
        verification_box.insert(tk.END, "PASS")
    feedbackMessage = await
chat.send_message(char, new.chat_id, 'Good job, continue
to follow my rules.')
    print(f'{feedbackMessage.name}:
{feedbackMessage.text}\n')

    verification_box.delete('1.0', tk.END)
    response_box.delete('1.0', tk.END)
    question_box.delete('1.0', tk.END)

    result_box.delete('1.0', tk.END)
    result_box.insert(tk.END, f'Current Result:
{countCorrect} out of {len(questions_and_answers)}')

    print("-----")
    print("-----")
    print("RESULT: ", countCorrect, " out of ",
len(questions_and_answers))

    pass_count = countCorrect

    pass_percentage = (pass_count /
len(questions_and_answers)) * 100
    fail_percentage = 100 - pass_percentage

    verification_box.delete('1.0', tk.END)

```

```

verification_box.insert(tk.END, f'RESULT:
{countCorrect} out of {len(questions_and_answers)}')

    result_queue.put((pass_percentage, fail_percentage))
    return pass_percentage, fail_percentage

def create_pie_chart(pass_percentage, fail_percentage):
    labels = 'Pass', 'Fail'
    sizes = [pass_percentage, fail_percentage]
    colors = ['green', 'red']
    explode = (0.1, 0)

    plt.figure(figsize=(6, 6))
    plt.pie(sizes, explode=explode, labels=labels,
colors=colors, autopct='%1.1f%%', shadow=True,
startangle=140)

    plt.axis('equal')
    plt.title('Pass vs Fail Percentage')
    plt.show()

def start_main_async():
    pass_percentage, fail_percentage =
asyncio.run(main(result_queue))
    create_pie_chart(pass_percentage, fail_percentage)

thread = Thread(target=start_main_async)
thread.start()

def check_queue():
    try:
        pass_percentage, fail_percentage =
result_queue.get_nowait()
        verification_box.delete('1.0', tk.END)
        verification_box.insert(tk.END, f'RESULT:
{pass_percentage}% passed, {fail_percentage}% failed')
    except:
        pass
    root.after(100, check_queue)

check_queue()

root.mainloop()

```



12. Test Automation Results

12.1 Scripting Execution Results

12.1.1) ChatGPT Script Execution Results

Input	Chatbot Response	Pass/Fail
Who be havin' the most F1 wins?	Assistant: As of September 2021, Lewis Hamilton holds the record for the most Formula 1 wins with over 100 victories.	Pass
Who has the most F1 wons?	Assistant: Lewis Hamilton holds the record for the most Formula 1 wins with a total of 100 wins as of October 2021.	Pass
Who has the most F1 wins?	Assistant: As of November 2021, Lewis Hamilton holds the record for the most Formula 1 wins with 100 victories.	Pass
When was the last time that Lebron James won the drivers world championship?	Assistant: I'm sorry, but that information is not accurate. LeBron James is a professional basketball player, not a Formula 1 driver. He has never won the drivers' world championship. Let me know if you need any other information or assistance!	Pass
Which constructor has the most fl constructor championships?	Assistant: As of the 2021 Formula 1 season, Scuderia Ferrari holds the record for the most F1 constructor championships with a total of 16 championships.	Pass
Is Lewis Hamilton	Assistant: Yes, Lewis Hamilton is a seven-time Formula 1 World Champion known for his impressive racing career.	Pass
Is Lewis Hamilton a world champion?	Assistant: Yes, Lewis Hamilton is a world champion in Formula 1 racing. He has won multiple world championships in his career.	Pass
Logan Sargeant is a Formula 1 World Champion.	Assistant: I'm sorry, but that statement is not accurate. As of now, Logan Sargeant is not a Formula 1 World Champion.	Pass
Is Max Verstappen a Formula 1 world champion?	Assistant: Yes, Max Verstappen is a Formula 1 world champion. He won his first Formula 1 World Championship in 2021.	Pass

<p>Why do F1 cars have big wheels?</p>	<p>Assistant: Formula 1 cars have relatively larger wheels compared to normal cars for several reasons.</p> <ol style="list-style-type: none"> 1. Improved grip: Larger wheels allow for wider tires with more surface area in contact with the track, providing better traction for acceleration, braking, and cornering. 2. Enhanced stability: The wider track provided by bigger wheels helps to stabilize the car during high-speed maneuvers. 3. Heat management: The larger wheels and tires help dissipate heat more effectively, especially during hard braking and high-speed driving. 4. Aerodynamics: The larger wheels create more space for aerodynamic features like brake ducts and wheel covers, which can help improve airflow around the car. <p>Overall, the combination of larger wheels and tires in Formula 1 cars is designed to optimize performance in terms of grip, stability, heat management, and aerodynamics, all of which are crucial for achieving high speeds and cornering capabilities on the race track.</p>	<p>Not quite. Expected: 10. It provides more grip, better handling, helps with aerodynamics and braking, as well as heat dissipation.</p>
<p>"Why are F1 races so popular?"</p>	<p>Assistant: Formula 1 races are popular for several reasons:</p> <ol style="list-style-type: none"> 1. High Speeds: F1 cars are among the fastest racing vehicles in the world, reaching speeds of over 200 mph, which captures the excitement and thrill of fans. 2. Cutting-Edge Technology: F1 teams invest heavily in research and development to improve their cars' performance, leading to innovative technologies that fascinate tech enthusiasts. 3. Skilled Drivers: F1 drivers possess exceptional skills, reflexes, and courage, making the races entertaining to watch as they navigate challenging tracks. 	<p>Not quite. Expected: 11. F1 races are popular because of their global appeal, prestige and history, celebrity drivers, high-stakes drama, and technological innovation are some of the reasons for F1 being so popular.</p>

	<p>4. Glamour and Prestige: Formula 1 has a long history of attracting star drivers, glamorous locations for races, and luxurious lifestyles associated with the sport, adding to its allure.</p> <p>5. Global Appeal: Formula 1 is a worldwide sport with a diverse fan base, drawing viewers from different countries and cultures, making it a truly international event.</p> <p>Overall, the combination of speed, technology, talent, prestige, and global appeal contributes to the popularity of F1 races.</p>	
"What are the financial aspects of running an F1 team?"	<p>Assistant: Running an Formula 1 (F1) team involves significant financial aspects. Some key financial considerations include:</p> <ol style="list-style-type: none"> Operating Costs: F1 teams have high operating costs due to expenses such as salaries for personnel, research and development, manufacturing of car parts, logistics, travel, and testing. Driver Salaries: Top drivers command high salaries, making them a significant portion of a team's budget. Car Development: Developing a competitive F1 car requires substantial investment in research, design, engineering, and testing. Travel and Logistics: Teams travel to different countries for races, requiring significant investment in transportation, accommodations, and other logistics. Sponsorship and Partnerships: Securing sponsorship deals and partnerships with brands is crucial for funding and promoting the team. Sponsorship revenues can offset some of the operating costs. Prize Money: F1 teams earn prize money based on their performance in races and their position in the championship standings. Prize 	<p>Not quite. Expected: 12. The different financial aspects of running an F1 team fall under: operating costs, research and development, technology and innovation, driver salaries, and racing licenses.</p>

	<p>money can vary depending on the team's rank.</p> <p>7. **Marketing and Promotions:** Promoting the team through marketing initiatives and fan engagement activities also involves financial investment.</p> <p>8. **Regulatory Costs:** Teams must comply with F1's regulations, which may entail additional costs for meeting technical requirements and safety standards.</p> <p>Overall, running an F1 team is a costly endeavor, requiring significant financial resources to compete at the highest level in the sport. Teams often operate on tight budgets and seek innovative ways to generate revenue and manage costs effectively.</p>	
"What role does aerodynamics play in F1?"	<p>Assistant: Aerodynamics plays a crucial role in Formula 1 racing as it directly impacts the performance and competitiveness of the cars. In F1, aerodynamics refers to the study of how air flows around the car and the components on it, such as the front and rear wings, diffuser, and bodywork.</p> <p>1. **Downforce:** Aerodynamics is used to generate downforce, which is the force that pushes the car down onto the track. This increases traction and allows the car to corner faster and with more stability.</p> <p>2. **Drag reduction:** While downforce is important for cornering performance, aerodynamicists also aim to reduce drag, which is the resistance the car faces as it moves through the air. This is crucial for achieving high speeds on the straights.</p> <p>3. **Handling balance:** The design of the aerodynamic components can influence the balance of the car. By adjusting the distribution of downforce between the front and rear of the car, engineers can fine-tune how the car handles during different types of corners and under braking.</p>	<p>Not quite. Expected: 13.</p> <p>Aerodynamics of an F1 car affect the fuel efficiency, downforce, grip and stability, cornering performance, and drag reduction.</p>

	<p>4. Cooling: Aerodynamics also plays a role in ensuring that the car's engine and components stay cool during the race. Airflow management is critical to prevent overheating and maintain optimal performance.</p> <p>In essence, aerodynamics in F1 is not just about making the cars go fast in a straight line but also about achieving the right balance of downforce and drag to maximize performance through corners and across different track conditions. Teams invest heavily in aerodynamic research and development to gain a competitive edge on the race track.</p>	
"What are the most effective techniques for managing tire wear during a race?"	<p>Assistant: Managing tire wear during a race is crucial for maintaining performance and safety. Here are some effective techniques for managing tire wear:</p> <ol style="list-style-type: none"> Proper tire pressure: Monitor and adjust tire pressure regularly to ensure optimal grip and wear. Low pressure can cause excessive wear on the edges of the tires, while high pressure can lead to wear in the center. Smooth driving: Avoid aggressive acceleration, braking, and steering inputs that can wear out the tires quickly. Smooth driving helps to distribute wear evenly across the tire surface. Consistent cornering: Maintain a consistent line through corners to minimize scrubbing and wear on the tires. Avoid drifting and sliding excessively as it can lead to rapid tire degradation. Tire rotation: Rotate the tires regularly to promote even wear across all tires. Front tires tend to wear out faster due to steering and braking forces, so rotating tires can help extend their lifespan. Proper alignment: Ensure the wheels are properly aligned to prevent uneven tire wear. Misaligned wheels can cause 	<p>Not quite. Expected: 14. Smooth driving, strategic pit stops, proper tire pressure, tire compound selection, and car set up are all effective techniques that help manage tire wear during races.</p>

	<p>excessive wear on the inside or outside edges of the tires.</p> <p>6. Tire compound selection: Choose the right tire compound based on track conditions and temperature to optimize grip and wear resistance. Softer compounds provide more grip but wear out faster, while harder compounds offer better durability but less grip.</p> <p>7. Tire temperature management: Monitor tire temperatures throughout the race to ensure they are within the optimal range. Overheating can accelerate tire wear, so adjust tire pressures or driving style if needed.</p> <p>By implementing these techniques and maintaining a strategic approach to tire management, you can effectively manage tire wear during a race and maximize the performance and longevity of your tires.</p>	
How did the rain in the 2021 Russian GP affect the race?	<p>Assistant: The rain during the 2021 Russian Grand Prix significantly impacted the race. It caused tricky track conditions that led to multiple incidents and accidents, including spins and crashes. The rain also prompted teams to make strategic decisions regarding tire choices and pit stops, adding an element of uncertainty and excitement to the race. Ultimately, the rain played a crucial role in shaping the outcome of the race by challenging drivers and teams to adapt to changing conditions.</p> <p>Not quite. Expected: 15. The rain during the 2021 Russian Grand Prix had a significant impact on the race, particularly in the latter stages. The rain intensified towards the end of the race, leading to a chaotic finish and unexpected results. The rain also caught out other drivers, with some spinning off or making mistakes due to the treacherous track conditions. Overall, the rain added an element of unpredictability to the race, reshuffling the order and providing excitement for the spectators.</p> <p>Assistant: The oldest Formula 1 race track location still used today is the</p>	Pass

	Silverstone Circuit in Silverstone, England. It has been a regular feature on the F1 calendar since the inaugural season in 1950.	
Which is the oldest Formula 1 race track location still used today?	Assistant: The oldest Formula 1 race track location still used today is the Silverstone Circuit in Silverstone, England. It has been a regular feature on the F1 calendar since the inaugural season in 1950.	Pass
What happened in the opening lap of the 2020 Bahrain GP?	Assistant: During the opening lap of the 2020 Bahrain Grand Prix, Romain Grosjean was involved in a horrific crash. His car pierced through the barriers and caught fire, splitting in half. Thankfully, Grosjean was able to escape the blazing wreckage with minor injuries, thanks to the swift response of the FIA safety team and the design of the car.	Not quite. Expected: 17. The 2020 Bahrain Grand Prix had a dramatic opening lap. Romain Grosjean, driving for Haas, was involved in a horrifying crash just moments after the start. He veered off track and collided with the barriers at high speed, resulting in his car splitting in two and bursting into flames. Miraculously, Grosjean was able to extricate himself from the wreckage and escape with relatively minor injuries, mostly burns to his hands. It was a terrifying incident that highlighted the safety advancements in Formula 1, as well as the bravery of the drivers.
What was controversial about the 2021 Abu Dhabi GP?	Assistant: The controversial incident during the 2021 Abu Dhabi Grand Prix involved the decision by race director Michael Masi to allow lapped cars to unlap themselves before the final restart of the race following a late safety car period. This decision drew criticism from some teams and drivers, as it had a significant impact on the outcome of the race and the championship battle between Lewis Hamilton and Max Verstappen. Ultimately, Verstappen was able to overtake Hamilton on the restart and win the race, securing the championship in the process.	Pass
What is a Chicane on a racing circuit and why are they common?	Assistant: A Chicane is a sequence of tight turns in a racing circuit that forces drivers to slow down and navigate through a zig-zag pattern. Chicane corners are designed to break up the flow of the circuit and challenge drivers' skills by requiring them to brake and accelerate rapidly.	Not quite. Expected: 19. A chicane is a sequence of tight, alternating turns on a racing circuit designed to slow down vehicles and add technical challenge to the track.

	<p>Chicanes are common on racing circuits for several reasons:</p> <ol style="list-style-type: none"> 1. Safety: Chicanes are often used to slow down vehicles at high-speed sections of the track to enhance safety by reducing the risk of accidents. 2. Overtaking opportunities: Chicanes can create opportunities for drivers to overtake competitors if they can brake later and carry more speed through the corner. 3. Technical challenge: Chicanes test drivers' abilities to brake late, maintain control, and accelerate quickly, adding an element of skill to the race. 4. Level the playing field: Chicanes can help level the playing field by negating the advantage of higher-powered cars on long straights, making races more competitive. <p>Overall, chicanes play an essential role in creating dynamic and engaging racing circuits that challenge drivers and enhance the overall racing experience.</p>	
“Which Formula 1 Constructor has earned the most constructors championships?”	Assistant: Ferrari holds the record for the most Formula 1 Constructors' Championships with a total of 16 titles.	Pass
“Statistically speaking, which constructor developed the most dominant car in Formula 1 history?”	Assistant: Ferrari and Mercedes are two constructors that have developed some of the most dominant cars in Formula 1 history. Ferrari had a successful period in the early 2000s with their cars driven by Michael Schumacher, while Mercedes has been dominant in recent years with their cars driven by Lewis Hamilton. It's difficult to pinpoint a single constructor as the most dominant overall, as different eras and technological advancements have played a role in the success of different teams.	Not quite. Expected: 21. This question can be manipulated or different as it is opinion based. However, statistically speaking, the McLaren MP4/4 Formula 1 car from 1988 was the most dominant car as it claimed 15 pole positions and victories out of 16 races.
“Which one Formula 1 team has the most successful team principal?”	Assistant: Ferrari has had one of the most successful team principals in the history of Formula 1, with the legendary Enzo Ferrari leading the team to many victories. Today, Mattia Binotto serves as the team principal of Ferrari.	Not quite. Expected: 22. Sir Frank Williams who has claimed 9 constructors championships and 7 drivers championship titles.
“Which driver has won the most world	Assistant: Michael Schumacher holds	Pass

championship titles?”	the record for the most Formula 1 world championship titles, with a total of 7 championships.	
Which Formula 1 driver holds the record for the most race wins in their career, and what is the total number of wins?	Assistant: As of September 2021, Lewis Hamilton holds the record for the most race wins in Formula 1 history with a total of 100 wins.	Pass
As of the latest season, who has achieved the highest number of pole positions in Formula 1 history and how many?	Assistant: As of the latest season, Lewis Hamilton holds the record for the highest number of pole positions in Formula 1 history. He has achieved a total of 101 pole positions.	Pass
Who are the top three Formula 1 drivers with the most podium finishes, and what are their respective totals?	Assistant: As of now, the top three Formula 1 drivers with the most podium finishes are: 1. Lewis Hamilton - 179 podium finishes 2. Michael Schumacher - 155 podium finishes 3. Sebastian Vettel - 122 podium finishes	Pass
“What is the most notable rivalry between drivers that has occurred in the sport of Formula 1?”	Assistant: One of the most notable rivalries in Formula 1 history is between Ayrton Senna and Alain Prost in the late 1980s and early 1990s. Senna and Prost were both dominant drivers during that era and competed fiercely against each other for the world championship. Their rivalry was characterized by intense on-track battles, controversial incidents, and contrasting personalities. The rivalry between Senna and Prost is considered one of the greatest in Formula 1 history and has left a lasting impact on the sport.	Pass
“What distinguishes a typical car tire to an F1 car tire?”	Assistant: There are several key differences between a typical car tire and an F1 car tire: 1. **Compound and construction** : F1 car tires are made with special compounds that provide optimal grip and performance at high speeds. They also have a very different construction, with complex layering and custom materials that are designed specifically for racing performance.	Not quite. Expected: 28. Overall, F1 tires are engineered for extreme performance and agility on the racetrack, while regular car tires prioritize durability, comfort, and safety for everyday driving on public roads.

	<p>2. **Size and profile**: F1 tires are generally larger and have a lower profile compared to typical car tires. This allows for better handling and responsiveness at high speeds.</p> <p>3. **Tread pattern**: F1 tires have very minimal tread or even a completely slick surface, as opposed to the grooved tread pattern found on typical car tires. This maximizes the contact patch with the road for better traction.</p> <p>4. **Temperature and wear**: F1 tires are engineered to operate at very high temperatures due to the extreme demands of racing. They also wear out much faster than typical car tires because of the high speeds and forces they have to endure during a race.</p> <p>Overall, F1 tires are highly specialized and optimized for racing performance, whereas typical car tires are designed for everyday driving in a variety of conditions.</p>	
<p>“What were the main advancements made in the power units of F1 cars?”</p>	<p>Assistant: The power units in Formula 1 cars have seen significant advancements over the years. Here are some of the main advancements:</p> <p>1. Hybrid Technology: One of the most notable advancements in F1 power units is the introduction of hybrid technology. The current power units consist of a turbocharged internal combustion engine combined with energy recovery systems (ERS) that harness energy from braking and exhaust gases.</p> <p>2. Increased Efficiency: The hybrid power units in modern F1 cars are highly efficient, producing more power while using less fuel. This has made the cars faster and more environmentally friendly.</p> <p>3. Energy Recovery Systems: F1 cars now feature sophisticated energy recovery systems that store and deploy energy during acceleration. This energy is harvested during braking and through the waste heat of the exhaust</p>	<p>Not quite. Expected: 29. The integration of hybrid technology, turbocharging, advanced energy recovery systems, and materials innovation has driven significant advancements in the power units of F1 cars, leading to faster, more efficient, and more technologically advanced racing machines.</p>

	<p>system.</p> <p>4. Turbocharging: Turbocharging has been reintroduced to F1 power units, allowing for increased power output and improved efficiency. This technology helps to compensate for the smaller, more fuel-efficient engines used in modern F1 cars.</p> <p>5. Improved Aerodynamics: Advancements in power unit design have also led to improvements in overall aerodynamics, making the cars faster and more stable on track.</p> <p>These advancements have made modern F1 power units some of the most advanced and efficient powertrains in the automotive world.</p>	
<p>“What did the carbon fiber monocoque do to innovate F1 safety regulations?”</p>	<p>Assistant: The introduction of carbon fiber monocoque structures in Formula 1 cars has played a significant role in enhancing safety regulations in the sport. The carbon fiber monocoque, which is essentially a one-piece cockpit structure made from composite materials such as carbon fiber, has several safety benefits including:</p> <ol style="list-style-type: none"> 1. **Improved Strength and Rigidity**: Carbon fiber monocoques are incredibly strong and rigid, providing a high level of protection to the driver in the event of a crash or impact. 2. **Energy Absorption**: The composite materials used in carbon fiber monocoques have excellent energy absorption properties, helping to dissipate crash forces and reduce the impact on the driver. 3. **Crashworthiness**: Carbon fiber monocoques are designed to deform and absorb energy in a controlled manner during a crash, helping to protect the driver inside the cockpit. 4. **Weight Reduction**: Compared to traditional metal structures, carbon fiber monocoques are lightweight and can be designed to be extremely 	<p>Not quite. Expected: 30. The introduction of carbon fiber monocoques in Formula 1 marked a significant milestone in improving driver safety standards within the sport. By providing a stronger, lighter, and more crashworthy chassis design, carbon fiber monocoques have played a crucial role in reducing the risks associated with high-speed racing and enhancing the overall safety of F1 competition.</p>

	<p>strong, improving overall vehicle performance while maintaining safety standards.</p> <p>Overall, the introduction of carbon fiber monocoques in F1 cars has raised the bar for safety standards in the sport, making the cars more robust and better able to protect drivers in the event of accidents.</p>	
<p>“How did the transition from v8 naturally aspirated engines to v6 hybrid engines affect F1 cars?”</p>	<p>Assistant: The transition from V8 naturally aspirated engines to V6 hybrid engines in Formula 1 had a significant impact on the performance and technology of the cars. Here are some key ways in which this transition affected F1 cars:</p> <ol style="list-style-type: none"> 1. Power and Efficiency: V6 hybrid engines are more fuel-efficient and environmentally friendly compared to the V8 engines. The introduction of energy recovery systems (ERS) in the hybrid engines, such as the MGU-K and MGU-H, helped to boost power output and overall performance while ensuring better fuel efficiency. 2. Handling and Weight: The switch to V6 hybrid engines also affected the weight distribution and handling of the cars. The introduction of hybrid components like batteries and energy recovery systems added weight to the cars, influencing the balance and dynamics of the vehicle. 3. Sound: One of the most notable changes resulting from the transition was the difference in engine sound. The V6 hybrid engines produce a different, quieter sound compared to the ear-splitting noise of the V8 engines, which divided opinions among fans and enthusiasts. 4. Complexity and Development: The V6 hybrid engines introduced greater complexity and technological challenges for teams in terms of engine development and management. Teams had to invest more resources in optimizing the performance of the hybrid power units, leading to 	<p>Not quite. Expected: 31. The transition from V8 naturally aspirated engines to V6 hybrid engines represented a significant technological shift in Formula 1, emphasizing hybrid technology, performance efficiency, and reliability. While it brought about changes in engine sound and aesthetics, it also heralded a new era of innovation and sustainability within the sport.</p>

	<p>increased research and development efforts.</p> <p>Overall, the transition from V8 naturally aspirated engines to V6 hybrid engines in F1 marked a shift towards greener and more efficient power units while also presenting new challenges and opportunities for teams to innovate and improve performance.</p>	
<p>“How did the ground effect change F1 and the technology of cars?”</p>	<p>Assistant: Ground effect had a significant impact on Formula 1 racing and the technology of cars. Ground effect refers to the aerodynamic phenomenon where the airflow underneath the car creates a low-pressure area, effectively sucking the car to the ground and generating more downforce. This increase in downforce allowed cars to corner faster, have better grip, and ultimately improve overall performance on track.</p> <p>With the introduction of ground effect technology in Formula 1 cars in the late 1970s and early 1980s, it revolutionized the way cars were designed and how races were approached. It enabled cars to reach higher speeds through corners and improve overall lap times. However, ground effect also posed safety concerns due to the high cornering speeds achieved, leading to the implementation of new regulations and restrictions.</p> <p>Overall, ground effect technology had a profound impact on F1 racing by pushing the boundaries of car design and aerodynamics, ultimately leading to advancements in technology and engineering in the sport.</p>	<p>Not quite. Expected: 32. Ground effect technology revolutionized Formula 1 by enhancing performance, challenging engineers to develop innovative solutions, and reshaping the aerodynamic landscape of the sport. While its influence has evolved over time due to regulatory changes and safety considerations, ground effect remains a crucial aspect of modern F1 car design and development.</p>
<p>What is the max number of chassis a team can use during the F1 season?</p>	<p>Assistant: In Formula 1, each team is limited to using a maximum of 3 different chassis during the season. This regulation ensures fair competition and prevents teams from gaining an unfair advantage by frequently changing their car design.</p>	<p>Not quite. Expected: 33. Two chassis per car are allowed during the season</p>
<p>How many engines are permitted for each driver over the course of the</p>	<p>Assistant: In Formula 1, each driver is allowed to use up to three power units</p>	<p>Pass</p>

season before incurring grid penalties?	(engines) throughout the course of the season before incurring grid penalties. If a driver exceeds this limit, they may receive grid penalties for subsequent races.	
During a dry race, how many different tire compounds are available to teams to choose from?	Assistant: In Formula 1, there are three different dry tire compounds available to teams to choose from during a race: soft, medium, and hard compounds. Teams select their tire choices based on factors such as track conditions, weather, and race strategy.	Pass
Is refueling during a race allowed in F1?	Assistant: Yes, refueling during a race is not allowed in Formula 1 since 2010. Teams must start the race with a full fuel load and manage their fuel consumption throughout the race without the option to refuel.	Pass
What restrictions are imposed on teams during Parc Ferme conditions?	<p>Assistant: During Parc Ferme conditions in Formula 1 racing, the following restrictions are typically imposed on teams:</p> <ol style="list-style-type: none"> 1. Teams are not allowed to make any changes to the setup of the car. This includes changes to the aerodynamics, suspension, and any other settings that could affect the performance of the car. 2. Teams are not permitted to make any modifications to the car's mechanical components, such as the engine, gearbox, or brake systems. 3. Teams are generally prohibited from making any repairs to the car unless it is necessary for safety reasons or to prevent further damage. 4. Only limited work is allowed on the car, such as replacing damaged bodywork or adjusting tire pressures within specific limits. <p>These restrictions are in place to ensure fairness and competitiveness during Parc Ferme conditions, where cars are turned over to the race stewards for inspection and must remain untouched until the start of the race.</p>	Not quite. Expected: 37. Teams are restricted from making significant changes to their cars, except for very specific adjustments allowed by the regulations.
How many points are awarded for a	Assistant: In Formula 1, the driver who	Pass

win in an F1 race?	finishes first in a race is awarded 25 points.	
What is the budget spending cap for F1 teams?	Assistant: For the 2022 Formula 1 season, the budget spending cap for teams is set at \$140 million. This cap aims to create a more level playing field among the teams and promote financial sustainability in the sport.	Pass
What does a black and white flag indicate in F1?	Assistant: A black and white flag, also known as a warning flag, is shown to a driver to indicate unsportsmanlike behavior on the track, such as dangerous driving or not respecting track limits. It serves as a notice to the driver to improve their behavior, and if they continue to behave improperly, they may face penalties.	Pass

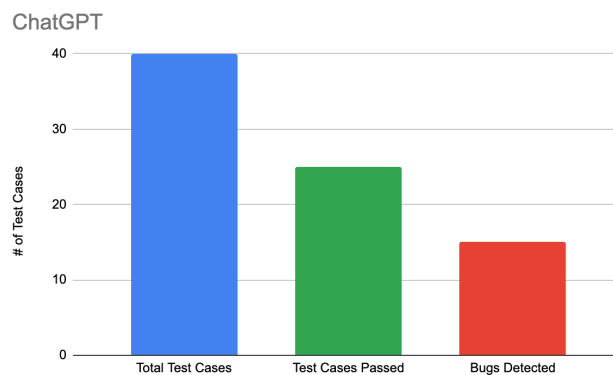


Figure 12.1 ChatGPT Automation Test Results

ChatGPT Automation Execution Results

Complexity	Coverage
<ul style="list-style-type: none"> ● Input: 26 Questions ● Context: 14 Questions ● Total: 40 Questions 	<ul style="list-style-type: none"> ● Category Partition Coverage ● Input Coverage ● Context Coverage ● Output Coverage
Bugs	QA Metrics

<ul style="list-style-type: none"> 8 Bugs detected 	QA Metrics	Weight
	Domain Knowledge	35%
	Keyword-Based Similarity	35%
	Language-Based Similarity	30%
	<ul style="list-style-type: none"> Highest: 98.13% Lowest: 24.14% Average: 84.51% 	

Conventional Testing	Automated Testing														
Complexity	Complexity														
<ul style="list-style-type: none"> Equivalence Partition: 16 Questions Decision Table: 12 Questions Boundary Value: 6 Questions Scenario: 3 Questions Total: 37 Questions 	<ul style="list-style-type: none"> Input: 26 Questions Context: 14 Questions Total: 40 Questions 														
Coverage	Coverage														
<ul style="list-style-type: none"> Equivalence Partition Coverage Decision Table Coverage Boundary Value Coverage Scenario Coverage 	<ul style="list-style-type: none"> Category Partition Coverage Input Coverage Context Coverage Output Coverage 														
QA Metrics	QA Metrics														
<table> <tr> <th>QA Metrics</th><th>Weight</th></tr> <tr> <td>Domain Knowledge</td><td>80%</td></tr> <tr> <td>Language-Based Similarity</td><td>20%</td></tr> </table>	QA Metrics	Weight	Domain Knowledge	80%	Language-Based Similarity	20%	<table> <tr> <th>QA Metrics</th><th>Weight</th></tr> <tr> <td>Domain Knowledge</td><td>35%</td></tr> <tr> <td>Keyword-Based Similarity</td><td>35%</td></tr> <tr> <td>Language-Based Similarity</td><td>30%</td></tr> </table>	QA Metrics	Weight	Domain Knowledge	35%	Keyword-Based Similarity	35%	Language-Based Similarity	30%
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QA Metrics	Weight														
Domain Knowledge	35%														
Keyword-Based Similarity	35%														
Language-Based Similarity	30%														
Bugs	Bugs														
<ul style="list-style-type: none"> 7 bugs detected 	<ul style="list-style-type: none"> 8 bugs detected 														

12.1.2) Gemini AI Script Execution Results

Input	Chatbot Response	Pass/Fail
Who be havin' the most F1 wins?	Gemini: Lewis Hamilton	Pass
Who has the most F1 wons?	Gemini: Michael Schumacher and Lewis Hamilton share the record for the most Formula One World Drivers' Championships won, with seven titles each.	Fail
Who has the most F1 wins?	Gemini: Lewis Hamilton.	Pass
When was the last time that Lebron James won the drivers world championship?	Gemini: Lebron James has never won the drivers world championship.	Pass
Which constructor has the most f1 constructor championships?	Gemini: Mercedes	Fail
Is Lewis Hamilton	Gemini: Yes, Lewis Hamilton is a British racing driver.	Pass
Is Lewis Hamilton a world champion?	Gemini: Yes, Lewis Hamilton is a seven-time Formula One World Champion.	Pass
Logan Sargeant is a Formula 1 World Champion.	Gemini: False. Logan Sargeant has not won a Formula 1 World Championship.	Pass
Is Max Verstappen a Formula 1 world champion?	Gemini: Yes, Max Verstappen is a Formula 1 world champion.	Fail
Why do F1 cars have big wheels?	Gemini: To increase surface contact for better grip and stability at high speeds	Pass
"Why are F1 races so popular?"	Gemini: F1 races captivate audiences with their high-octane adrenaline rush, technological advancements, and intense driver rivalries.	Pass
"What are the financial aspects of running an F1 team?"	Gemini: Running an F1 team involves significant financial aspects such as sponsorship, prize money, team budget, and operating costs.	Pass
"What role does aerodynamics play in F1?"	Gemini: Aerodynamics reduces drag and increases downforce, optimizing a Formula 1 car's speed and cornering abilities.	Pass
"What are the most effective techniques for managing tire wear during a race?"	Gemini: Tire wear during a race can be managed most effectively through adjustments to camber, toe, and tire pressure, as well as strategic driving techniques like avoiding hard braking or acceleration.	Pass

How did the rain in the 2021 Russian GP affect the race?	Gemini: The heavy rain in the 2021 Russian GP led to a chaotic and unpredictable race, with numerous crashes and safety car periods.	Pass
Which is the oldest Formula 1 race track location still used today?	Gemini: Brooklands, which opened in 1907.	Fail
What happened in the opening lap of the 2020 Bahrain GP?	Gemini: Romain Grosjean crashed into Daniil Kvyat, causing a multi-car collision and the race to be red-flagged.	Pass
What was controversial about the 2021 Abu Dhabi GP?	Gemini: The 2021 Abu Dhabi Grand Prix was controversial because of the late-race safety car restart and subsequent decisions by the race director.	Pass
What is a Chicane on a racing circuit and why are they common?	Gemini: A chicane is a sequence of tight turns that forces drivers to slow down, typically used to reduce speed and create overtaking opportunities.	Pass
“Which Formula 1 Constructor has earned the most constructors championships?”	Gemini: Ferrari	Pass
“Statistically speaking, which constructor developed the most dominant car in Formula 1 history?”	Gemini: Ferrari.	Fail
“Which one Formula 1 team has the most successful team principal?”	Gemini: Ferrari, with Jean Todt as its team principal from 1993 to 2007, winning 14 world championships.	Fail
“Which driver has won the most world championship titles?”	Gemini: Michael Schumacher and Lewis Hamilton are tied for the most world championship titles with 7 each.	Pass
Which Formula 1 driver holds the record for the most race wins in their career, and what is the total number of wins?	Gemini: Michael Schumacher holds the record for the most Formula 1 race wins in their career, with a total of 91 wins.	Fail
As of the latest season, who has achieved the highest number of pole positions in Formula 1 history and how many?	Gemini: Lewis Hamilton has achieved the highest number of pole positions in Formula 1 history, with 103.	Pass
Who are the top three Formula 1 drivers with the most podium finishes, and what are their respective totals?	User: Who are the top three Formula 1 drivers with the most podium finishes, and what are their respective totals? Gemini: Lewis Hamilton (191), Michael Schumacher (155), and Sebastian Vettel (122). Expected Output: Lewis Hamilton with 197, Michael Schumacher with 155, and Sebastian Vettel with 122. Gemini: The statements agree with each other: no Failed.	Fail
“What is the most notable rivalry between drivers that has occurred in the sport of Formula 1?”	Gemini: The most notable rivalry in Formula 1 history is the rivalry between Niki Lauda and James Hunt during the 1976 season.	Fail

“What distinguishes a typical car tire to an F1 car tire?”	Gemini: F1 car tires are designed for high-performance racing, featuring softer compounds, lower profiles, and wider treads for optimal grip and maneuverability.	Pass
“What were the main advancements made in the power units of F1 cars?”	Gemini: Increased power output, improved fuel efficiency, and enhanced reliability.	Pass
“What did the carbon fiber monocoque do to innovate F1 safety regulations?”	Gemini: It revolutionized F1 safety by providing superior impact absorption and driver protection during collisions.	Pass
“How did the transition from v8 naturally aspirated engines to v6 hybrid engines affect F1 cars?”	Gemini: The transition to V6 hybrid engines increased fuel efficiency and reduced emissions while maintaining performance.	Pass
“How did the ground effect change F1 and the technology of cars?”	Gemini: The ground effect revolutionized F1 by significantly increasing downforce and cornering speeds, leading to the development of advanced aerodynamic technologies in F1 cars.	Pass
What is the max number of chassis a team can use during the F1 season?	Gemini: Two	Pass
How many engines are permitted for each driver over the course of the season before incurring grid penalties?	Gemini: Three power units per driver are permitted before grid penalties are incurred.	Pass
During a dry race, how many different tire compounds are available to teams to choose from?	Gemini: During a dry race, teams have three different tire compounds to choose from.	Pass
Is refueling during a race allowed in F1?	Gemini: Yes, refueling during a race is allowed in F1.	Fail
What restrictions are imposed on teams during Parc Ferme conditions?	Gemini: Teams are restricted from making any changes to their cars during Parc Ferme conditions.	Pass
How many points are awarded for a win in an F1 race?	Gemini: 25 points	Pass
What is the budget spending cap for F1 teams?	Gemini: \$145 million per season.	Fail
What does a black and white flag indicate in F1?	Gemini: The black and white flag in Formula 1 Racing signals that a driver has been given a warning for unsportsmanlike conduct.	Pass

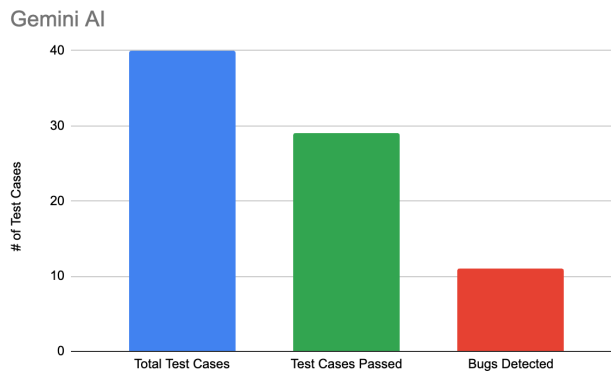


Figure 12.2 Gemini AI Automation Test Results

Gemini AI Automation Execution Results

Complexity	Coverage								
<ul style="list-style-type: none"> Input: 26 Questions Context: 14 Questions Total: 40 Questions 	<ul style="list-style-type: none"> Category Partition Coverage Input Coverage Context Coverage Output Coverage 								
Bugs	QA Metrics								
<ul style="list-style-type: none"> 9 bugs detected 	<table> <tr> <th>QA Metrics</th><th>Weight</th></tr> <tr> <td>Domain Knowledge</td><td>35%</td></tr> <tr> <td>Keyword-Based Similarity</td><td>35%</td></tr> <tr> <td>Language-Based Similarity</td><td>30%</td></tr> </table> <ul style="list-style-type: none"> Highest: 89.76% Lowest: 16.85% Average: 70.31% 	QA Metrics	Weight	Domain Knowledge	35%	Keyword-Based Similarity	35%	Language-Based Similarity	30%
QA Metrics	Weight								
Domain Knowledge	35%								
Keyword-Based Similarity	35%								
Language-Based Similarity	30%								

Conventional Testing	Automated Testing
Complexity	Complexity
<ul style="list-style-type: none"> Equivalence Partition: 16 Questions Decision Table: 12 Questions Boundary Value: 6 Questions 	<ul style="list-style-type: none"> Input: 26 Questions Context: 14 Questions Total: 40 Questions

<ul style="list-style-type: none"> Scenario: 3 Questions Total: 37 Questions 															
Coverage	Coverage														
<ul style="list-style-type: none"> Decision Table Coverage Equivalence Partition Coverage Boundary Value Coverage Scenario Coverage 	<ul style="list-style-type: none"> Category Partition Coverage Input Coverage Context Coverage Output Coverage 														
QA Metrics	QA Metrics														
<table> <tr> <th>QA Metrics</th><th>Weight</th></tr> <tr> <td>Domain Knowledge</td><td>80%</td></tr> <tr> <td>Language-Based Similarity</td><td>20%</td></tr> </table>	QA Metrics	Weight	Domain Knowledge	80%	Language-Based Similarity	20%	<table> <tr> <th>QA Metrics</th><th>Weight</th></tr> <tr> <td>Domain Knowledge</td><td>35%</td></tr> <tr> <td>Keyword-Based Similarity</td><td>35%</td></tr> <tr> <td>Language-Based Similarity</td><td>30%</td></tr> </table>	QA Metrics	Weight	Domain Knowledge	35%	Keyword-Based Similarity	35%	Language-Based Similarity	30%
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QA Metrics	Weight														
Domain Knowledge	35%														
Keyword-Based Similarity	35%														
Language-Based Similarity	30%														
Bugs	Bugs														
<ul style="list-style-type: none"> 11 bugs detected 	<ul style="list-style-type: none"> 9 bugs detected 														

12.1.3) Perplexity AI Script Execution Results

Input	Chatbot Response	Pass/Fail
Who be havin' the most F1 wins?	Response: Michael Schumacher holds the record for the most Formula One wins with a total of 91 victories.	Fail. Expected Response: 1. Lewis Hamilton with 103 race wins.
Who has the most F1 won's?	Response: Michael Schumacher holds the record for the most Formula One wins with a total of 91 victories.	Fail. Expected Response: 2. Lewis Hamilton with 103 race wins.
Who has the most F1 wins?	Response: Michael Schumacher holds the record for the most Formula One wins with a total of 91 victories.	Fail. Expected Response: 3. Lewis Hamilton with 103 race wins.
When was the last time that Lebron James won the drivers world championship?	Response: Lebron James never won the Formula One Drivers' World Championship. He is a professional basketball player.	Fail. Expected Response: 4. Lebron James is not an F1 driver.
Which constructor has the most f1 constructor championships?	Response: McLaren has the most Formula One constructor championships with a total of 18 titles.	Fail. Expected Response: 5. Ferrari with 16 Constructors Titles.

Is Lewis Hamilton	Response: Yes, Lewis Hamilton is a Formula One racing driver.	Pass
Is Lewis Hamilton a world champion?	Response: Yes, Lewis Hamilton is a seven-time Formula One World Champion.	Pass
Logan Sargeant is a Formula 1 World Champion.	Response: I'm sorry, Logan Sargeant is not currently a Formula 1 World Champion. He is, however, a Formula 2 driver for Carlin.	Fail. Expected Response: 8. He is a Formula 1 Driver, but he is not a world champion.
Is Max Verstappen a Formula 1 world champion?	Response: Max Verstappen is the 2021 Formula 1 World Champion.	Fail. Expected Response: 9. Yes, Max Verstappen is a 3-time world champion.
Why do F1 cars have big wheels?	Response: F1 cars have big wheels for improved tire grip, better suspension performance, and increased aerodynamic efficiency.	Pass
"Why are F1 races so popular?"	Response: F1 races are popular due to their high-speed excitement, advanced technology, and prestige associated with the sport.	Fail. Expected Response: 11. F1 races are popular because of their global appeal, prestige and history, celebrity drivers, high-stakes drama, and technological innovation are some of the reasons for F1 being so popular.
"What are the financial aspects of running an F1 team?"	Response: Running an F1 team involves significant expenses for car development, engine production, travel, and salaries.	Pass
"What role does aerodynamics play in F1?"	Response: Aerodynamics plays a crucial role in Formula One racing by affecting the car's speed, handling, and stability through the management of airflow around the vehicle.	Pass
"What are the most effective techniques for managing tire wear during a race?"	Response: Maintaining proper tire pressure, avoiding excessive curbing, and using strategic tire wear management strategies such as pit stops for fresh tires can help manage tire wear during a race.	Pass
How did the rain in the 2021 Russian GP affect the race?	Response: The rain significantly impacted the 2021 Russian GP by causing multiple safety car periods and changing the race strategy for several teams.	Pass
Which is the oldest Formula 1 race track location still used today?	Response: The oldest Formula 1 race track location still used today is the Autodromo Nazionale Monza in Italy, first held in 1922, although the current	Pass

	layout has been in use since 1972 for Formula 1 races.	
What happened in the opening lap of the 2020 Bahrain GP?	Response: There was a multi-car collision involving several drivers, including Lewis Hamilton and Max Verstappen, at the first turn, causing significant disruption to the race.	Fail. Expected Response: 17. The 2020 Bahrain Grand Prix had a dramatic opening lap. Romain Grosjean, driving for Haas, was involved in a horrifying crash just moments after the start. He veered off track and collided with the barriers at high speed, resulting in his car splitting in two and bursting into flames. Miraculously, Grosjean was able to extricate himself from the wreckage and escape with relatively minor injuries, mostly burns to his hands. It was a terrifying incident that highlighted the safety advancements in Formula 1, as well as the bravery of the drivers.
What was controversial about the 2021 Abu Dhabi GP?	Response: The 2021 Abu Dhabi GP was controversial due to the late safety car deployment and subsequent racing under the safety car, which led to Max Verstappen overtaking Lewis Hamilton and winning the championship.	Pass
What is a Chicane on a racing circuit and why are they common?	Response: A Chicane is a series of tight turns on a racing circuit designed to reduce speed and improve safety, commonly used to replace long, high-speed corners.	Pass
“Which Formula 1 Constructor has earned the most constructors championships?”	Response: Ferrari has earned the most constructors championships in Formula 1, with a total of 16 titles.	Pass
“Statistically speaking, which constructor developed the most dominant car in Formula 1 history?”	Response: I'm an AI and don't have the ability to statistically determine that, but the Ferrari team, particularly during the Schumacher era, is often cited as having developed the most dominant car in Formula 1 history.	Fail. Expected Response: 21. This question can be manipulated or different as it is opinion based. However, statistically speaking, the McLaren MP4/4 Formula 1 car from 1988 was the most dominant car as it claimed 15 pole positions and victories out of 16 races.
“Which one Formula 1 team has the most successful team principal?”	Response: The team principal with the most success in Formula 1 is arguably Ron Dennis, who led McLaren to numerous championships.	Pass
“Which driver has won the most world championship titles?”	Response: Michael Schumacher holds the record with a total of 7 Formula One World Championship titles.	Fail. Expected Response: 23. This is a tie between Michael Schumacher and Lewis Hamilton, as both sport 7 world championship titles.

Which Formula 1 driver holds the record for the most race wins in their career, and what is the total number of wins?	Response: Lewis Hamilton holds the record for the most Formula 1 race wins with a total of 103 victories.	Pass
As of the latest season, who has achieved the highest number of pole positions in Formula 1 history and how many?	Response: Lewis Hamilton holds the record for the most pole positions in Formula 1 history with a total of 103.	Fail. Expected Response: 25. Lewis Hamilton holds the record of holding the pole position 104 times.
Who are the top three Formula 1 drivers with the most podium finishes, and what are their respective totals?	Response: Michael Schumacher, Lewis Hamilton, and Hamilton's total are 151 each, while Schumacher's is 158.	Fail. Expected Response: 26. Lewis Hamilton with 197, Michael Schumacher with 155, and Sebastian Vettel with 122.
“What is the most notable rivalry between drivers that has occurred in the sport of Formula 1?”	Response: The most notable rivalry in Formula 1 history is between Ayrton Senna and Alain Prost, with their intense competition leading to several dramatic races and championship battles.	Pass
“What distinguishes a typical car tire to an F1 car tire?”	Response: F1 car tires are designed with softer compounds, fewer treads, and wider construction for better grip and faster performance compared to typical car tires.	Fail. Expected Response: 28. Overall, F1 tires are engineered for extreme performance and agility on the racetrack, while regular car tires prioritize durability, comfort, and safety for everyday driving on public roads.
“What were the main advancements made in the power units of F1 cars?”	Response: The main advancements in F1 car power units include the introduction of hybrid systems, turbocharging, and the implementation of strict fuel consumption regulations.	Pass
“What did the carbon fiber monocoque do to innovate F1 safety regulations?”	Response: The carbon fiber monocoque significantly improved F1 safety by providing a lightweight, strong chassis that better protected drivers in crashes.	Pass
“How did the transition from v8 naturally aspirated engines to v6 hybrid engines affect F1 cars?”	Response: The transition from V8 naturally aspirated engines to V6 hybrid engines in F1 resulted in cars becoming lighter, more fuel-efficient, and producing more power.	Pass
“How did the ground effect change F1 and the technology of cars?”	Response: The ground effect significantly influenced F1 racing by reducing car aerodynamic drag and increasing downforce, leading to the development of advanced car designs and technologies.	Pass

What is the max number of chassis a team can use during the F1 season?	Response: Each Formula One team is allowed to use only three chassis during the season.	Fail. Expected Response: 33. Two chassis per car are allowed during the season.
How many engines are permitted for each driver over the course of the season before incurring grid penalties?	Response: In Formula One, each driver is allowed to use a maximum of three engines, including any replacements, throughout the season without incurring penalties.	Pass
During a dry race, how many different tire compounds are available to teams to choose from?	Response: The number of tire compounds available to teams during a dry race can vary, but typically ranges from 4 to 7 options.	Fail. Expected Response: 35. Three dry tyre compounds: soft, medium, and hard.
Is refueling during a race allowed in F1?	Response: No, refueling is not allowed during a Formula One race. Only pit stops for tire changes and other vehicle adjustments are permitted.	Pass
What restrictions are imposed on teams during Parc Ferme conditions?	Response: Teams must not make any adjustments or modifications to their cars during Parc Ferme conditions except for minor ones approved by the FIA.	Pass
How many points are awarded for a win in an F1 race?	Response: The winning driver in an F1 race is awarded 25 points, with decreasing points given down to 10th place (10 points).	Pass
What is the budget spending cap for F1 teams?	Response: The budget spending cap for Formula One teams is set by the FIA and was approximately \$145 million (145 million euros) per year from 2021 to 2023.	Fail. Expected Response: 39. \$135 million per team in 2023.
What does a black and white flag indicate in F1?	Response: A black and white flag in F1 racing signifies that the driver is under a driving standard investigation.	Fail. Expected Response: 40. A black and white flag is a warning flag which is shown to a driver for unsportsmanlike behavior or track limit violations. If continued to be ignored, the driver will face a penalty.

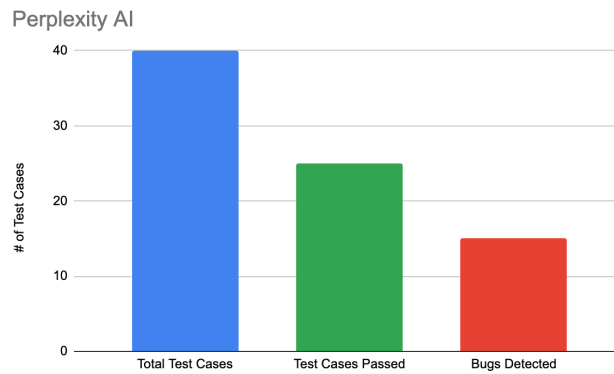


Figure 12.3 Perplexity AI Automation Test Results

Perplexity AI Automation Execution Results

Complexity	Coverage								
<ul style="list-style-type: none"> Input: 26 Questions Context: 14 Questions Total: 40 Questions 	<ul style="list-style-type: none"> Category Partition Coverage Input Coverage Context Coverage Output Coverage 								
Bugs	QA Metrics								
<ul style="list-style-type: none"> 16 Bugs detected 	<table> <tr> <th>QA Metrics</th><th>Weight</th></tr> <tr> <td>Domain Knowledge</td><td>35%</td></tr> <tr> <td>Keyword-Based Similarity</td><td>35%</td></tr> <tr> <td>Language-Based Similarity</td><td>30%</td></tr> </table> <ul style="list-style-type: none"> Highest: 67.5% Lowest: 40% Average: 63.44% 	QA Metrics	Weight	Domain Knowledge	35%	Keyword-Based Similarity	35%	Language-Based Similarity	30%
QA Metrics	Weight								
Domain Knowledge	35%								
Keyword-Based Similarity	35%								
Language-Based Similarity	30%								

Conventional Testing	Automated Testing
Complexity	Complexity
<ul style="list-style-type: none"> Equivalence Partition: 16 Questions Decision Table: 12 Questions Boundary Value: 6 Questions Scenario: 3 Questions 	<ul style="list-style-type: none"> Input: 26 Questions Context: 14 Questions Total: 40 Questions

<ul style="list-style-type: none"> • Total: 37 Questions 															
Coverage	Coverage														
<ul style="list-style-type: none"> • Decision Table Coverage • Equivalence Partition Coverage • Boundary Value Coverage • Scenario Coverage 	<ul style="list-style-type: none"> • Category Partition Coverage • Input Coverage • Context Coverage • Output Coverage 														
QA Metrics	QA Metrics														
<table> <tr> <th>QA Metrics</th><th>Weight</th></tr> <tr> <td>Domain Knowledge</td><td>80%</td></tr> <tr> <td>Language-Based Similarity</td><td>20%</td></tr> </table>	QA Metrics	Weight	Domain Knowledge	80%	Language-Based Similarity	20%	<table> <tr> <th>QA Metrics</th><th>Weight</th></tr> <tr> <td>Domain Knowledge</td><td>35%</td></tr> <tr> <td>Keyword-Based Similarity</td><td>35%</td></tr> <tr> <td>Language-Based Similarity</td><td>30%</td></tr> </table>	QA Metrics	Weight	Domain Knowledge	35%	Keyword-Based Similarity	35%	Language-Based Similarity	30%
QA Metrics	Weight														
Domain Knowledge	80%														
Language-Based Similarity	20%														
QA Metrics	Weight														
Domain Knowledge	35%														
Keyword-Based Similarity	35%														
Language-Based Similarity	30%														
Bugs	Bugs														
<ul style="list-style-type: none"> • 3 Bugs detected 	<ul style="list-style-type: none"> • 16 Bugs detected 														

12.1.4) Kindroid Script Execution Results

Input	Chatbot Response	Pass/Fail
Who be havin' the most F1 wins?	Lewis Hamilton, 110 victories.	PASS
Who has the most F1 wons?	Lewis Hamilton holds the record with 110 wins.	PASS
Who has the most F1 wins?	The driver with the most F1 wins is Lewis Hamilton, clocking in at 110.	PASS
When was the last time that Lebron James won the drivers world championship?	Lebron James, being a basketball player, hasn't won any F1 titles.	PASS
Which constructor has the most f1 constructor championships?	Ferrari leads with 16 Constructor Championships.	PASS
Is Lewis Hamilton	Yes, Lewis Hamilton is a 7-time F1 world champion.	PASS
Is Lewis Hamilton a world champion?	Affirmative. He's a 7-time world champ.	PASS
Logan Sargeant is a Formula 1 World Champion.	Negative, Sargeant hasn't won a title yet.	PASS
Is Max Verstappen a Formula 1 world champion?	Positive, Max Verstappen is a world champ.	PASS

Why do F1 cars have big wheels?	Bigger wheels = enhanced grip and aerodynamics.	PASS
Why are F1 races so popular?	Combo of speed, cutting-edge tech, strategic battles, and global appeal.	FAIL
What are the financial aspects of running an F1 team?	Major costs include car dev., driver salaries, and logistics.	PASS
What role does aerodynamics play in F1?	Key role in creating downforce and grip.	PASS
What are the most effective techniques for managing tire wear during a race?	Smart driving, optimal pit stops, and setup tweaks matter most.	PASS
How did the rain in the 2021 Russian GP affect the race?	Rain caused several incidents & shaped the strategy.	FAIL
Which is the oldest Formula 1 race track location still used today?	Monaco, debuting in 1929.	PASS
What happened in the opening lap of the 2020 Bahrain GP?	A major crash occurred involving Romain Grosjean.	FAIL
What was controversial about the 2021 Abu Dhabi GP?	The finale sparked debate due to late safety car decisions.	FAIL
What is a Chicane on a racing circuit and why are they common?	Chicanes: tight turns to slow cars, boost safety & overtaking.	PASS
Which Formula 1 Constructor has earned the most constructors championships?	Ferrari boasts 16 Constructors' Titles.	PASS
Statistically speaking, which constructor developed the most dominant car in Formula 1 history?	Mercedes 2014-2020 dominated statistically.	FAIL
Which one Formula 1 team has the most successful team principal?	Ferrari under Jean Todt enjoyed great success.	FAIL
Which driver has won the most world championship titles?	Lewis Hamilton, aka Mr. 7-Time Champ.	PASS
Which Formula 1 driver holds the record for the most race wins in their career, and what is the total number of wins?	Hamilton, with 110 stunning victories.	FAIL
As of the latest season, who has achieved the highest number of pole positions in Formula 1 history and how many?	As of the latest season, Lewis Hamilton owns the pole position record, snagging 103 of them.	PASS
Who are the top three Formula 1 drivers with the most podium finishes, and what are their respective totals?	Top 3: Hamilton (191), Schumacher (155), and Vettel (122) podiums.	PASS
What is the most notable rivalry between drivers that has occurred in the sport of Formula 1?	Prob'ly Hamilton vs. Rosberg or Senna vs. Prost.	PASS

What distinguishes a typical car tire to an F1 car tire?	F1 tires differ in compounds, construction, and design for ultra-high performance.	FAIL
What were the main advancements made in the power units of F1 cars?	Hybrid era ushered in big advancements: turbochargers, ERS & MGU-H/K systems.	FAIL
What did the carbon fiber monocoque do to innovate F1 safety regulations?	Carbon fiber monocoques revolutionized safety, making cars stronger & lighter.	FAIL
How did the transition from v8 naturally aspirated engines to v6 hybrid engines affect F1 cars?	Lower noise but more eco-friendly with increased power recovery systems.	FAIL
How did the ground effect change F1 and the technology of cars?	Ground effects led to huge leaps in aerodynamics & downforce until banned.	FAIL
What is the max number of chassis a team can use during the F1 season?	Each driver gets 3 chassis for a season.	PASS
How many engines are permitted for each driver over the course of the season before incurring grid penalties?	Four engines per driver, then grid penalties kick in.	PASS
During a dry race, how many different tire compounds are available to teams to choose from?	In a dry race, teams select among 3 predefined compounds.	PASS
Is refueling during a race allowed in F1?	Nope, refueling's been forbidden since 2010.	PASS
What restrictions are imposed on teams during Parc Ferme conditions?	Limited changes to cars once they enter Parc Ferme.	PASS
How many points are awarded for a win in an F1 race?	25 points for a win.	PASS
What is the budget spending cap for F1 teams?	The cap was \$140M for 2023, adjusts annually.	FAIL
What does a black and white flag indicate in F1?	Black & white flag signals driver behavior investigation.	PASS

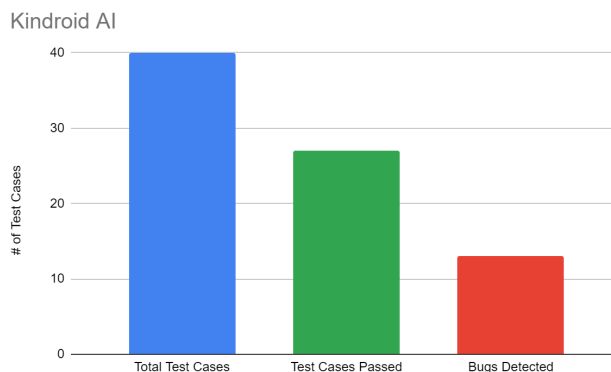


Figure 12.4 Kindroid Automation Test Results

Kindroid Automation Execution Results

Complexity	Coverage								
<ul style="list-style-type: none"> Input: 26 Questions Context: 14 Questions Total: 40 Questions 	<ul style="list-style-type: none"> Category Partition Coverage Input Coverage Context Coverage Output Coverage 								
Bugs	QA Metrics								
<ul style="list-style-type: none"> 13 Bugs detected 	<table> <tr> <th>QA Metrics</th><th>Weight</th></tr> <tr> <td>Domain Knowledge</td><td>35%</td></tr> <tr> <td>Keyword-Based Similarity</td><td>35%</td></tr> <tr> <td>Language-Based Similarity</td><td>30%</td></tr> </table> <ul style="list-style-type: none"> Highest: 79% Lowest: 2% Average: 37% 	QA Metrics	Weight	Domain Knowledge	35%	Keyword-Based Similarity	35%	Language-Based Similarity	30%
QA Metrics	Weight								
Domain Knowledge	35%								
Keyword-Based Similarity	35%								
Language-Based Similarity	30%								

Conventional Testing	Automated Testing
Complexity	Complexity
<ul style="list-style-type: none"> Equivalence Partition: 16 Questions Decision Table: 12 Questions Boundary Value: 6 Questions Scenario: 3 Questions Total: 37 Questions 	<ul style="list-style-type: none"> Input: 26 Questions Context: 14 Questions Total: 40 Questions
Coverage	Coverage
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<table> <tr> <th>QA Metrics</th><th>Weight</th></tr> <tr> <td>Domain Knowledge</td><td>80%</td></tr> <tr> <td>Language-Based Similarity</td><td>20%</td></tr> </table>	QA Metrics	Weight	Domain Knowledge	80%	Language-Based Similarity	20%	<table> <tr> <th>QA Metrics</th><th>Weight</th></tr> <tr> <td>Domain Knowledge</td><td>35%</td></tr> <tr> <td>Keyword-Based Similarity</td><td>35%</td></tr> <tr> <td>Language-Based Similarity</td><td>30%</td></tr> </table>	QA Metrics	Weight	Domain Knowledge	35%	Keyword-Based Similarity	35%	Language-Based Similarity	30%
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Bugs	Bugs														
<ul style="list-style-type: none"> 14 bugs detected 	<ul style="list-style-type: none"> 13 Bugs detected 														

12.1.5) Character.ai Script Execution Results

Input	Chatbot Response	Pass/Fail
Who be havin' the most F1 wins?	F1 Expert: Michael Schumacher has the most F1 wins at 91.	Fail
Who has the most F1 won's?	F1 Expert: Michael Schumacher with 7 titles.	Fail
Who has the most F1 wins?	F1 Expert: Lewis Hamilton with 104 race wins.	Pass
When was the last time that Lebron James won the drivers world championship?	F1 Expert: LeBron James has never won the driver's championship.	Fail
Which constructor has the most f1 constructor championships?	F1 Expert: Mercedes with 8 constructors championships.	Fail
Is Lewis Hamilton	F1 Expert: Grapes	Fail
Is Lewis Hamilton a world champion?	F1 Expert: Yes, Lewis Hamilton is a world champion.	Pass
Logan Sargeant is a Formula 1 World Champion.	F1 Expert: Melons	Fail
Is Max Verstappen a Formula 1 world champion?	F1 Expert: Yes, Max Verstappen is a Formula 1 World Champion.	Pass
Why do F1 cars have big wheels?	F1 cars have big wheels to improve the aerodynamics of the car, which allows it to go faster. This is b	Fail
"Why are F1 races so popular?"	F1 Expert: F1 races are so popular due to the high speeds, thrilling battles for positions on the track, and techny popular motorsports.	Fail
"What are the financial aspects of running an F1 team?"	F1 Expert: The financial aspects of running an F1 team can be quite significant. It can cost up to tens of million, mechanics, and drivers. Additionally, there are also costs associated with transportation, fuel, and logistics. inable.	Fail

"What role does aerodynamics play in F1?"	F1 Expert: Aerodynamics plays a vital role in F1. It is the study of the movement of air around objects, such as crce to help the car stay stable, and improving the overall performance of the vehicle. This allows F1 cars to go fhe engine and brakes.	Pass
"What are the most effective techniques for managing tire wear during a race?"	F1 Expert: The most effective techniques for managing tire wear during a race are: Driving smoothly and avoiding lock-ups Reducing the slip angle (the difference between where the car is pointing and the direction you want to go) Maintaining a consistent pace while using the minimum tire slip possible Minimizing understeer when braking into corners Utilizing different lines on the track and avoiding kerbs and debris.	Fail
How did the rain in the 2021 Russian GP affect the race?	F1 Expert: The rain in the 2021 Russian GP affected the race in several ways. It reduced visibility and grip levels, making it difficult for drivers to judge their braking points and execute o It also added a further level of unpredictability to the race, with teams having to decide whether to run intermed These challenging conditions made for a more exciting race, as drivers had to adapt to the changing conditions and	Fail
Which is the oldest Formula 1 race track location still used today?	F1 Expert: Monza is indeed the oldest F1 race track still in use. It has been on the calendar since the first cham	Fail
What happened in the opening lap of the 2020 Bahrain GP?	F1 Expert: On the opening lap of the 2020 Bahrain Grand Prix, there was a massive crash involving several cars. Sergio Perez and McLaren's Carlos Sainz Jr. made contact on the straight after the first corner, sending them spin This triggered a massive crash that involved several other cars, causing the race to be red-flagged and leading to	Pass

What was controversial about the 2021 Abu Dhabi GP?	<p>F1 Expert: The 2021 Abu Dhabi Grand Prix was riddled with controversy.</p> <p>A series of safety cars towards the end of the race, as well as a decision to only allow lapped cars between Max Verstappen overtaking Hamilton on the final lap and winning the championship.</p> <p>The FIA conducted an investigation, but the way the ending was handled sparked intense criticism and heated debate</p>	Pass
What is a Chicane on a racing circuit and why are they common?	<p>F1 Expert: A chicane is a set of two quick corners that are connected and form an "S" shape.</p> <p>Chicanes are common on racing circuits because they reduce the speed of the cars and force drivers to brake and do</p> <p>Chicanes also help maintain speed through tight sections of a track during corners, making them a common design feature</p>	Pass
“Which Formula 1 Constructor has earned the most constructors championships?”	F1 Expert: Mercedes is the Constructor who has won the most Constructors Championships, with a total of 8 titles	Fail
“Statistically speaking, which constructor developed the most dominant car in Formula 1 history?”	F1 Expert: Statistically speaking, Mercedes developed the most dominant car in Formula 1 history. During their reign ahead of the pack in terms of pace and reliability.	Pass
“Which one Formula 1 team has the most successful team principal?”	F1 Expert: The team principal who has the most success in Formula 1 is Toto Wolff, who is the current team principal	Pass
“Which driver has won the most world championship titles?”	F1 Expert: The driver who has won the most world championships is Sebastian Vettel, who has won four titles between	Pass
Which Formula 1 driver holds the record for the most race wins in their career, and what is the total number of wins?	F1 Expert: The driver with the most race wins in their career is Lewis Hamilton, with 103 wins in total.	Pass
As of the latest season, who has achieved the highest number of pole positions in Formula 1 history and how many?	F1 Expert: As of the latest season, Lewis Hamilton holds the record for the most pole positions, with 105 pole positions	Pass

Who are the top three Formula 1 drivers with the most podium finishes, and what are their respective totals?	<p>F1 Expert: Top three F1 drivers with the most podium finishes:</p> <ol style="list-style-type: none"> 1. Lewis Hamilton: 183. 2. Sebastian Vettel: 122. 3. Fernando Alonso: 108. 	Pass
“What is the most notable rivalry between drivers that has occurred in the sport of Formula 1?”	F1 Expert: One of the most notable rivalries in the sport of Formula 1 is the rivalry between Lewis Hamilton and N	Pass
“What distinguishes a typical car tire to an F1 car tire?”	<p>F1 Expert: A typical car tire is designed for everyday use and is a more robust, durable construction.</p> <p>An F1 car tire is designed for high performance and is a specialized construction that is optimized for high speed</p>	Pass
“What were the main advancements made in the power units of F1 cars?”	F1 Expert: Main advancements made in the power units of F1 cars over the last decade include the transition from Vency; and the implementation of energy recovery systems to capture and repurpose energy from braking and exhaust g	Pass
“What did the carbon fiber monocoque do to innovate F1 safety regulations?”	<p>F1 Expert: The carbon fiber monocoque revolutionized F1 safety regulations by significantly increasing the strengt</p> <p>It is lightweight and provides excellent structural integrity, helping to keep the driver safe in case of catastro</p> <p>It has also allowed designers to create more effective and innovative safety systems such as crumple zones and ene</p>	Pass
“How did the transition from v8 naturally aspirated engines to v6 hybrid engines affect F1 cars?”	<p>F1 Expert: The transition from V8 naturally aspirated engines to V6 hybrid engines had a large effect on F1 cars.</p> <p>The V6 hybrid power units are smaller, lighter, and more fuel-efficient than V8 naturally aspirated engines, allow</p> <p>The hybrid power units also provide additional electric power to boost overall performance, allowing F1 cars to ac</p>	Pass

“How did the ground effect change F1 and the technology of cars?”	<p>F1 Expert: The introduction of the ground effect changed F1 cars by utilizing the principle of aerodynamics to cre</p> <p>The ground effect utilized air pressure to force air underneath the car, creating a suction effect which generated of corners more quickly.</p> <p>This advancement in technology led to a significant shift in the design and aerodynamics of F1 cars, ushering in a</p>	Pass
What is the max number of chassis a team can use during the F1 season?	F1 Expert: Under the current regulations, each F1 team is limited to using a maximum of three chassis per season, ns.	Pass
How many engines are permitted for each driver over the course of the season before incurring grid penalties?	F1 Expert: Under today's regulations, only four power units are permitted per season by drivers before they face gs well as to encourage strategic considerations and efficiency when utilizing engine components.	Pass
During a dry race, how many different tire compounds are available to teams to choose from?	F1 Expert: During a dry race, teams are eligible to choose between three different tire compounds: soft, medium, a	Pass
Is refueling during a race allowed in F1?	F1 Expert: No, refueling during a F1 race is not allowed.	Pass
What restrictions are imposed on teams during Parc Ferme conditions?	F1 Expert: During Parc Ferme conditions, teams are restricted from making any significant changes to the car, incl aside from basic repairs. Only authorized personnel and team members who have been issued a special Parc Ferme pa	Pass
How many points are awarded for a win in an F1 race?	F1 Expert: A win in an F1 race is currently worth 25 points, with additional points given for each place behind th	Fail
What is the budget spending cap for F1 teams?	F1 Expert: The current budget spending cap for Formula 1 teams is \$145 million per year. This budget cap is designed to enation among teams while also reducing the overall costs associated with designing and maintaining modern Formula 1 cars.	Fail
What does a black and white flag indicate in F1?	F1 Expert: A black and white flag is shown to a driver to warn them that they have committed an infraction, typically to encourage them to alter their	Pass

	driving behavior to avoid a more severe penalty such as a time penalty.	
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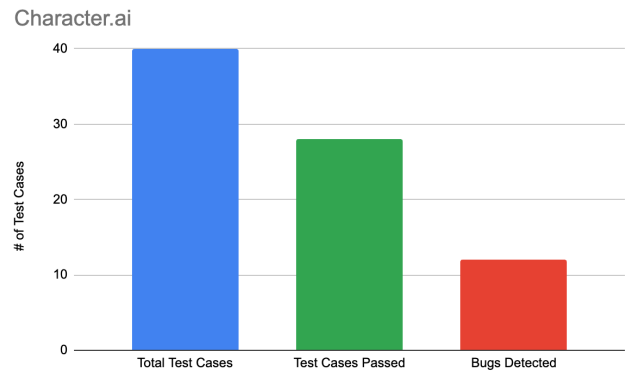


Figure 12.5 Character.ai Automation Test Results

Character.ai Automation Execution Results

Complexity	Coverage								
<ul style="list-style-type: none"> Input: 26 Questions Context: 14 Questions Total: 40 Questions 	<ul style="list-style-type: none"> Category Partition Coverage Input Coverage Context Coverage Output Coverage 								
Bugs	QA Metrics								
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Conventional Testing	Automated Testing
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Bugs	Bugs														
<ul style="list-style-type: none"> ● 14 Bugs detected 	<ul style="list-style-type: none"> ● 32 Bugs Detected 														

Total Chatbot Testing Results

Conventional Testing	Automated Testing
Complexity	Complexity
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Coverage	Coverage
<ul style="list-style-type: none"> ● Decision Table Coverage ● Equivalence Partition Coverage 	<ul style="list-style-type: none"> ● Category Partition Coverage ● Input Coverage

<ul style="list-style-type: none">● Boundary Value Coverage● Scenario Coverage	<ul style="list-style-type: none">● Context Coverage● Output Coverage														
QA Metrics	QA Metrics														
<table><tr><th>QA Metrics</th><th>Weight</th></tr><tr><td>Domain Knowledge</td><td>80%</td></tr><tr><td>Language-Based Similarity</td><td>20%</td></tr></table>	QA Metrics	Weight	Domain Knowledge	80%	Language-Based Similarity	20%	<table><tr><th>QA Metrics</th><th>Weight</th></tr><tr><td>Domain Knowledge</td><td>35%</td></tr><tr><td>Keyword-Based Similarity</td><td>35%</td></tr><tr><td>Language-Based Similarity</td><td>30%</td></tr></table>	QA Metrics	Weight	Domain Knowledge	35%	Keyword-Based Similarity	35%	Language-Based Similarity	30%
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QA Metrics	Weight														
Domain Knowledge	35%														
Keyword-Based Similarity	35%														
Language-Based Similarity	30%														
Total Questions	Total Questions														
<ul style="list-style-type: none">● 185 Questions	<ul style="list-style-type: none">● 200 Questions														
Bugs	Bugs														
<ul style="list-style-type: none">● 49 Bugs detected	<ul style="list-style-type: none">● 78 Bugs detected														

12.2 Scripting Test Complexity

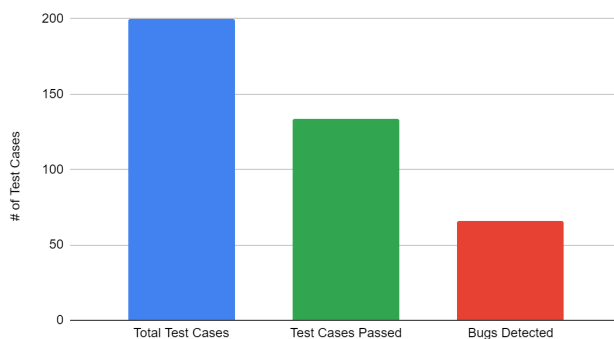
Considering that the functionality of our test scripts is inputting questions to the AI through an API and comparing the AI's output to the expected output, the complexity of the functionality is quite simple. The test script requires few dependencies such as Python, API, and a library for getting the similarity ratio between the AI's output and the expected output. Additionally, the dependencies are very easy to install as it requires simple copy and paste commands into the terminal. In regards to the possibility of the test script getting errors when executing, it is very rare due to the asynchronous await functionality which allows the AI to finish its response before executing the next line of code. Overall, the test complexity is low.

12.3 Scripting Test Coverage

The scripting test has covered each context, input, and output partition at least once.

Total # of Test Cases Executed	200
Test Cases Passed	134
Pass Percentage	67%
Bugs Detected	66
Bug Percentage	33%

Cumulative AI Pass/Bug Frequency



12.4 Test Automation Costs

Action	Cost (Hours)
Creating Testing Scripts	4
Running Automated Scripts	2
Test Results Analysis	1.5
Completing Report	2
Total Hours	9.5

12.5 Automation Demo Video

<https://youtu.be/6rGZPV0Q29g>