Welcome! We will begin shortly

Mentored Learning Session

"Machine Learning Foundations for Generative AI"

Learning Outcomes

- Identify what kind of problems can be solved by Machine Learning in various domains and functions
- Understand the difference between Supervised, Unsupervised and Reinforcement Learning
- Understand how Regression and Classification works
- Understand how Machine Learning models are evaluated for performance

Agenda

- Understanding Supervised,Unsupervised and Reinforcement Learning
- Understanding how Regression and Classification work
- Test your understanding on Regression and Classification
- Generative AI vs Discriminative AI
- Observations of LLM Behaviour

Supervised vs Unsupervised vs Reinforcement Learning

Great Learning
POWER AHEAD

Supervised Learning

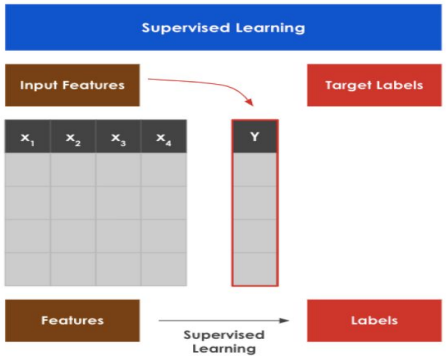
Supervised Learning is the paradigm of Machine Learning where ***algorithms learn from labeled data to make predictions or decisions on unseen data.*** In this approach, the learning process is guided by a supervisor mechanism, where the algorithm is provided with a set of input-output pairs known as the training data.

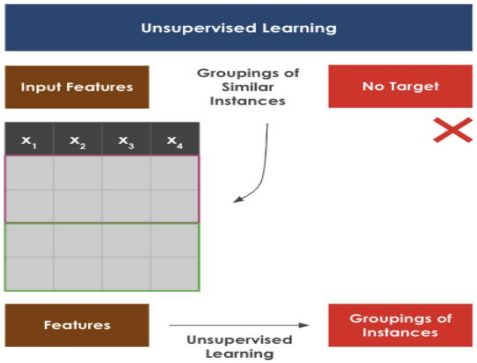
Unsupervised Learning

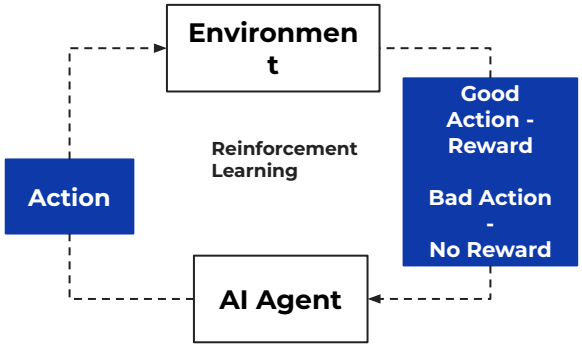
Unsupervised Learning, on the other hand, is the Machine Learning paradigm where the algorithm is just trained on a dataset of features without being provided explicit **labels** or **target** values that correspond to those features. ***The goal of Unsupervised Learning is to discover patterns, structures, and relationships within the data all by itself, without any predefined categories provided to it.***

Reinforcement Learning

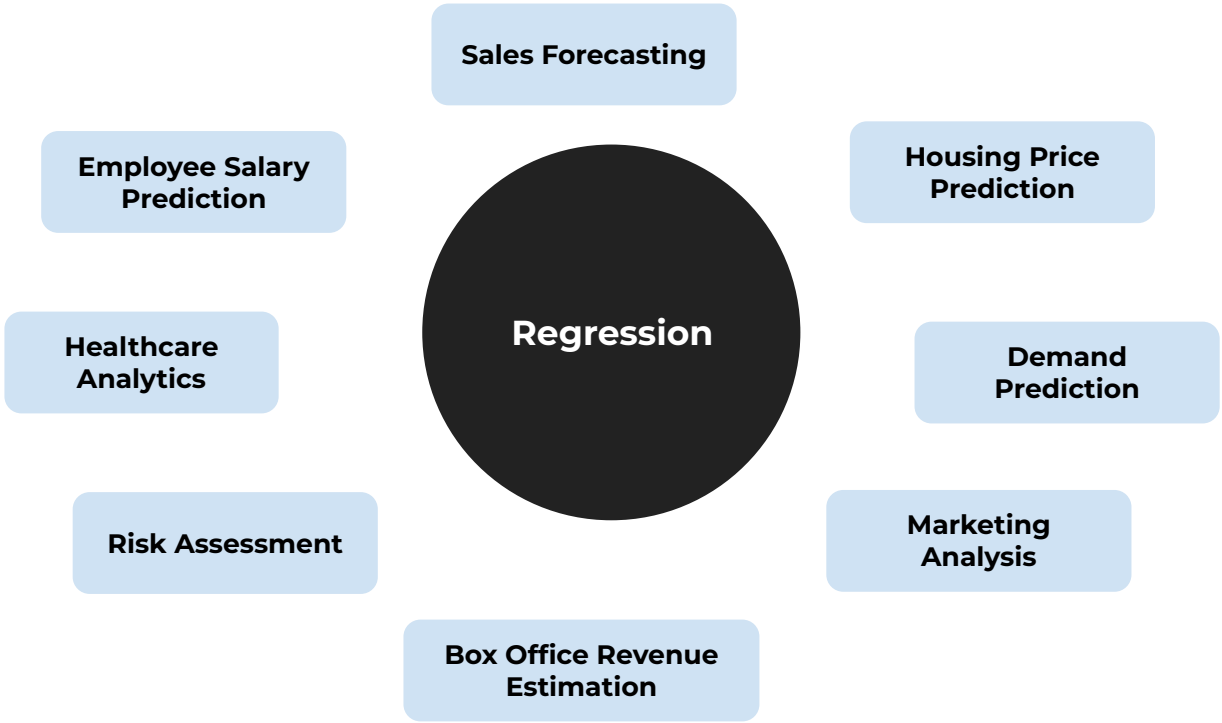
Reinforcement Learning is a type of Machine Learning where an **agent** learns by interacting with its **environment.** Instead of being told what to do (like in supervised learning) or finding patterns on its own (like in unsupervised learning), the agent figures out the best actions to take through **trial and error**. It gets **feedback** from its actions and adjusts its strategies over time to achieve its goals.



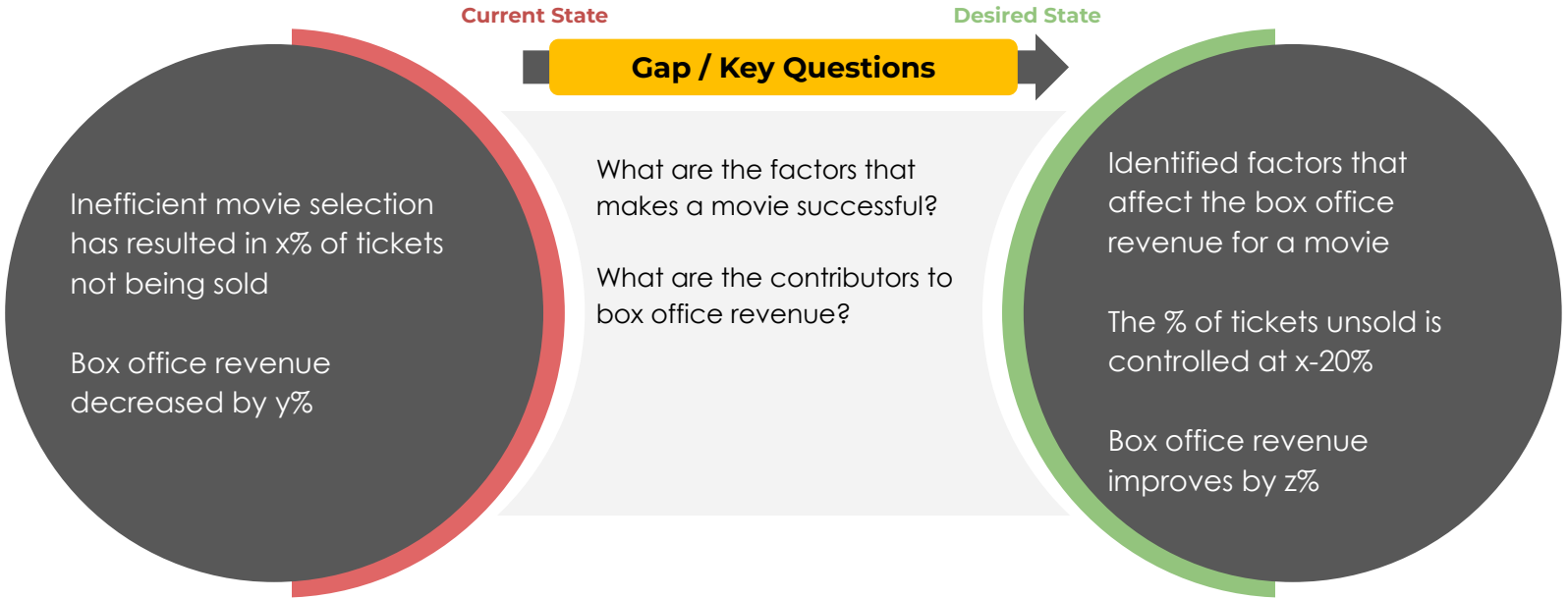




Applications of Regression



Box Office Revenue Estimation



Business Use Case - Box Office Revenue Estimation

Box office revenue estimation is crucial for the film industry to forecast the potential success of movies and allocate resources effectively.

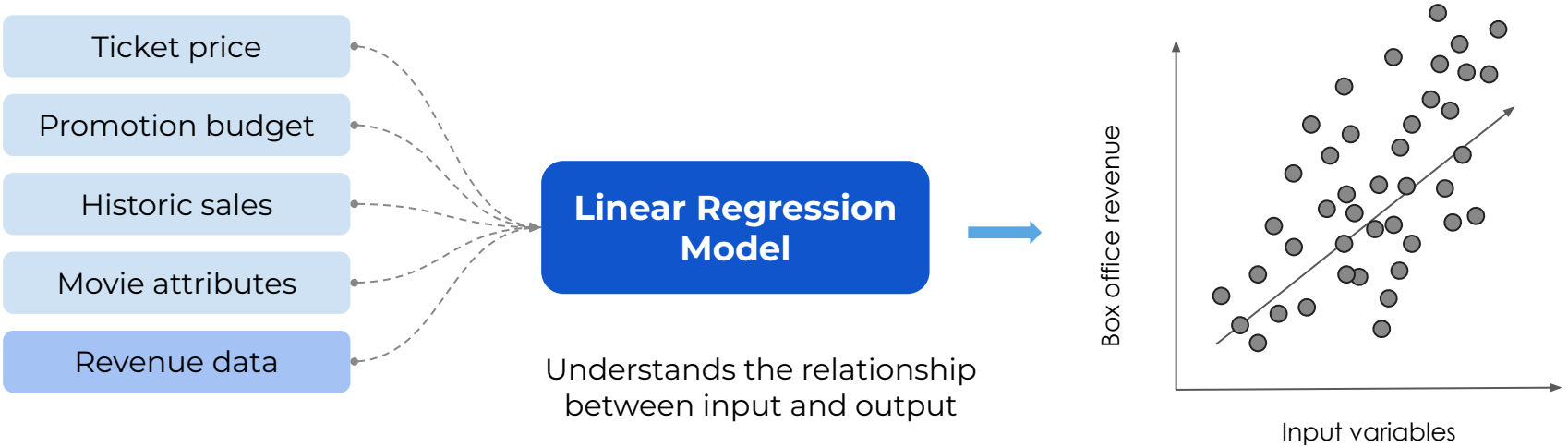
Traditional revenue estimation methods are subjective and often lack accuracy, posing financial risks for film producers and partners.

Predicting box office revenue accurately is challenging due to various influencing factors such as genre, cast, marketing efforts, release timing, and audience preferences.

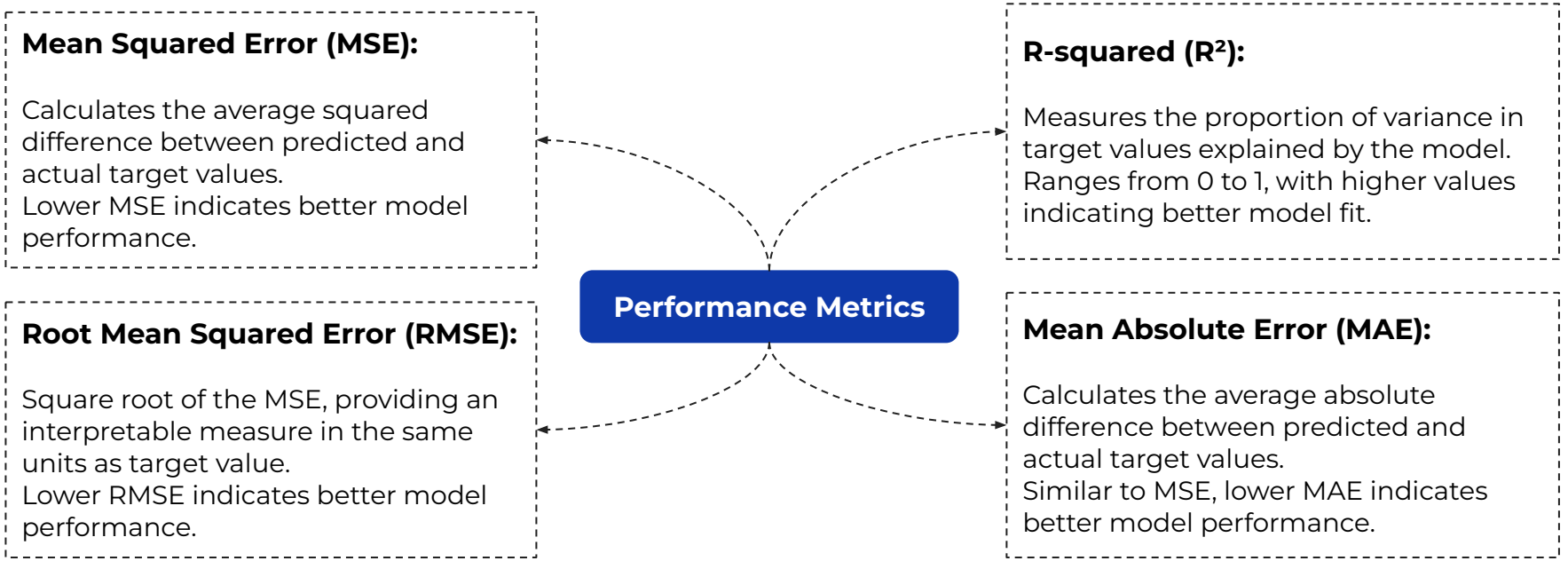
Inaccurate revenue estimations can lead to financial losses and impact decision-making processes regarding production budgets, marketing strategies, and distribution plans.

The objective is to use machine learning that leverages movie-related data to predict box office revenue accurately.

Box Office Revenue Estimation - Approach



Evaluating Regression Model Performance



These metrics help assess how well the regression model predicts revenue estimation based on factors like ticket price,promotion budget,historic sales,movie attributes etc.
Lower values of MSE, RMSE, and MAE, and higher values of R^2 indicate a more accurate model.

Regression Quiz 1

What is the primary goal of Linear Regression?

A. To maximize the Mean Squared Error (MSE)

B. To minimize the Mean Squared Error (MSE)

C. To maximize the Mean Absolute Error (MAE)

D. To minimize the Mean Error (ME)

Regression Quiz 2

What is the purpose of using a Linear Regression model?

A. To make predictions about future events

B. To describe the relationship between variables

C. To classify data into distinct groups

D. To reduce the dimensionality of data

Regression Quiz 3

In which scenario would linear regression be most appropriate?

A. Predicting house prices based on images of houses

B. Forecasting stock prices based on historical market data

C. Analyzing customer sentiment based on social media posts

D. Predicting weather patterns based on satellite images

Regression Quiz 4

Which of the following is used to evaluate the performance of a linear regression model?

A. Mean Squared Error (MSE)

B. Root Mean Squared Error (RMSE)

C. R-squared (R^2)

D. All of the above

Regression Quiz 5

Which statement best describes the role of Root Mean Square Error (RMSE) in evaluating regression models?

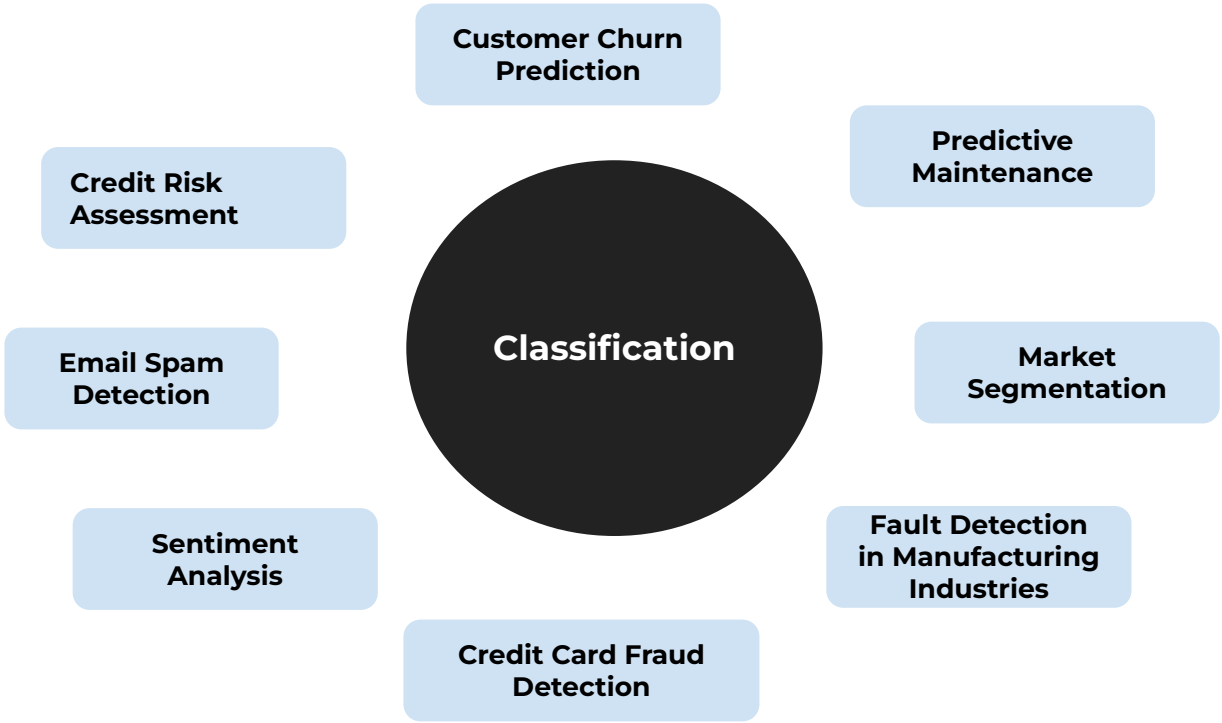
A. Lower RMSE indicates higher accuracy, reflecting reduced discrepancies between predicted and actual values

B. Minimum RMSE guarantees the best model, ensuring no significant prediction errors

C. RMSE quantifies prediction accuracy, with lower values indicating that the model will always perform better, regardless of the dataset used.

D. Achieving low RMSE is the ultimate goal, as it ensures that the model will generalize well to any future data.

Applications of Classification



Business Use Case - Credit Card Fraud Detection

Credit card fraud poses a significant challenge globally, impacting both financial institutions and cardholders.

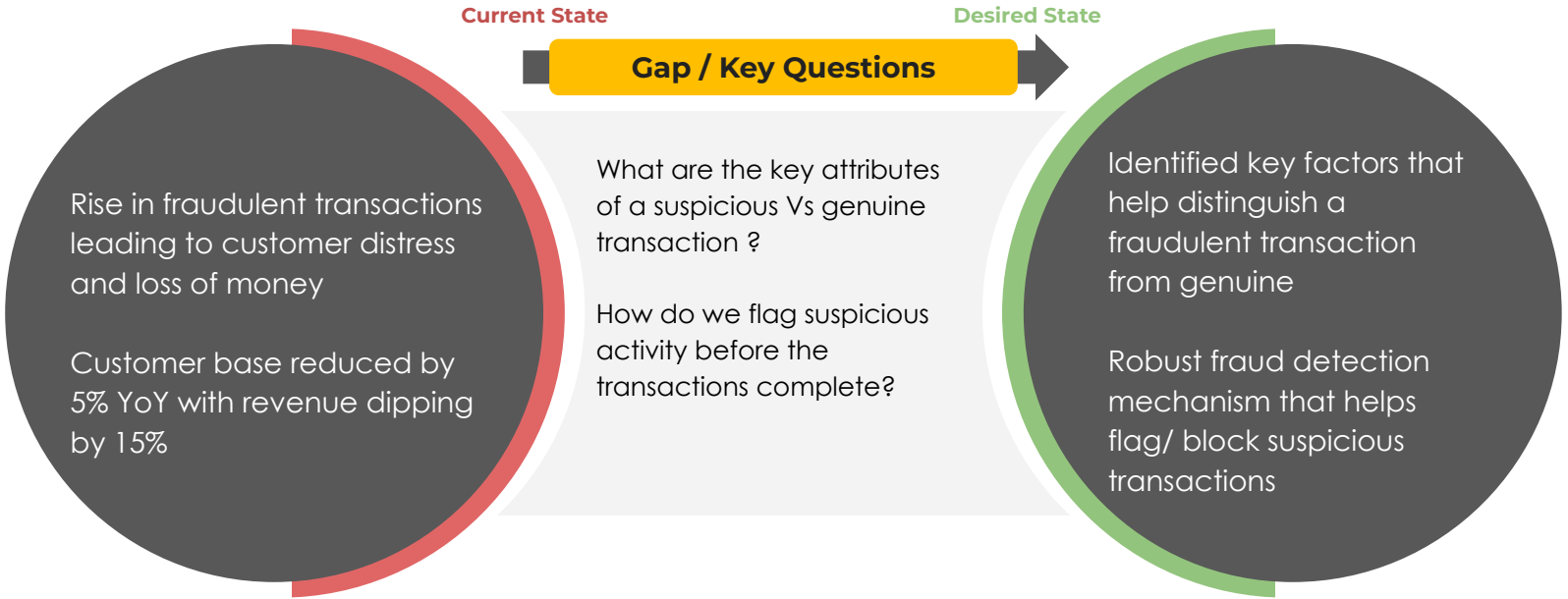
The rise in fraudulent transactions has resulted in increased customer distress and substantial financial losses for businesses.

Over the past year, there has been a noticeable decline in the customer base by 5%, coupled with a significant revenue dip of 15%.

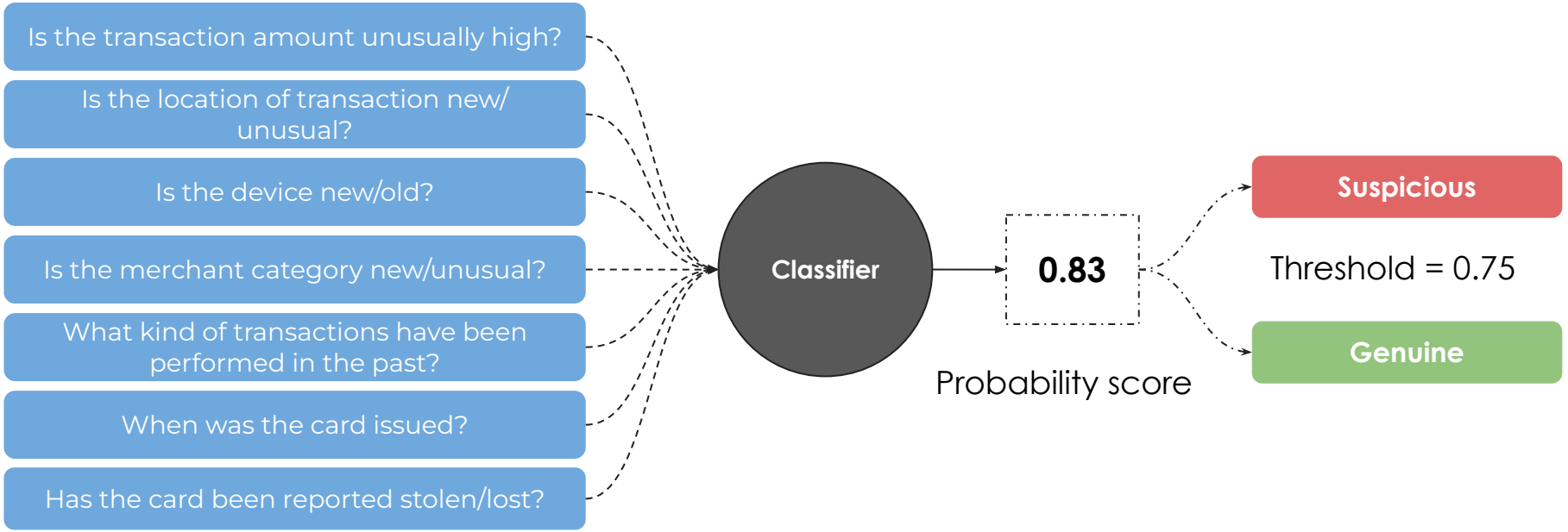
Detecting fraudulent transactions in credit card data is particularly challenging due to the complex nature of fraud patterns and the large volume of legitimate transactions.

The objective is to use machine learning to detect fraudulent transactions

Credit Card Fraud Detection - Current vs Desired



Credit Card Fraud Detection - Approach

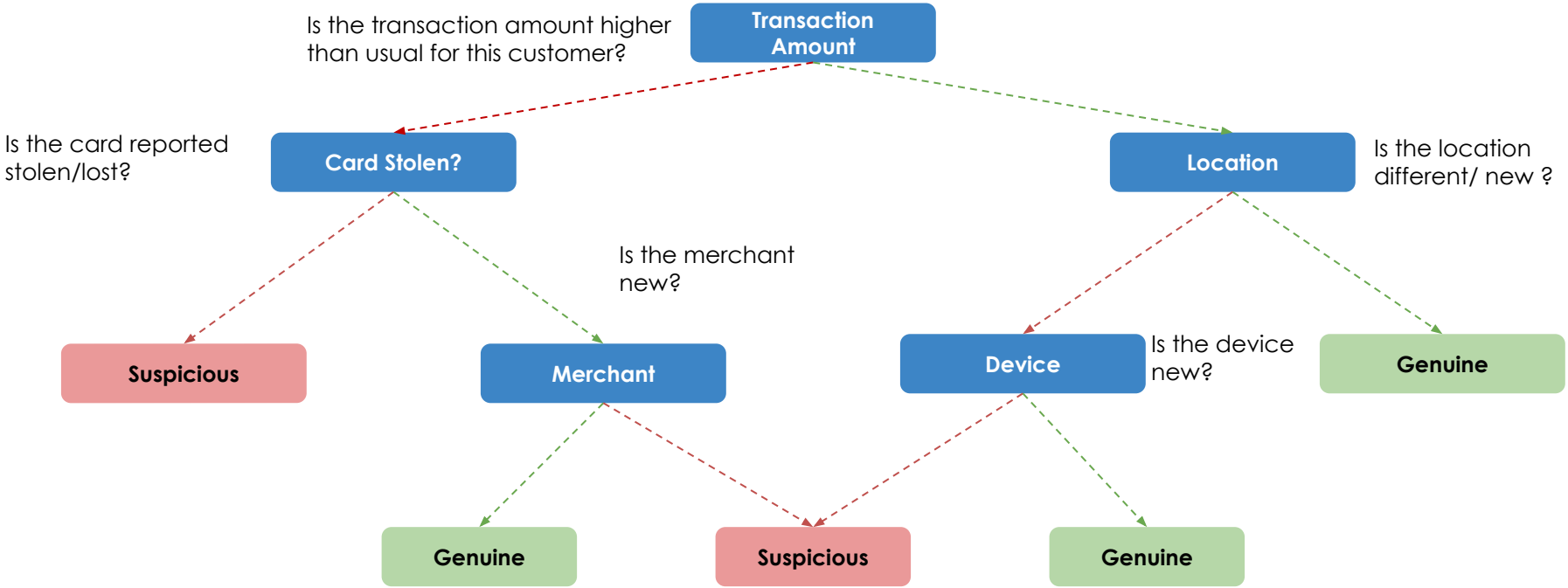


The classifier learns the features of the input data to classify data into categories based on a certain threshold

Credit Card Fraud Detection - Approach

A simple decision tree

Threshold: More than 2 questions are suspicious



Evaluating Classification Model Performance

Accuracy:

Measures the proportion of correctly classified instances out of the total instances.
Higher accuracy indicates better model performance in correctly predicting class labels.

Recall:

Computes the ratio of true positives to the total actual positives.
Emphasizes the model's ability to capture all positive instances, minimizing false negative errors.

Performance Metrics

Precision:

Calculates the ratio of true positives to the total predicted positives.
Focuses on the correctness of positive predictions, minimizing false positive errors.

F1 -score:

Represents the harmonic mean of precision and recall, providing a balanced measure of model performance.
High F1-score indicates both high precision and high recall, suggesting a well-performing classifier.

These metrics help evaluate how effectively the classification model categorizes instances based on various input features. Lower values of classification error metrics and higher values of accuracy, precision, recall, F1-score, and AUC-ROC indicate superior model performance.

Classification Quiz 1

Which of the following is the primary objective of classification?

A. Predicting continuous numerical values

B. Identifying patterns and relationships in data

C. Categorizing instances into predefined classes or categories

D. Clustering data points into groups based on similarity

Classification Quiz 2

Which metric is used to evaluate the correctness of positive predictions made by a classification model?

A. Accuracy

B. Precision

C. Recall

D. F1-score

Classification Quiz 3

What does the F1-score represent in classification evaluation?

A. The harmonic mean of precision and recall

B. The ratio of true positives to the total actual positives

C. The proportion of correctly classified instances out of the total instances

D. The average absolute difference between predicted and actual target values

Classification Quiz 4

What does the term "accuracy" measure in classification evaluation?

A. The ratio of true positives to the total predicted positives

B. The proportion of correctly classified instances out of the total instances

C. The ability of the model to distinguish between classes

D. The harmonic mean of precision and recall

Classification Quiz 5

What is the primary application of classification in email management systems?

A. Identifying patterns and relationships in email content

B. Predicting the urgency of email messages

C. Categorizing emails as spam or non-spam

D. Clustering emails based on sender addresses

QnA

Generative AI vs Discriminative AI

Generative AI

Generative AI - Focuses on creating new data or content

Summarize : An app summarizes customer reviews for products, highlighting key features and feedback.

Create : A design tool generates custom logos for small businesses based on their preferences.

Translate : A language app translates phrases into different languages to aid travellers.

Label : An image editing software automatically adds labels to photos, like "mountains" or "beach."

Retrieve : A search engine fetches relevant articles based on user queries, delivering tailored results.

Tasks in Solving Business Problems

- **Aggregate**
- **Classify / Predict**
- **Retrieve**
- **Generate**

Discriminative AI

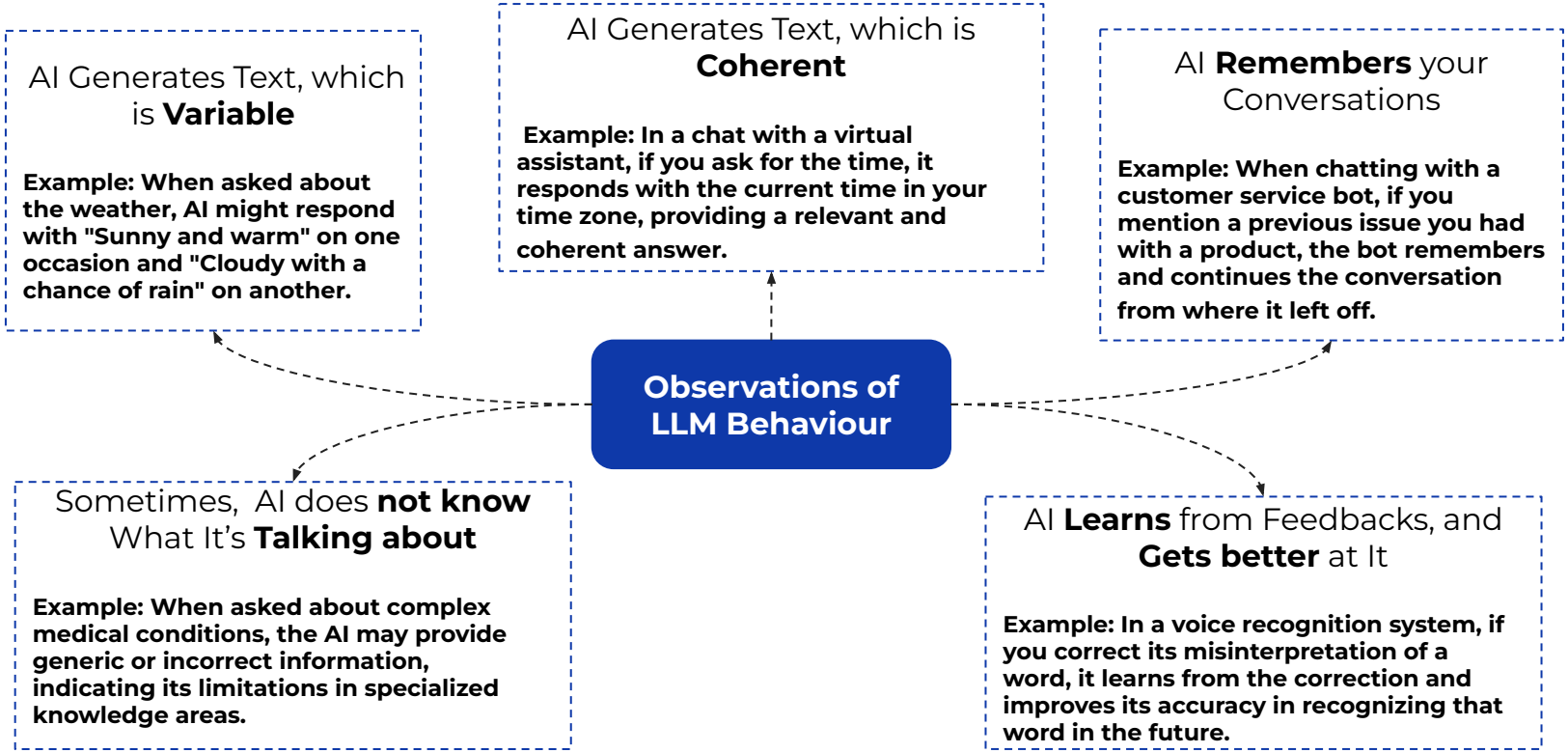
Discriminative AI - Focuses on focuses on classifying and predicting based on existing data

Classify : An email filter categorizes incoming emails as either "important" or "spam" to prioritize inbox organization.

Predict : A traffic app predicts travel times for commuters based on historical traffic data and current road conditions.

Aggregate : A retail store aggregates sales data from multiple branches to analyze overall performance and identify top-selling products.

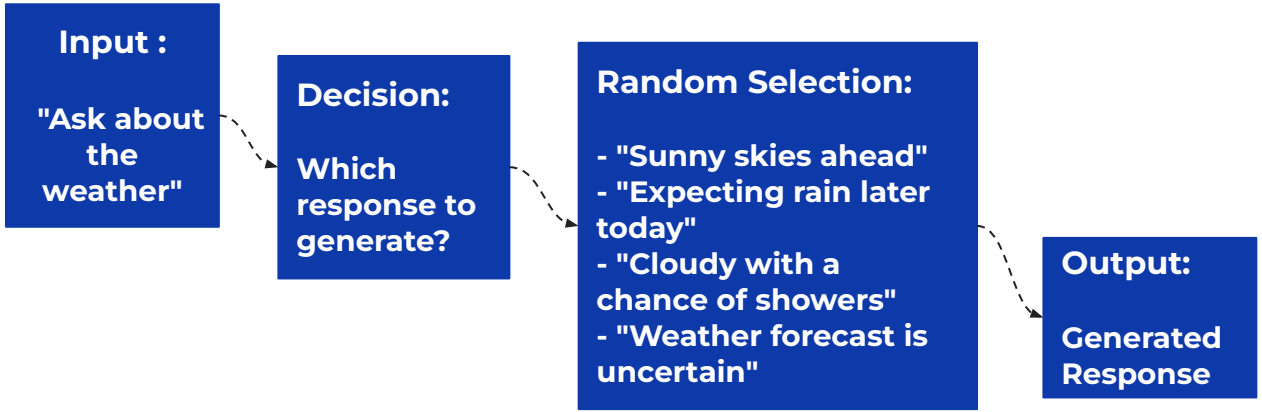
Observations of LLM Behaviour



Variability in LLM Behaviour

Variability refers to the tendency of LLMs to make decisions during text generation that may appear random. These decisions include choosing which words to use, when to end a sentence, the length of the sentence, the tone of the text etc.

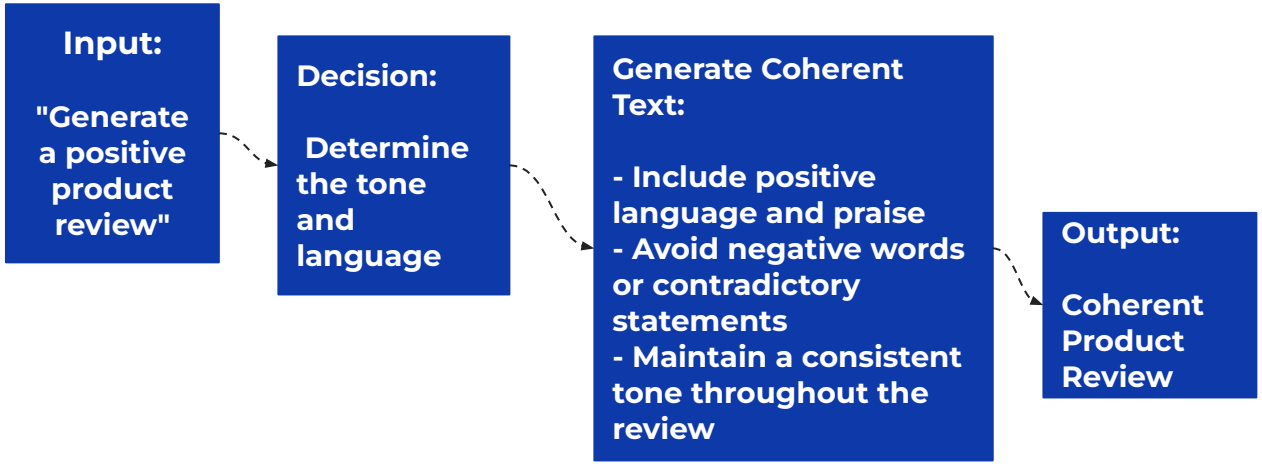
Example:
In a chatbot conversation, the AI may respond differently each time it encounters the same input. For instance, when asked about the weather, it may generate responses like **"Sunny skies ahead"** or **"Expecting rain later today."**



Coherence in LLM Behaviour

Coherence refers to the ability of LLMs to produce text that follows a logical flow and is contextually relevant. Despite the variability in the generated text, LLMs aim to maintain coherence to ensure that the output makes sense within the given context.

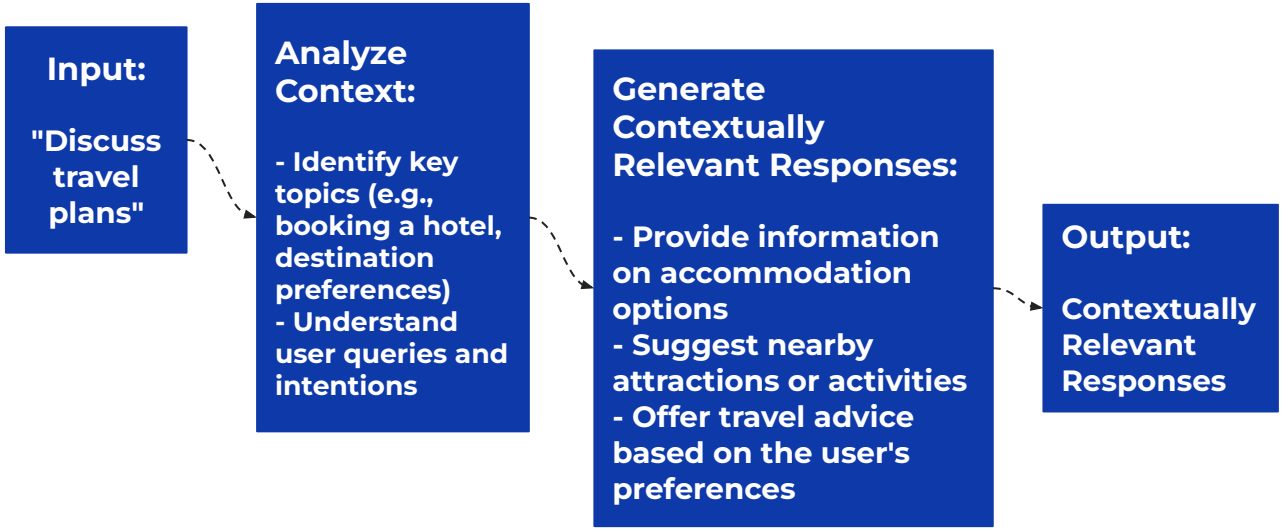
Example:
In a customer review generation task, if the input specifies a positive sentiment, the AI should generate text with positive language and refrain from contradicting the sentiment. For instance, in a positive product review, the AI should avoid using negative words or phrases that would disrupt the coherence of the review.



Contextual Understanding in LLM Behaviour

Contextual understanding refers to the LLM's ability to generate text that is relevant and appropriate to the given context. LLMs analyze the surrounding context to produce responses that are consistent with the topic of conversation or the task at hand.

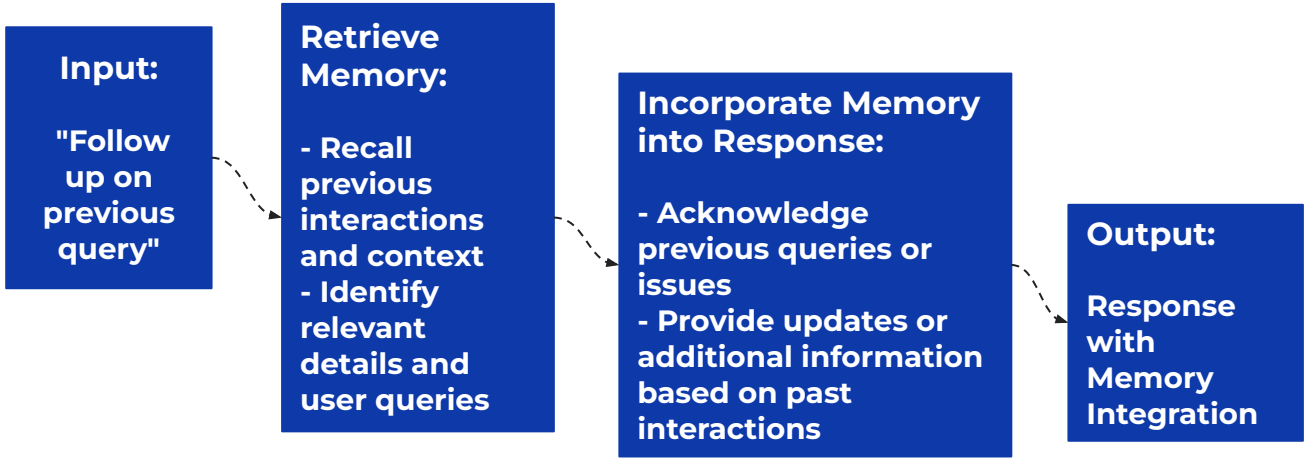
Example:
In a chatbot conversation about travel plans, if the user mentions booking a hotel, the AI should generate responses related to accommodation options, local attractions, or travel tips. It should understand the context of the conversation to provide relevant and helpful information to the user.



Memory in LLM Behaviour

Memory in LLM behavior refers to the ability of the model to retain information from previous interactions or inputs. This enables the LLM to maintain continuity in conversations and generate responses that build upon past exchanges.

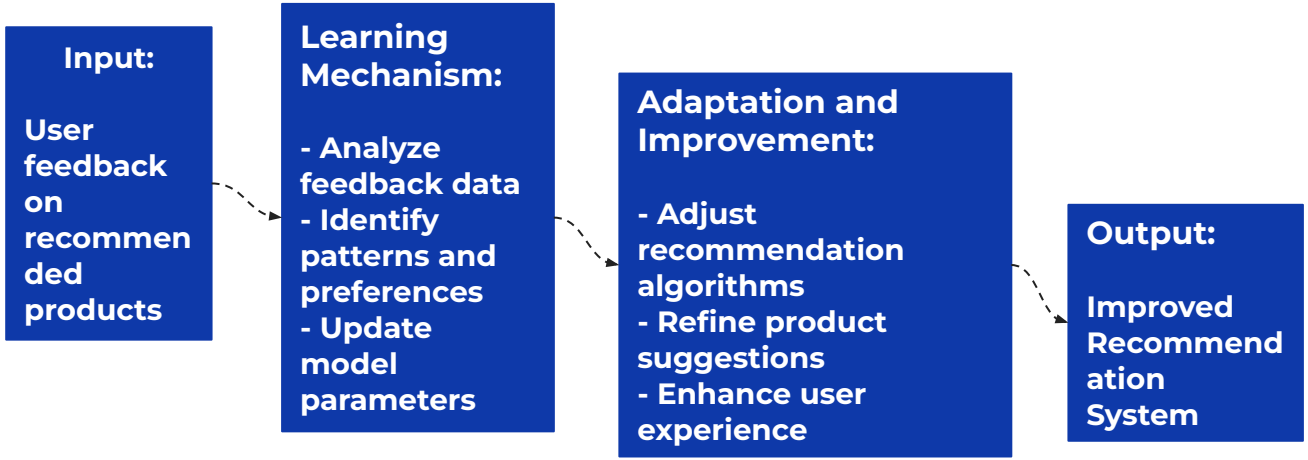
Example:
In a chatbot conversation, if a user follows up on a previous query, the AI should remember the context and integrate this information into its responses. For example, if the user previously reported a technical issue with a product and requests an update, the AI should recall the issue and offer relevant status updates or troubleshooting steps.



Learning Behaviour in LLM

Learning behavior in LLMs refers to the model's ability to adapt and improve over time based on feedback and new data. LLMs utilize various techniques, such as reinforcement learning and fine-tuning, to enhance their performance and accuracy.

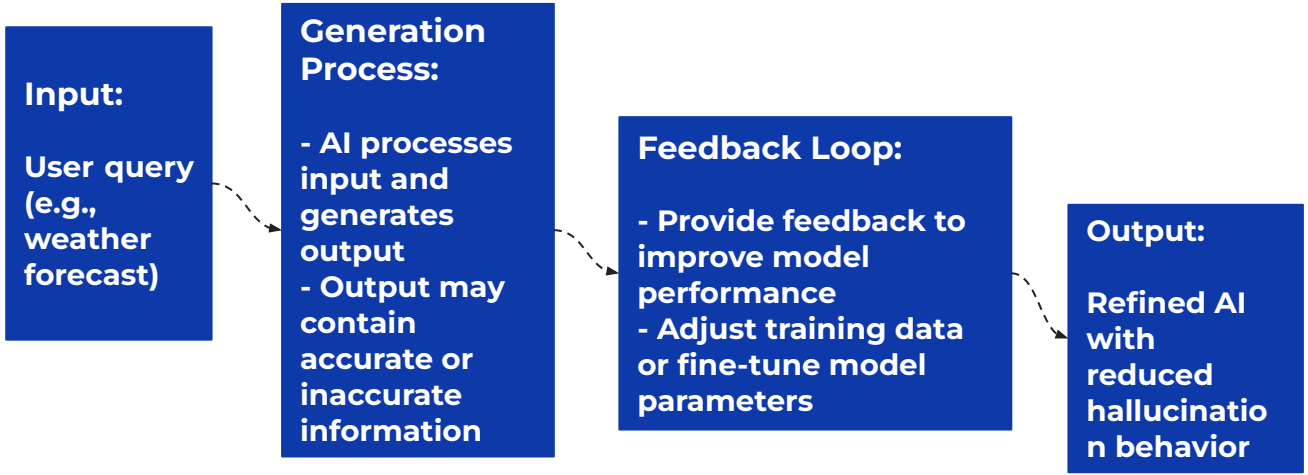
Example:
In an e-commerce recommendation system, user feedback on suggested products helps the AI improve recommendations. If a user rates or buys items, the AI learns to refine future suggestions. Over time, this adaptation leads to more personalized and relevant product recommendations.



Hallucination Behaviour in LLM

Hallucination behavior in LLMs refers to instances where the model generates inaccurate or nonsensical outputs that do not align with the input data or context. This phenomenon can occur due to various factors, such as insufficient training data, overfitting, or ambiguity in the input.

Example:
In a chatbot conversation, when asked about the weather forecast, the AI might provide absurd predictions like "unicorns galloping under rainbow skies" instead of the actual forecast. This demonstrates hallucination behavior, where the AI generates nonsensical outputs not relevant to the user's query.



QnA

Great Learning

Happy Learning !