**INPUT DESIGN AND OUTPUT DESIGN**

**INPUT DESIGN:**

Input design specifies how the data is entered into the system, validated, and processed for analysis. The system accepts both **single-transaction inputs** and **batch dataset uploads** to accommodate different use cases.

### **1. Data Sources**

* The dataset used for model training and testing is sourced from **Kaggle**, containing anonymized transaction details.
* Each record includes multiple attributes representing the transaction’s statistical and behavioral features (e.g., transaction amount, time, and PCA-transformed features).

### **2. Input Methods**

The system supports two primary modes of input:

1. **Single-Transaction Input:**
   1. Users manually enter details such as *Transaction Amount*, *Time*, and other derived features.
   2. The system immediately predicts whether the transaction is **Legitimate** or **Fraudulent**.
2. **Batch Input (File Upload):**
   1. Users can upload a .csv file containing multiple transactions.
   2. The system processes all records, predicts outcomes for each entry, and returns summarized results.

### **3. Input Validation**

To ensure system reliability and prevent errors, the following input validation techniques are implemented:

* **Data Type Validation:** Ensures numerical values for transaction-related fields.
* **Missing Value Handling:** Missing or null fields are automatically replaced using mean or median imputation.
* **Range Checking:** Detects extreme or invalid values that may distort predictions.
* **File Format Validation:** Ensures uploaded files conform to the .csv format before processing.

### **4. Input Interface Design**

The **Flask web interface** includes:

* A **file upload button** for batch datasets.
* **Form fields** for single-transaction testing.
* A **submit button** that triggers model inference.

**OUTPUT DESIGN:**

The output design focuses on providing informative and visually interpretable results that aid in decision-making. Outputs are generated both in **textual** and **graphical** formats.

### **1. Prediction Output**

After processing the input data, the system displays:

* A **prediction label** for each transaction:
  + *“Legitimate Transaction”*
  + *“Fraudulent Transaction”*
* In batch processing mode, results are displayed in a **tabular format** showing each transaction’s predicted class and confidence score.

### **2. Graphical Output**

For better interpretability and performance assessment, the system generates:

* **Confusion Matrix:** Visual representation of correct and incorrect classifications.
* **ROC Curve:** Plots the true positive rate against the false positive rate to measure classifier performance.
* **Accuracy & Loss Graphs:** Indicate training and testing accuracy trends.

### **3. User Interface Output**

The **Flask web application** provides interactive result visualization:

* Users can download the output table as a .csv file.
* Real-time predictions appear instantly after submission.
* Evaluation metrics are displayed below the result panel.