1. Background & Problem Statement

In the trucking, shipping, and cargo industry, documentation is a critical operational and compliance component. Documents such as Bills of Lading, Proof of Delivery, Commercial Invoices, and others are essential for cargo identification, delivery confirmation, regulatory compliance, and customer billing.

Currently, drivers capture these documents using mobile phones and send them to the back-office in PDF or image format. The back-office team manually:

- Reviews each document

- Identifies the document type

- Checks document quality and readability

- Verifies compliance with customer-specific billing rules

This manual process is time-consuming, error-prone, and does not scale efficiently. The objective of this hackathon challenge is to design and build an **AI-powered Document Intelligence Solution** that automates document classification, validation, and quality checks.

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2. Objective of the Solution

The solution should leverage **AI / ML / Computer Vision** capabilities to:

1. Automatically identify the **type of document**

2. Assess whether the **scanned document image is clear and readable**

3. Detect and count the **number of signatures present** in the document

4. Validate documents against **predefined customer-specific rules**

The system should significantly reduce manual intervention and accelerate billing readiness.

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3. Document Types in Scope

The solution must support classification and processing of the following document types:

1. **Bill of Lading (BOL)**

   o Contract of carriage, receipt of goods, and document of title

2. **Proof of Delivery (POD)**

      o   Signed confirmation by consignee that goods were delivered

3. **Packing List**

      o   Itemized list of package contents, weights, and dimensions

4. **Commercial Invoice**

      o   Product details, declared value, and payment terms

5. **Hazardous Materials (Hazmat) Documents**

      o   Required for dangerous goods with regulatory information

6. **Lumper Receipts**

      o   Proof of payment for loading/unloading labor

7. **Trip Sheets / Trip Reports**

      o   Miles driven, fuel stops, and state crossings

8. **Freight Invoices / Bills**

      o   Carrier invoices for transportation services

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4. Input & Output Specifications

4.1 Input

- PDF files or scanned images (JPEG, PNG)

- Documents captured via mobile phone cameras

- Single or multi-page documents

4.2 Output

For each uploaded document, the system should produce:

- Document Type (BOL, POD, Invoice, etc.)

- Readability Score (Clear / Partially Clear / Unreadable)

- Signature Count (Numeric value)

- Detected Metadata (Order/Load Number, if present)

- Validation Status (Pass / Fail / Needs Review)

- Reason for Failure (if applicable)

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5. Functional Requirements

5.1 Document Ingestion

- Allow upload of one or multiple documents

- Support PDF and image formats

- Auto-split multi-page PDFs into logical pages (if applicable)

5.2 Document Type Identification

The system must automatically classify the document into one of the supported document types using AI/ML techniques such as:

- Text-based classification (OCR + NLP)

- Layout and visual pattern recognition

Expected Output:

- Document Type with confidence score

5.3 Image Quality & Readability Assessment

The system must determine whether the document is suitable for further processing and billing.

Quality checks include:

- Blurriness detection

- Skew / rotation detection

- Overexposure or underexposure

- Partial or cropped document detection

Expected Output:

- Readability Status: Clear / Not Clear

- Quality Score (0–100)

- Recommendation: Accept / Re-upload

5.4 Signature Detection & Counting

The system must detect and count handwritten signatures present in the document.

Capabilities:

- Identify signature-like regions

- Distinguish signatures from printed names or stamps

- Count total number of signatures across pages

Expected Output:

- Number of signatures detected

- Signature presence flag (Yes / No)

5.5 Metadata Extraction

The system should attempt to extract key identifiers using OCR:

- Order Number / Load Number

- Invoice Number (if applicable)

- Date fields

Expected Output:

- Extracted fields with confidence score

5.6 Rule-Based Document Validation

The system must validate documents against predefined rules that can vary per customer.

Sample Rules:

1. **Bill of Lading** must contain **two signatures**

2. **Proof of Delivery** must contain **consignee signature**

3. **BOL, POD, Commercial Invoice, Lumper Receipt, Freight Invoice** must contain **Order/Load Number**

4. Some customers require **all documents** for billing

5. Some customers require **no documents** for billing

Expected Output:

- Validation Result: Pass / Fail

- Rule(s) violated (if any)

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6. Non-Functional Requirements

6.1 Performance

- Process a single document within acceptable time limits (near real-time preferred)

- Support batch processing

6.2 Scalability

- Handle increasing document volumes

- Modular architecture preferred

6.3 Accuracy

- High accuracy for document classification and signature detection

- Confidence scores should be exposed

6.4 Security

- Secure document storage

- Role-based access (optional for hackathon)

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7. Assumptions & Constraints

- Documents may be of varying quality

- Handwritten content may differ widely

- Training datasets may be limited

- Cloud services and open-source libraries are allowed

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8. Success Criteria

A solution will be considered successful if it:

- Correctly identifies document types

- Accurately assesses readability

- Reliably detects and counts signatures

- Validates documents based on customer rules

- Clearly flags documents that need manual review