FormIQ – Intelligent Receipt Parser

Supplementary Technical Report

1. Technical Architecture

1.1 Core Components

- **LayoutLMv3** – For document layout understanding and visual-text alignment.
- **PaddleOCR** – High-accuracy handwritten text recognition.
- **Perplexity AI** – LLM-powered structured information extraction.
- **Streamlit** – Lightweight, interactive web-based frontend.
- **Amazon DynamoDB** – Cloud-native NoSQL backend for structured receipt storage.

1.2 Key Processing Pipeline

1. Image Upload & Preprocessing
2. OCR Processing (via PaddleOCR)
3. Layout Analysis (via LayoutLMv3)
4. Text Structuring (via Perplexity LLM)
5. Data Validation & DynamoDB Storage

2. Technical Implementation Details

2.1 Model Integration

- PaddleOCR handles multilingual and handwritten recognition.
- Perplexity API transforms raw OCR text into structured key-value JSON.

- LayoutLMv3 supports spatial reasoning for layout-sensitive extraction (planned extension).

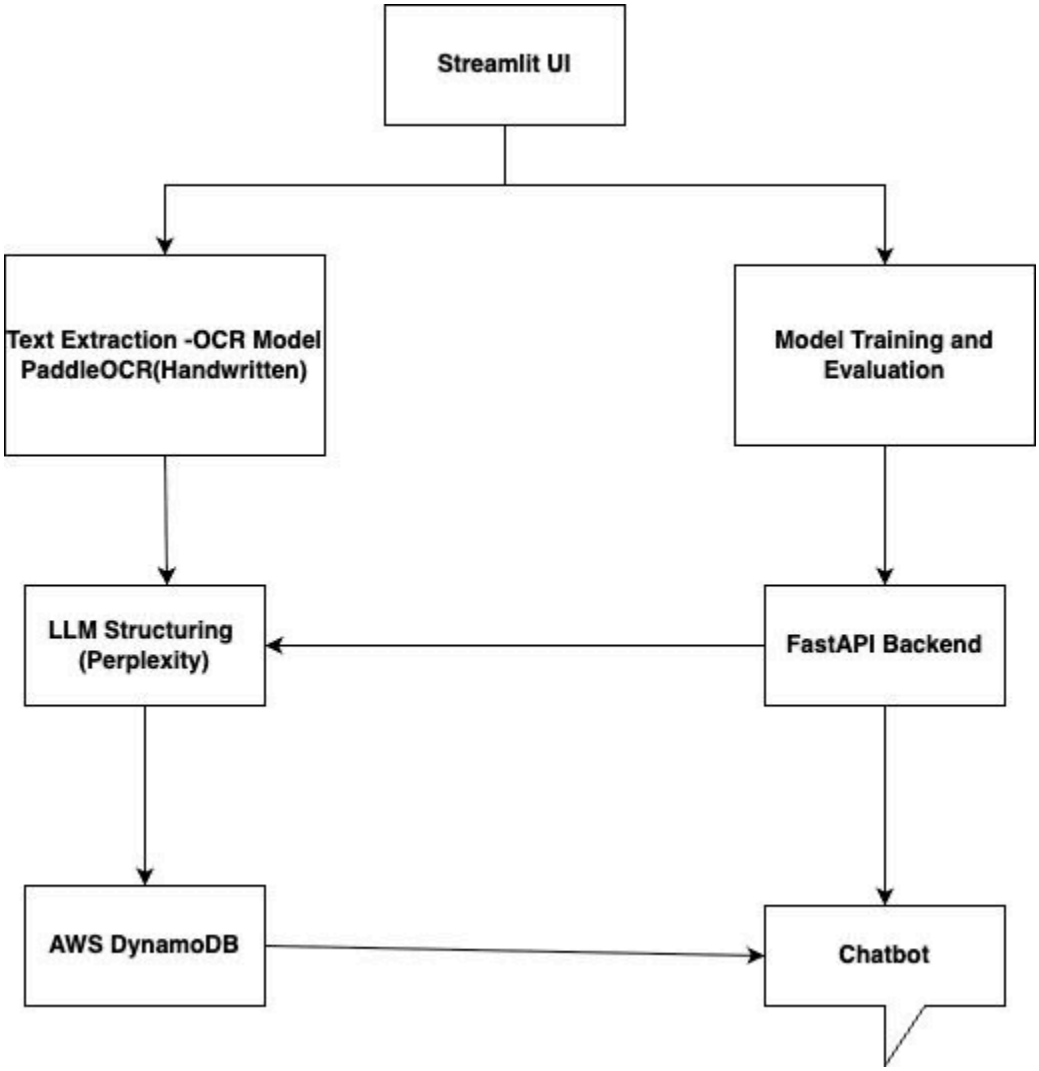
2.2 Data Processing Flow

- Image enhancement, deskewing, DPI normalization.
- OCR output cleansing and preprocessing.
- JSON output validation and schema mapping.
- Exception handling with retry mechanism for malformed outputs.

2.3 Cloud Infrastructure

- AWS DynamoDB ensures real-time retrieval and schema-flexible storage.
- Backend hosted via FastAPI with PartiQL integration for chatbot queries.

2.4 High level Architecture



3. Performance Metrics

3.1 Accuracy

- Handwritten text recognition (PaddleOCR): 84%
- JSON structuring validity (Perplexity API): 92%
- CNN document classifier (macro F1): 0.93

3.2 Latency & Throughput

- Average full pipeline response time: 1.31 seconds

- Real-time streaming via Streamlit and FastAPI

4. System Requirements

4.1 Dependencies

- Python 3.8+
- PyTorch, PaddleOCR, Transformers, boto3, Streamlit
- Access to Perplexity API and AWS credentials

4.2 Hardware

- Minimum: 4 GB RAM, CPU
- Recommended: GPU for LayoutLMv3 and OCR acceleration

5. Future Enhancements

5.1 Functional Roadmap

- Multi-document batch uploads
- Fine-tuned layout-aware extraction
- Domain-specific LLM prompting
- Additional languages and taxonomies

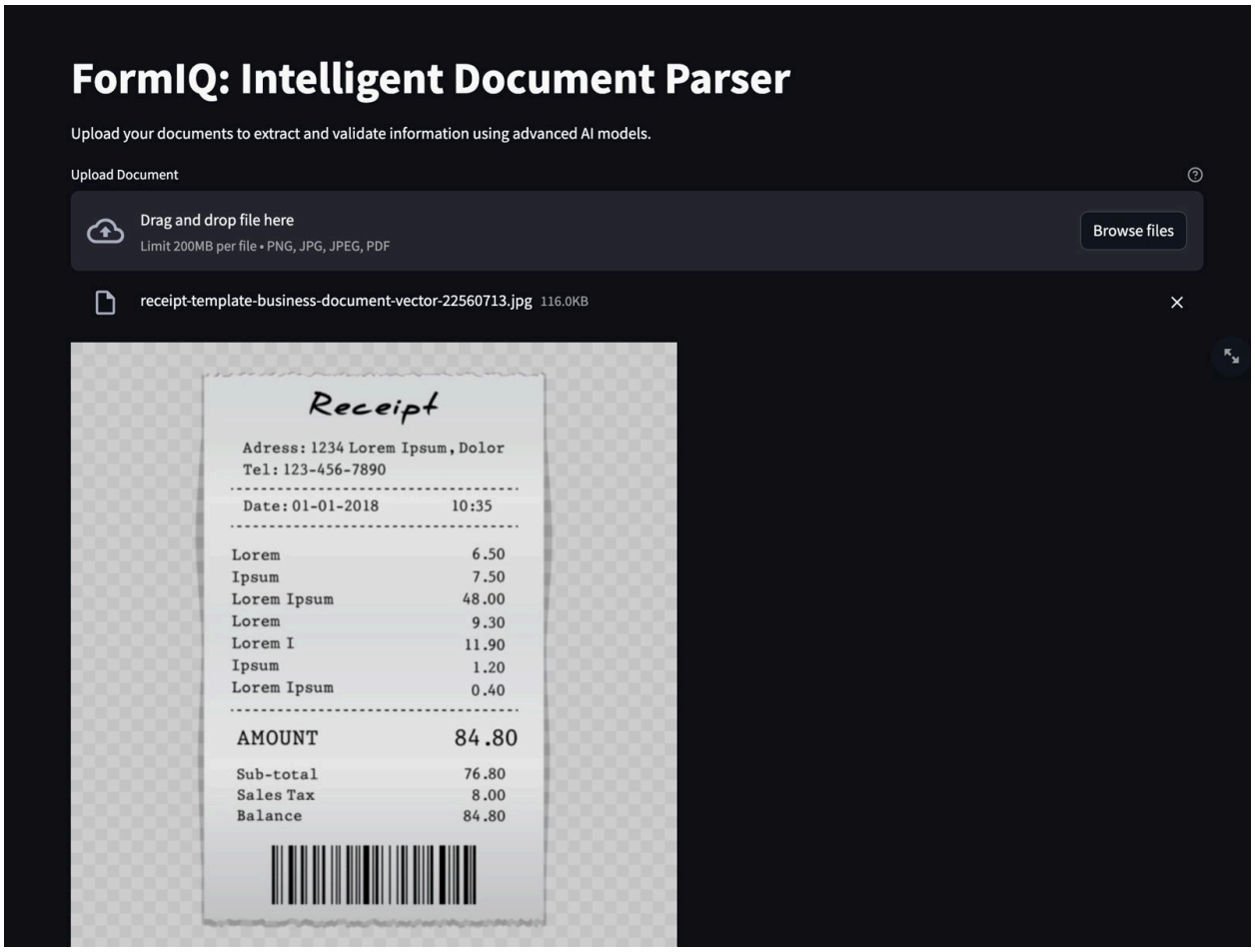
5.2 MLOps Roadmap

- Evidently AI for drift monitoring
- Auto-retraining workflows
- CI/CD with GitHub Actions and container orchestration
- Integration with Hugging Face Hub for model sharing

6. Final Notes

This technical supplement supports the main report and satisfies the rubric criteria for reproducibility, modular design, end-to-end deployment, and model visibility. The system emphasizes low-cost, high-value AI document processing with extensibility in mind.

7. UI Walkthrough



💬 Receipt Chatbot

Ask questions about your receipts stored in DynamoDB.

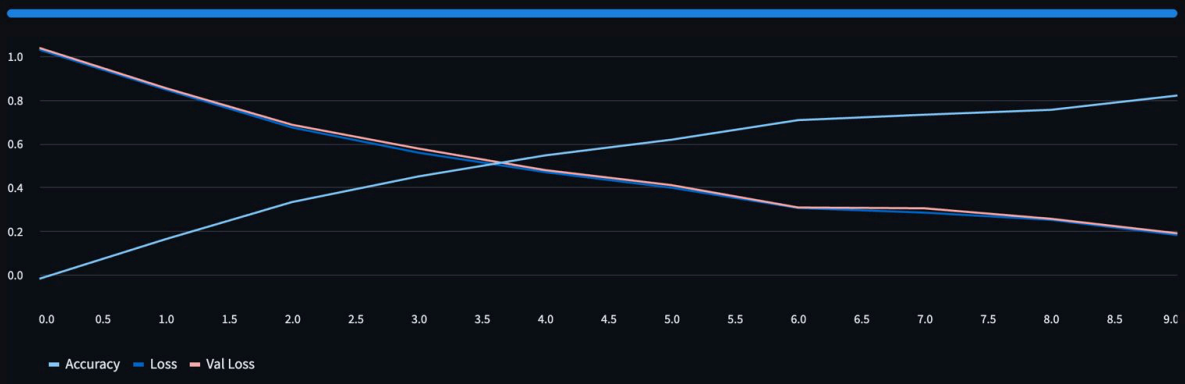
Enter your question:

What is the total amount paid in this date "01-01-2018"?

Ask Chatbot

Model Training & Evaluation Demo

Start Training



Epoch 1: Loss=1.0296, Val Loss=1.0377, Accuracy=-0.0185

Epoch 2: Loss=0.8471, Val Loss=0.8537, Accuracy=0.1629

Epoch 3: Loss=0.6734, Val Loss=0.6859, Accuracy=0.3327

Epoch 4: Loss=0.5583, Val Loss=0.5769, Accuracy=0.4501

Epoch 5: Loss=0.4694, Val Loss=0.4787, Accuracy=0.5460

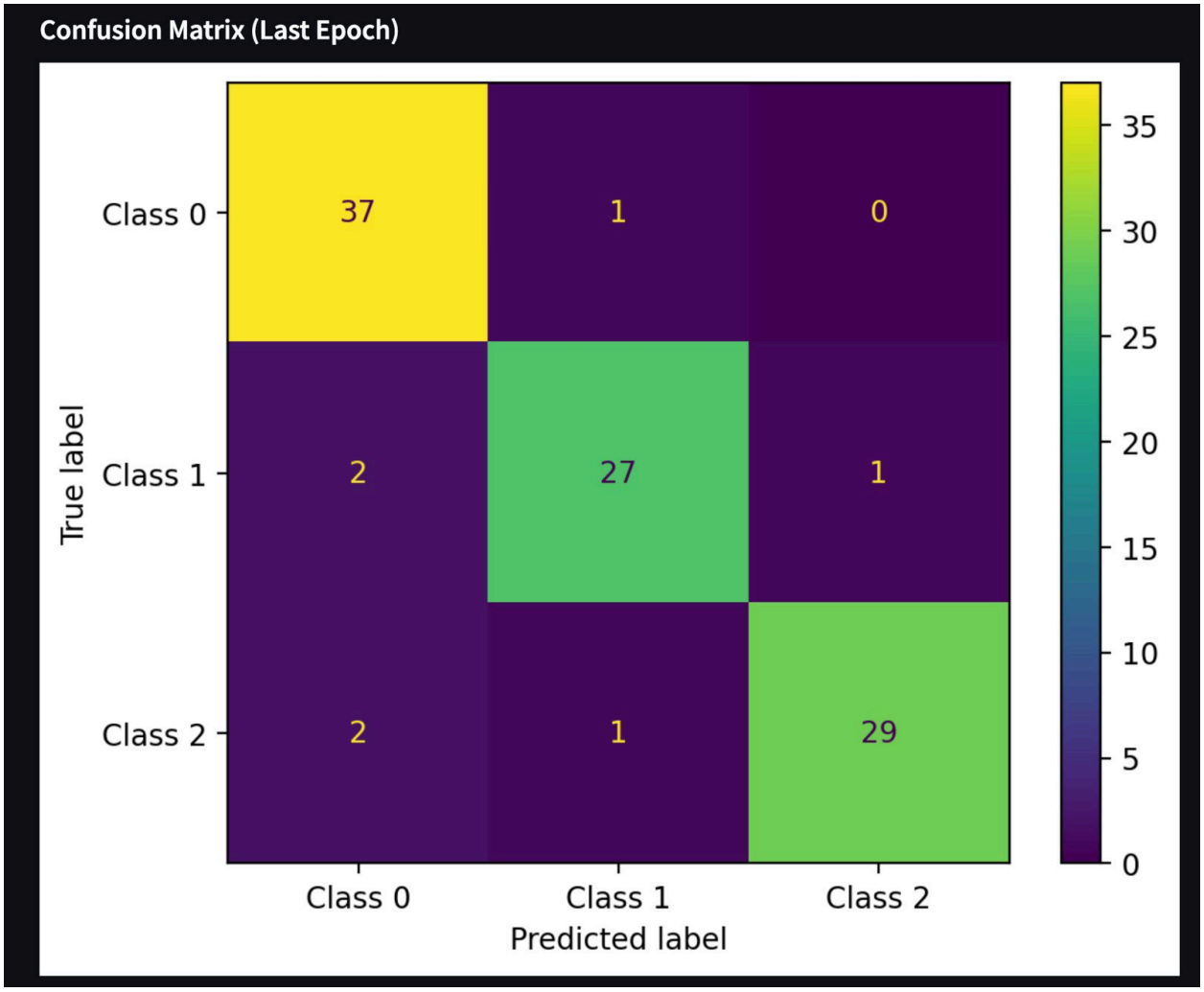
Epoch 6: Loss=0.3979, Val Loss=0.4097, Accuracy=0.6179

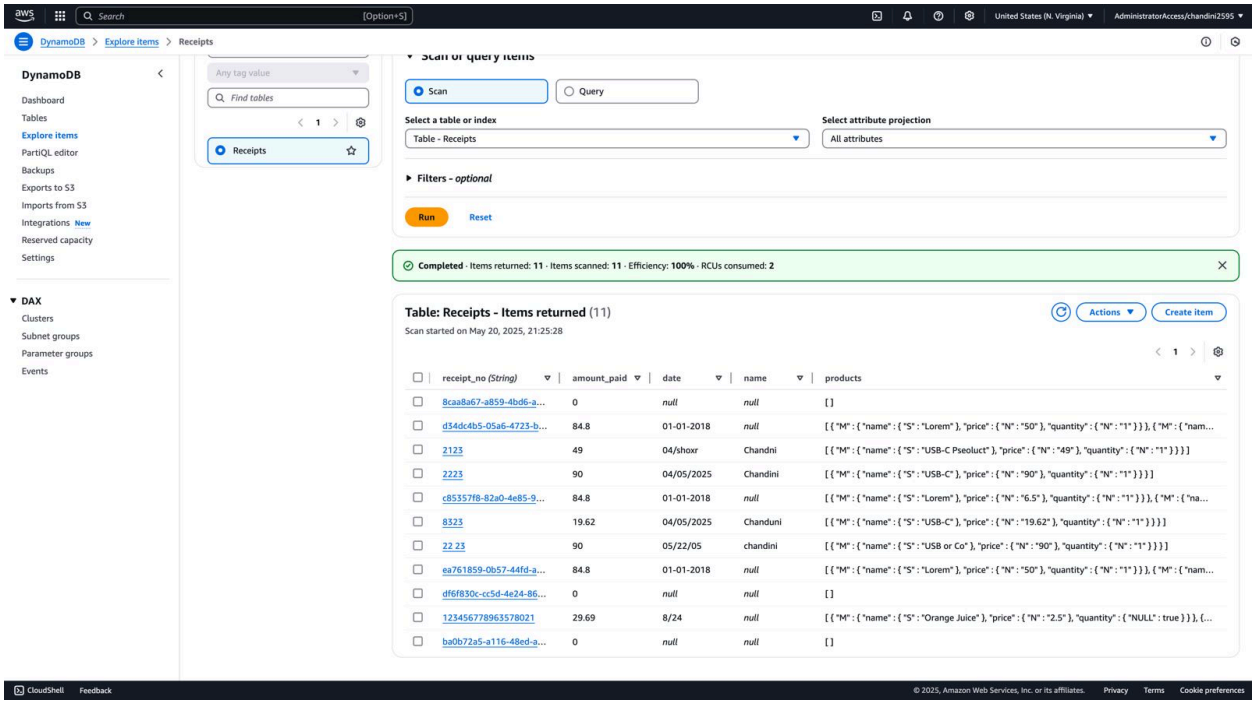
Epoch 7: Loss=0.3054, Val Loss=0.3076, Accuracy=0.7073

Epoch 8: Loss=0.2842, Val Loss=0.3038, Accuracy=0.7322

Epoch 9: Loss=0.2510, Val Loss=0.2559, Accuracy=0.7545

Epoch 10: Loss=0.1816, Val Loss=0.1894, Accuracy=0.8200


Confusion Matrix (Last Epoch)
Class 0
Class 1
Class 2
True label
37
1
0
2
27
1
2
1
29
Class 0
Class 1
Class 2
Predicted label
35
30
25
20
15
10
5
0


aws
Search
[Option+S]
United States (N. Virginia)
AdministratorAccess/chandini2595
DynamoDB
Explore items
Receipts
DynamoDB
Dashboard
Tables
Explore items
PartiQL editor
Backups
Exports to S3
Imports from S3
Integrations New
Reserved capacity
Settings
DAX
Clusters
Subnet groups
Parameter groups
Events
Any tag value
Find tables
Receipts
Scan
Query
Select a table or index
Table - Receipts
Select attribute projection
All attributes
Filters – optional
Run
Reset
Completed · Items returned: 11 · Items scanned: 11 · Efficiency: 100% · RCUs consumed: 2
Table: Receipts - Items returned (11)
Scan started on May 20, 2025, 21:25:28
Actions
Create item
receipt_no (String)
amount_paid
date
name
products
8caa8a67-a859-4bd6-a...
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null
[ ]
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01-01-2018
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[ ]
CloudShell
Feedback
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