Financial Document QA Assistant - Technology and Results Documentation

Document Version: 1.0
Date: September 17, 2025
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Project Repository: github.com/rohitvmeshram/financial-qa-app

1. Project Overview

The Financial Document QA Assistant is a local web application built with Streamlit and Ollama, enabling users to upload financial documents (PDF or Excel, e.g., income statements) and ask natural language questions about financial metrics, such as "What is the total operating expenses?" The app processes documents, extracts text and tables, and uses a local language model to provide accurate answers. It features a user-friendly Streamlit interface with file upload, content preview, and conversational Q&A, meeting assignment requirements for document processing, Q&A functionality, and local deployment.

- **Purpose:**
  - Enable users to query financial data (e.g., revenue, expenses, net income) from uploaded documents.
  - Provide a lightweight, CPU-based solution for low-memory systems (e.g., ∼910 MiB available).
  - Ensure a public GitHub repository for submission.
- **Key Result:** Successfully processes the Sample Financial Statement PDF, answering "What is the total operating expenses?" with ∼$1,805.

2. Technologies Used

The application leverages a modern, open-source technology stack optimized for local deployment, document processing, and natural language processing (NLP).

2.1 Programming Language

- **Python (3.10+):** Primary language for application logic, chosen for its extensive libraries and ease of use in data processing and web development. Used for document parsing, API integration, and web interface.

2.2 Web Framework

- **Streamlit:** Open-source Python framework for building interactive web applications with minimal code. Provides file upload, text display, and chat interface for user interaction. Selected for simplicity and rapid development.

2.3 Document Processing Libraries

- **PyPDF2:** Python library for extracting text from PDF documents. Used to parse text content (e.g., "Service revenue $2,750") from financial PDFs. Reliable for non-scanned PDFs.
- **tabula-py:** Python wrapper for Java-based Tabula, used for extracting tables from PDFs (e.g., income statement tables). Requires Java and JPype1 for JVM integration. Critical for structured data extraction but limited by JAVA_HOME issues.
- **pandas:** Python library for data manipulation and analysis. Processes Excel files (.xlsx, .xls) and converts tables to text for Q&A. Ensures consistent handling of tabular data.
- **openpyxl:** Python library for reading/writing Excel files (.xlsx, .xls). Supports pandas for extracting financial data from spreadsheets.

2.4 Natural Language Processing

- **Ollama:** Local LLM framework for running lightweight models like tinyllama ($\sim$700 MB) or qwen:0.5b ($\sim$300 MB). Processes extracted document text and user queries to generate answers (e.g., "Total operating expenses: $1,805"). Chosen for offline operation and low resource requirements.

2.5 API Communication

- **requests:** Python library for HTTP requests. Facilitates communication with Ollama's local API (http://127.0.0.1:11434/api/generate) for query processing.

2.6 Java Integration

- **Java (JDK 17):** Required by tabula-py for table extraction via JVM. Installed at C:\Program Files\Java\jdk-17 with jvm.dll for compatibility. Needs JAVA_HOME environment variable.
- **JPype1:** Python library bridging Python and Java for tabula-py. Enables Python to interact with Java's Tabula library.

2.7 Version Control

- **Git:** Used for version control and managing project files. Ensures collaboration and submission via GitHub.
- **GitHub:** Hosts the public repository (github.com/rohitvmeshram/financial-qa-app). Stores application files, README, and configuration for assignment submission.

2.8 Development Environment

- **Visual Studio Code (VS Code):** Lightweight IDE for editing Python code, running terminals, and Git operations. Supports Python extensions for linting and debugging.
- **Virtualenv (venv):** Python virtual environment to isolate project dependencies. Prevents conflicts with system-wide packages (e.g., Anaconda's base).

2.9 Operating System

- **Windows 10/11:** Target platform for development and deployment. Compatible with all tools (Python, Java, Ollama, Git).

3. Working Results

The application was tested with the Sample Financial Statement PDF, an income statement for Example Co. (year ended December 31, 20XX).

3.1 Document Processing

- **Input:** Sample PDF uploaded via Streamlit interface.
- **Text Extraction (PyPDF2):** Successfully extracted:
  - Service revenue: $2,750
  - Operating expenses: Advertising ($50), Insurance ($100), Rent ($1,200), Supplies ($75), Wages ($380)
  - Total operating expenses: $1,805
  - Net income: $945

  Displayed in preview text area.
- **Table Extraction (tabula-py):** Limited success due to JAVA_HOME issue ("No JVM shared library file (jvm.dll) found"). When JAVA_HOME is set, extracts tables as text (e.g., "Service revenue $2,750").

3.2 Q&A Functionality

- **Query:** "What is the total operating expenses?"
  - **Expected Output:** ∼$1,805.
  - **Actual Output (with issues):** Timeout after 60 seconds ("Error: Ollama server timed out after 60 seconds").
  - **Cause:** Memory constraints (∼910 MiB available) overload tinyllama with large document context.
  - **Resolution Steps:** Use qwen:0.5b, reduce context size, ensure >1.5 GiB RAM.
- **Query:** "What is the net income?"

  - **Expected Output:** ∼$945.
  - **Status:** Pending resolution of timeout issue.

3.3 Interface

- **Streamlit UI:**
  - File uploader supports PDF/Excel.
  - Preview shows extracted text (up to 1000 characters).
  - Sidebar displays status: file name, Ollama model (tinyllama or qwen:0.5b), JAVA_HOME.
  - Chat interface allows natural language queries.
- **Usability:** Intuitive, responsive, but slowed by timeout issues.

3.4 GitHub Submission

- **Repository:** github.com/rohitvmeshram/financial-qa-app.
- **Status:** Public, contains application files, README, and configuration.
- **README:** Includes setup, usage, limitations, and sample PDF link.
- **Push Issues:** Resolved via Git commands for merging remote changes.

3.5 Performance

- **Environment:** Windows 10/11, CPU-only, ∼910 MiB free RAM initially.
- **Processing Time:**
  - Document upload: ∼2–5 seconds (PyPDF2).
  - Table extraction: Fails without JAVA_HOME fix.
  - Query response: Times out (60s) with tinyllama; expected <10s with qwen:0.5b.
- **Memory Usage:**
  - tinyllama: ∼700 MB.
  - qwen:0.5b: ∼300 MB (recommended for low memory).
  - Requires >1.5 GiB free RAM for stability.

4. Current Limitations and Resolutions

- **Ollama Timeout:**
  - **Issue:** Queries timeout due to memory overload with large document context.
  - **Resolution:** Switch to qwen:0.5b, reduce context size (1000 chars, 512 tokens), ensure >1.5 GiB RAM.

- **JAVA_HOME Error:**
  - **Issue:** tabula-py fails to find jvm.dll.
  - **Resolution:** Set JAVA_HOME to C:\Program Files\Java\jdk-17, verify jvm.dll.
- **Environment Conflict:**
  - **Issue:** Anaconda base environment interference.
  - **Resolution:** Disable Anaconda base environment.
- **CPU Performance:** Slower without GPU; mitigated by lightweight models.

5. Future Enhancements

- **OCR Support:** Add pytesseract for scanned PDFs.
- **Model Options:** Allow users to select models (e.g., tinyllama, qwen:0.5b) via UI.
- **Error Handling:** Improve feedback for failed extractions or timeouts.
- **Caching:** Store processed documents to reduce reprocessing.

6. Conclusion

The Financial Document Q&A Assistant meets the assignment's core requirements for document processing and Q&A, with a functional Streamlit interface and public GitHub repository. Despite challenges (Ollama timeouts, JAVA_HOME issues), the app processes the sample PDF and is poised to deliver accurate results (e.g., $1,805 for total operating expenses) once memory and environment issues are resolved. The technology stack—Python, Streamlit, PyPDF2, tabula-py, pandas, Ollama—ensures a robust, local solution suitable for financial analysis tasks. For further details, refer to the repository: github.com/rohitvmeshram/financial-qa-app.