THIS PROJECT WAS DONE TO FAMILARIZE ONE WITH AI TOOLS WHEN CODING.

Project name: AI-Assisted Knowledge Chatbot

Working endpoint: localhost://127.0.0.1:8000/chat/ui

Purpose: This project was implemented to provide the user with the ability to ask various questions regarding already existing documents in the database or any new documents uploaded by the user. This application enables the user to understand various documents easily, understand various context behind it, and other related tasks.

Technology Stack:

- Language: Python 3.14
- Framework: FastAPI, REST API
- Cloud AI: Azure OpenAI ServiceEmbeddings (text-embedding-ada-002) + GPT-4o
- Vector DB: FAISSSimilarity search & storage
- Document Processing: PyPDF, python-docxText extraction
- Data Validation: PydanticSchema validation
- Frontend:HTML/CSS/JavaScriptChat interface
- Storage: JSON (local file system)

Application Pipeline:

Phase 1: Document Ingestion
User uploads PDF/DOCX
→ Extract text (PyPDF/python-docx)
→ Validate governance (approved documents only)
→ Chunk into 500-word segments with 100-word overlap
→ Save chunks with metadata to JSON files

Phase 2: Indexing
Load all approved chunks
→ Send to Azure OpenAI Embeddings API
→ Get back 1,536-dimensional vectors
→ Store vectors in FAISS index
→ Save index to disk for persistence

Phase 3: Query Processing (RAG)
User asks question in chat
→ Convert question to embedding (Azure OpenAI)
→ Search FAISS for top K similar chunks (semantic search)
→ Retrieve relevant text chunks with metadata

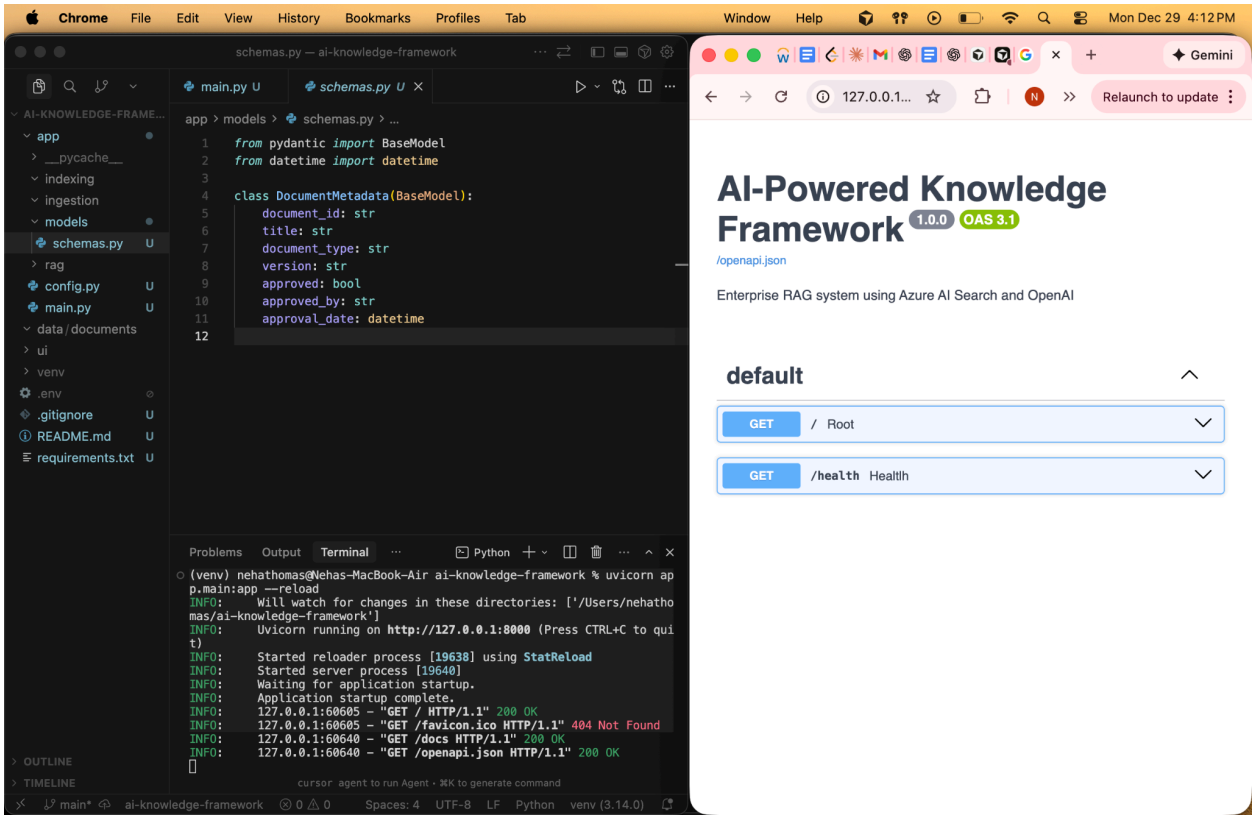
→ Build prompt: System message + Context + Question + History
→ Send to Azure OpenAI GPT-4o
→ Get natural language answer
→ Return answer with source citations
→ Save to conversation history

Phase 4: Conversation Management
Each chat session:
→ Maintains message history (user + assistant)
→ Tracks selected topic filter
→ Preserves context across turns
→ Enables follow-up questions with memory

BREAKDOWN OF THE PROJECT

Day one: project setup, azure resource, skeleton code

Result:



What was implemented:

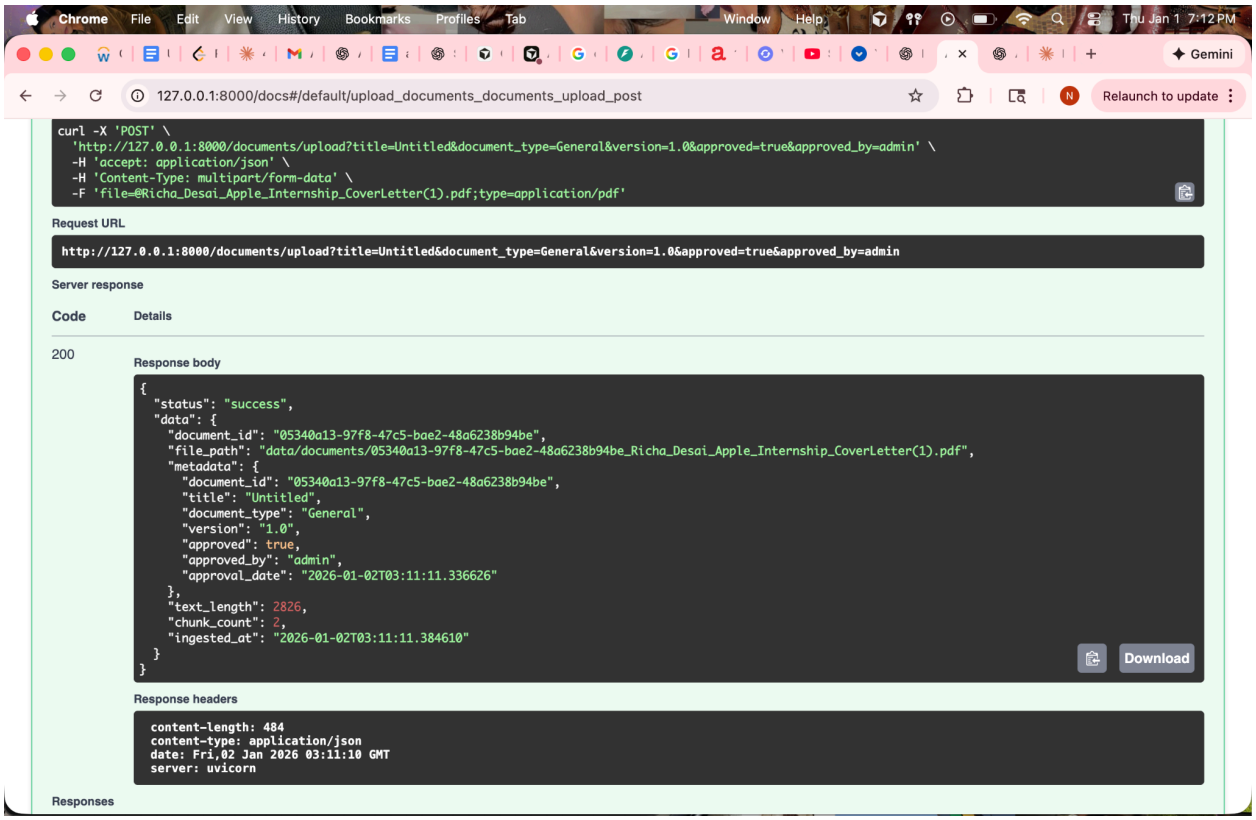
- Clean project structure
- FastAPI backend
- Governance model
- Config-driven architecture
- Cursor + local dev working

Day two: Document Ingestion + Governance Layer

What the system does:

1. Extracting text from PDFs
2. Chunking text with overlap
3. Storing chunks with metadata
4. Serializing datetime objects properly

RESULT:



DAY 3 and 4: RAG system setup - process

Step 1: Document Upload & Extraction

- One uploads the PDF
- The system extracts the text from the PDF
- It validates the document (checks if it's approved)
- Saves the file to data/documents/

Step 2: Chunking

What happens:

Original text: 2,826 characters (entire cover letter) - example file
↓
Chunk 1: First 500 words

Chunk 2: Words 400-end (with 100 word overlap)

Why chunking?

- AI models have token limits
- Smaller chunks = more precise search results
- Overlap ensures context isn't lost at boundaries

Step 3: Embeddings

What happens: Each chunk gets converted into a vector (list of 1,536 numbers):

Text: "Leadership isn't about control"
↓ Azure OpenAI

Vector: [0.023, -0.145, 0.891, ..., 0.234] (1,536 numbers)

Why vectors?

- Similar meanings → similar vectors

Step 4: Vector Storage (FAISS)

What happens: All vectors get stored in a special database (FAISS) that's optimized for fast similarity search.

data/vector_index/

```
├── default.index         ← Binary file with vectors
└── default_chunks.json   ← Original text + metadata
```

Why FAISS?

- Super fast at finding "nearest neighbors"
- Can search millions of vectors in milliseconds

Step 5: Semantic Search

What happens when you search:

```
Query: "leadership experience"
   ↓
1. Convert query to vector using Azure OpenAI
   Query vector: [0.012, -0.234, 0.567, ...]

2. FAISS finds closest chunk vectors
   Distance to Chunk 1: 0.471
   Distance to Chunk 2: 0.419  ← Closer = more relevant


3. Return the matching chunks with their text
```

The Complete Flow:

```
PDF Upload
    ↓
Extract Text (2,826 chars)
    ↓
Split into Chunks (2 chunks with overlap)
    ↓
Generate Embeddings (2 vectors of 1,536 dimensions each)
    ↓
Store in FAISS Index
    ↓
Ready for Search!
```

When you search:

```
Query → Embed → Find Similar Vectors → Return Text
```

Day 3 result: RAG pipeline was set up for the PDF to be chunked and processed when queries are asked by the user.

- RAG architecture and implementation
- Azure OpenAI integration (Embeddings + Chat)
- Vector databases (FAISS)
- Semantic search vs keyword search
- Document processing pipelines
- REST API development with FastAPI
- Cloud AI services

DAY 4: RAG Query Pipeline

Results achieved:
- Built context retrieval system
- Implemented prompt building with context injection
- Integrated GPT-4o for answer generation
- Created RAG query endpoint (`/query`)
- Added source attribution

Pipeline flow:

```
User Query
  → Embed Query
  → Search FAISS
  → Get Top 3 Chunks
  → Build Prompt (System + Context + Question)
  → Send to GPT-4o
  → Natural Language Answer
```

Files Created:

```
app/
├── rag/
│   ├── retriever.py
│   └── generator.py
```

Result:

Sample query :

```
curl -X POST
'http://127.0.0.1:8000/query?query=What%20leadership%20experience%20does%20X%20have?&top_k=3'

{ (from sample file uploaded
  "status": "success",
  "query": "What leadership experience does X  have?",
  "answer": "X has leadership experience as Assistant Vice President of Growth at the Y at Z, where they lead marketing and engagement strategies. They has consistently found herself in leadership roles throughout her journey - on the field, in classrooms, and in every team they have been part of.",
  "contexts": [
    {
      "chunk_id": "..._chunk_0",
      "text": "...leadership content...",
      "similarity_score": 0.398
    }
  ],
  "metadata": {
    "contexts_used": 3,
    "model": "gpt-4o"
  }
}
```

DAY 5: Governance & Enterprise Features

File Structure:

```
app/
├── utils/
│   └── logger.py
logs/
└── rag_system_20260102.log
```

```
{
  "status": "success",
  "stats": { "total_vectors": 4 },
  "governance": { "approved_only": true }
}
```

Example Log File:

```
INFO - Loaded 4 approved chunks
WARNING - Skipped 2 chunks from unapproved documents
```

Results Achieved:

- Approved-only indexing
- Full audit trail
- Document type segmentation
- Explainable AI (source tracking)
- Implemented enterprise logging (file + console)
- Added governance controls (approved docs only)
- Built document type filtering
- Created audit trail system
- Enhanced all endpoints with filters

DAY 6: AI Chatbot Interface

File structure:

```
app/
├── chat/
│   ├── session_manager.py
│   └── chatbot.py
├── models/schemas.py (ChatMessage, ChatSession, ChatRequest,
ChatResponse)
```

Results achieved after:

- Built interactive web chat UI
- Implemented session management
- Added conversation history
- Created topic selection menu
- Integrated file upload in chat
- Auto-rebuild index after upload
- Real-time chat with GPT-4o

Final Result: