CAPSTONE PROJECT

Research Agentic Model

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OUTLINE

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Problem Statement

Researchers often struggle with:

- Navigating large volumes of academic literature
- Extracting meaningful insights from complex papers
- Generating structured summaries, citations, and content
- Lack of unified tools integrating reading, understanding, and content generation
- These challenges hinder productivity, innovation, and learning—especially for students and early-stage researchers.

Proposed Solution

The proposed system aims to address the challenge faced by researchers in quickly understanding, summarizing, and reusing academic content for research writing. This involves leveraging Large Language Models (LLMs) and agentic planning to automate critical parts of the research process. The solution will consist of the following components:

Data Collection:

- Allow users to upload academic papers (PDF format) containing abstracts or full text.
- Store uploaded documents securely in IBM Cloud Object Storage.

Data Preprocessing:

- Extract text from PDF files using PyPDF2 for further processing.
- Sanitize input to remove formatting issues or non-relevant characters.
- Identify key sections like title, abstract, and metadata using rule-based extraction.

LLM-based Processing:

- Use IBM Granite LLMs via Watsonx.ai Prompt Lab to perform multiple tasks:
  - Summarize the research text into 5–7 structured bullet points
  - Generate citations in APA, MLA, and IEEE formats
  - Draft sections like Introduction and Literature Review
- Use predefined prompt templates for consistent output and accuracy.

Deployment:

- Build a web-based application using Streamlit for interactive UI.
- Deploy the app on Lightning AI Studio for fast, GPU-enabled inference.
- Integrate backend with IBM Cloud Object Storage and Watsonx.ai for seamless data flow.

Evaluation:

- Test the system across various research papers and academic fields.
- Evaluate generated outputs for accuracy, formatting, and relevance based on user feedback.
- Perform continuous prompt refinement and implement prompt chaining or RAG in future iterations.

Result:

- Users can upload PDFs and instantly receive:
  - Bullet-point summaries
  - Formatted citations
  - Auto-generated research section content
- Reduces manual effort and accelerates the research writing workflow.
- Offers a lightweight, no-login, cloud-powered research assistant tool.

System Approach

Technologies Used:

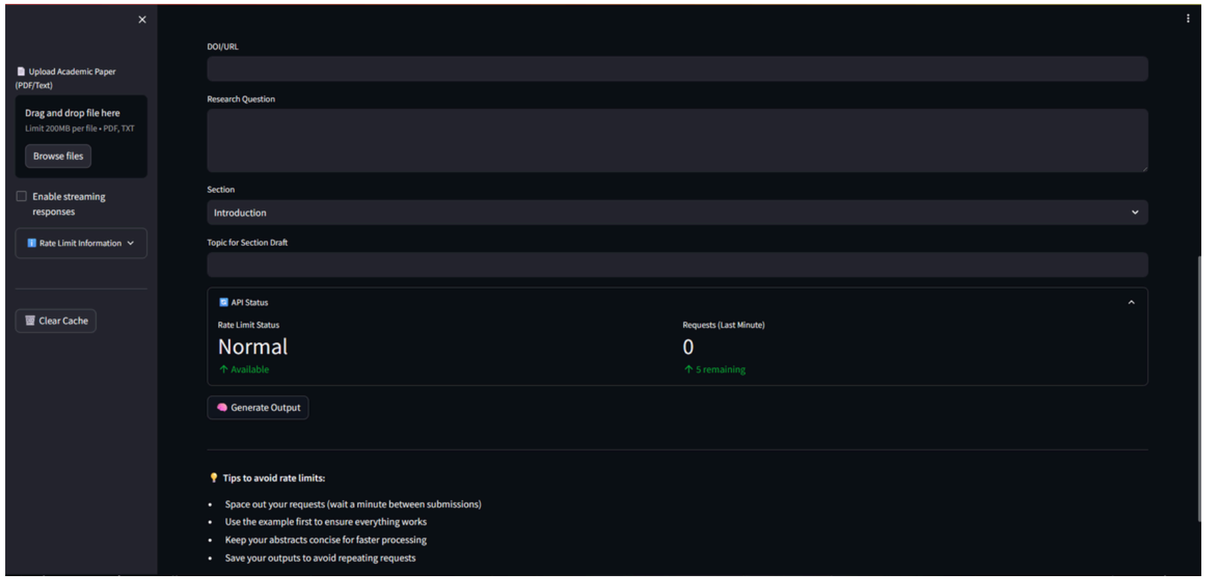
- **Frontend: Streamlit (Python)**
- **Backend: IBM Watsonx.ai (Granite LLMs)**
- **Storage: IBM Cloud Object Storage**
- **Orchestration: Agentic planning for reasoning tasks**
- **Deployment Platform: Lightning AI Studio (for GPU access)**
- **Libraries: requests, streamlit, PyPDF2, ibm_boto3, dotenv, logging, traceback**

Algorithm & Deployment

- Model: granite-3–3-8B LLMs from IBM (Prompt-driven)
- Input: PDF Abstract → Extracted text → Prompt Template
- Prompt Template Tasks:
- Bullet point summary
- Generate citations in 3 formats
- Generate structured research section content
- Deployment:
- RESTful interaction with Watsonx Prompt Lab
- Frontend deployed via Streamlit and Lightning AI Studio
- Object Storage API for file handling

Result

- Successfully processes academic PDFs and outputs:
- Bullet-point summaries
- Correctly formatted citations
- Introduction/Lit Review content
- Provides real-time responses through web UI
- Modular design with easy update paths



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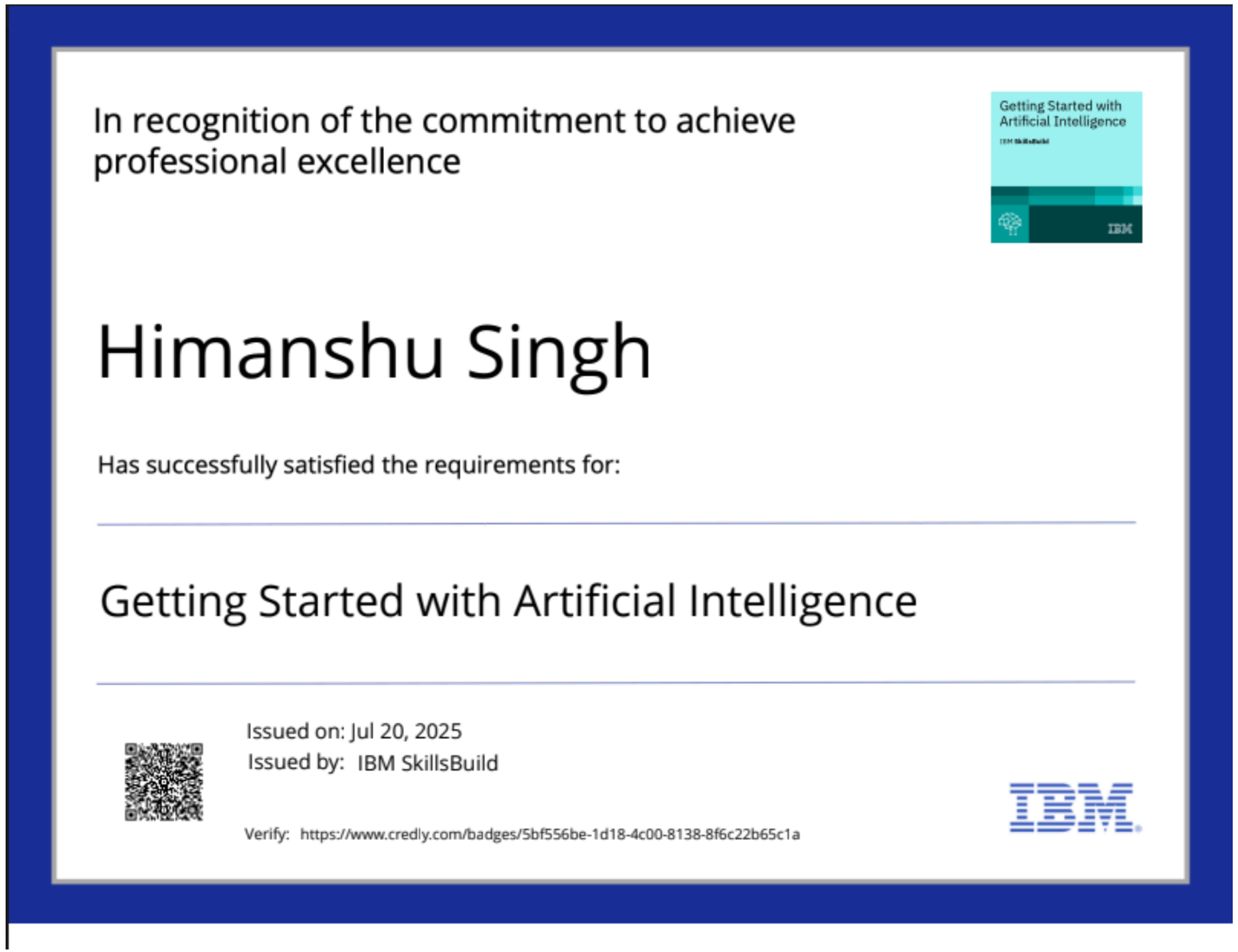
Conclusion

- The research assistant reduces effort in academic writing and research
- Empowers users to:
- Understand complex papers faster
- Get correctly formatted citations instantly
- Generate research content through automation
- Modular, cloud-based architecture ensures scalability and flexibility

Future scope

- Add full paper analysis using LangChain + vector DB for RAG
- Integrate full-fledged chatbot for interactive Q&A over PDFs
- Add plagiarism checker & grammar enhancer
- Enable user-uploaded prompt templates
- Expand support for multilingual papers and journals

IBM Certifications



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IBM **SkillsBuild** Completion Certificate

This certificate is presented to

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for the completion of

Lab: Retrieval Augmented Generation with LangChain

(ALM-COURSE_3824998)

According to the Adobe Learning Manager system of record

Completion date: 24 Jul 2025 (GMT) **Learning hours:** 20 mins

THANK YOU

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