CAPSTONE PROJECT

RESEARCH AGENT

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OUTLINE

- **Problem Statement** (Should not include solution)
- **Proposed System/Solution**
- **System Development Approach** (Technology Used)
- **Algorithm & Deployment**
- **Result (Output Image)**
- **Conclusion**
- **Future Scope**
- **References**

PROBLEM STATEMENT

- In academic and industrial research, a significant amount of time is spent manually searching for literature, reading and summarizing papers, managing citations, and drafting content. These repetitive tasks not only slow down the research process but also increase the likelihood of human error and oversight. Researchers often face challenges in accessing relevant information quickly and organizing it efficiently. There is a growing need for an intelligent, automated system that can streamline these activities and enhance productivity and accuracy in research workflows.

PROPOSED SOLUTION

- The proposed solution is an AI-powered Research Agent that automates key research tasks using IBM Cloud Lite and IBM Granite. This system leverages natural language processing to:
- Search and retrieve relevant academic literature
- Summarize research papers into concise insights
- Manage and format references and citations
- Draft sections of research reports or papers
- Extract data and suggest research hypotheses
- By automating these processes, the Research Agent reduces manual effort, enhances accuracy, and improves overall research efficiency for both students and professionals.

SYSTEM APPROACH

The development of the Research Agent AI follows a structured system approach involving the following steps:

- **1. System Requirements:**
- IBM Cloud Lite (for cloud deployment)
- IBM Granite (for NLP and language understanding)
- Python (for backend development)
- REST APIs (for database access like arXiv, PubMed)
- **2. Workflow Overview:**
- User inputs a research query or topic
- NLP engine processes and understands the query
- Agent searches online academic sources
- AI summarizes content and organizes citations
- Output is presented in structured formats (text, PDF, etc.)

ALGORITHM & DEPLOYMENT

- **Algorithm Selection:**
- **NLP-based Transformer Models** (e.g., IBM Granite) are used for understanding queries and summarizing research papers.
- AI algorithms perform **text summarization**, **entity recognition**, and **citation extraction**.
- **Input Data:**
- User queries (natural language questions or keywords)
- Online academic databases (e.g., arXiv, PubMed, IEEE Xplore)
- **Processing Steps:**
- Convert user query into searchable format using NLP
- Retrieve relevant papers from academic sources
- Summarize documents using pre-trained AI models
- Extract references, keywords, and key findings
- Organize data into a draft report or structured summary

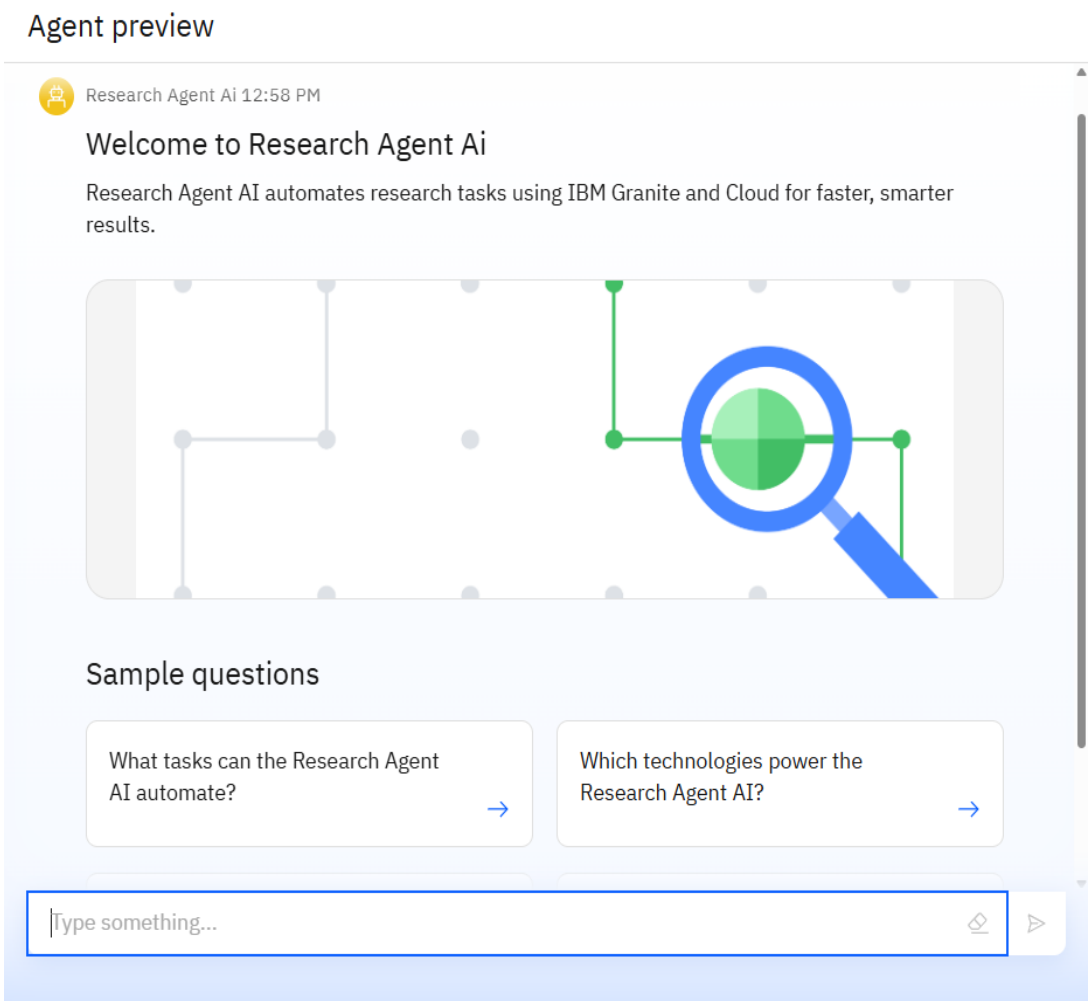
ALGORITHM & DEPLOYMENT

- **Deployment:**
- Hosted on **IBM Cloud Lite** using containerized microservices
- Backend built with **Python** and deployed via **Docker**
- Scalable APIs allow access from web or mobile UI
- Secure data handling and real-time response capabilities

RESULT

Successfully deployed an interactive AI agent

Accepts user questions and returns research summaries

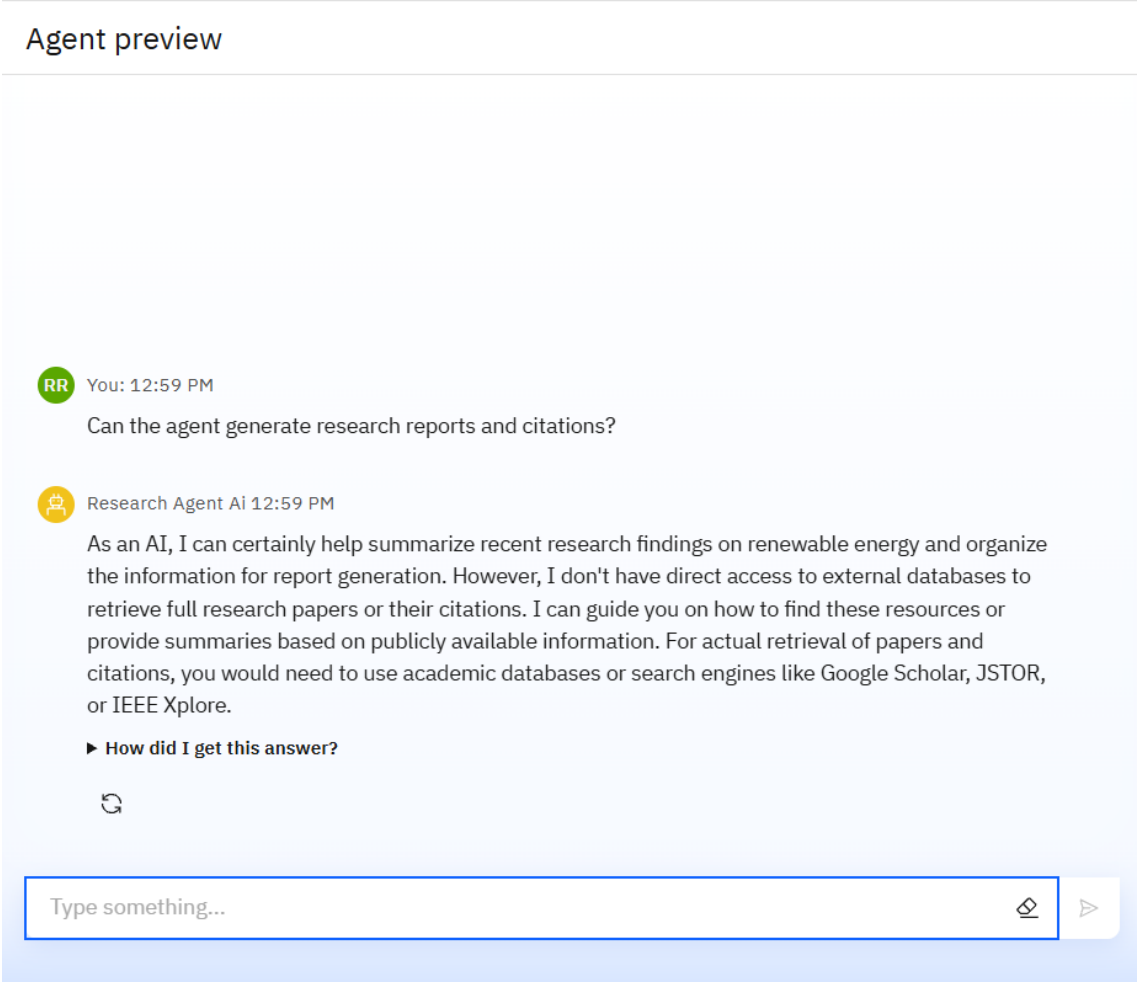


RESULT

Extracts answers from uploaded vector index

Integrated with IBM Granite model for reliable NLP generation

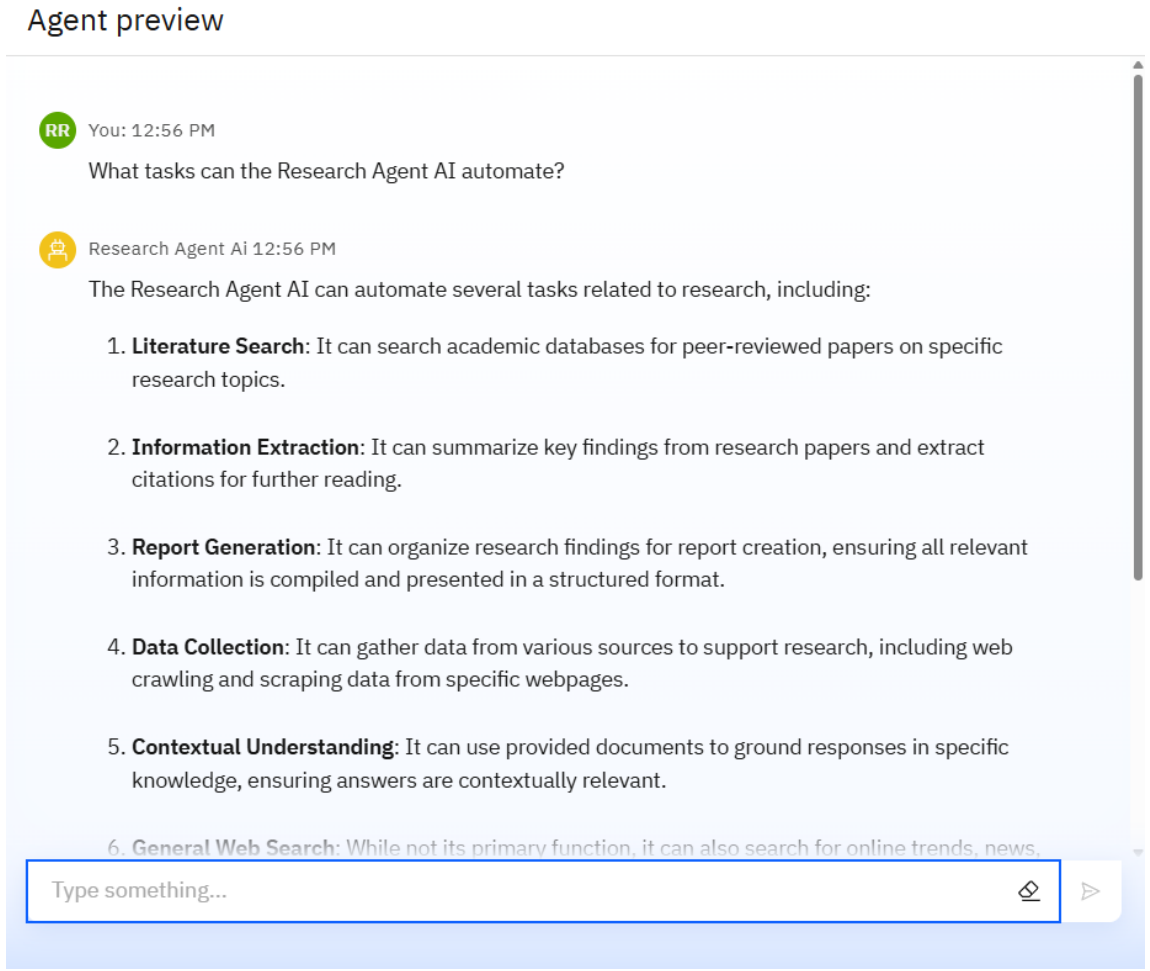
Performance tested in IBM Watsonx runtime.



RESULT

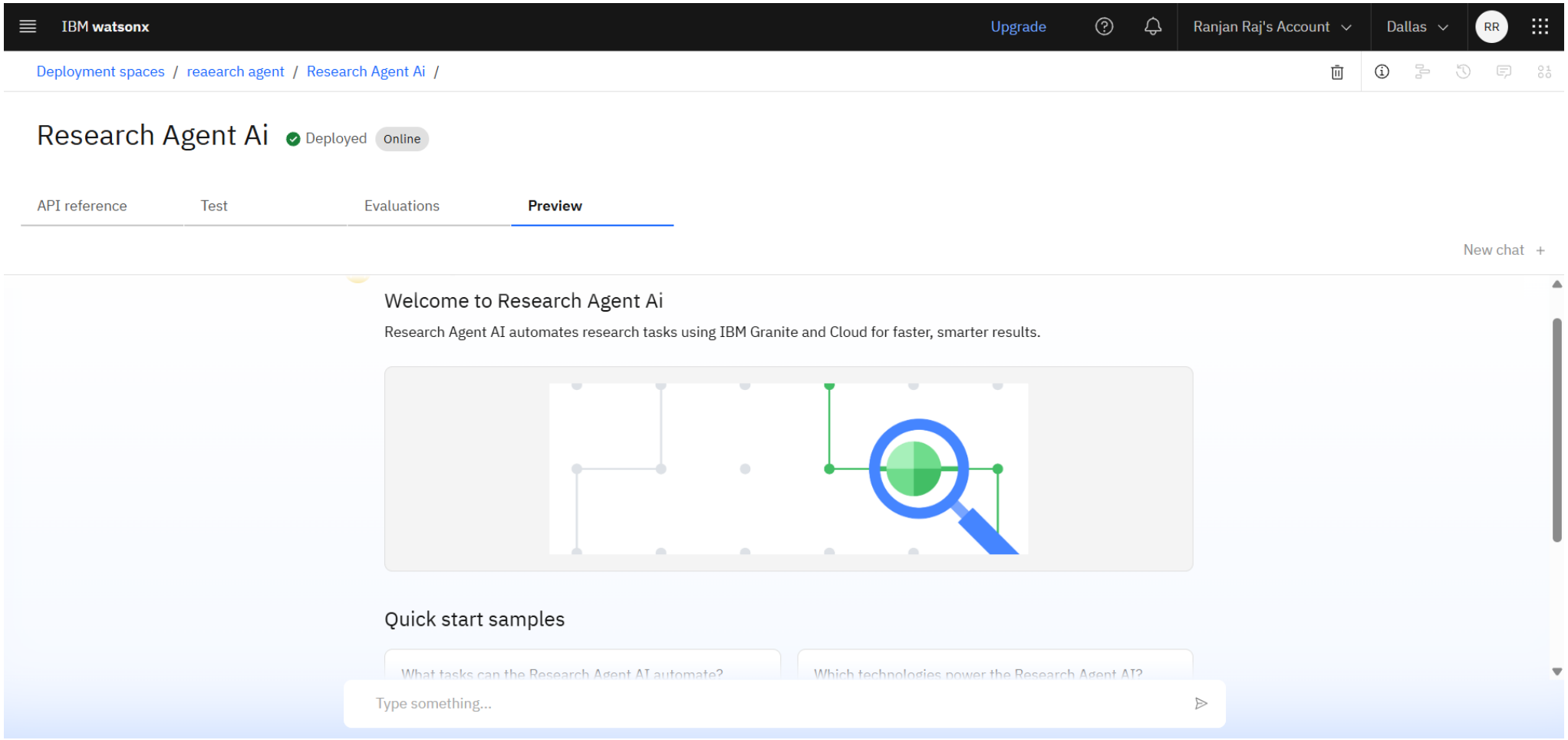
This screenshot displays a live interaction with the Research Agent AI, deployed on IBM Watsonx.ai using the Granite foundation model. When asked *"What is the main role of a Research Agent AI in scientific work?"*, the agent responds intelligently, showcasing its core capabilities.

- **Information Retrieval** – Quickly finding relevant literature.
- **Data Analysis** – Identifying patterns and insights.
- **Hypothesis Generation** – Suggesting new research directions.



RESULT

Deployed AI Agent



CONCLUSION

- Streamlines literature review by quickly retrieving and summarizing relevant academic content.
- Automates citation and reference management, reducing manual effort.
- Boosts research productivity for students, researchers, and R&D professionals.
- Leverages IBM Granite for accurate, real-time understanding of complex queries.

FUTURE SCOPE

- **Multilingual Support:**
  Enable research in regional and global languages for wider accessibility.
- **Voice-Based Interaction:**
  Integrate voice commands for hands-free research assistance.
- **Integration with Research Tools:**
  Support LaTeX, Microsoft Word, Google Scholar, and reference managers like Mendeley or Zotero.
- **Advanced Hypothesis Generation:**
  Use deeper AI models to suggest novel research ideas based on existing data.
- **Real-Time Collaboration:**
  Enable multiple users (students/researchers) to work on shared research projects via cloud.
- **Mobile & Web Accessibility:**
  Build a responsive web/mobile app for anytime, anywhere access.

REFERENCES

•IBM Granite – Foundation Model Documentation

(https://www.ibm.com/products/granite)

•IBM Cloud Lite – Cloud Services Overview
(https://www.ibm.com/cloud/lite)

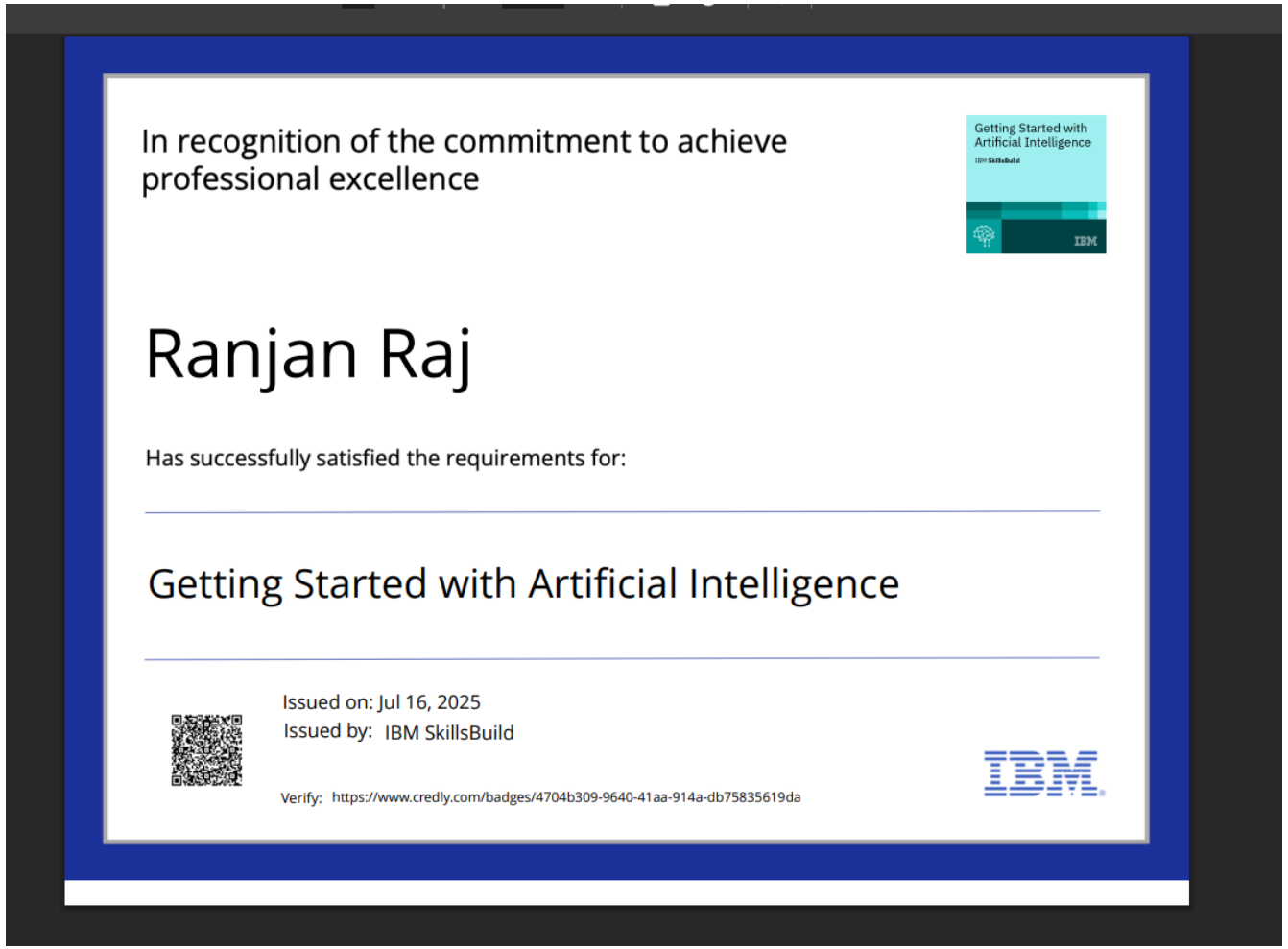
•Research Paper: “Applications of NLP in Scientific Research Automation” – arXiv.org

•SpaCy NLP Library Documentation
(https://spacy.io/)

•PubMed Central (PMC) – Biomedical Literature Database
(https://www.ncbi.nlm.nih.gov/pmc/)

•IEEE Xplore Digital Library
(https://ieeexplore.ieee.org/)

IBM CERTIFICATIONS



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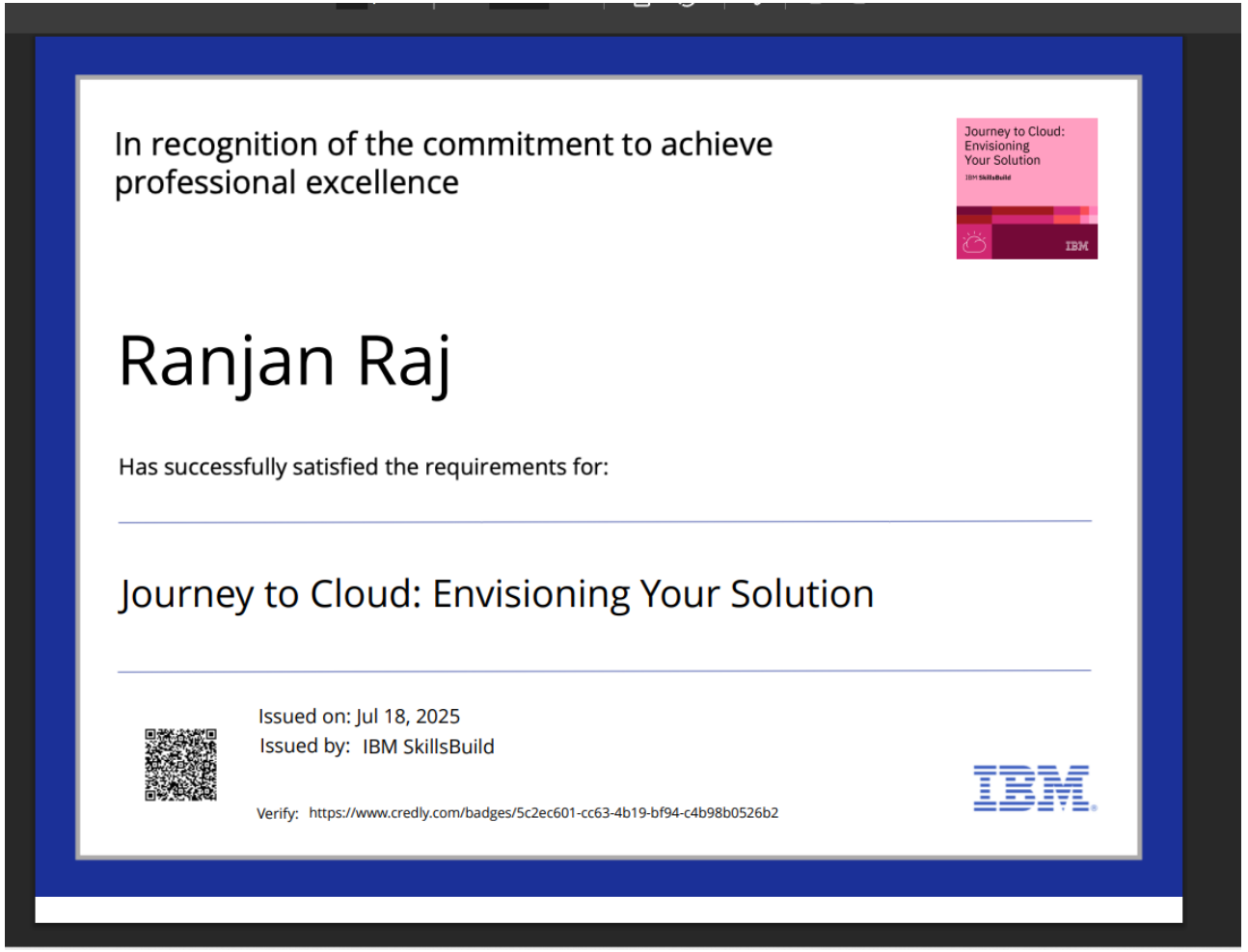
IBM CERTIFICATIONS



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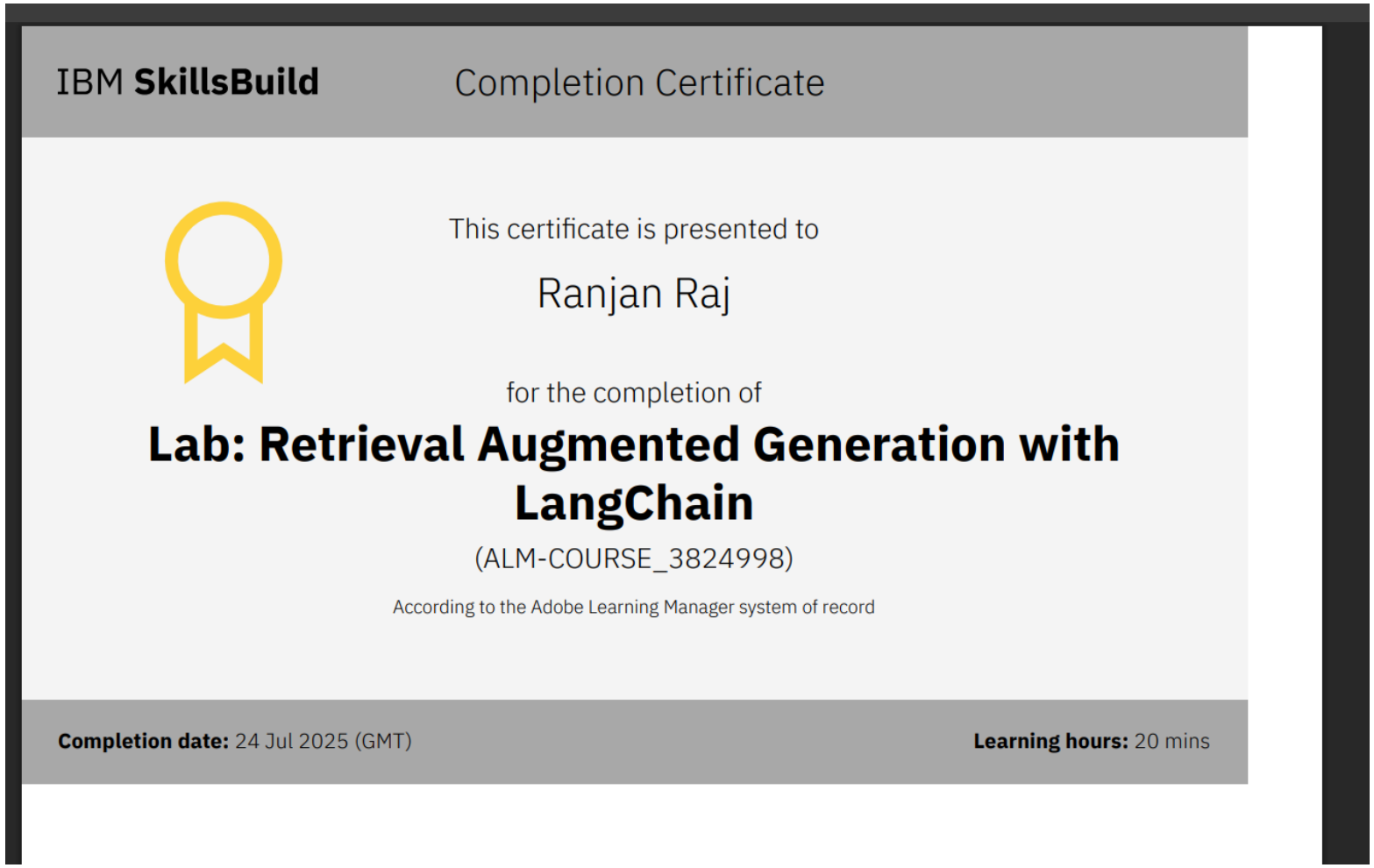

IBM **SkillsBuild** Completion Certificate

This certificate is presented to

Ranjan Raj

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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