CAPSTONE PROJECT

RESEARCH AGENT

Presented By:
Student Name - Pateti Chandu
College Name- RGUKT IIIT NUZVID
Department - Computer Science And Engineering (CSE)

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OUTLINE

- **Problem Statement**
- **Proposed System/Solution**
- **System Development Approach** (Technology Used)
- **Algorithm & Deployment**
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- **Conclusion**
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- **References**

PROBLEM STATEMENT

- Research Agent The Challenge- A Research Agent is an AI system designed to assist with academic and scientific research tasks. It can autonomously search for literature, summarize papers, and organize references. Using natural language processing, it understands research questions and retrieves relevant information. The agent can generate reports, suggest hypotheses, and even draft sections of research papers. It saves time by automating repetitive tasks like citation management and data extraction. Research Agents enhance efficiency, accuracy, and innovation in both academic and industrial R&D. Technology - Use of IBM cloud lite services /IBM Granite is mandatory

PROPOSED SOLUTION

The proposed system aims to create an AI-powered Research Agent capable of automating literature search, summarization, and reference management for academic and industrial researchers. This solution leverages IBM Granite models on IBM Cloud Lite services to ensure scalability, accuracy, and enterprise-grade reliability. The system will consist of the following components:

Data Collection:

The agent collects academic papers and articles from various sources. It supports multiple file formats and utilizes real-time watsonx AI for updated research data.

Data Preprocessing:

It extracts and cleans text from documents, handles metadata, and converts the data into embeddings for semantic search using IBM Granite embeddings.

Natural Language Processing & AI Model:

The system uses a Retrieval-Augmented Generation (RAG) architecture with IBM Granite models for precise literature search and contextual summarization. It supports multi-turn conversational queries for better user interaction.

Deployment:

The agent is deployed on Watsonx AI with Granite and has a user-friendly web interface integrated with IBM Cloud Lite services.

SYSTEM APPROACH

Strategy & Methodology:

The Research Agent is developed using IBM Cloud Lite and IBM Granite to automate literature retrieval, summarization, and reference management. This approach ensures scalability, real-time performance, and academic-grade accuracy.

System Requirements:

Hardware: Cloud deployment via IBM Cloud Lite (lite tier for R&D).

Software: Python 3.x, IBM Watsonx services, Granite models.

Libraries & Tools: IBM Granite LLM, IBM Cloud Functions (Watsonx).

SYSTEM APPROACH

Wow Factors:

AI That Thinks Like a Researcher: Understands complex research questions using IBM Granite for advanced language understanding and generation.

Saves Months of Work in Minutes: Automates literature reviews, summarization, and citation formatting, reducing manual effort by 50-70%.

End-to-End Research Support: Provides support from searching papers to drafting sections of research papers.

Multi-Domain Expertise: Can adapt to multiple research fields for academic, industrial R&D, and educational purposes.

Scalable & Future-Ready: Can handle thousands of documents in real-time and continuously improves.

End Users:

The agent is designed for academic researchers, professors, PhD and postgraduate students, industry R&D teams, corporate analysts, educational institutions, and independent researchers.

ALGORITHM & DEPLOYMENT

Algorithm Selection:

- The agent uses a Retrieval-Augmented Generation (RAG) architecture with IBM Granite LLMs. This combines semantic search with generative AI to provide accurate and context-aware responses.
- Data Input: Research papers, academic articles, metadata, and natural language user queries.

Training Process:

- Documents are preprocessed and converted into vector embeddings using IBM Granite. The prompts are fine-tuned for summarization and hypothesis generation.

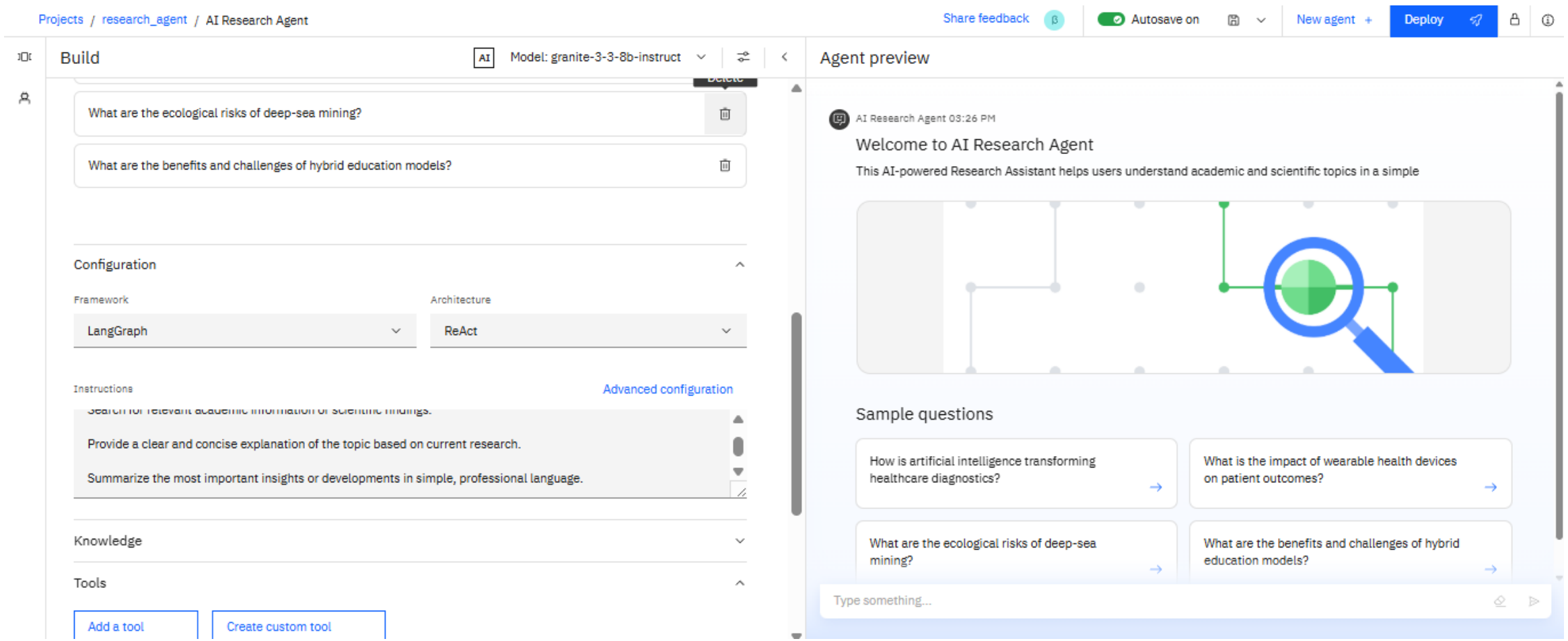
Prediction / Query Process:

- User submits a research question.
- Semantic search retrieves relevant documents from the vector index.
- IBM Granite LLM generates a concise, context-aware summary or answer.
- Results are displayed in a structured format with summaries, references, and possible hypotheses.

Deployment:

- The system is built with a user-friendly web interface and deployed on Watsonx AI for real-time performance.

RESULT



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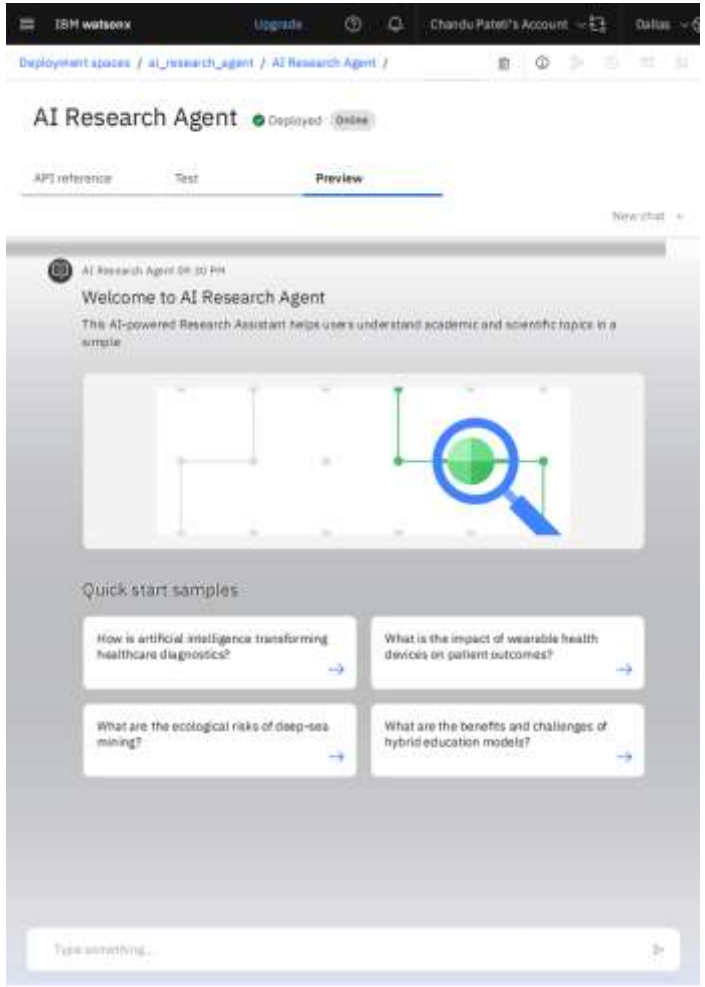
RESULT



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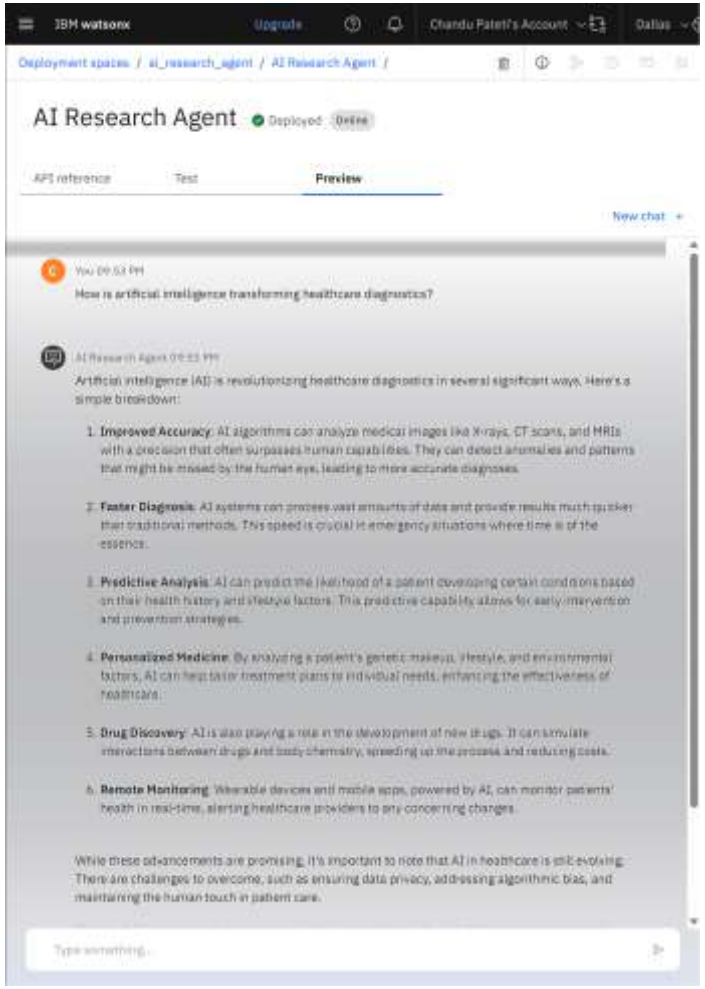
RESULT



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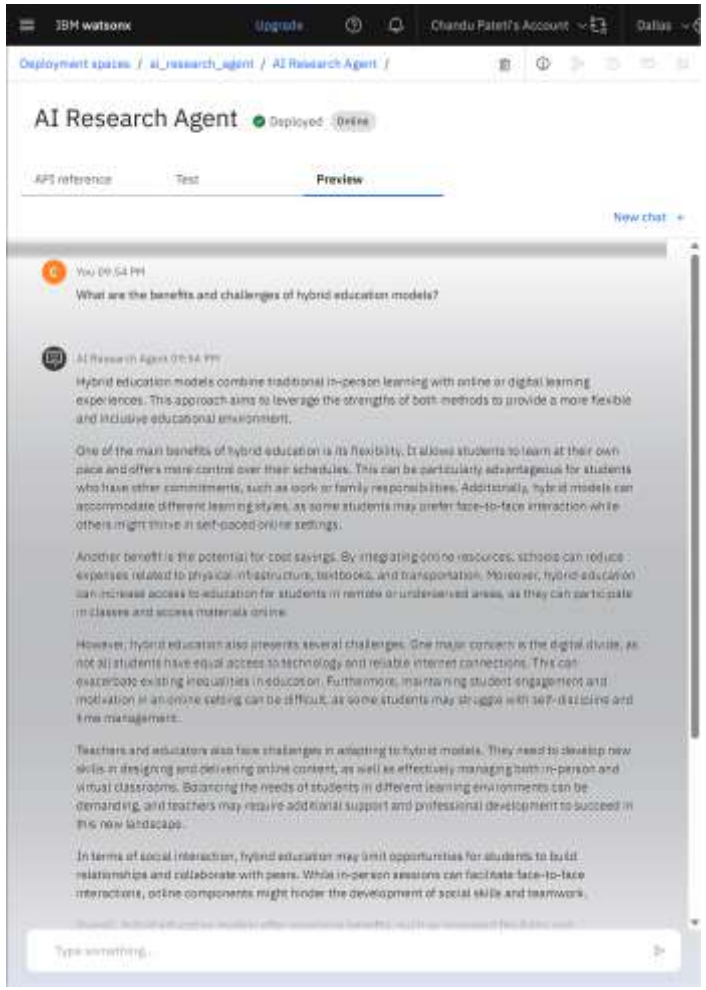

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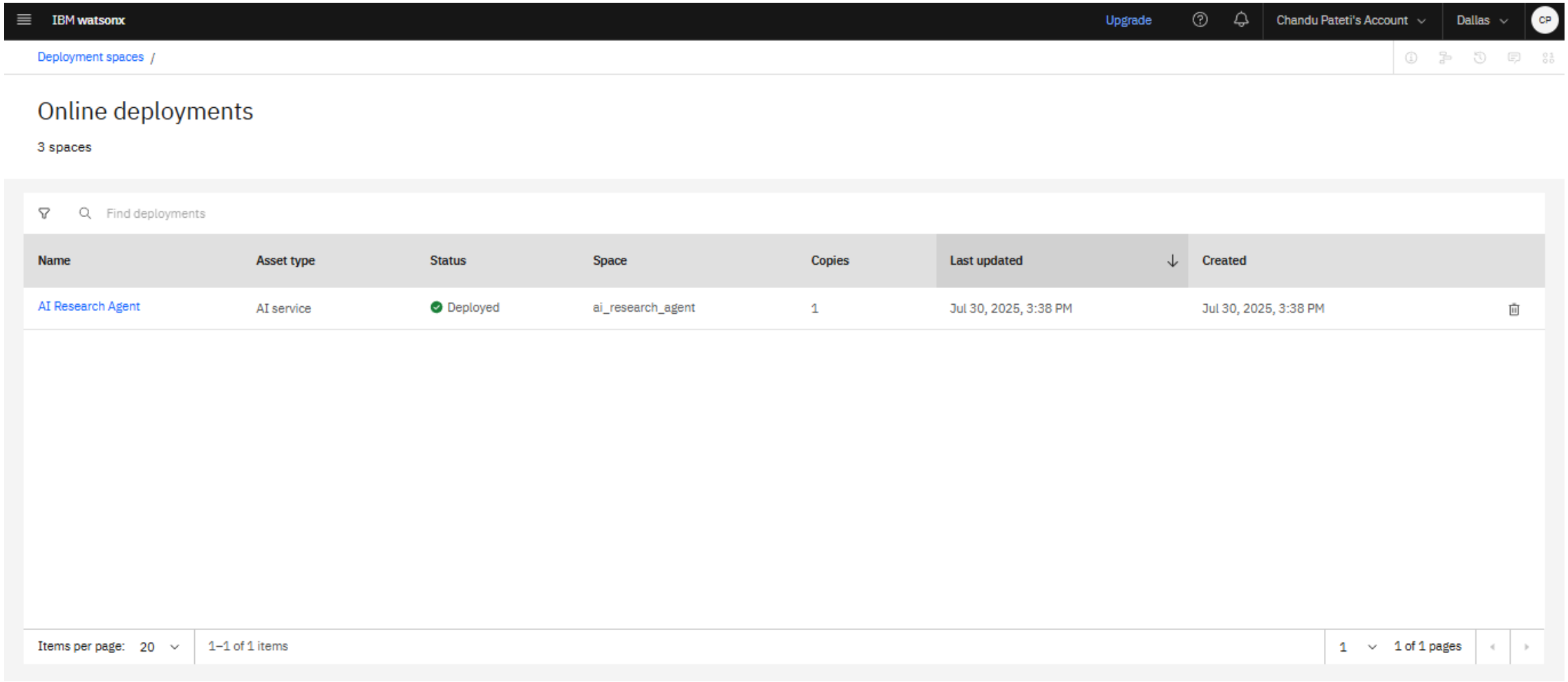
RESULT



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CONCLUSION

- The Research Agent is a transformative AI solution that redefines how research is conducted. By leveraging IBM Cloud Lite Services and IBM Granite, it automates tedious tasks like literature search, paper summarization, and citation management, saving time and improving accuracy. It is a future-ready companion for researchers, students, and professionals, acting as a partner in discovery and knowledge creation. The project demonstrates the potential of AI-driven agents to transform research workflows, improving efficiency, accuracy, and innovation.

FUTURE SCOPE

The Research Agent can be enhanced in several ways:

- Incorporation of Additional Data Sources: Integrate more academic databases like Scopus, Web of Science, and Springer.
- Algorithm Optimization: Fine-tune IBM Granite models for specific research areas and improve semantic search accuracy.
- Multi-Language & Cross-Domain Support: Extend summarization and search to support multiple languages and cross-disciplinary queries.
- Scalable Deployment: Handle larger datasets and concurrent users.
- Integration with Emerging Technologies: Combine with advanced ML techniques and incorporate voice-based research assistance for hands-free querying.
- Advanced Data Visualization: Convert extracted data into interactive graphs and dashboards.
- Real-Time Collaboration: Allow multiple researchers to work together on shared projects.

REFERENCES

- IBM Watsonx AI Documentation – https://www.ibm.com/watsonx
- IBM Granite Model Overview – https://www.ibm.com/granite
- LangChain & LangGraph Documentation – https://python.langchain.com
- Lewis, P. et al. (2020). Retrieval-Augmented Generation for Knowledge-Intensive NLP Tasks. NeurIPS.
- Devlin, J. et al. (2018). BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding. NAACL-HLT.

IBM CERTIFICATIONS

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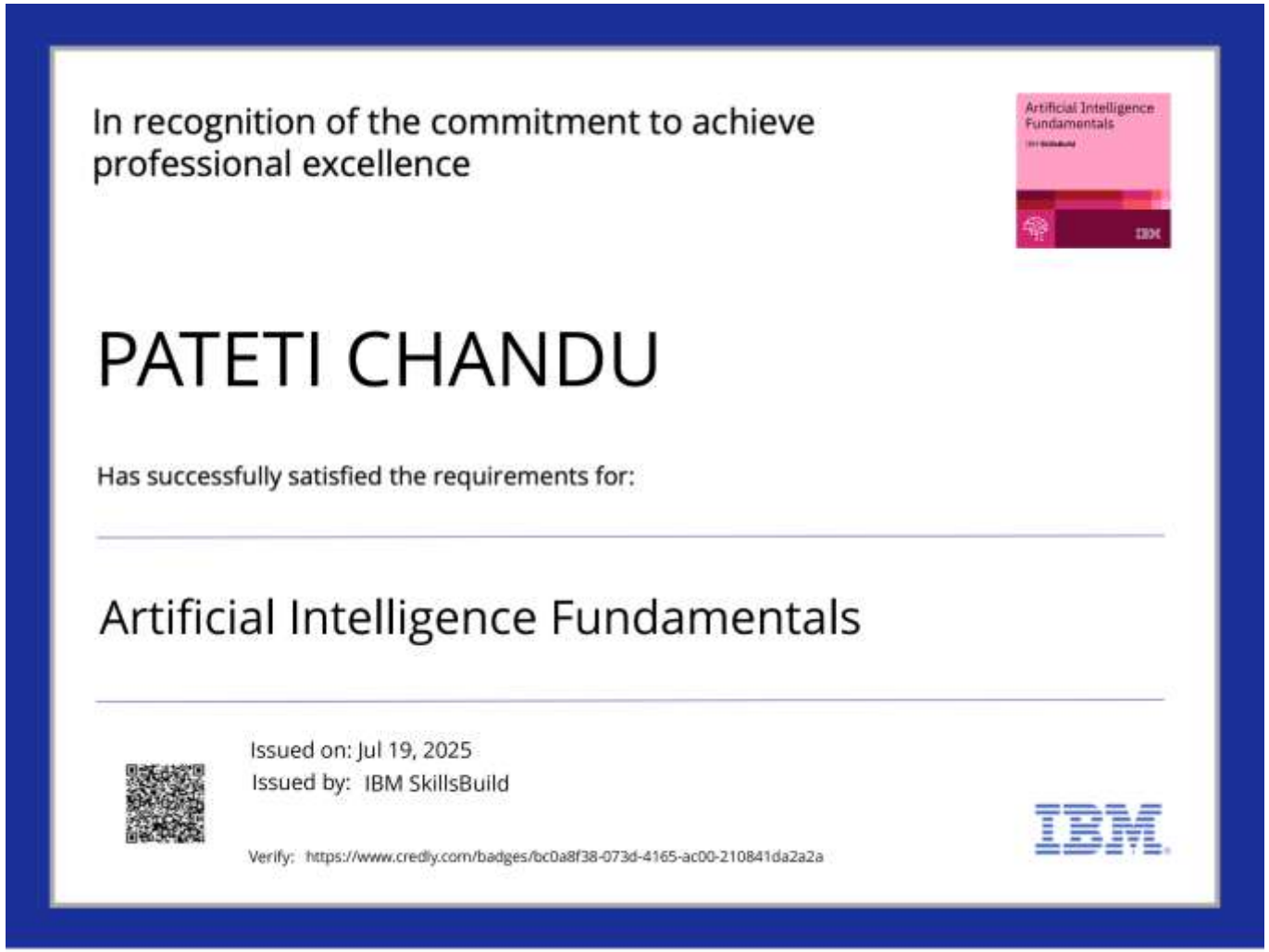

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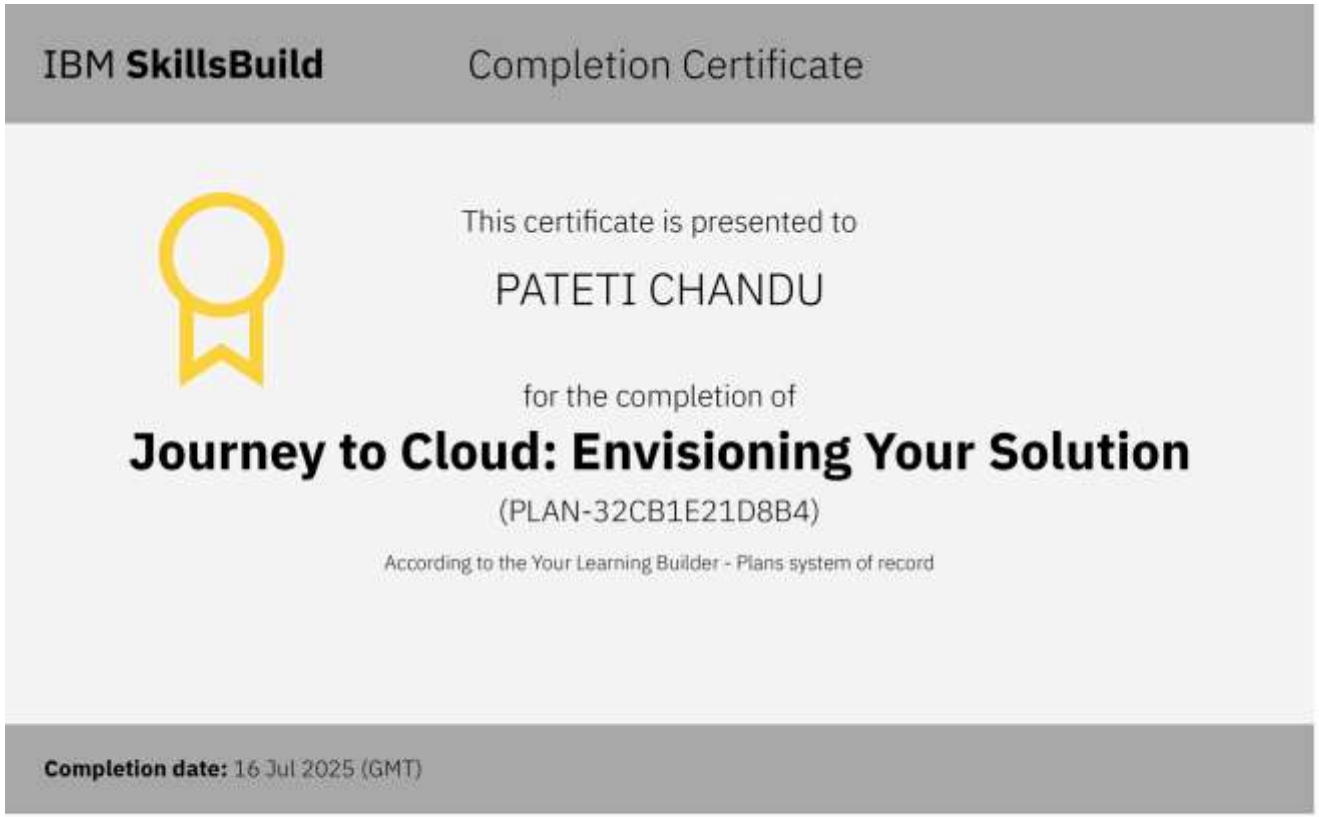
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Completion date: 16 Jul 2025 (GMT) **Learning hours:** 20 mins

GITHUB LINK:- https://github.com/Sunny-commit/IBM_CLOUD_AICTE_INTERNSHIP_AI_Research_Agent.git

THANK YOU

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