CAPSTONE PROJECT

Research Agent

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Problem Statement

The Challenge :

Researchers, students, and professionals often struggle to stay updated with the rapidly growing volume of academic publications, technical articles, and evolving research trends. Manually reviewing and synthesizing this information is time-consuming and inefficient.

Proposed Solution :

An AI Research Agent that uses Natural Language Processing (NLP) and Retrieval-Augmented Generation (RAG) to assist users in conducting efficient literature reviews, generating summaries, identifying research gaps, and recommending relevant papers.

Technology used

Technologies Used:

- **IBM Cloud Lite Services :** We utilized the free Lite tier for hands-on access to powerful AI services. This enabled cost-free development and deployment of our sophisticated agent for this capstone project.
- **IBM Granite Foundation Model :** This powerful, enterprise-grade LLM from IBM serves as the core intelligence of our agent. It was chosen for its strong reasoning and efficiency in generating accurate, relevant text from research queries.
- **Natural Language Processing (NLP) :** This core AI technology allows our agent to understand and interpret human language. It processes user questions and document text to enable meaningful analysis and interaction.
- **Retrieval-Augmented Generation (RAG) :** This advanced AI pattern allows the agent to first retrieve facts from a specific knowledge base. It then uses this retrieved information to generate more accurate and contextually relevant answers.

IBM cloud services used

IBM Cloud Services Used :

- **IBM Cloud watsonx.ai Studio :** This comprehensive, web-based platform served as our central development environment. It allowed us to access foundation models, manage project data, and build the AI agent from a single interface.
- **IBM Cloud Agent Lab :** This specific tool within watsonx.ai Studio provided the user-friendly interface to define our agent's instructions. We used it to connect the knowledge base, add tools like web search, and test agent behavior.
- **IBM Cloud watsonx.ai Runtime :** This service is the underlying computational engine that executes our agent in real-time. It provides the necessary processing power to run the Granite model and generate a response to the user's query.

Wow factors

This Agent Significantly reduces Research Time, Improves the Quality of literature reviews, and fosters Interdisciplinary Collaboration by making knowledge more Accessible and Actionable.

Unique Features:

- **Semantic Search :** Conducts searches across research papers, journals, and datasets.
- **Auto-Summarization :** Automatically summarizes selected papers to provide quick insights.
- **Smart Recommendations :** Recommends relevant research papers based on the user's current topic.
- **Hypothesis Generation :** Assists in creating simple hypotheses based on provided information.
- **Drafting Assistance :** Helps draft introductions and other sections of research papers.

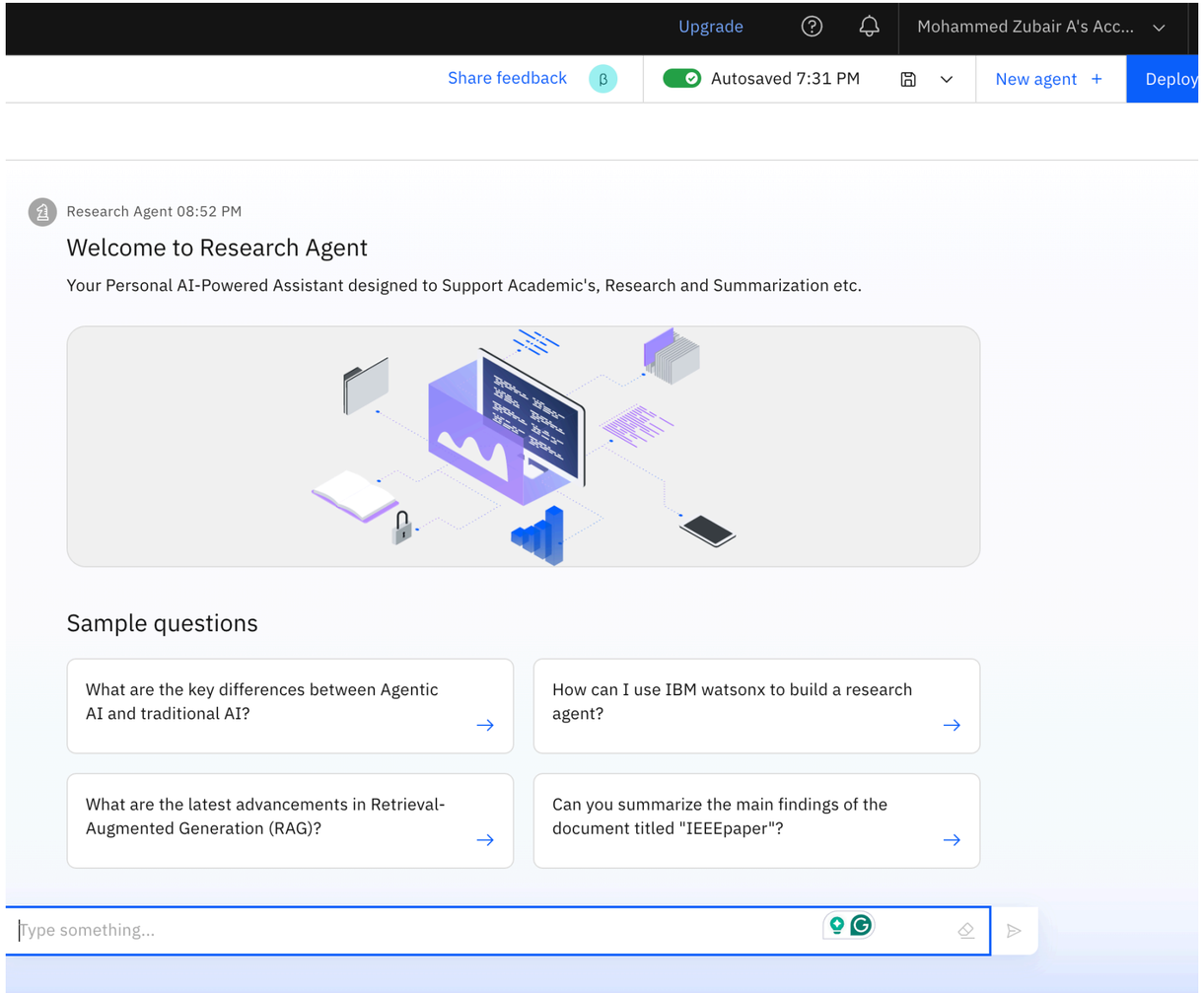
End users

- **Academic Researchers :** For literature reviews and staying current in their field.
- **Students:** To understand complex topics and find relevant sources for their assignments and theses.
- **Research Institutions and Universities :** To enhance the research capabilities of their staff and students.
- **Industry R&D Teams :** To accelerate innovation by quickly surveying the state-of-the-art in their domain.
- **Educators :** To prepare course materials and find relevant examples for teaching.

Results

Agent Welcome Screen

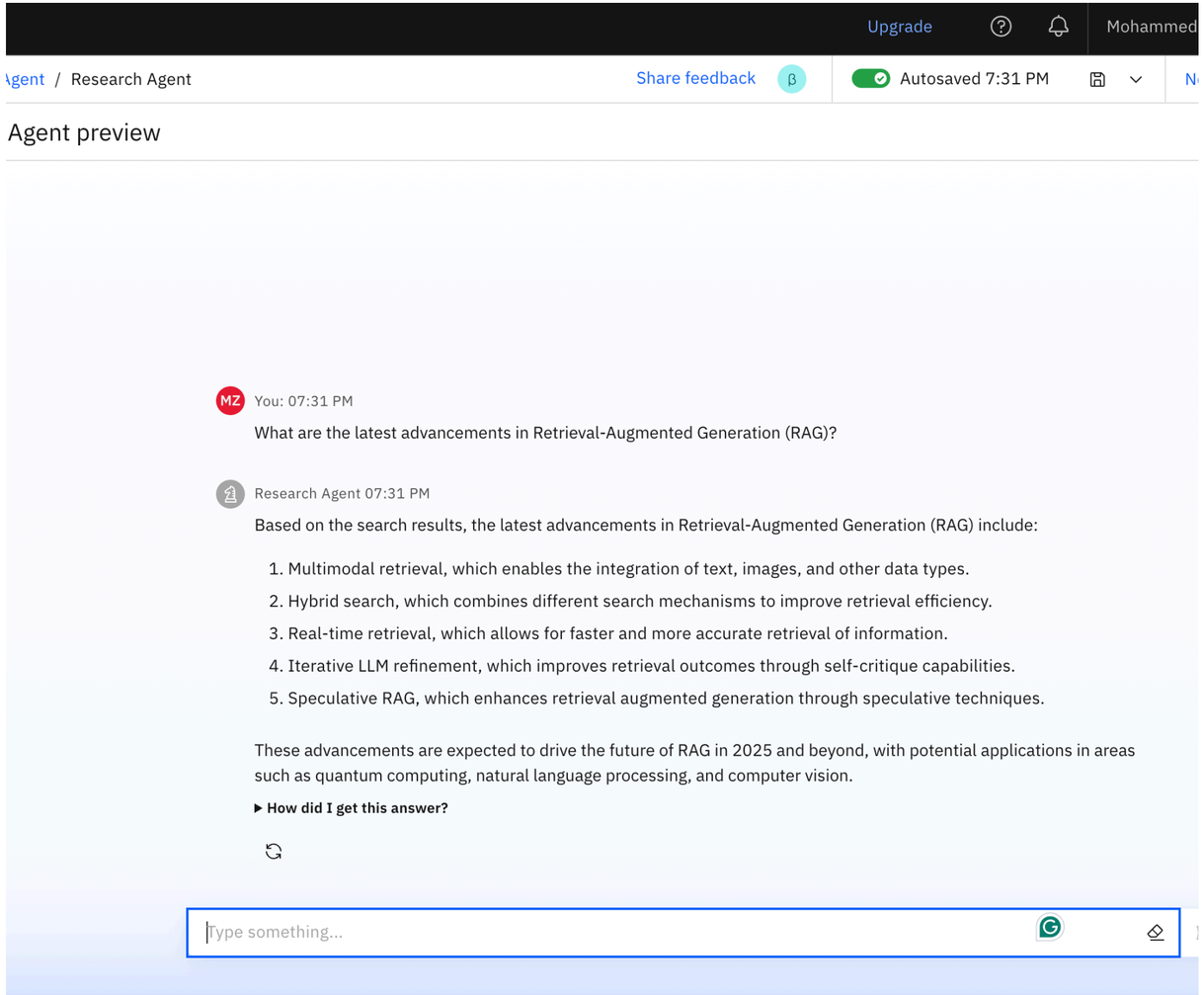
- **User-Centric Design :** This screen shows a clean, intuitive user interface, welcoming the user to the "Research Agent." The personalized description clarifies its purpose immediately.
- **Guided Interaction :** The "Sample questions" are a key feature. They guide the user on how to interact with the agent effectively, showcasing its primary capabilities like comparing AI types, summarizing documents, and explaining how it was built.
- **Ready for Input :** The prominent text input bar at the bottom indicates the agent is active and ready to receive user queries, providing a clear call to action.



Results

Answering a General Knowledge Question

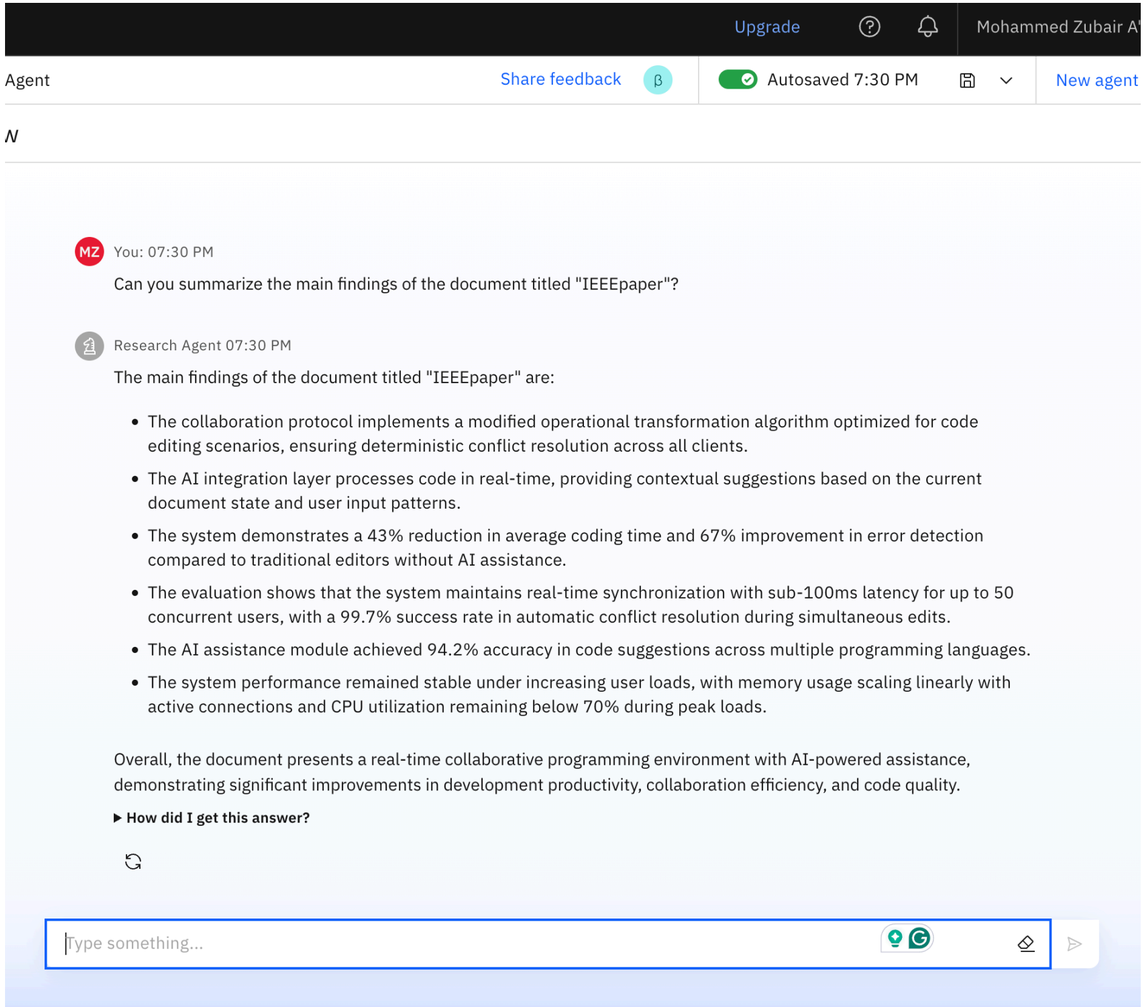
- **Tool Usage Demonstration :** This image demonstrates the agent's ability to use its integrated tools (like a web search). The question about "advancements in RAG" is broad and not based on a specific uploaded document.
- **Information Synthesis :** The agent doesn't just return a link. It has retrieved information from multiple sources and synthesized it into a concise, numbered list, highlighting key advancements like multimodal retrieval and hybrid search.
- **Attribution and Transparency :** The "How did I get this answer?" link is crucial for building trust. It allows the user to see the sources and reasoning process the agent used, which is vital for academic and research applications.



Results

Summarizing a Specific Document

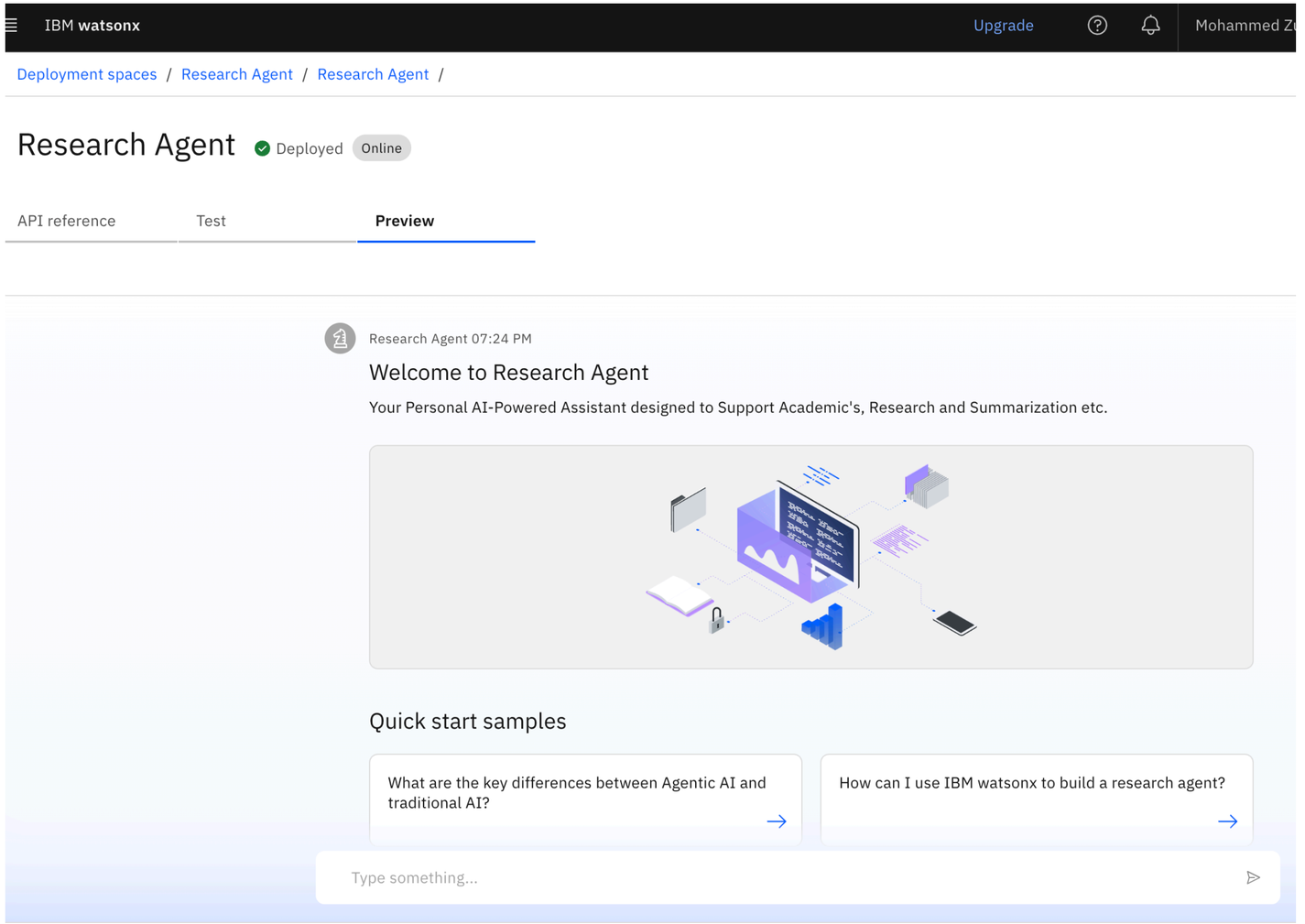
- **Core RAG Functionality :** This is the most important demonstration. The agent is answering a question about a specific document in its knowledge base ("IEEEpaper"). This shows it's not using general knowledge but is retrieving and analyzing the provided text.
- **Quantitative Data Extraction :** The agent successfully extracts specific, quantitative findings from the paper, such as "43% reduction in average coding time" and "sub-100ms latency." This proves its ability to go beyond simple text summarization and pull out key data points.
- **Contextual Accuracy :** The entire response is framed within the context of the document, demonstrating the power of RAG to provide highly relevant and factually grounded answers based on a custom knowledge source.



Results (Deployed)

Deployed Agent Welcome Screen

- **Successful Deployment :** The key takeaway from this image is the "Deployed" and "Online" status indicators at the top. This confirms that the agent has been successfully published as a live AI service on IBM Cloud.
- **Public-Facing Interface :** This screen shows the agent's preview interface from the "Deployment spaces." This is how an end-user or another application would interact with the live agent, separate from the internal build environment.
- **Consistency :** The UI remains consistent with the build preview, offering quick start samples and a clear input method, ensuring a seamless user experience from development to deployment.



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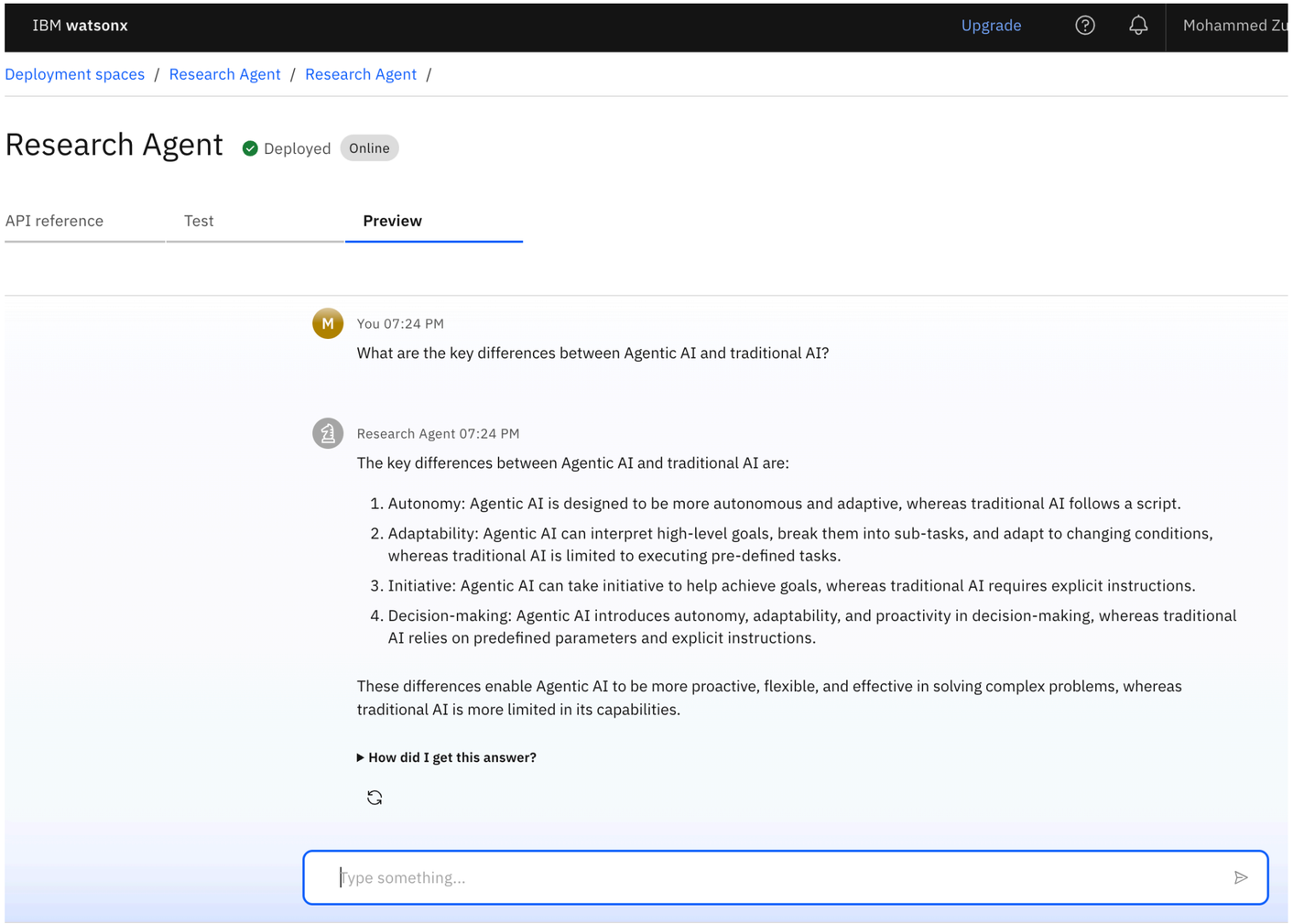
Results (Deployed)

Interacting with the Deployed Agent

- **End-to-End Validation:** This image validates the entire project pipeline. A user is asking a question in the live, deployed interface, and the agent is responding correctly. This proves that the API endpoint is working and the backend service is functioning as expected.
- **Real-time Performance:** The agent provides a structured, detailed answer to the question about "Agentic AI vs. traditional AI." This demonstrates that the deployed service is responsive and can handle complex queries in real-time.
- **Scalability and Accessibility:** Having a deployed agent means it can now be integrated into other applications via its API or shared with other users. It has moved from a development prototype to a functional, accessible cloud service.



Conclusion

- The **AI Research Agent** successfully addresses the challenges of modern research.
- It saves valuable time by **Automating Repetitive tasks like literature searches and data extraction.**
- The AI Agent can **generate reports, suggest hypotheses, and even draft sections of research papers.**
- By leveraging IBM watsonx and the Granite model, this tool enhances **efficiency, accuracy, and innovation** in both academic and industrial R&D settings.

Future scope

- **Voice-Activated Research Assistant :** Implement voice commands for hands-free operation.
- **AI-Assisted Paper Drafting :** Enhance the agent's ability to help write, edit, and format entire research papers.
- **Research Gap Identification :** Develop capabilities to analyze the existing literature and identify novel research gaps.
- **Collaboration Mapping :** Suggest potential co-authors or institutions based on analyzing research interests and publication history.
- **Integration with Publishing Platforms :** Allow for direct submission or formatting for specific journals and publishing platforms.
- **Multilingual Research Support :** Add support for multiple languages to assist a global research community.

IBM Certifications

IBM Certifications

IBM **SkillsBuild** Completion Certificate

This certificate is presented to

Mohammed Zubair A

for the completion of

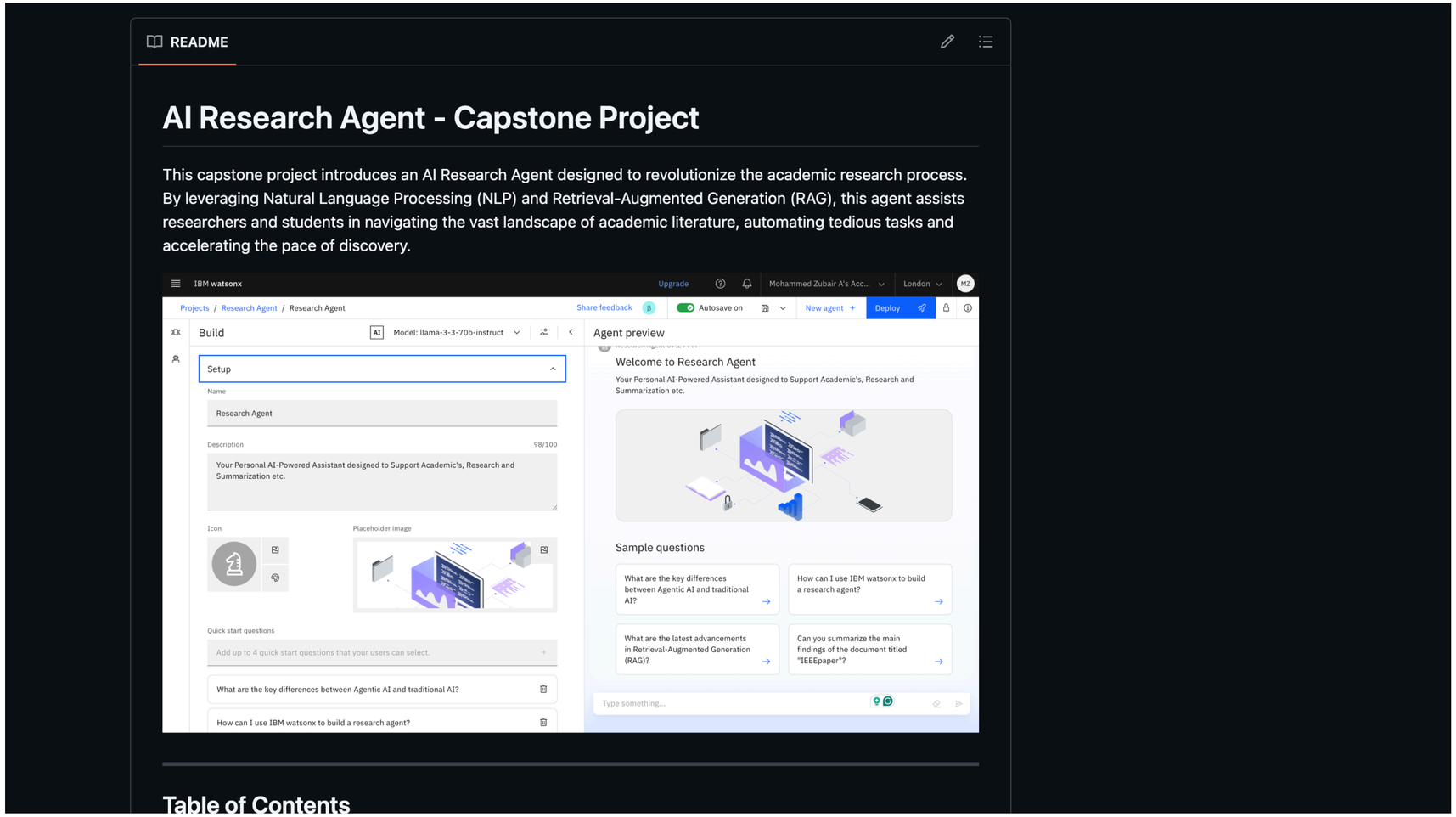
Lab: Retrieval Augmented Generation with LangChain

(ALM-COURSE_3824998)

According to the Adobe Learning Manager system of record

GitHub Link

Github link : https://github.com/Mdzub7/Research-Agent



THANK YOU

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