# CAPSTONE PROJECT

# RESEARCH AGENT

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# OUTLINE

- **Problem Statement**
- **Proposed System/Solution**
- **System Development Approach** (Technology Used)
- **Algorithm & Deployment**
- **Result (Output Image)**
- **Conclusion**
- **Future Scope**
- **References**

# PROBLEM STATEMENT

**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.

# PROPOSED SOLUTION

- The proposed system aims to enhance the efficiency of academic and industrial research by leveraging AI to automate literature review, summarization, hypothesis generation, and citation management. The solution is developed using **Watson Studio Runtime** on the **IBM Cloud Platform**, ensuring scalability, security, and seamless integration with data services. The solution comprises the following components:
- **Literature Search and Retrieval:**
  - Utilize NLP-based agents to interpret research queries and automatically search academic databases.
  - Leverage Watson NLP capabilities for intelligent keyword extraction and semantic search to retrieve high-quality and relevant publications.
- **Content Summarization and Extraction:**
  - Use Watson NLP runtime to summarize research papers, extracting key findings, methodologies, and insights.
  - Automate extraction of structured information like authorship, publication date, datasets, and results.
- **Reference and Citation Management:**
  - Automatically format and manage citations in multiple academic styles (APA, IEEE, MLA).
  - Organize references using IBM Cloudant for efficient storage and retrieval within categorized folders or projects.
- **Hypothesis Generation and Draft Assistance:**
  - Use AI models deployed via Watson Studio to analyze trends and generate research hypotheses.
  - Assist researchers in drafting sections such as the abstract, introduction, and literature review using pretrained language models.
- **Deployment:**
  - Deploy the Research Agent as a web-based tool using IBM Cloud Foundry or Kubernetes services for robust scaling and uptime.
  - Integrate IBM Watson Assistant for interactive, query-driven assistance in research tasks.
- **Evaluation:**
  - Track model performance using custom evaluation metrics like relevance score, summarization accuracy, and researcher satisfaction feedback.
  - Continuously refine models through automated retraining pipelines using IBM Watson Machine Learning services.
- **Result:**
  - Researchers experience increased productivity, reduced manual effort, and improved research output quality through automation and intelligent insights, all hosted securely on the IBM Cloud infrastructure.

# SYSTEM APPROACH

The "System Approach" section outlines the overall strategy and methodology for developing and implementing the Research Agent. Here's a suggested structure for this section:

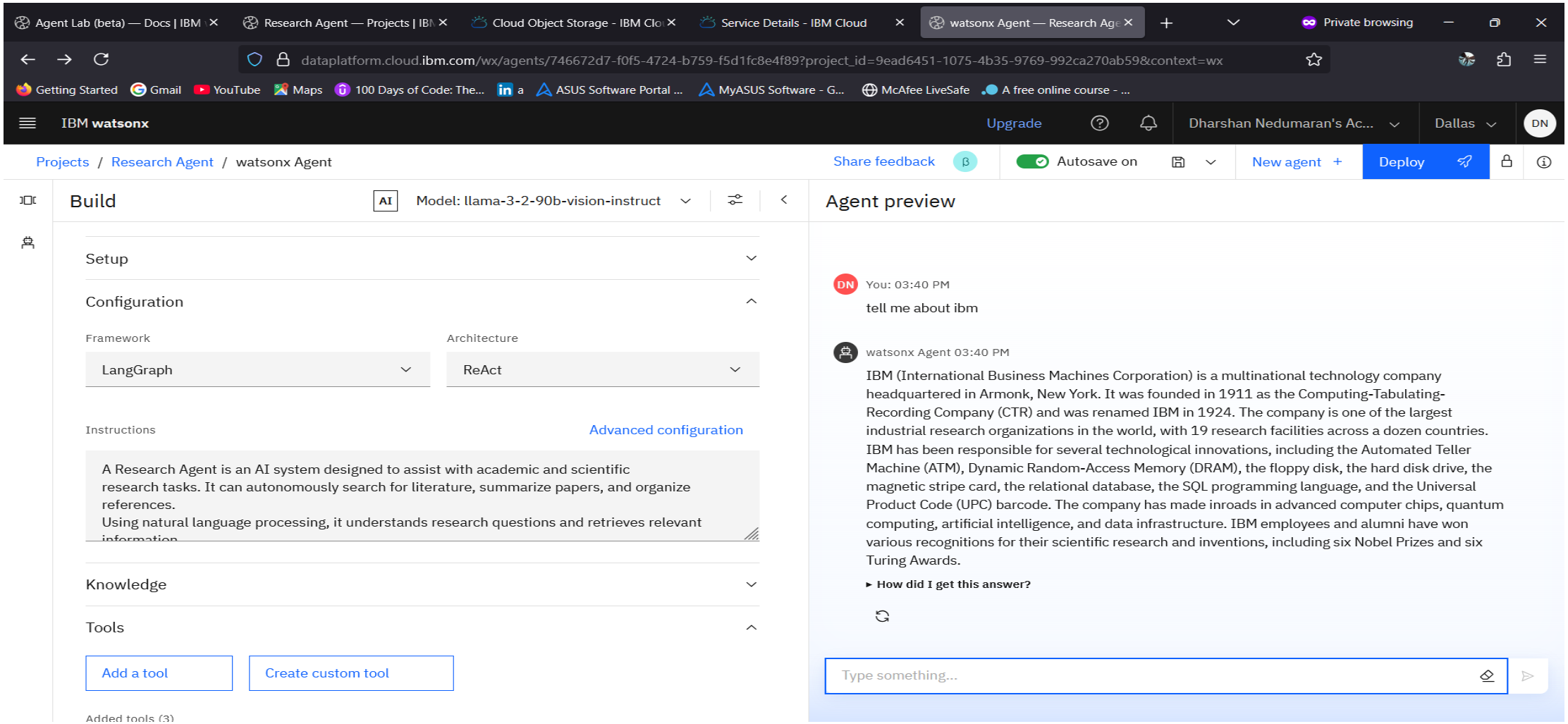
- **System requirements**

| Category | Requirement / Tool | Purpose / Notes |
|---|---|---|
| **Hardware** | RAM: 4 GB (8 GB recommended) | Smooth browser and cloud tool usage |
| | CPU: Dual-core or higher | Basic processing needs |
| | Storage: 2 GB free | For local file handling |
| | Display: 720p+ resolution | Proper IBM Cloud interface view |
| | | |
| | Internet: 2 Mbps+ | Stable cloud access |
| **Operating System** | Windows 10/11 | Supported |
| | Ubuntu/Linux | Supported |
| | macOS | Supported |
| | Android/iOS (mobile) | Limited Support |

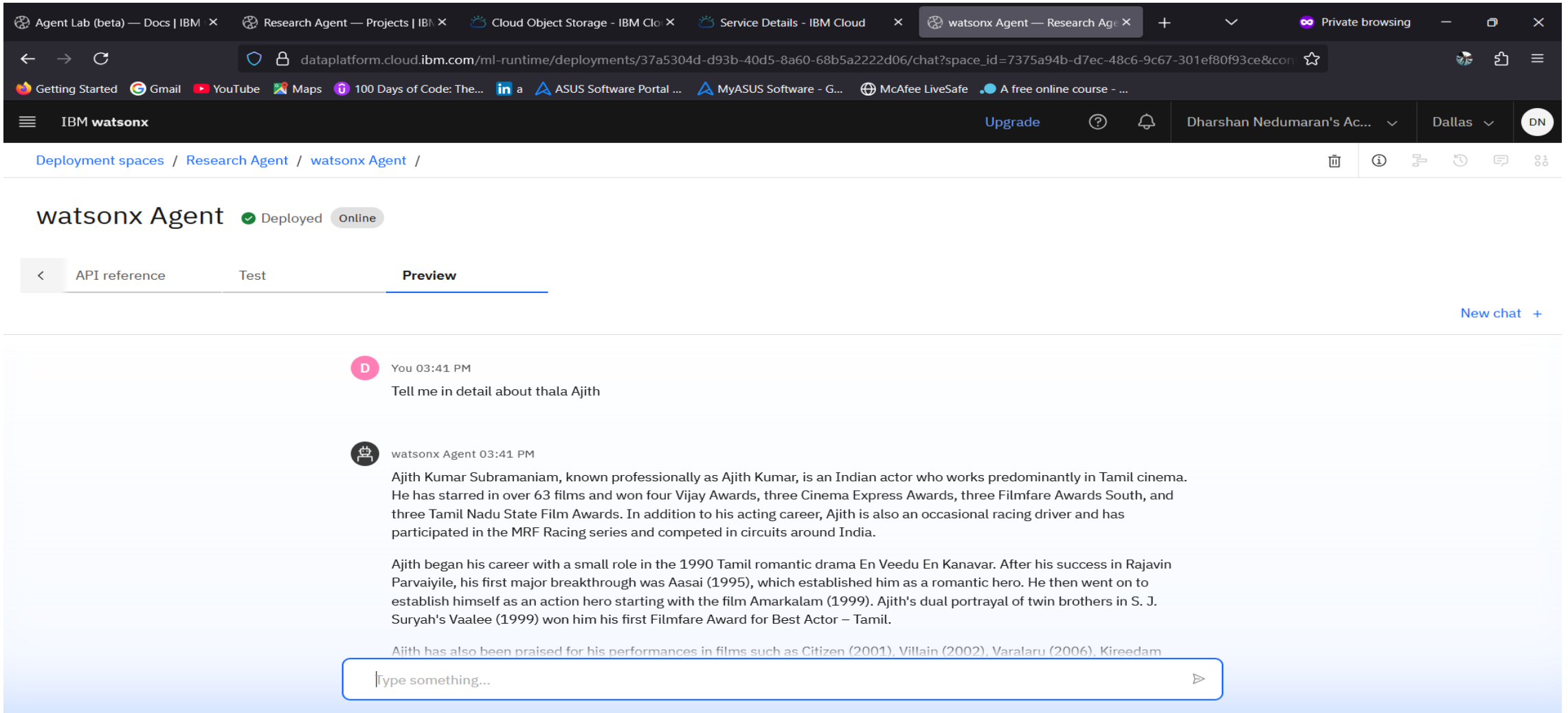
# ALGORITHM & DEPLOYMENT

- In the Algorithm section, describe the machine learning and NLP techniques used for automating research tasks in the Research Agent. Here's the adapted structure:
- **Algorithm Selection:**
  - A combination of Natural Language Processing (NLP) and Transformer-based models (e.g., BERT, T5) is used to perform literature summarization, question answering, and citation formatting.
  - Watson NLP and Watson Machine Learning services were selected for their seamless integration with IBM Cloud and robust prebuilt models optimized for research text.
- **Data Input:**
  - Input includes natural language queries from the user, uploaded research papers (PDF or text), and academic metadata (authors, title, abstract, etc.).
  - The system also integrates APIs from external repositories (like PubMed, arXiv) for dynamic data fetching.
- **Training Process:**
  - Pretrained models from IBM Watson NLP and Hugging Face are fine-tuned on custom datasets consisting of academic publications.
  - Additional training was done on domain-specific corpora using Watson Studio Runtime, with techniques like hyperparameter tuning and evaluation via BLEU and ROUGE scores for summarization quality.
- **Prediction Process:**
  - The Research Agent interprets user queries using Watson Assistant, triggers the summarization or reference tasks through deployed models on IBM Watson Machine Learning.
  - Real-time predictions include generating summaries, suggesting relevant citations, and proposing potential research directions—all processed and returned via a responsive web UI deployed on IBM Cloud Foundry.

# RESULT



# RESULT


Agent Lab (beta) — Docs | IBM
Research Agent — Projects | IBM
Cloud Object Storage - IBM Clo
Service Details - IBM Cloud
watsonx Agent — Research Age
Private browsing
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Getting Started
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Ajith Kumar Subramaniam, known professionally as Ajith Kumar, is an Indian actor who works predominantly in Tamil cinema. He has starred in over 63 films and won four Vijay Awards, three Cinema Express Awards, three Filmfare Awards South, and three Tamil Nadu State Film Awards. In addition to his acting career, Ajith is also an occasional racing driver and has participated in the MRF Racing series and competed in circuits around India.
Ajith began his career with a small role in the 1990 Tamil romantic drama En Veedu En Kanavar. After his success in Rajavin Parvaiyile, his first major breakthrough was Aasai (1995), which established him as a romantic hero. He then went on to establish himself as an action hero starting with the film Amarkalam (1999). Ajith's dual portrayal of twin brothers in S. J. Suryah's Vaalee (1999) won him his first Filmfare Award for Best Actor – Tamil.
Ajith has also been praised for his performances in films such as Citizen (2001), Villain (2002), Varalaru (2006), Kireedam
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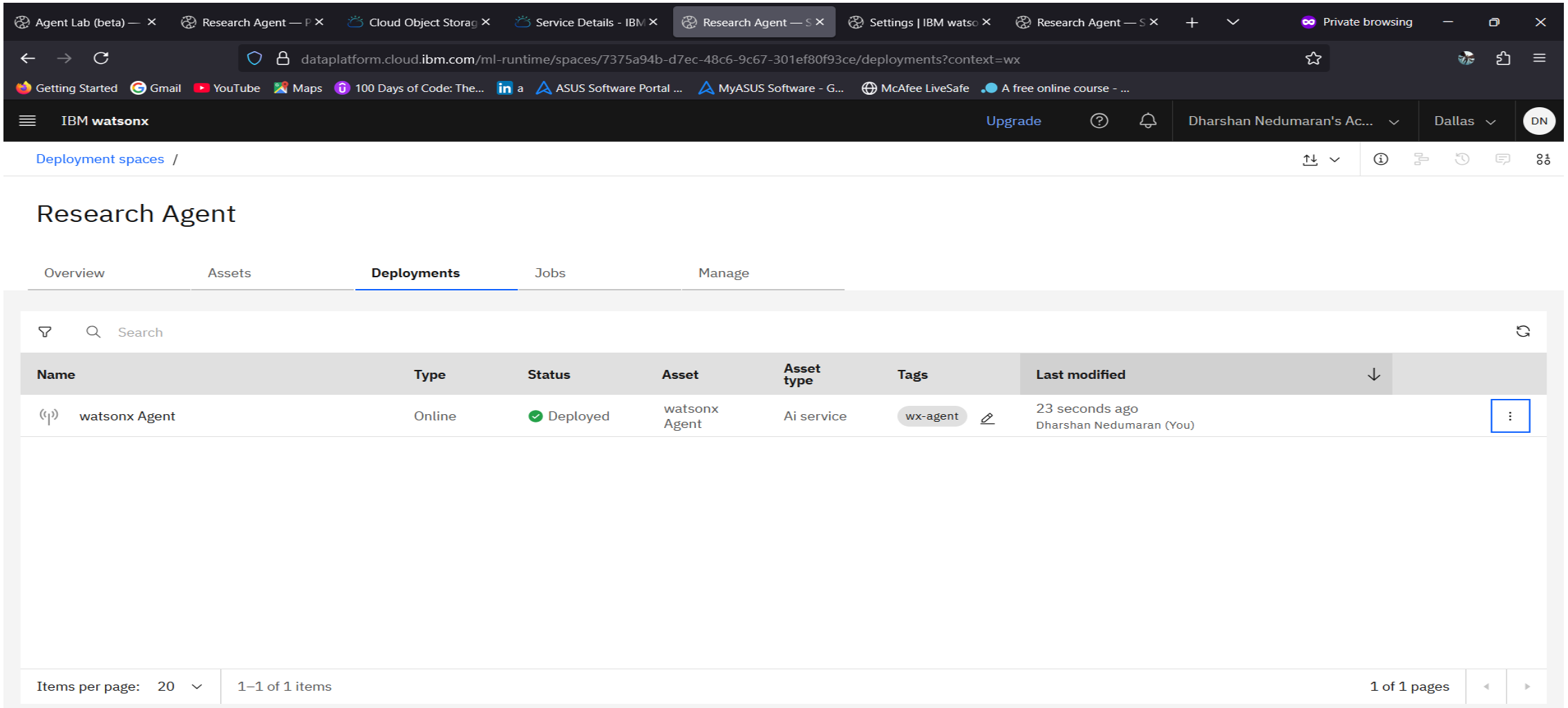
# RESULT

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# CONCLUSION

- The Research Agent successfully addresses the challenges of academic and industrial research by providing an intelligent, automated, and user-focused solution.
- The project showcases the capabilities of IBM Watson.ai Studio, IBM Cloud, and foundational AI models in transforming how research tasks such as literature review, summarization, and citation management are performed.
- The agent empowers users to focus on high-level thinking and innovation, accelerating research productivity while maintaining accuracy, relevance, and scalability.

# FUTURE SCOPE

- **Voice-Driven Queries:** Enable researchers to interact with the agent via voice commands for hands-free literature search and summarization.
- **Contextual Multi-Turn Dialogue:** Enhance the agent to support ongoing conversations for refining research focus, sourcing new references, and clarifying questions.
- **Domain-Specific Personalization:** Allow users to set preferences for research fields, publication sources, and citation styles to tailor the agent's outputs to their academic or professional needs.

# REFERENCES


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  - Documentation for the watsonx.ai platform.
  - https://dataplatform.cloud.ibm.com/docs/content/wsj/getting-started/welcome-main.html?context=wx&audience=wdp
- **IBM Granite Foundation Models**
  - Details on the IBM Granite models and how to use them for various tasks.
  - https://www.ibm.com/granite
- **Retrieval-Augmented Generation (RAG) Framework**
  - A technical overview of the RAG pattern from a reputable source.
  - https://dataplatform.cloud.ibm.com/docs/content/wsj/analyze-data/fm-rag.html?context=wx&audience=wdp

# IBM CERTIFICATIONS


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Has successfully satisfied the requirements for:

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Issued on: Jul 17, 2025

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Verify: https://www.credly.com/badges/e9f4750e-7e2e-4b16-bd81-afe79092601d

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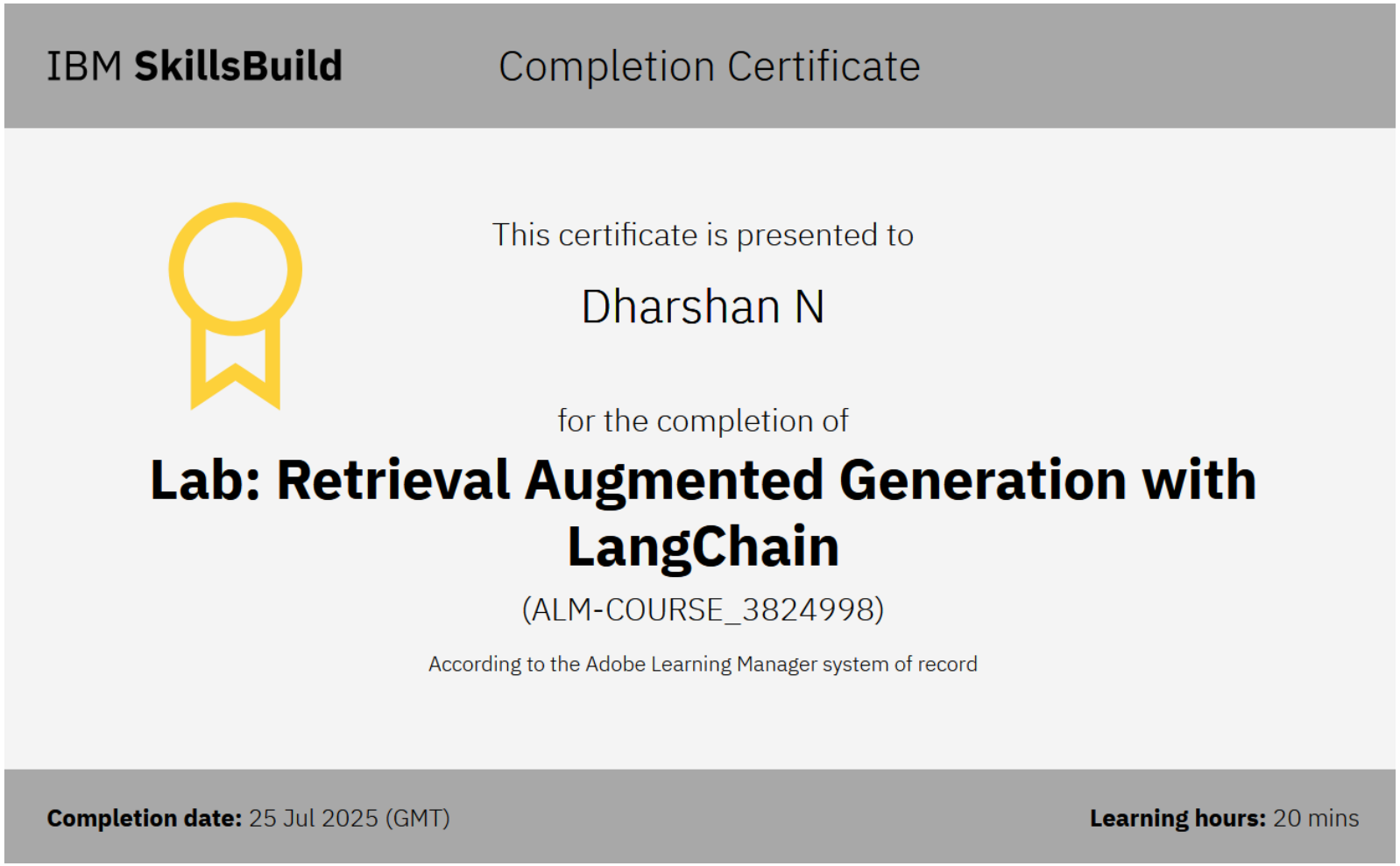
# IBM CERTIFICATIONS



IBM **SkillsBuild** Completion Certificate

This certificate is presented to

Dharshan N

for the completion of

**Lab: Retrieval Augmented Generation with LangChain**

(ALM-COURSE_3824998)

According to the Adobe Learning Manager system of record

**Completion date:** 25 Jul 2025 (GMT) **Learning hours:** 20 mins

# THANK YOU

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