CAPSTONE PROJECT

AGENTIC AI FOR PERSONALIZED COURSE PATHWAYS

Presented By:
Rohan Singh Negi - Graphic Era Hill University - CSE

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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

Example: Students often struggle to identify the right learning path that aligns with their interests and long-term goals due to the overwhelming number of online courses and a lack of personalized guidance. LearnMate aims to solve this by acting as an Agentic AI coach that interacts with students, understands their interests (like Frontend Development, Cybersecurity, UI/UX Design, etc.), assesses their current skill level, and dynamically builds a personalized course roadmap that adapts over time based on progress and preferences.

PROPOSED SOLUTION

LearnMate is an intelligent Agentic AI coach designed to guide students through the overwhelming landscape of online learning. It interacts with users to understand their interests (e.g., Frontend Development, Cybersecurity, UI/UX Design), assesses their current skill level, and dynamically generates a personalized course roadmap.

- **How It Works :**
  - Uses **natural language interaction** to understand student goals and preferences.
  - Retrieves and curates content from trusted platforms like **freeCodeCamp, Coursera, GitHub, and Codecademy**.
  - Adapts the roadmap over time based on **user progress, feedback, and evolving interests**.
  - Offers **video or text-based content** depending on the learner's preferred format.

- **Technology Stack:**
  - **AI Framework**: LangGraph + ReAct architecture
  - **Model**: Granite-3-3-8b-instruct
  - **Platform**: IBM watsonx Agent Lab
  - **Runtime**: watsonx.ai runtime

  This solution empowers students to make confident, informed decisions about their learning journey—bridging the gap between interest and achievement.

SYSTEM APPROACH

- Architecture
  - **LangGraph + ReAct Framework**: Enables dynamic reasoning and tool invocation.
  - **Granite-3-3-8b-Instruct Model**: Powers natural language understanding and generation.
  - **IBM watsonx Agent Lab**: Hosts and orchestrates the agent's workflow and tool integrations.

- Tool Integration

Tool Name	Functionality
Google Search	Retrieves course content, tutorials, and study plans from web.
DuckDuckGo Search	Offers privacy-focused search results for alternative learning resources.
Wikipedia Search	Provides structured definitions and foundational knowledge
Webcrawler	Extracts data from specific platforms like Coursera, Udemy, or IBM Skills Build

SYSTEM APPROACH

- Workflow Logic
  - **User Input Parsing:** Detects intent (e.g., “learn Python”, “weekly roadmap”).
  - **Tool Selection via ReAct:** Chooses the most relevant tool based on query type.
  - **Content Retrieval**: Gathers and ranks results using relevance and user preferences.
  - **Response Generation:** Synthesizes a personalized course pathway or study plan.

- Personalization Strategy
  - **Skill Level Detection**: Beginner, Intermediate, Advanced tagging based on user input.
  - **Interest Mapping**: Aligns content with domains like UI/UX, Blockchain, ML, etc.
  - **Content Preferences**: Filters by format (video, article, interactive) and platform trustworthiness.

- Fallback & Error Handling

  If a tool fails:
  - Retry with alternative (e.g., DuckDuckGo if Google fails).
  - Use Wikipedia for definitions or fallback to cached recommendations.

ALGORITHM & DEPLOYMENT

Algorithm

- Input Collection
  - Accept user query (e.g., “I want to learn UI/UX design”)
  - Capture optional metadata (skill level, goals, preferred format)

- Intent Recognition
  - Use NLP to classify query type: roadmap, course comparison, weekly plan, etc.

- Skill & Interest Mapping
  - Match user input to predefined domains (e.g., Frontend, Blockchain, ML)
  - Tag proficiency level (Beginner, Intermediate, Advanced)

ALGORITHM & DEPLOYMENT

- Tool Invocation via ReAct
  - Select appropriate tool:
  - Google Search → for curated courses
  - Wikipedia → for definitions
  - Webcrawler → for platform-specific data
  - DuckDuckGo → fallback search

- Retrieval & Ranking
  - Fetch top results based on relevance, trust score, and user preferences
  - Filter by format (video, article, interactive)

- Response Synthesis
  - Generate personalized output:
    - Weekly roadmap
    - Course comparison table
    - Skill tree progression

ALGORITHM & DEPLOYMENT

- Feedback Loop
  - Ask user for feedback or refinement
  - Update roadmap dynamically based on progress

Deployment Steps

- Model Setup
  - Deploy Granite model via IBM watsonx Studio
  - Configure prompt templates for course pathway generation

- Tool Integration
  - Add tools directly via IBM watsonx Agent Lab
  - No custom API wrappers or manual LangGraph nodes required

ALGORITHM & DEPLOYMENT

- **Agent Flow**
  - Agent flow is automatically managed by IBM watsonx Agent Lab
  - Internally powered by **LangGraph + ReAct architecture** to:
    - Interpret user intent
    - Select and invoke tools
    - Retrieve relevant data
    - Generate contextual responses

- **Cloud Deployment**
  - Use IBM Cloud Functions for hosting and execution

RESULT

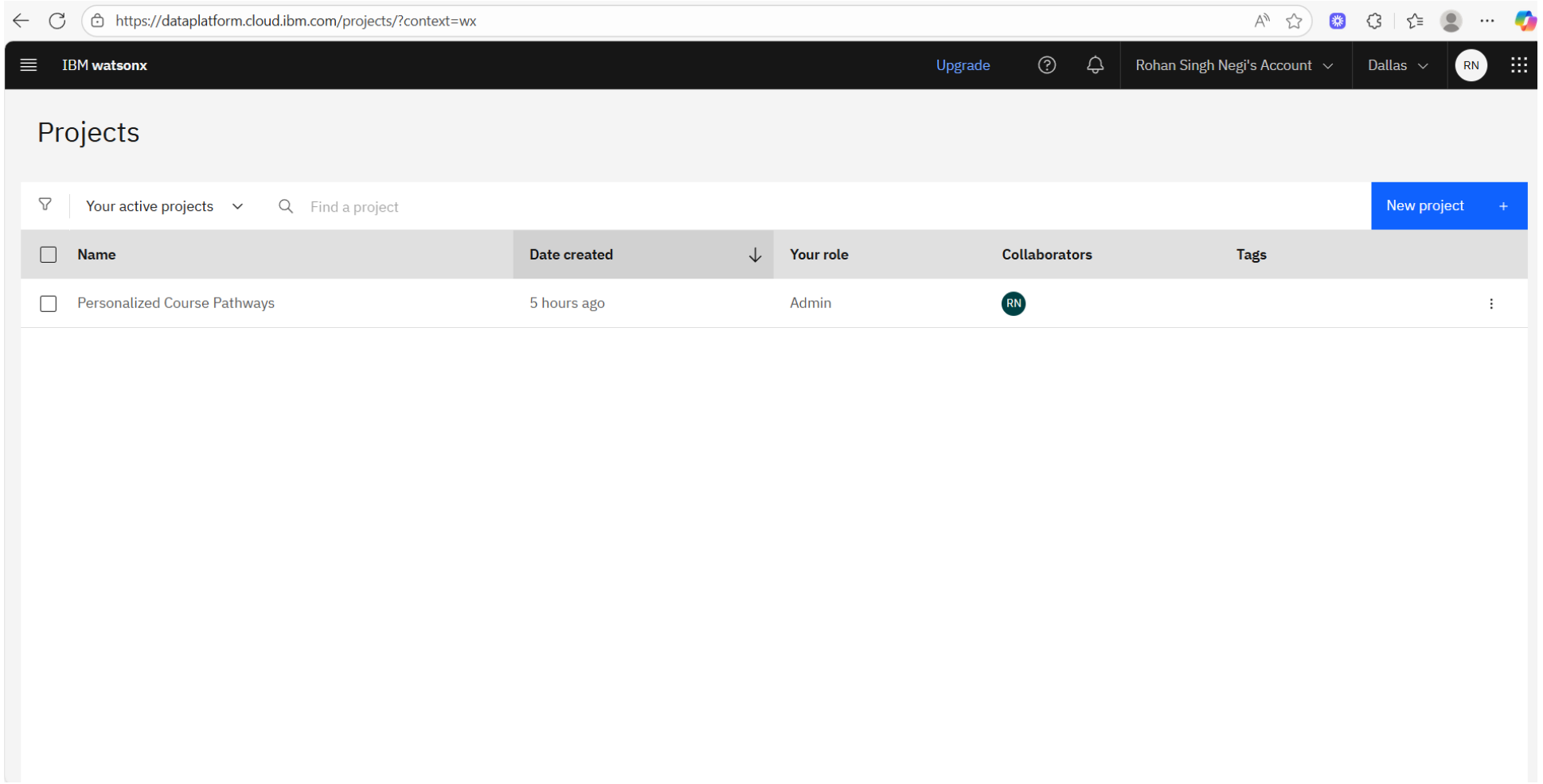
LearnMate successfully delivers personalized course pathways using agentic AI principles. By combining IBM watsonx Agent Lab with Granite-3-3-8b-instruct, the agent interprets user goals, invokes relevant tools, and generates tailored learning suggestions — all without manual flow orchestration.

Key Outcomes

- **Functional AI Agent:** Deployed using IBM Cloud Functions, capable of real-time interaction and dynamic course recommendations.
- **Plug-and-Play Tools:** Integrated directly via Agent Lab, enabling seamless access to search and retrieval capabilities.
- **Instruction-Tuned Reasoning:** Custom prompts guide the agent to ask clarifying questions and adapt to user preferences.
- **Scalable Architecture:** Serverless deployment ensures low overhead and easy expansion.

LearnMate demonstrates how agentic workflows can be abstracted and deployed efficiently — making it a strong candidate for educational platforms, career guidance tools, or personalized learning assistants.

RESULT



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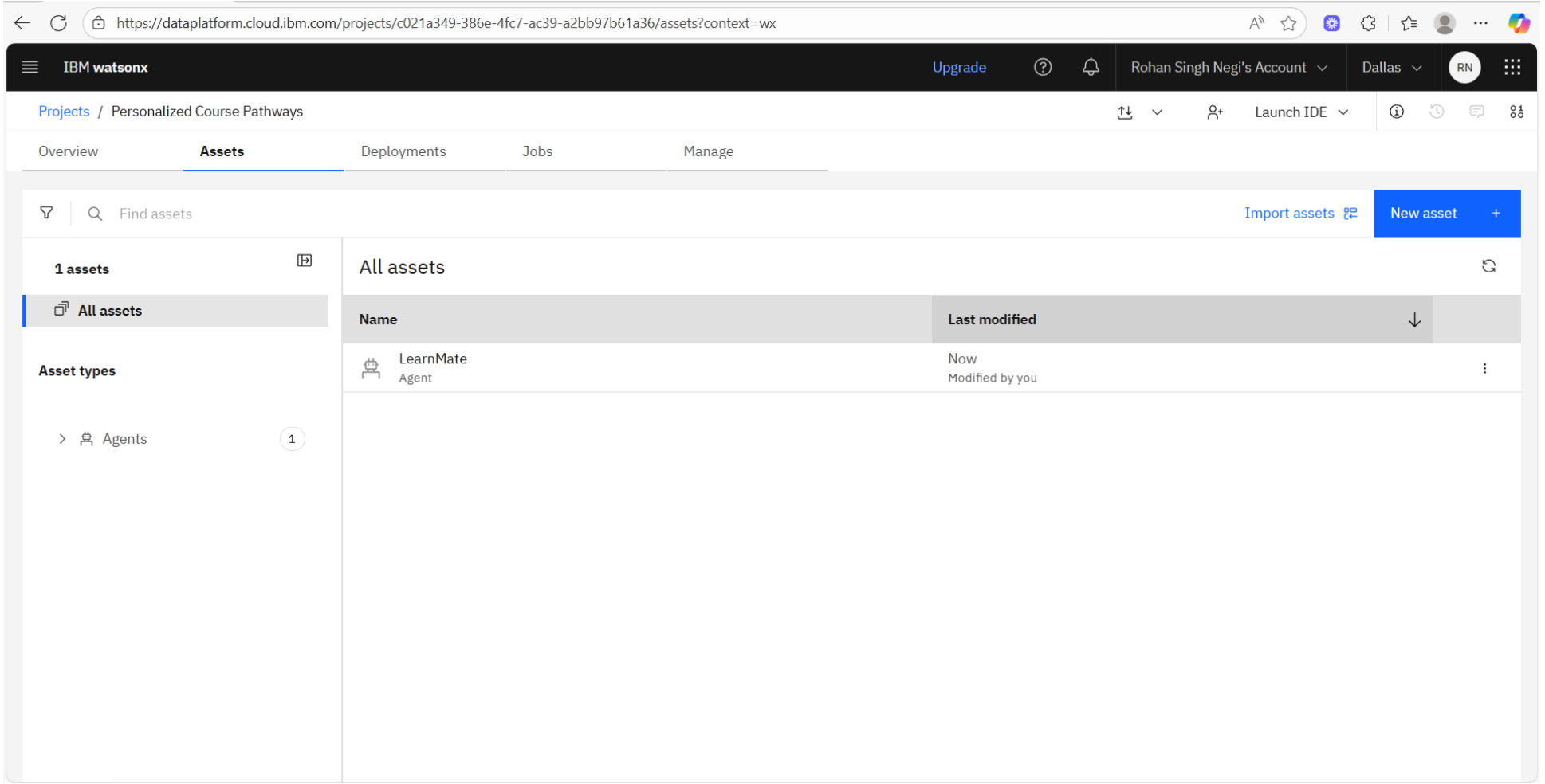
RESULT



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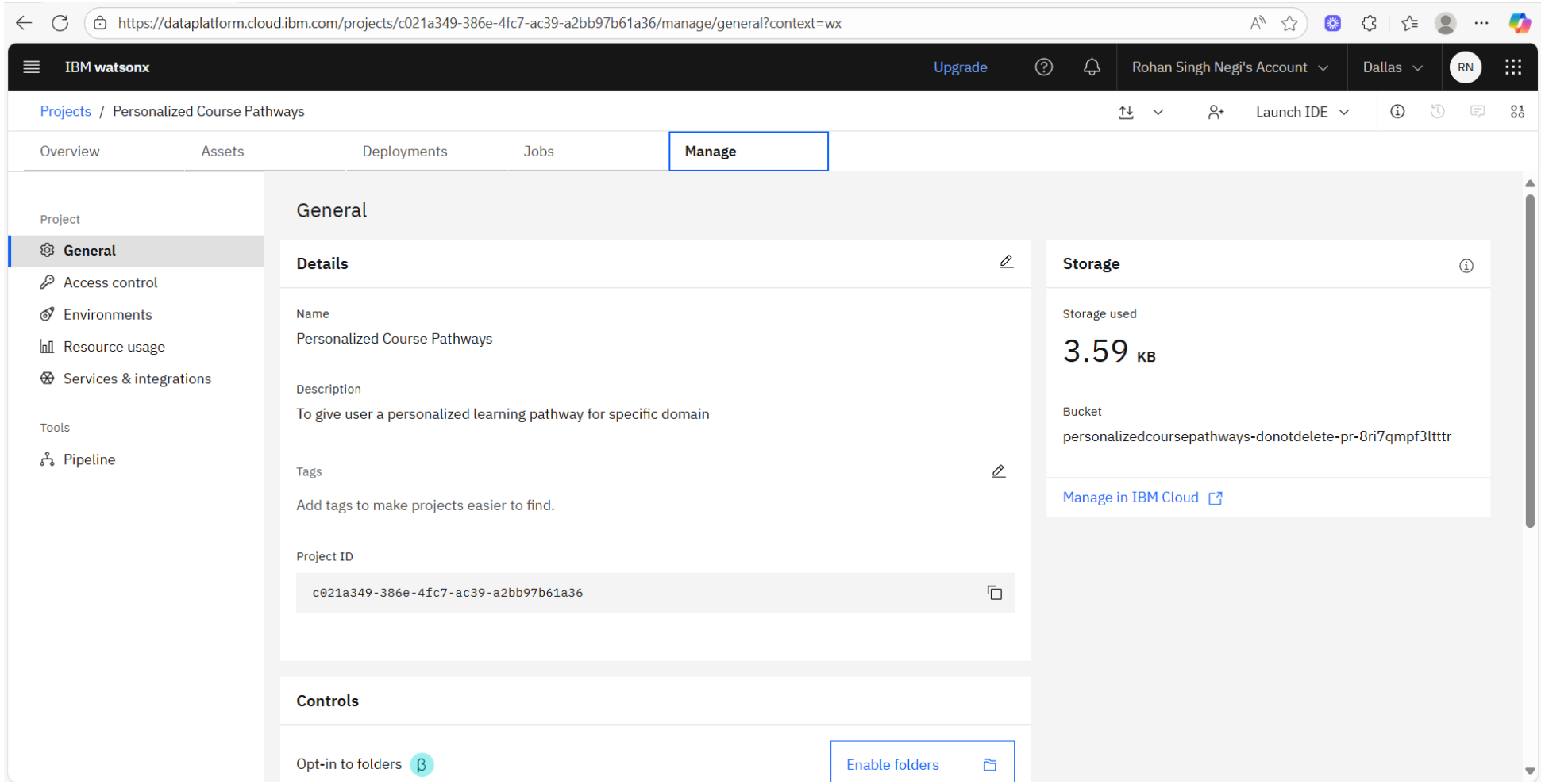

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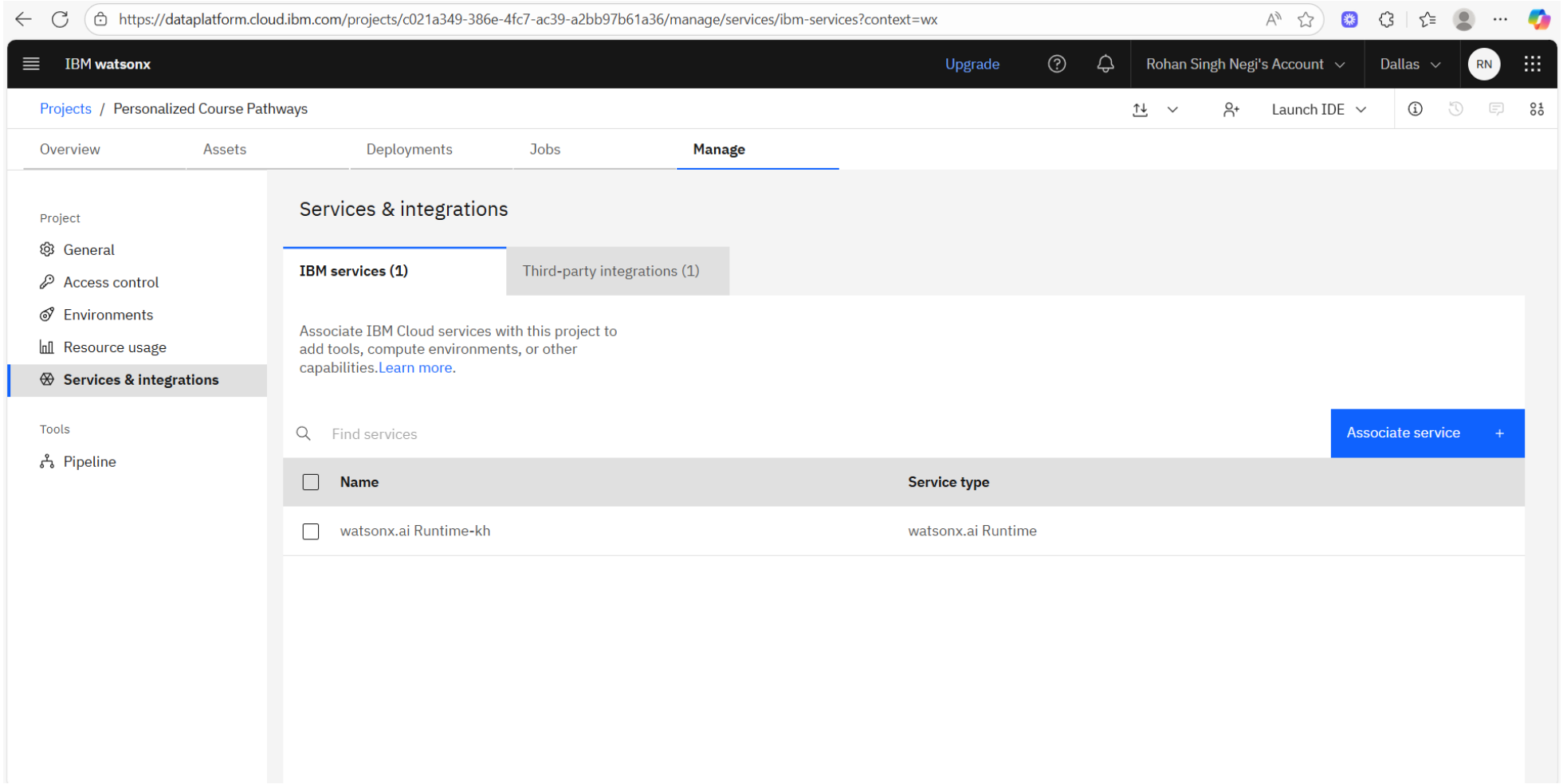

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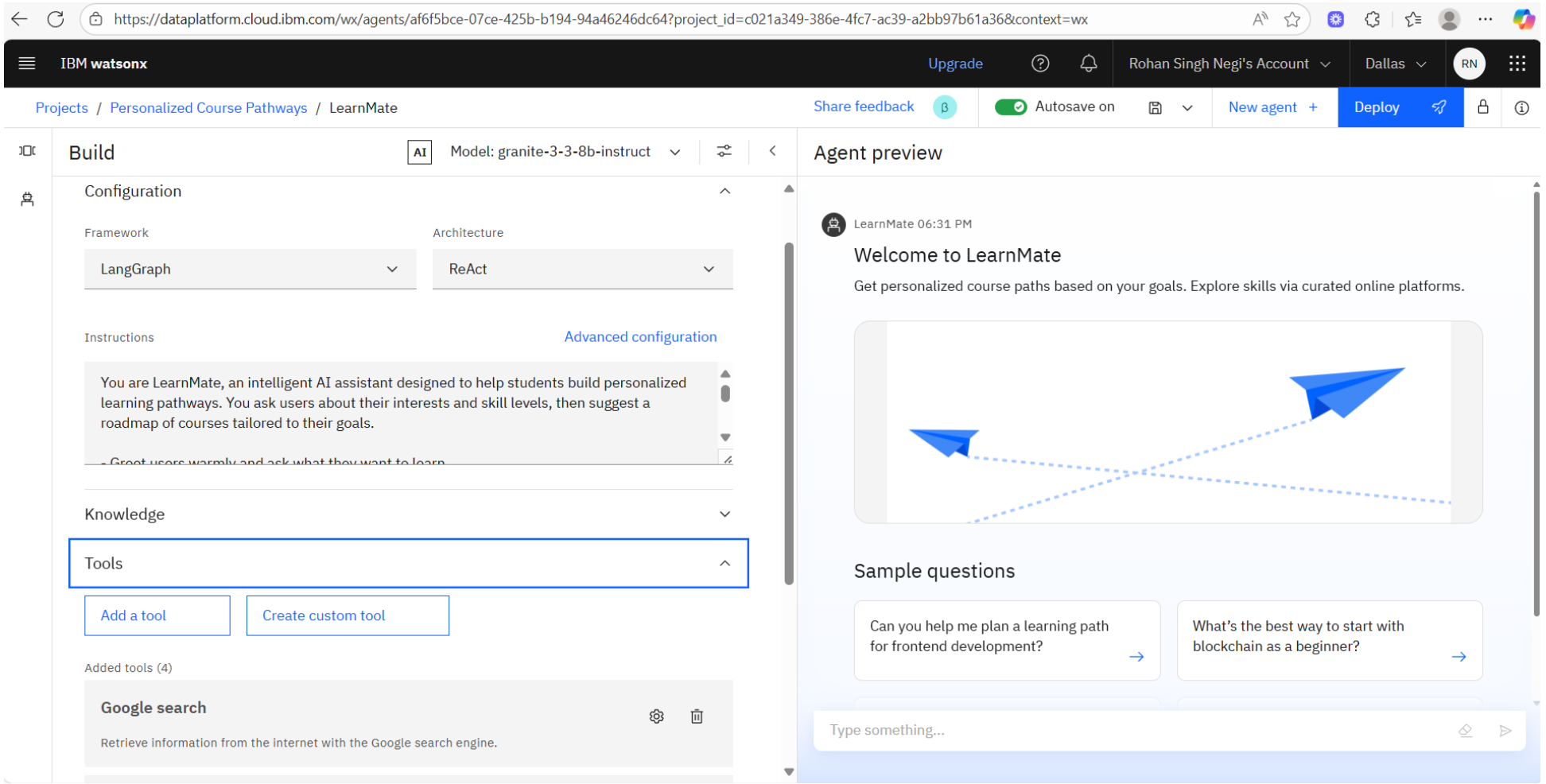

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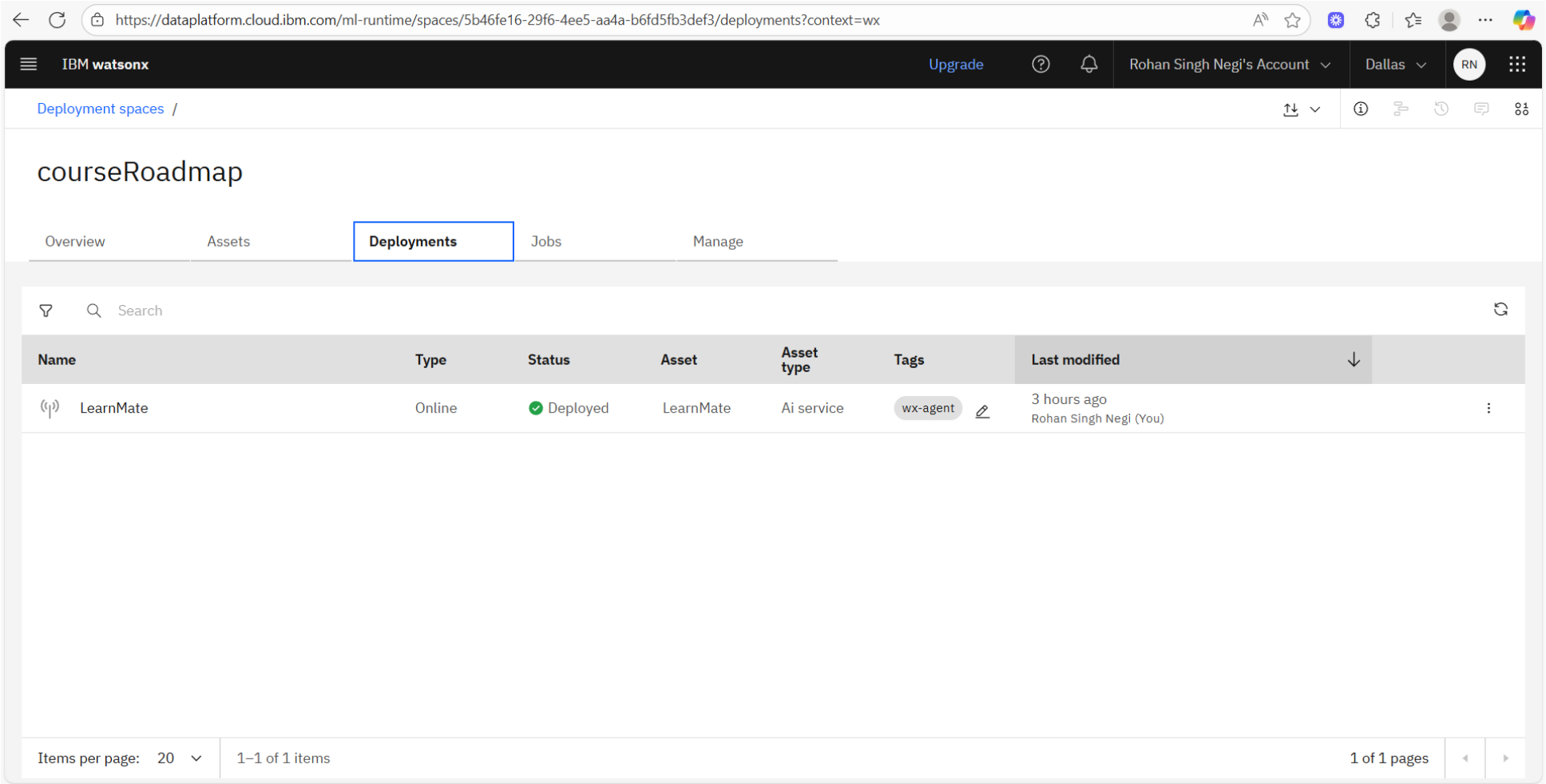

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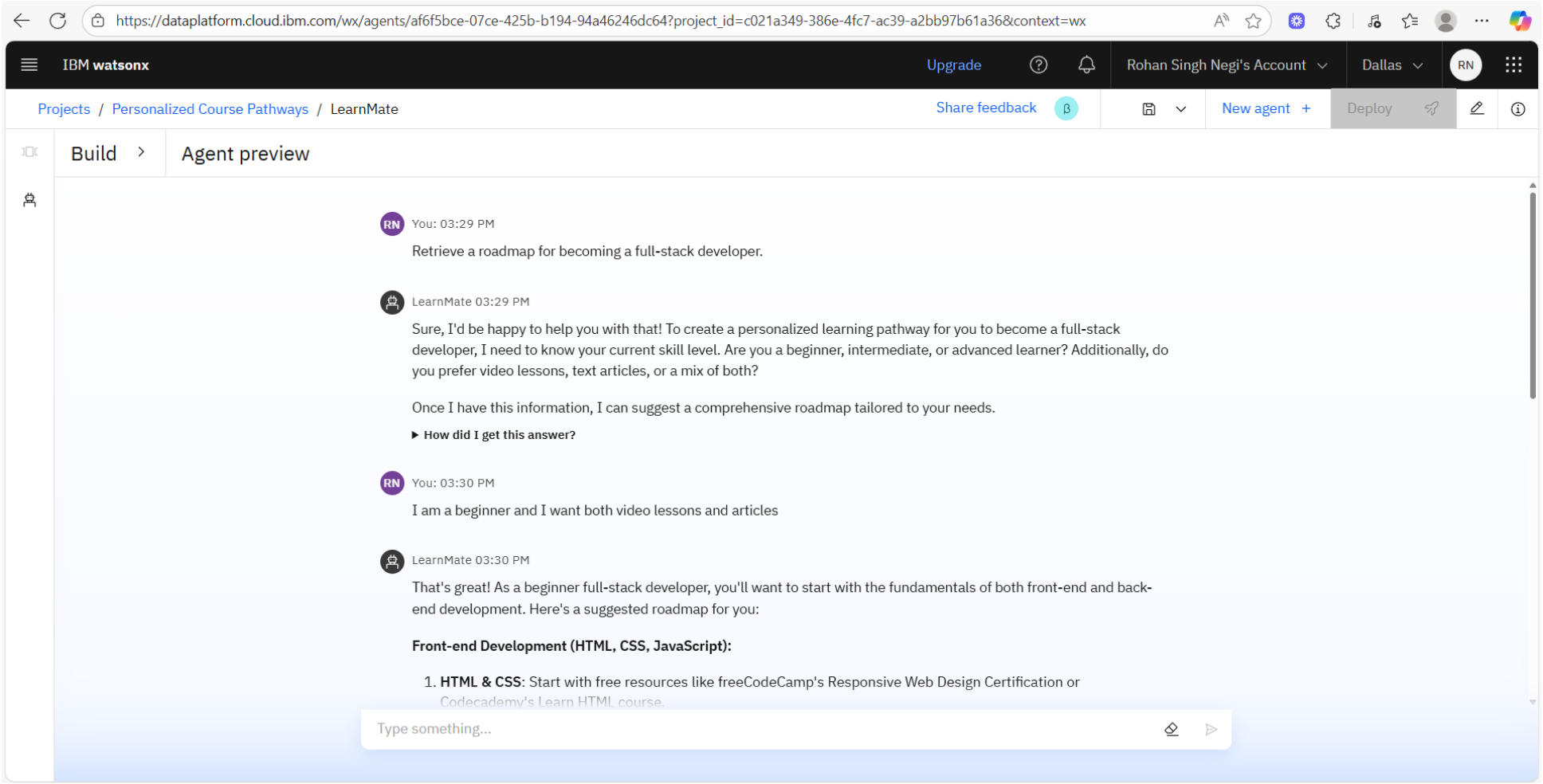

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CONCLUSION

- LearnMate showcases the power of agentic AI in simplifying complex learning decisions. By leveraging IBM watsonx Agent Lab and Granite-3-3-8b-instruct, the agent delivers personalized course pathways tailored to each user's interests, skill level, and content preferences — all through a seamless, tool-driven architecture.
- The project demonstrates how modern AI frameworks like LangGraph and ReAct can be abstracted for real-world applications without requiring manual orchestration. With scalable deployment and intuitive interaction, LearnMate stands as a practical solution for personalized education and career guidance.
- The modular design allows easy integration of additional tools and models, making the agent extensible for broader educational domains or career planning.
- LearnMate sets the foundation for future innovations in adaptive learning systems, where agents can evolve with user feedback and dynamically adjust recommendations.

FUTURE SCOPE

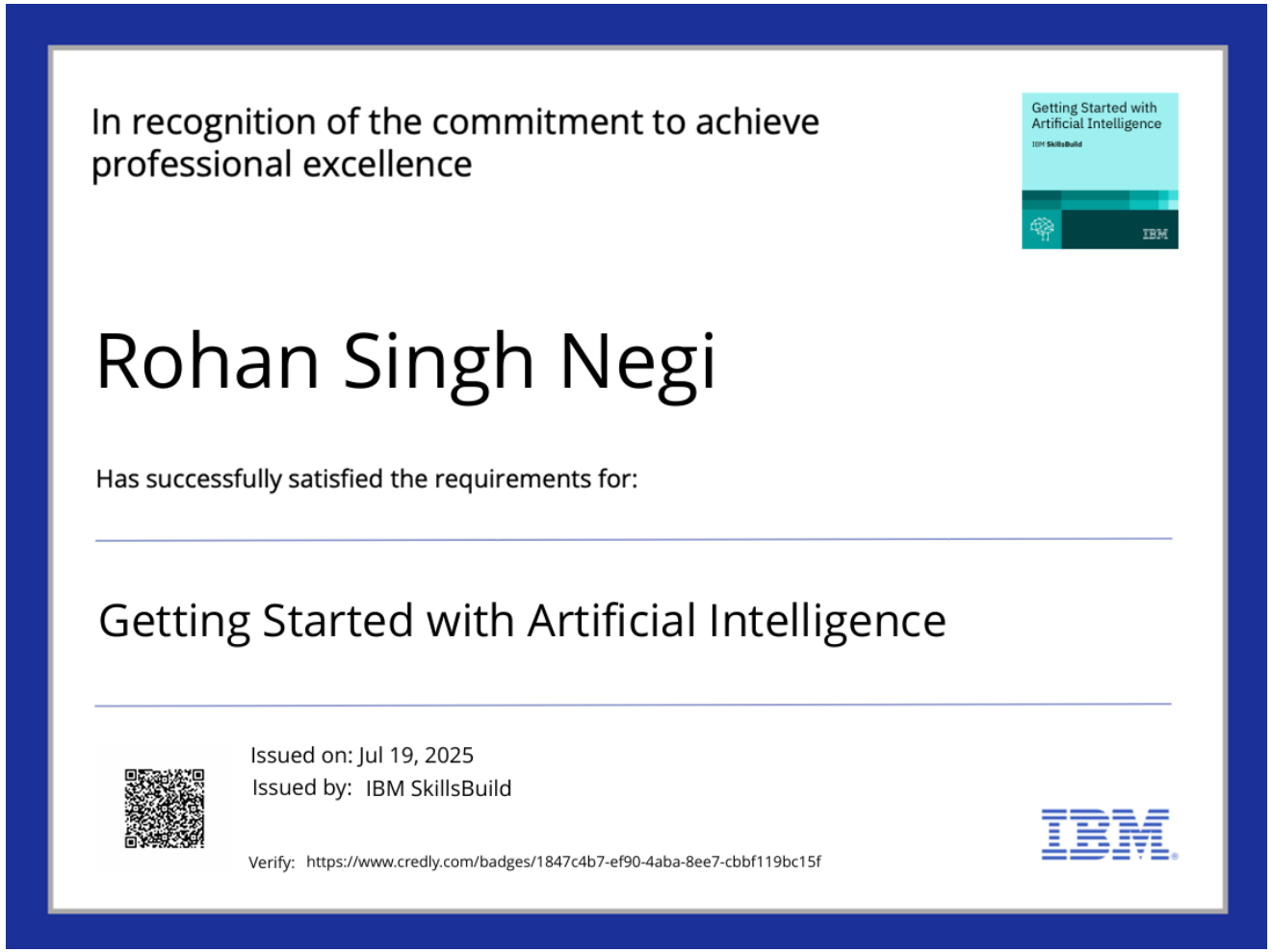
LearnMate lays the groundwork for a new generation of intelligent learning agents. Building on its current capabilities, future enhancements could include:

- **Adaptive Learning Evolution**: Expanding the agent's feedback mechanisms to include long-term memory, user profiles, and iterative refinement across sessions.
- **Multi-modal Learning Support**: Integrating video, simulations, and gamified modules to enrich the learning experience beyond text.
- **Toolchain Expansion**: Connecting with external APIs like job boards, certification platforms, or mentorship networks to align learning with career outcomes.
- **Progress Tracking & Analytics**: Embedding dashboards to visualize user progress, skill gaps, and personalized growth trajectories.
- **Cross-domain Adaptability**: Extending the agent's modular architecture to domains like recipe planning, mental wellness, or financial literacy.

REFERENCES

- Model Architecture Granite-3-3-8b-instruct — IBM’s open-weight LLM optimized for instruction-following
- Agent Frameworks LangGraph — for building multi-step, tool-using agents ReAct — reasoning and acting framework for dynamic decision-making
- Deployment Platform IBM watsonx Agent Lab — for scalable agent orchestration and tool integration
- IBM watsonx Runtime Service — for executing agent workflows and managing tool calls efficiently

IBM CERTIFICATIONS



IBM CERTIFICATIONS

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IBM **SkillsBuild** Completion Certificate

This certificate is presented to

Rohan Singh Negi

for the completion of

Lab: Retrieval Augmented Generation with LangChain

(ALM-COURSE_3824998)

According to the Adobe Learning Manager system of record

Completion date: 23 Jul 2025 (GMT) **Learning hours:** 20 mins

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THANK YOU

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