
CAPSTONE PROJECT

Machine Fault Diagnosis Agent

Presented By:
Avirup Biswas(Narula Institute of Technology – CSE department)

OUTLINE

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

Problem Statement

- An AI agent helps detect faults in machines like lathes, mills, or pumps based on vibrations, temperature, or unusual noises. It can answer: "Why is my CNC machine vibrating too much?" or "What could cause overheating in a hydraulic pump?". It suggests basic maintenance actions and safety precautions.

Proposed Solution

- The proposed AI agent helps detect faults in machines like lathes, mills, or pumps based on vibrations, temperature, or unusual noises. This system use agentic ai approach to give answers to our prompts. The solution will consist of the following components:
- **Data Collection:**
 - Sensors on the machinery (like lathes, mills, or pumps) collect real-time data on key indicators such as vibration, temperature, and noise.
 - Gave a initial prompt or direction to our agentic ai to identify the desired prompt.
- **Artificial Intelligence Model:**
 - Used IBM's "Granite-3-3-8b-instruct" model. An AI model to detect patterns and anomalies that are early signs of a potential fault.
- **Deployment:**
 - Deployed on IBM cloud, can use the public and private endpoint and preview to use the model.
- **Evaluation:**
 - This project addresses a critical need in industrial maintenance by enabling early fault detection in machinery using AI. Leveraging IBM Granite AI for natural language understanding makes the system user-friendly, while integration with sensor data ensures real-time diagnosis. The use of IBM Cloud Lite ensures scalability and accessibility.

System Approach

The proposed system follows a layered architecture that integrates sensor-based monitoring, intelligent fault analysis, and natural language interaction. It combines real-time machine data with AI-driven reasoning to diagnose faults and provide actionable maintenance suggestions. The entire system is deployed on IBM Cloud Lite using the IBM Granite AI model for seamless, scalable, and intelligent operations.

- **System requirements:**

- Used DELL Inspiron with 16GB RAM with 250GB SSD and 1TB HDD.
- Used windows 10 Operating System and Microsoft Edge browser.

- **Library required to build the model:**

- Used IBM lite services.
- Used IBM granite-3-3-8b-instruct model for AI services and watsonx ai runtime.
- Used IBM storage services for storage purpose

Result

Agent Lab (beta) — Docs | IBM watsonxNew project | IBM watsonxCloud Object Storage — Services

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IBM watsonx

Avirup Biswas's AccountDallasAB

Services catalog /

Cloud Object Storage

Author: IBM • Date of last update: Apr 15, 2025 • Docs • API Docs

CreateAbout

Pricing plan

Displayed prices do not include tax. Monthly prices shown are for country or region: United States

Plan	Features	Pricing
One-Rate	One-Rate Plan is a Pay-as-You-Go option with a single, flat monthly rate (\$/GB) that includes storage, API operations, retrieval, and outbound bandwidth—making it ideal for high-activity workloads with frequent access and data transfer, such as analytics, media, and web apps. The plan includes built-in allowances that scale with stored capacity and offers automatic volume discounts as usage grows	
Lite(deprecated)	<div>Lite plan instance is free to use for Storage capacity up to 25 GB per month. Lite plan instance is used for trial, and can be easily upgraded to Standard plan for unlimited scalability and full functionality.</div> <div>None</div> <div>Lite plan services are deleted after 30 days of inactivity.</div>	Free
Standard	Standard Plan is a flexible Pay-as-You-Go option with no minimum fee—ideal for workloads with large storage needs but low or infrequent access and outbound traffic. It includes a Free Tier with 5GB of	

Summary

Cloud Object Storage

Region: Global

Plan: Lite(deprecated)

Service name: Cloud Object Storage-af

Resource group: Default

Create

View terms

Cancel

Result

Agent Lab (beta) — Docs | IBM watsonxMachine Fault Diagnosis Agent

https://dataplatform.cloud.ibm.com/projects/5c2ae148-c188-4bb7-a072-64fe6d45a162/manage/services?context=wx&associate=true

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Projects / Machine Fault Diagnosis Agent

OverviewAssociate service

Project

Tools

P

watsonx.ai Runtime

Author: IBM • Date of last update: Jul 23, 2025 • Docs • API Docs

CreateAbout

Select a region

Select a region

Dallas

Pricing plan

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Plan	Features	Pricing
Lite	Service instance Instance includes: <ul style="list-style-type: none">• 20 capacity unit-hours (CUH) per month• 50,000 tokens/data points per month• 100 pages per month	Free

Summary

watsonx.ai Runtime

Region: Dallas

Plan: Lite

Service name: watsonx.ai Runtime-cn

Resource group: Default

Create

View terms

Cancel

Result

Agent Lab (beta) — Docs | IBM watsonx

Agent Lab — Machine Fault Diag

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Projects / Machine Fault Diagnosis Agent / Agent Lab

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Build

AI Model: granite-3-3-8b-instruct

Setup

Configuration

Framework LangGraph Architecture ReAct

Instructions

You are an AI agent ,a specialized system designed to act as an expert diagnostic assistant for machine operators and maintenance personnel. Its primary purpose is to diagnose and provide solutions for faults in industrial machinery, including but not limited to CNC lathes, mills, and hydraulic pumps. It bases its analysis on interpreting sensor data such as vibration patterns, temperature fluctuations, and unusual

Knowledge

Tools

Add a tool Create custom tool

Added tools (4)

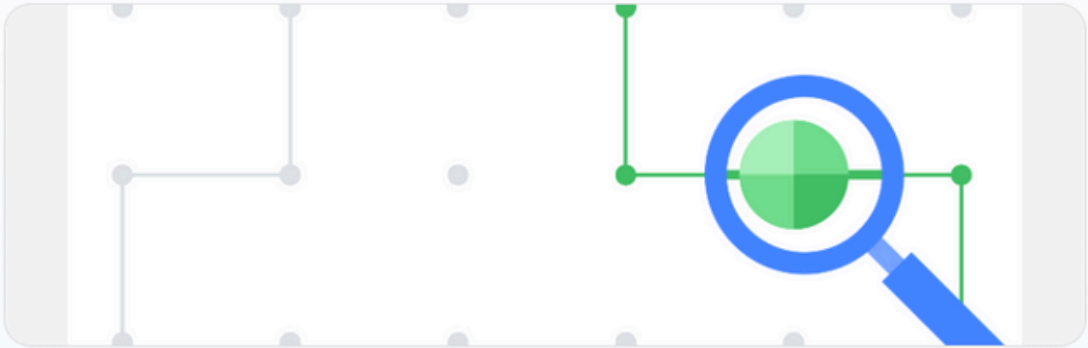
Google search

Agent preview

Avirup's Agent 12:48 AM

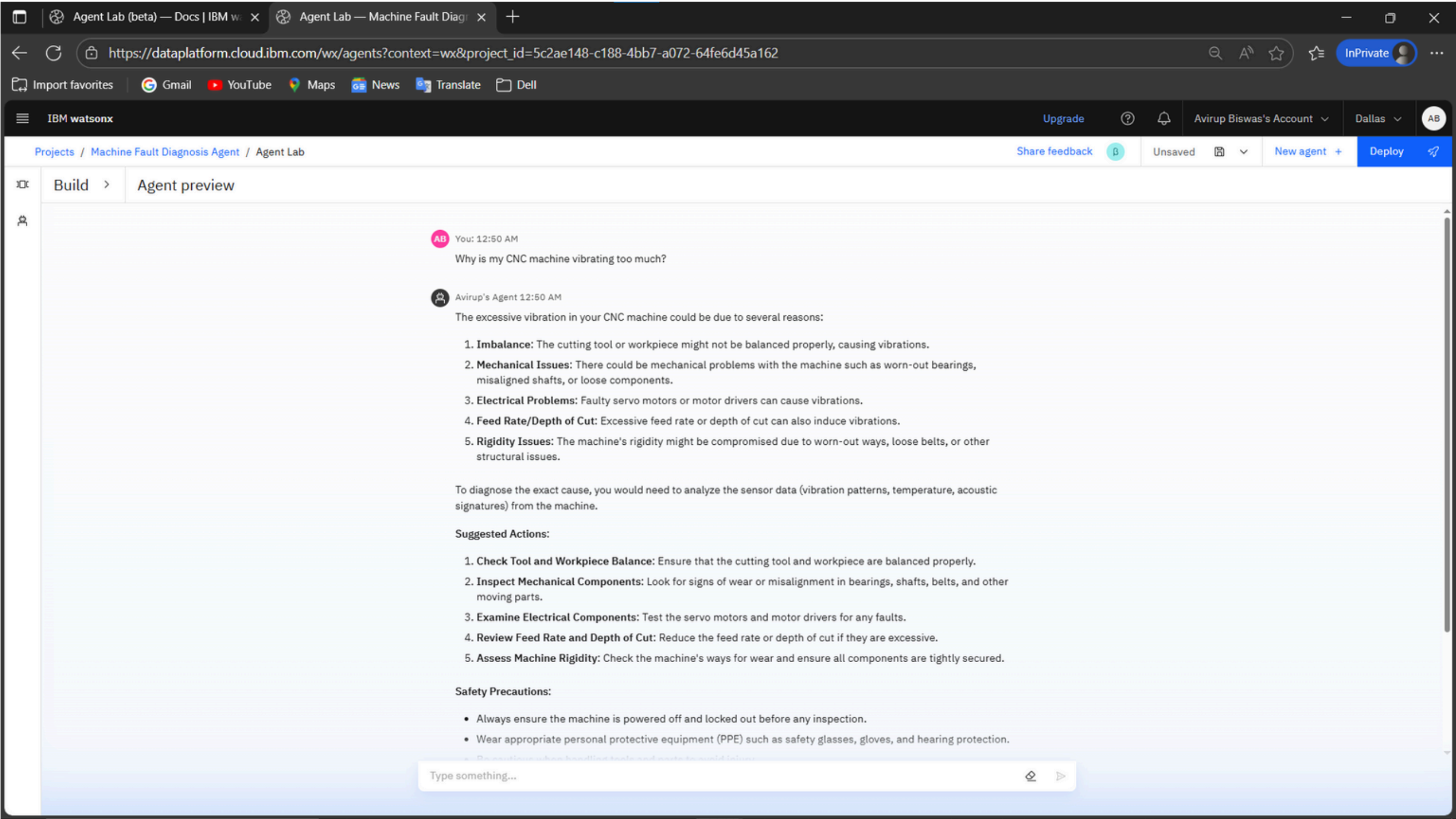
Welcome to Avirup's Agent

Hello! this is your personal AI assistance which can help you any problem with your machineries.



Type something...

Result



Result

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Agent Lab — Machine Fault Diag

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https://dataplatform.cloud.ibm.com/wx/agents?context=wx&project_id=5c2ae148-c188-4bb7-a072-64fe6d45a162

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New agent +

Deploy

Build >

Agent preview

AB

You: 12:51 AM

What could cause overheating in a hydraulic pump?

AB

Avirup's Agent 12:51 AM

Overheating in a hydraulic pump can be caused by several factors:

1. **Inadequate Cooling:** Insufficient cooling due to a clogged or dirty heat exchanger, or a malfunctioning cooling fan.

2. **High Ambient Temperatures:** Operating the pump in an environment with high ambient temperatures.

3. **Overloading:** Exceeding the pump's rated capacity or flow rate, causing it to work harder than it's designed for.

4. **Poor Quality Fluid:** Using hydraulic fluid that is not up to the manufacturer's specifications (wrong viscosity, contaminated, or degraded).

5. **Internal Leaks:** Internal leaks within the pump can lead to a loss of charge and increased internal friction, causing overheating.

6. **Cavitation:** This occurs when the hydraulic fluid in the pump drops below its vaporization pressure, forming vapor bubbles that collapse, causing vibration and heat.

Suggested Actions:

1. **Check Cooling System:** Ensure the heat exchanger is clean and the cooling fan is functioning correctly.

2. **Inspect for Overloading:** Verify that the pump is not being overloaded. If necessary, redistribute the load or consider upgrading the pump.

3. **Fluid Quality:** Replace the hydraulic fluid if it's old, contaminated, or not the correct type for your system.

4. **Look for Leaks:** Inspect the pump for any signs of internal or external leaks.

5. **Avoid Cavitation:** Ensure the pump inlet is below the fluid reservoir level and that the fluid level in the reservoir is sufficient.

Safety Precautions:

• Always ensure the hydraulic system is depressurized before performing any maintenance.

• Use appropriate PPE, including gloves and eye protection, when handling hydraulic fluids.

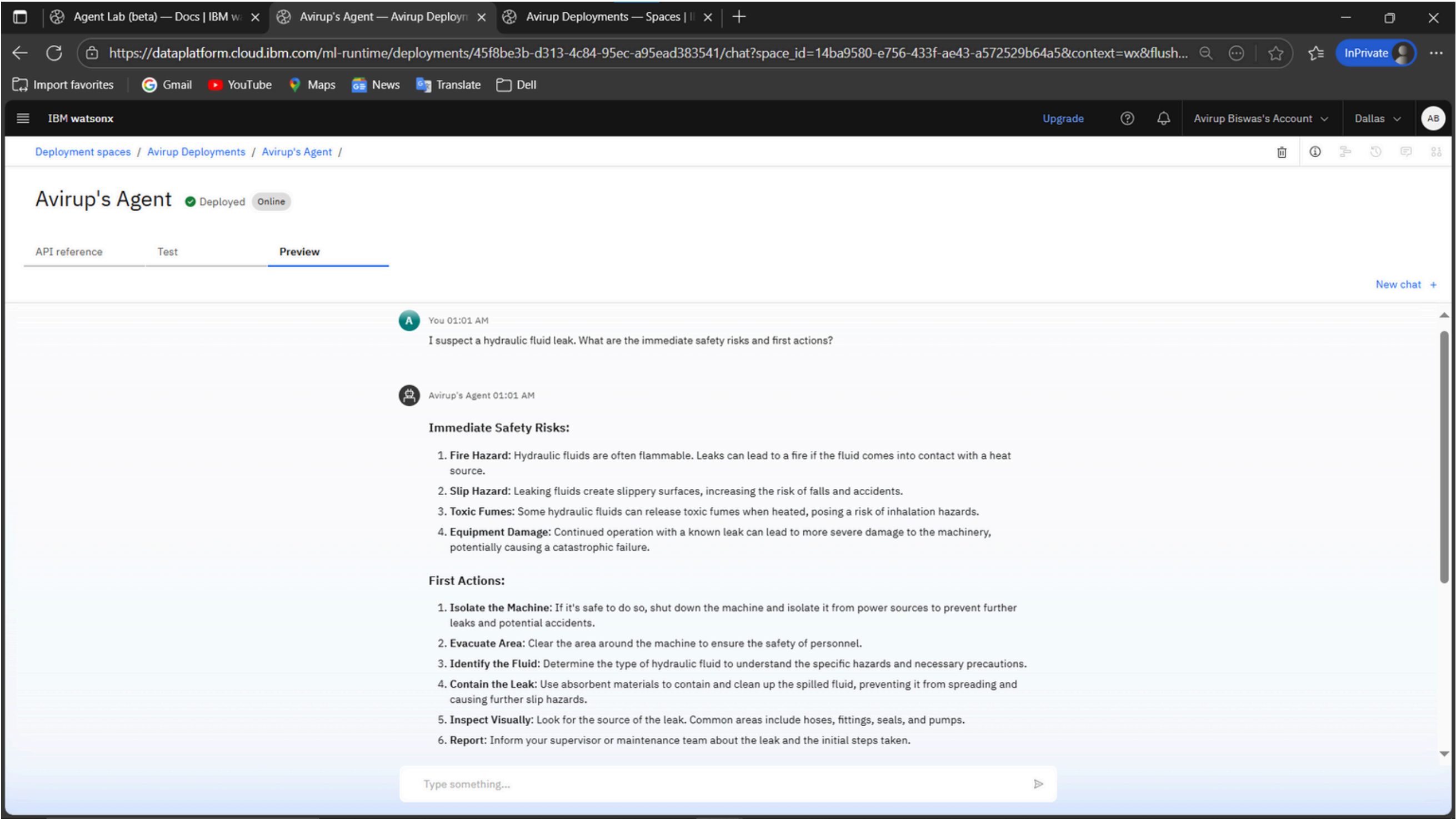
• Be cautious when working around moving parts of the pump.

Type something...

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➤

Result



Conclusion

- The Machine Fault Diagnosis Agent successfully demonstrates how AI can enhance industrial maintenance by detecting faults in machinery based on real-time sensor data. By integrating the IBM Granite AI model with IBM Cloud Lite services, the system provides intelligent, user-friendly diagnostics through natural language interaction. This not only reduces machine downtime and maintenance costs but also improves operational safety and efficiency. The project highlights the practical potential of combining mechanical engineering knowledge with modern AI technologies.

Future scope

- In the future, the Machine Fault Diagnosis Agent can be enhanced by integrating predictive maintenance capabilities using historical data and machine learning, enabling it to forecast issues before they occur. The system can be expanded to support a wider variety of industrial machines and offer a mobile application for on-site access. Features like automated fault reporting, multilingual support, and self-learning from past diagnostics can further improve its usability, efficiency, and adaptability in diverse industrial environments.

References

- In this project, IBM's Granite-3-3-8B-Instruct AI model was used to enable intelligent natural language understanding and reasoning for machine fault diagnosis. IBM Cloud services provided the deployment infrastructure, while watsonx.ai facilitated seamless integration of the large language model. The IBM SkillsBuild platform supported learning and practical application of these technologies. All development, testing, and cloud access were carried out using the Microsoft Edge browser.

IBM Certifications

- Getting started with AI:-



IBM Certifications

- Journey to Cloud: Envisioning your Solution:-

In recognition of the commitment to achieve professional excellence



Avirup Biswas

Has successfully satisfied the requirements for:

Journey to Cloud: Envisioning Your Solution



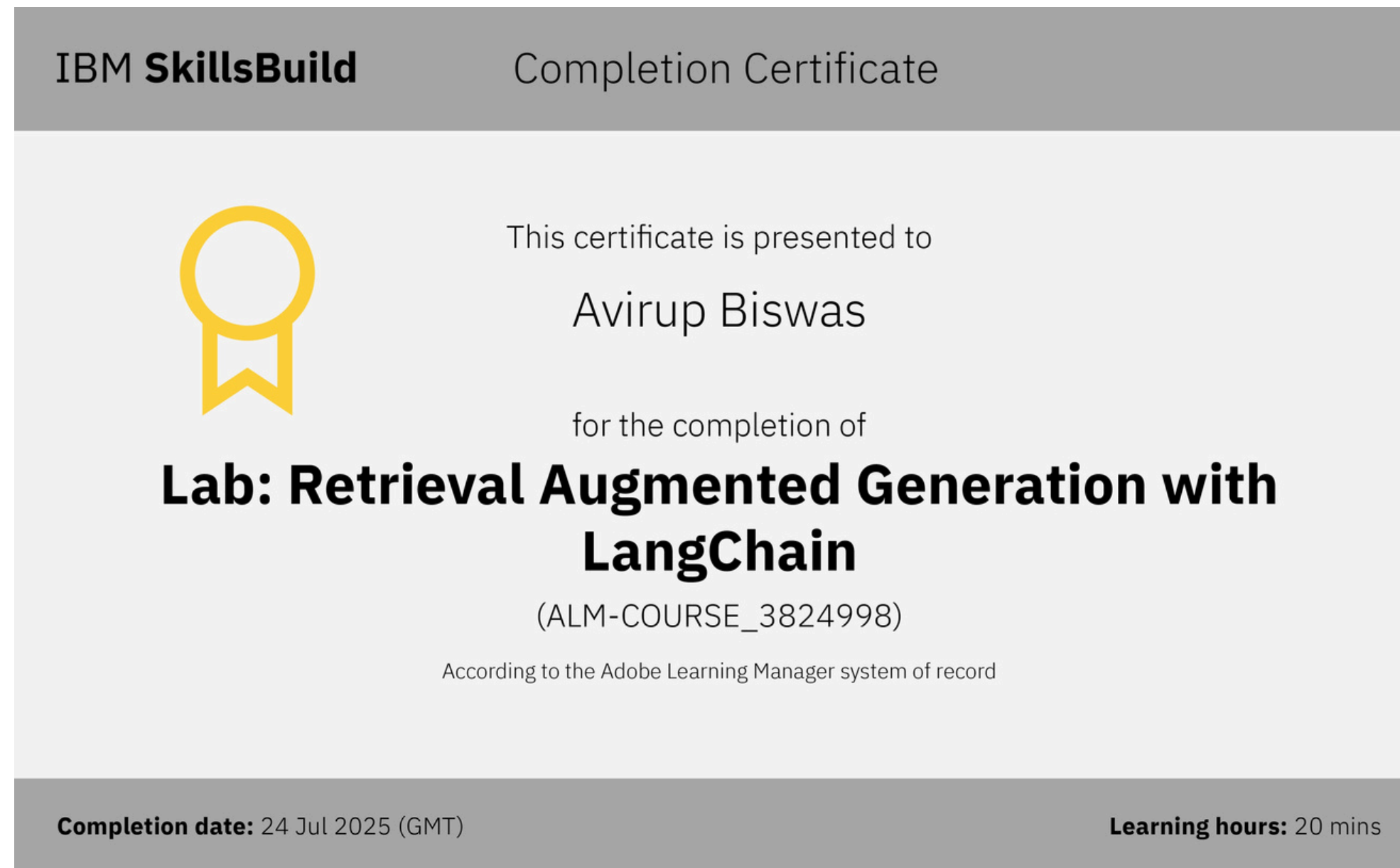
Issued on: Jul 20, 2025
Issued by: IBM SkillsBuild

Verify: <https://www.credly.com/badges/16991438-81b6-43d6-ba73-2d94de5bec3a>



IBM Certifications

- Lab: Retrieval Augmented Generation with Lang chain:-





THANK YOU