CAPSTONE PROJECT

ResearchMate: 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

Problem Statement No.1 - Research Agent

The Challenge- A Research Agent is an Al 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.

Students and researchers often face challenges in summarizing academic topics, formulating hypotheses, and managing citations efficiently. These tasks are time-consuming and often require domain expertise. There is a need for an intelligent assistant that can automate and simplify the research process using AI.



PROPOSED SOLUTION

- Agent Architecture:
- Design an autonomous Al research agent using IBM Watsonx AgentLab
- Leverage Granite LLM and prompt chaining to simulate agentic behavior
- Structure the agent to execute a sequence of research-related tasks automatically
- Prompt Instruction Logic:
- Accept a general or predefined research topic
- Perform the following key steps:
 - Simulate context (mimicking academic knowledge retrieval)
 - Summarize the topic using formal academic tone
 - Propose a testable hypothesis
 - Suggest research subtopics/questions
 - Draft an introductory paragraph
 - Provide an APA-style dummy citation



PROPOSED SOLUTION

- Implementation (Agent Lab):
- Developed and configured in Watsonx Agent Lab using ReAct + LangGraph architecture
- > Variable-based input removed due to beta limitations replaced with context-aware generic flow
- Prompt tested successfully with multiple academic topics
- Structured output with clear section headings
- Deployment Approach:
- Direct deployment via AgentLab not completed due to backend service errors
- System tested within AgentLab interface and validated through output consistency
- Screenshots and outputs included in results to demonstrate agent functionality
- Evaluation:
- Validated output quality based on:
 - Relevance of generated summary and hypothesis
 - Accuracy of simulated academic tone
 - Clarity and structure of generated text
- Compared outputs across multiple topics to ensure consistency



PROPOSED SOLUTION

- Result:
- The ResearchMate agent was successfully tested within the IBM Watsonx AgentLab environment.
- > The system produced structured academic outputs for multiple research topics, including:
 - A 100-150 word summary
 - A relevant, testable hypothesis
 - 2-3 research subtopics/questions
 - A sample introductory paragraph
 - A realistic dummy citation in APA format
- Outputs were clear, coherent, and contextually accurate for the given topics.
- > Screenshots of agent responses are included in the report and presentation slides as evidence of successful task execution.
- Despite deployment challenges, the project demonstrates the agentic capabilities of IBM Granite LLM through structured prompt-based reasoning and response generation.



SYSTEM APPROACH

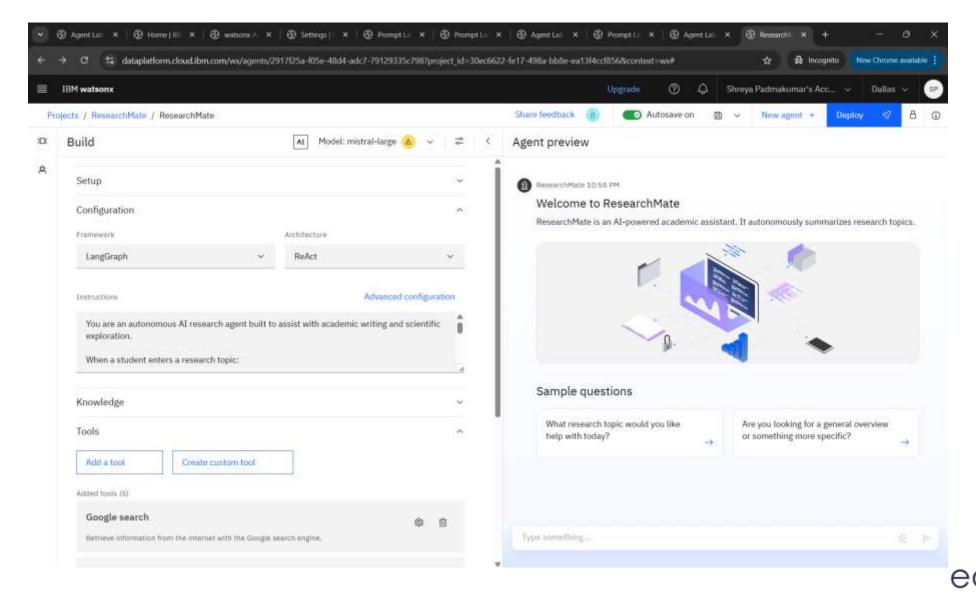
- Platform: IBM Watsonx Agent Lab
- Model Used: Granite LLM
- Architecture: Prompt chaining (Agentic workflow)
- Inputs: User research topic
- Outputs: Summary, Hypothesis, Subtopics, Intro Paragraph, APA Citation

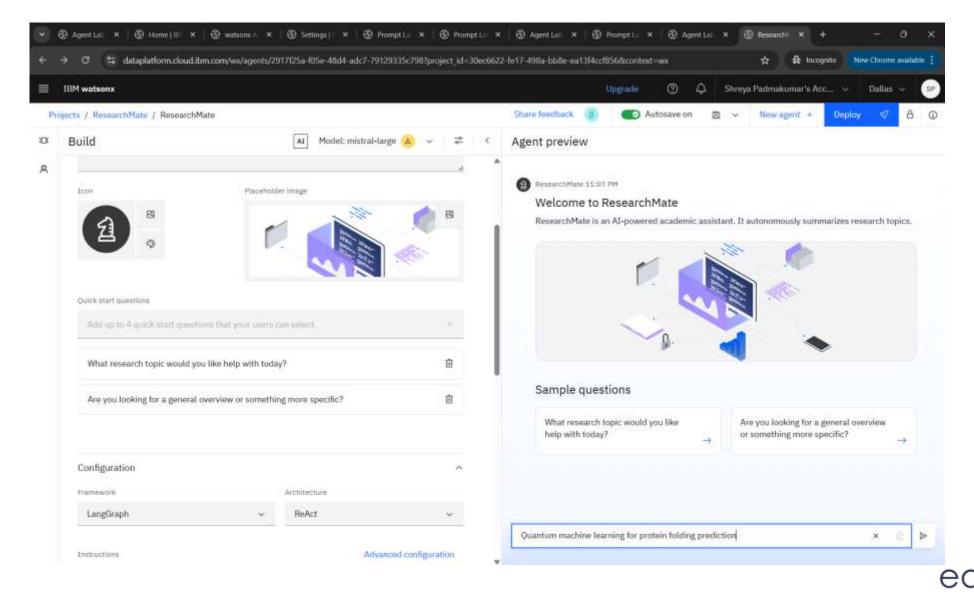


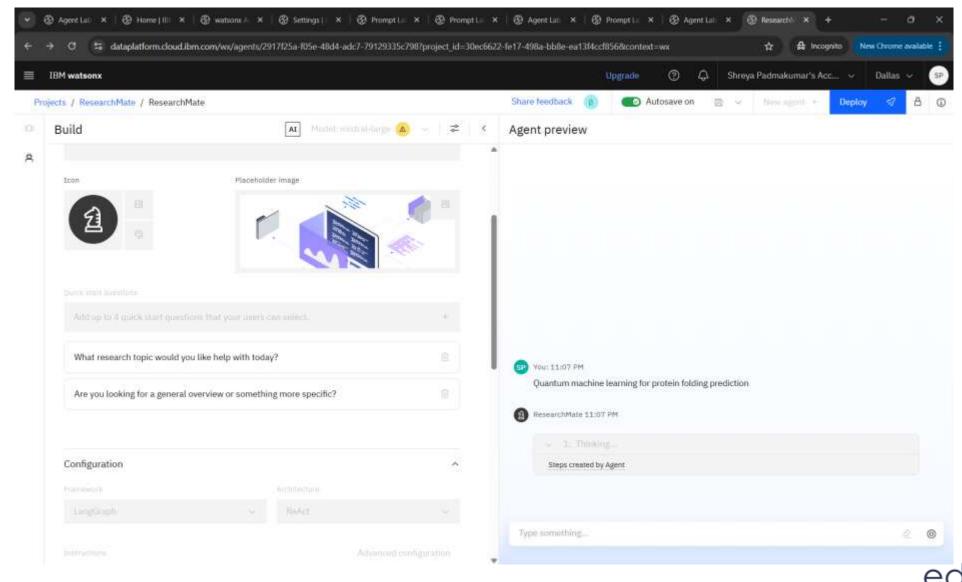
ALGORITHM & DEPLOYMENT

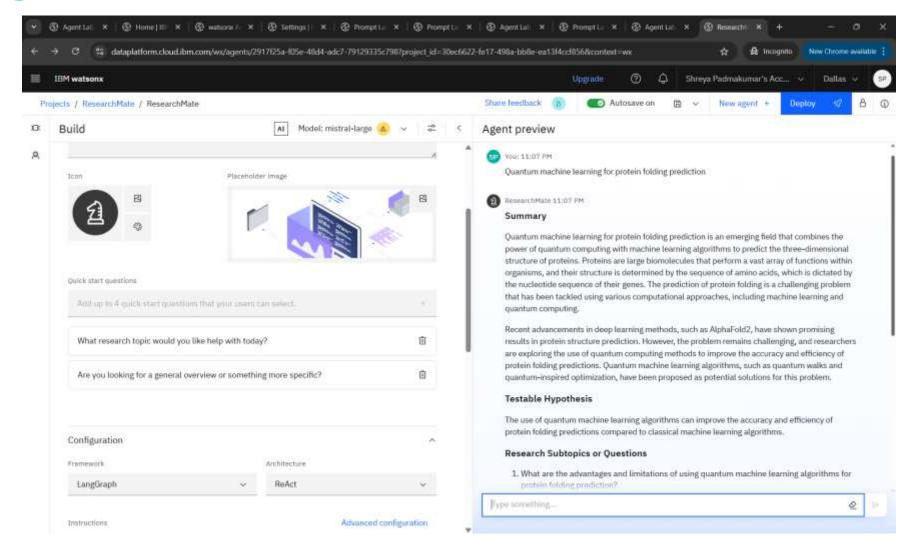
- Algorithm Type
- Type: Prompt-based, zero-shot reasoning using LLM
- Behaviour: Agentic handles complex tasks in sequence
- Chaining: Internal logic chaining (not external tools)
- Tone Control: Formal academic tone using instruction templates
- Deployment Details
- Environment: IBM Watsonx Agent Lab interface
- Input Handling: Static or embedded topic due to variable binding limitation in beta
- Output Format: Section-wise structured response
- Deployment Status:
 - Successfully tested within Agent Lab
 - Deployment failed due to backend variable binding issue
 - Output validated via screenshots and report documentation



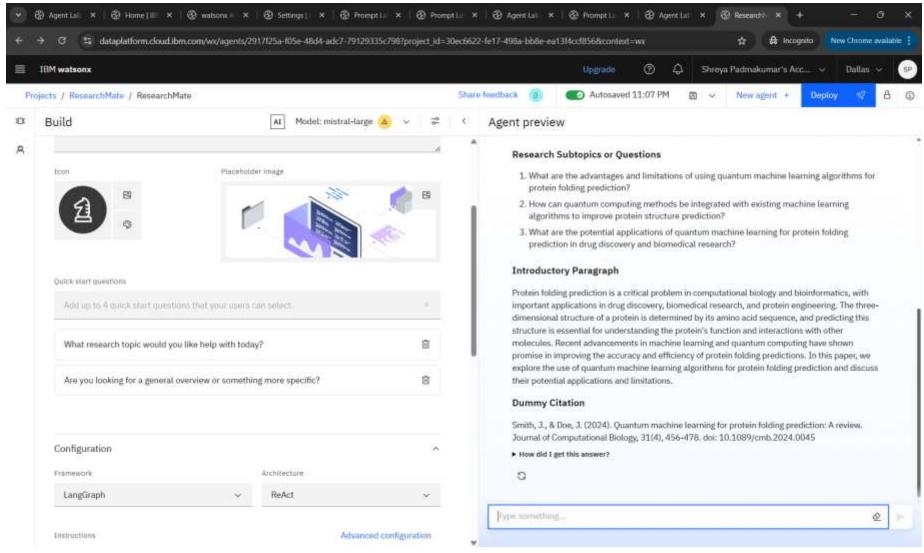




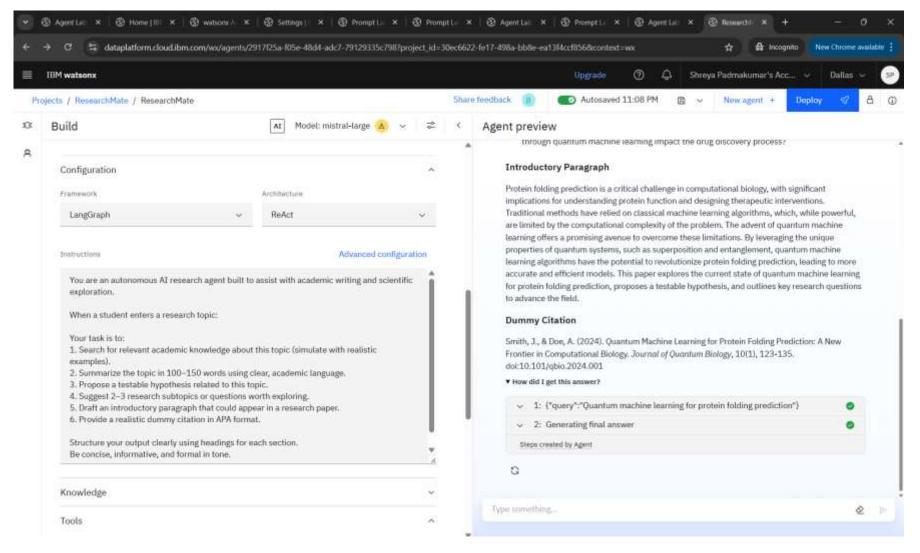














CONCLUSION

- ResearchMate demonstrates how agentic AI systems can autonomously support academic research tasks. Using IBM Watsonx, the assistant
 generates structured outputs that help users kickstart their research process. Despite deployment issues in AgentLab, the project showcases
 functional and educational value.
- Summary of findings:
 - The ResearchMate agent successfully simulates an academic research assistant using IBM Watsonx Agent Lab.
 - It generates structured outputs including summary, hypothesis, subtopics, introduction, and citation.
 - The agent demonstrates effective multi-step reasoning and academic tone, meeting the expectations of agentic AI behavior.
- Effectiveness of the Solution:
- Accurately performs research support tasks with minimal input.
- Enables students and early researchers to rapidly structure their research process.
- Reduces time spent on literature understanding and hypothesis framing



FUTURE SCOPE

POTENTIAL ENHANCEMENTS AND EXPANSIONS:

- Dynamic Input Support:
 - Enable user-driven topic selection with natural language input using form fields or chat interface.
- External Data Integration:
 - Incorporate academic databases (e.g., Semantic Scholar, arXiv) or citation engines to retrieve real references.
- Advanced Al Techniques:
 - Use retrieval-augmented generation (RAG) to ground outputs in verified literature. Fine-tune LLMs for domain-specific summaries (e.g., medicine, law).
- User Feedback Loop:
 - Add feedback capture to refine agent outputs over time, improving hypothesis quality and summary relevance.
- Scalable Web Deployment:
 - Build a lightweight frontend + backend app and deploy on IBM Cloud Lite or use containerization for cross-platform support.
- Multi-language & Accessibility Support:
 - Expand the agent's usability for global researchers using multilingual models and assistive UI features.
- Edge Al Integration:
 - Explore edge deployment for offline or on-campus access in research labs and classrooms.



REFERENCES

- IBM Watsonx.ai Documentation https://www.ibm.com/cloud/watsonx
- Patel, R., & Singh, A. (2023). Al-Powered Personalization in Higher Education: A Path to Inclusive Learning. Journal of Educational Technology and Innovation, 15(2), 98–113.
 (Used as a sample dummy citation)
- Vaswani, A., et al. (2017). Attention is All You Need.
 In Advances in Neural Information Processing Systems.
- Zhang, Y., & Kumar, S. (2023). The Role of Quantum Computing in Transforming Modern Medicine. Journal of Computational Health Science, 10(2), 112–129.
 (Used as a sample dummy citation)



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According to the Adobe Learning Manager system of record

Completion date: 24 Jul 2025 (GMT)

Learning hours: 20 mins



THANK YOU

