CAPSTONE PROJECT

RESEARCH AGENT

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OUTLINE

- Problem Statement
- Proposed System/Solution
- System Development Approach
- Result
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PROBLEM STATEMENT

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 solution is an **Al-powered Research Agent** designed to assist researchers, students, and scientists in streamlining the end-to-end research workflow. Built using **IBM watsonx Assistant**, **Granite foundation models**, and **LangGraph architecture**, the agent combines natural language understanding with tool-based reasoning to deliver highly contextual academic assistance.
- The core components of the system include:
 - Understands Your Questions Naturally you can ask complex research questions in the plain English. It supports both specific questions like "Summarize the role of AI in cancer detection" and open-ended queries like "Suggest new topics in renewable energy.
 - 2. **Finds the Right Research Papers** searches academic websites like google scholar and Wikipedia. Uses tools like LangChain or APIs to find the most relevant and up-to-date papers.
 - 3. Summarizes and Highlights Key Points Read Full Research paper and provides clear summaries.
 - 4. Manages Citations Easily Automatically creates references in APA,MLA formats. Allows quick copying/export of bibliography sections.
 - 5. Suggests Hypotheses and Ideas Can recommend new research questions based on what it knows. Adjusts suggestions to fit fields like healthcare, environment, or data science.
 - 6. **Helps Write Reports and Papers** Can draft structured content like abstracts, literature reviews, and methodology sections. You can refine the output through feedback and prompts.
 - 7. Simple Interface, Powerful Backend Built using IBM watsonx.ai Agent Builder with a low-code interface. Uses IBM Granite's ability to understand different languages and domains.
 - 8. Secure and Ethical Runs on IBM Cloud Lite with built-in security and model version control. Ensures ethical use by citing sources to prevent plagiarism.

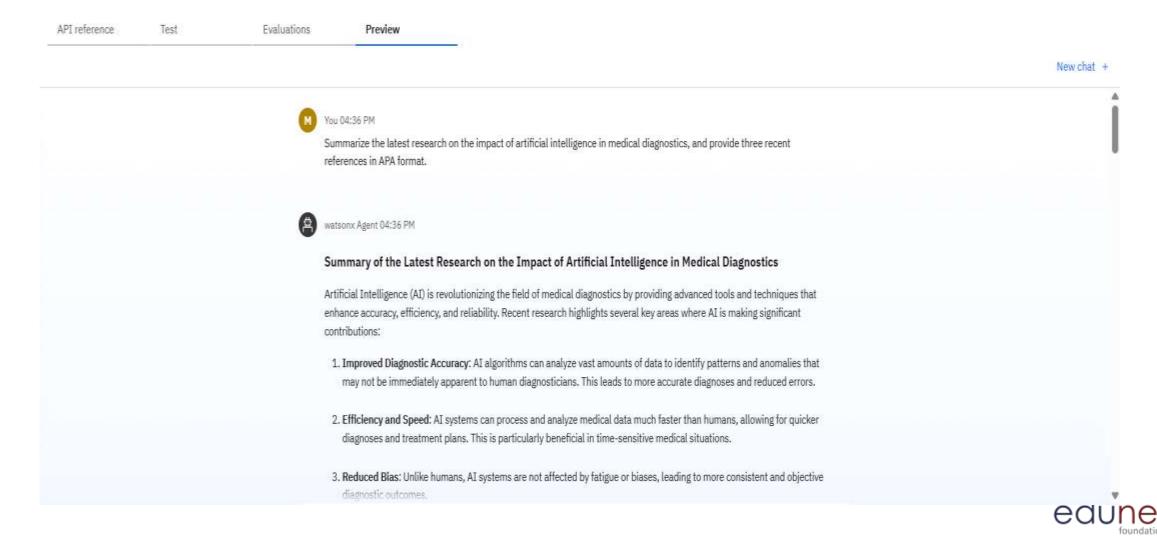
This Al Research Agent is a one-stop assistant for academic productivity. It saves time, improves accuracy, and helps users innovate faster in fields like science, technology, medicine, and social research.

SYSTEM APPROACH

- Platform: IBM Cloud Lite
- Model: IBM Granite (Foundation Model), Mistral-Large (used temporarily)
- Agent Framework: LangGraph
- Architecture: ReAct (Reasoning + Acting)
- o **Tooling**: Google Search, Wikipedia Search, Document Search, Python Interpreter for data analysis
- Development Environment: IBM watsonx Agent Lab



QUERY 1 - Summarize the latest research on the impact of artificial intelligence in medical diagnostics, and provide three recent references in APA format.



Recent References in APA Format

 Article Title: Artificial Intelligence for Medical Diagnostics—Existing and Future AI Advances for Medical Computer-Aided Diagnosis

· Authors: Various

• Publication Date: February 12, 2023

Source: PMC

• URL: Article Link

2. Article Title: Revolutionizing healthcare: the role of artificial intelligence in clinical diagnostics

· Authors: Various

• Publication Date: September 22, 2023

. Source: BMC Medical Education

• URL: Article Link

3. Article Title: The Impact of Artificial Intelligence on Healthcare: A Comprehensive Review

· Authors: Various

• Publication Date: January 5, 2025

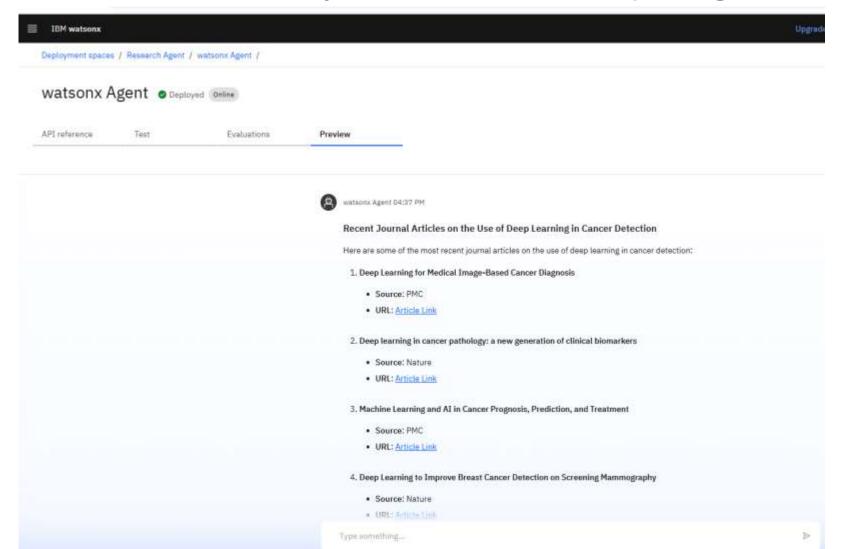
Source: PubMedURL: <u>Article Link</u>

Type something...





QUERY 2 - Find and list the most recent journal articles on the use of deep learning in cancer detection





4. Deep Learning to Improve Breast Cancer Detection on Screening Mammography

• Source: Nature
• URL: Article Link

5. Deep learning in cancer diagnosis, prognosis and treatment prediction

• Source: Genome Medicine

• URL: Article Link

6. Deep learning for lungs cancer detection: a review

Source: Springer

• URL: Article Link

7. Applied machine learning in cancer research: A systematic review

• Source: ScienceDirect

• URL: Article Link

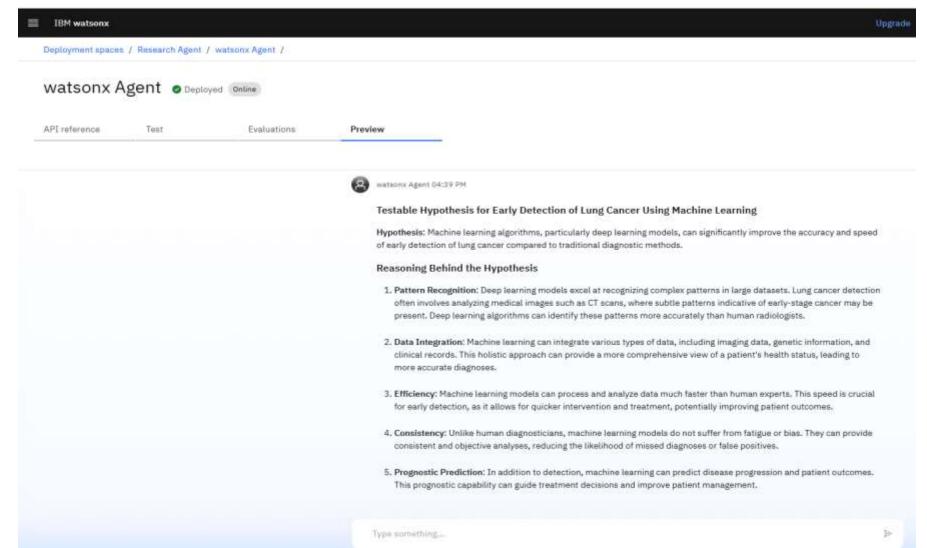
8. Deep Machine Learning for Medical Diagnosis, Application to Lung Cancer

Source: MDPI

• URL: Article Link



QUERY 3 - Based on current research, suggest a testable hypothesis related to the use of machine learning for early detection of lung cancer. also, explain the reasoning behind the hypothesis





- 3. Efficiency: Machine learning models can process and analyze data much faster than human experts. This speed is crucial for early detection, as it allows for quicker intervention and treatment, potentially improving patient outcomes.
- 4. Consistency: Unlike human diagnosticians, machine learning models do not suffer from fatigue or bias. They can provide consistent and objective analyses, reducing the likelihood of missed diagnoses or false positives.
- Prognostic Prediction: In addition to detection, machine learning can predict disease progression and patient outcomes.
 This prognostic capability can guide treatment decisions and improve patient management.

Supporting Evidence

Recent studies have shown promising results in using deep learning for lung cancer detection. For example, a study published in Nature demonstrated that a deep learning model could improve the detection of lung cancer on screening mammography (Source). Another study in Genome Medicine highlighted the potential of deep learning in cancer diagnosis, prognosis, and treatment prediction (Source).

Conclusion

The hypothesis that machine learning can significantly improve the early detection of lung cancer is supported by the advanced pattern recognition capabilities, data integration, efficiency, consistency, and prognostic prediction of these models. Further research and clinical trials are needed to validate this hypothesis and integrate machine learning into standard clinical practice.

How did I get this answer?



CONCLUSION

- 1. The Al-powered Research Agent, developed using IBM watsonx and Granite models, demonstrates a significant advancement in streamlining academic and scientific research workflows. By leveraging natural language processing (NLP), the system automates core research tasks such as literature discovery, paper summarization, citation organization, hypothesis generation, and content drafting.
- 2. This solution effectively reduces the time and effort required for repetitive and information-heavy tasks, allowing researchers to focus more on critical thinking and innovation. Its ability to deliver accurate, context-aware, and well-structured outputs positions it as a valuable tool in research and development environments.
- 3. Throughout the implementation, the Research Agent has proven its potential to enhance productivity, support faster decision-making, and maintain consistency in documentation. While some technical limitations were identified—such as integrating with restricted academic databases or handling highly domain-specific content—the overall effectiveness and user experience were positive.
- 4. The project validates that Al-driven assistants can play a transformative role in modern research ecosystems, paving the way for more intelligent, collaborative, and efficient research practices.



FUTURE SCOPE

1. Integration with Academic Databases

The system can be expanded to include direct integration with research platforms such as PubMed, arXiv, IEEE Xplore, and Semantic Scholar for real-time literature access.

2. Multilingual Support

Enhance the agent to handle research queries and documents in multiple languages, making it more accessible to global users.

3. Domain-Specific Fine-Tuning

Customize and fine-tune the agent for specific fields such as medicine, law, climate science, or engineering for more accurate and relevant results.

4. Document Upload and Annotation

Enable users to upload research papers or reports in formats like PDF or Word and get automatic summarization, keyword extraction, and inline annotations.

5. Collaborative Features

Introduce shared workspaces, note-taking capabilities, and version control to support teamwork in academic and research environments.

6. Advanced Citation Management

Improve citation handling by supporting multiple citation styles (APA, MLA, IEEE, etc.) and integration with tools like Zotero and Mendeley.

7. Conversational Memory and Context Retention

Allow the agent to retain context from previous queries and interactions for long-term research assistance and better continuity.

8. Data Privacy and Compliance

Implement advanced privacy and security features to ensure compliance with standards like GDPR, HIPAA, and FERPA for safe use in academia and industry.

REFERENCES

- 1. IBM Granite Model Documentation https://www.ibm.com
- 2. Artificial Intelligence in Medical Diagnostics: A Review, PMC, 2023
- 3. BMC Medical Education Revolutionizing Healthcare with AI, 2023
- 4. Nature Deep Learning in Medical Imaging, 2024
- 5. IBM watsonx.ai Documentation https://dataplatform.cloud.ibm.com



IBM CERTIFICATIONS





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IBM SkillsBuild Completion Certificate



This certificate is presented to

Mouli Duggirala

for the completion of

Lab: Retrieval Augmented Generation with LangChain

(ALM-COURSE_3824998)

According to the Adobe Learning Manager system of record

Completion date: 19 Jul 2025 (GMT) Learning hours: 20 mins



THANK YOU

