
CAPSTONE PROJECT

RESEARCH AGENT

Presented By:

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OUTLINE

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- Proposed System/Solution
- System Development Approach
- Result
- Conclusion
- Future Scope
- References

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 **AI-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:
 1. **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 AI 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)
- **Tooling:** Google Search, Wikipedia Search, Document Search, Python Interpreter for data analysis
- **Development Environment:** IBM watsonx Agent Lab

RESULT

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

API reference

Test

Evaluations

Preview

[New chat](#) +



You 04:36 PM

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



watsonx Agent 04:36 PM

Summary of the Latest Research on the Impact of Artificial Intelligence in Medical Diagnostics

Artificial Intelligence (AI) is revolutionizing the field of medical diagnostics by providing advanced tools and techniques that enhance accuracy, efficiency, and reliability. Recent research highlights several key areas where AI is making significant contributions:

- 1. Improved Diagnostic Accuracy:** AI algorithms can analyze vast amounts of data to identify patterns and anomalies that may not be immediately apparent to human diagnosticians. This leads to more accurate diagnoses and reduced errors.
- 2. Efficiency and Speed:** AI systems can process and analyze medical data much faster than humans, allowing for quicker diagnoses and treatment plans. This is particularly beneficial in time-sensitive medical situations.
- 3. Reduced Bias:** Unlike humans, AI systems are not affected by fatigue or biases, leading to more consistent and objective diagnostic outcomes.

RESULT

Recent References in APA Format

1. **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:** PubMed
- **URL:** [Article Link](#)

Type something...



RESULT

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

The screenshot displays the IBM watsonx Agent interface. At the top, the header shows 'IBM watsonx' and an 'Upgrade' button. Below the header, a breadcrumb trail reads 'Deployment spaces / Research Agent / watsonx Agent /'. The main section is titled 'watsonx Agent' with status indicators 'Deployed' and 'Online'. A navigation bar includes 'API reference', 'Test', 'Evaluations', and 'Preview', with 'Preview' being the active tab. The interface shows a chat conversation with a user icon and the timestamp 'watsonx Agent 04:37 PM'. The chat message reads: 'Recent Journal Articles on the Use of Deep Learning in Cancer Detection. Here are some of the most recent journal articles on the use of deep learning in cancer detection:'. Below this, a numbered list of four articles is provided, each with its source and a link to the full article.

IBM watsonx Upgrade

Deployment spaces / Research Agent / watsonx Agent /

watsonx Agent Deployed Online

API reference Test Evaluations **Preview**

watsonx Agent 04:37 PM

Recent Journal Articles on the Use of Deep Learning in Cancer Detection

Here are some of the most recent journal articles on the use of deep learning in cancer detection:

1. Deep Learning for Medical Image-Based Cancer Diagnosis
 - Source: PMC
 - URL: [Article Link](#)
2. Deep learning in cancer pathology: a new generation of clinical biomarkers
 - Source: Nature
 - URL: [Article Link](#)
3. Machine Learning and AI in Cancer Prognosis, Prediction, and Treatment
 - Source: PMC
 - URL: [Article Link](#)
4. Deep Learning to Improve Breast Cancer Detection on Screening Mammography
 - Source: Nature
 - URL: [Article Link](#)

Type something...

RESULT

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](#)

RESULT


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

 IBM watsonx Upgrade

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Testable Hypothesis for Early Detection of Lung Cancer Using Machine Learning

Hypothesis: Machine learning algorithms, particularly deep learning models, can significantly improve the accuracy and speed of early detection of lung cancer compared to traditional diagnostic methods.

Reasoning Behind the Hypothesis

- 1. Pattern Recognition:** Deep learning models excel at recognizing complex patterns in large datasets. Lung cancer detection often involves analyzing medical images such as CT scans, where subtle patterns indicative of early-stage cancer may be present. Deep learning algorithms can identify these patterns more accurately than human radiologists.
- 2. Data Integration:** Machine learning can integrate various types of data, including imaging data, genetic information, and clinical records. This holistic approach can provide a more comprehensive view of a patient's health status, leading to more accurate diagnoses.
- 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.
- 5. 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.

Type something...

RESULT

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.
5. **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 AI-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 AI-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://dataplatfrom.cloud.ibm.com>

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THANK YOU