
CAPSTONE PROJECT

RESEARCH AGENT

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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

Researchers and students often spend significant time on repetitive and manual tasks such as literature review, citation management, and data extraction, which slows down the research process and limits productivity. There is a need for an intelligent, automated system that can assist in understanding research queries, retrieving relevant literature, summarizing key insights, and organizing references.

The goal is to develop a Research Agent that leverages Natural Language Processing (NLP) to automate these tasks, thereby enhancing efficiency, accuracy, and innovation in academic and industrial research workflows.

PROPOSED SOLUTION

- The proposed system aims to address the challenge of analysing a large amount of data i.e. articles, research papers, etc . The agent will highlight key points, summarize research papers and can prepare detailed reports along with providing the data sources. The solution will consist of the following components:
- First, we prepare a IBM project to start our Agentic AI project.
- We choose required resources like watson.ai studio, watson.ai runtime, CloudObjectStorage, watsonx.governance.
- After preparing the setup, we start with selecting an LLM model for our agent who will analyse all the data and generate a response according to the prompt and query provided.
- The framework used is LangGraph, used to manage the workflow for organised and scalable development.
- The architecture used is ReAct used to make the agent interactive with its environment.
- Now, we prepare a prompt for our agent describing the task and its goal that its need to achieve. The prompt is very important in guiding the agent and in achieving desired results.
- We select the the tools that our agent will use in order to search for required knowledge to fulfill the task. The tools used are Google Search Engine, DuckDuckGo search, and Wikipedia search.
- After this, we test our agent by providing a sample query and if it generates the desired output then our agent is complete, otherwise we can tweek the prompt to increase the accuracy.
- After the agent is completed, we can save the agent.

SYSTEM APPROACH

The proposed solution uses IBM's watsonx platform and LangGraph framework to develop an Agentic AI system capable of autonomously analyzing large volumes of research data. The agent is built using a ReAct-based architecture for interactive reasoning and action, with a custom prompt to guide its behavior. Tools like Google Search, DuckDuckGo, and Wikipedia are integrated to enable knowledge retrieval. The workflow is designed for scalability and modular development.

RESULT

The Research Agent was successfully tested with academic queries. It could summarize articles, extract key points, and generate well-structured reports along with source links. The agent responded accurately to varied prompts, showcasing its ability to automate time-consuming research tasks efficiently.

The screenshot displays the IBM watsonx Agent Lab interface. The top navigation bar includes the IBM watsonx logo, an Upgrade button, a help icon, a notification bell, the user's account (Raghav Bansal's Account), the location (Frankfurt), and a user profile icon (RB). Below the navigation bar, the breadcrumb trail shows 'Projects / Raghav's sandbox / Agent Lab'. The main interface is divided into two panels. The left panel, titled 'Build', contains sections for 'Setup', 'Configuration', 'Instructions', 'Knowledge', and 'Tools'. Under 'Configuration', the 'Framework' is set to 'LangGraph' and the 'Architecture' is set to 'ReAct'. The 'Instructions' section contains a text area with the following text: 'You are a Research Agent, an AI system designed to assist with academic and scientific research tasks. You can autonomously search for literature, summarize papers, and organize references. Using natural language processing, you understand research questions and retrieve relevant information.' Below the instructions, there are buttons for 'Add a tool' and 'Create custom tool'. The 'Tools' section shows 'Added tools (2)' with a list containing 'Google search'. The right panel, titled 'Agent preview', shows a conversation log. The first message is from the user (RB) at 05:35 PM: 'Prepare me a report on deep learning for a research paper. Include references from various research papers available on the internet.' The second message is from the watsonx Agent at 05:35 PM: 'Here is a report on deep learning for a research paper, including references from various research papers available on the internet: Deep learning is a subfield of machine learning that involves the use of artificial neural networks to analyze and interpret data. It has been widely used in various applications such as image recognition, natural language processing, and speech recognition. One of the key breakthroughs in deep learning was the introduction of the backpropagation algorithm, which allows for the efficient training of neural networks (Rumelhart et al., 1986). This algorithm has been widely used in various deep learning architectures, including convolutional neural networks (CNNs) and recurrent neural networks (RNNs). CNNs have been widely used in image recognition tasks, and have achieved state-of-the-art performance in various benchmarks (Krizhevsky et al., 2012). RNNs, on the other hand, have been used in natural language processing tasks, such as language modeling and machine translation (Sutskever et al., 2014). Deep learning has also been used in various other applications, including speech recognition (Hinton et al., 2012), recommender systems (Covington et al., 2016), and game playing (Mnih et al., 2015)'. At the bottom of the preview panel, there is a text input field with the placeholder 'Type something...' and a send button.

CONCLUSION

- The Research Agent demonstrates how Agentic AI systems can transform the research process by automating literature analysis, information retrieval, and content generation. Leveraging IBM watsonx and LangGraph, the system offers a scalable and interactive solution to streamline academic and industrial research workflows.

FUTURE SCOPE

- Expand knowledge sources
- Enable real-time data extraction from PDFs
- Add support for domain-specific agents
- Deploy the agent as a web-based research assistant

REFERENCES

- IBM watsonx.ai Studio and Runtime
- LangGraph Documentation
- Wikipedia, Google Search, DuckDuckGo APIs
- Project-specific test data and prompts
- Also the sessions taken by the mentors in IBM skillsbuild internship.

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Learning hours: 20 mins



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