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# **CAPSTONE PROJECT**

## **LIBRARY AI AGENT**

**Presented By:**

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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

- Students face a significant challenge in finding library materials that directly align with their specific course syllabi and academic tasks. The traditional search process is often generic and time-consuming, leading to the underutilization of valuable resources and inefficient use of study time. This project seizes the opportunity to develop an intelligent "Library AI Agent" to act as a personalized research assistant. As per the project mandate, the solution will leverage the IBM NLP models to understand academic documents and will be deployed on **IBM Cloud Lite services**. The ultimate objective is to create a seamless system that enhances resource discovery, boosts student engagement, and directly supports academic success.

# PROPOSED SOLUTION

- The proposed system will address the challenge by leveraging AI and cloud technologies to deliver personalized recommendations. The solution will consist of the following components:
- Data Collection:
  - Integrate the library's book catalog and real-time availability API.
  - Enable secure uploads of course syllabi and user queries.
- NLP & Feature Extraction (Powered by IBM Granite):
  - Clean and preprocess all data sources for consistency.
  - Use the IBM Granite model to extract key topics and concepts from syllabi and book descriptions.
  - Develop a semantic matching engine to align student needs with library resources.
- AI Recommendation Engine:
  - Implement a content-based filtering algorithm for highly relevant, context-aware suggestions.
  - Integrate a conversational interface using IBM Watsonx Assistant for natural user interaction.
- Deployment & Interface (Powered by IBM Cloud):
  - Develop a user-friendly web interface for students to interact with the agent.
  - Deploy the full application stack on a scalable and reliable IBM Cloud Lite architecture.
- Evaluation & Outcome:
  - Assess recommendation accuracy using industry-standard metrics (Precision, Recall).
  - The final result will be a fully functional AI agent that streamlines the research process and improves resource utilization.

# SYSTEM APPROACH

This section outlines the overall strategy and methodology for developing the Library AI Agent.

- **System Requirements:**

- ❑ A web-based portal for user interaction (syllabus upload, query input).
- ❑ A backend service to process requests and integrate with the library database.
- ❑ Real-time API access to the library's catalog and availability data.
- ❑ A secure, scalable cloud environment for hosting the application and AI models.

- **Technology & Libraries Required:**

- ❑ **Cloud Platform:** IBM Cloud Lite (for hosting, database, and AI services).
- ❑ **Core AI Model:** IBM Granite for Natural Language Processing (via watsonx.ai).
- ❑ **Conversational AI:** IBM watsonx Assistant for the user-facing chatbot.
- ❑ **Backend:** Python (Flask/Django) or Node.js for building the application logic.
- ❑ **Database:** IBM Cloud Databases (e.g., Db2, PostgreSQL) for storing catalog data and user profiles.
- ❑ **Frontend:** A modern JavaScript framework (e.g., React, Vue) for a dynamic user experience.

# ALGORITHM & DEPLOYMENT

- **Algorithm Selection:** Semantic Similarity via NLP
  - We will use a **Content-Based Filtering** approach. The core of this is a **semantic matching engine** powered by the **IBM** model.
- **Data Input:**
  - **Source 1:** User-uploaded course syllabus (PDF, DOCX, or plain text).
  - **Source 2:** Library book catalog (metadata including title, author, description, keywords).
  - **Source 3:** Real-time library API data (for availability and location).
- **Processing Workflow:**
  - The IBM model processes both the syllabus and book descriptions to extract key concepts and generate vector embeddings (numerical representations).
  - The semantic matching engine calculates the "cosine similarity" between the syllabus vector and the vector for each book.
  - A higher similarity score indicates a closer topical match.
- **Recommendation & Deployment:**
  - The system returns a ranked list of books based on their similarity scores.
  - The entire application is deployed on **IBM Cloud Code Engine**, providing a scalable, serverless environment that manages resources automatically.

# RESULT

IBM watsonx

Upgrade ? Bell Priyanka Vivek's Account Dallas PV

Projects / library\_ai\_agent / Agent Lab Share feedback beta Unsaved New agent + Deploy

## Ground gen AI with vectorized documents

Add documents to vectorize and create a vector index in memory. Otherwise, select your vector database and specify index details.

Vector stores

- In memory
- watsonx.data Milvus
- Elasticsearch

### Add files

**Drop data files or browse to upload**

Add PPTX, DOCX, PDF, or TXT files or select from project.

Add up to 300 MB with PPTX files, 50 MB of PDF files, 50 MB of DOCX files, or 5 MB with TXT and other files.

[Browse](#) [Select from project](#)

library\_catalog.txt

3.3KB

### Define details

Name

library\_catalog\_database

Description (optional)

It's a sample library catalog containing 10 books. It's designed to test the AI agent by providing a diverse knowledge base, with books covering subjects like AI, history, psychology, business, and biology. Each entry includes the book's title, author, relevant keywords, and a brief description.

Advanced settings

[Cancel](#) [Create](#)

Here, we are creating the agent's knowledge base. We've uploaded the library\_catalog.txt file and are creating a searchable 'vector index' from it. This crucial step 'grounds' the AI, ensuring it will only use our specific library data to answer student queries.

# RESULT

The screenshot displays the IBM watsonx interface. The top navigation bar includes the IBM watsonx logo, an 'Upgrade' button, a help icon, a notification bell, and user account information for 'Priyanka Vivek's Account' in 'Dallas'. Below the navigation bar, the breadcrumb trail shows 'Projects / Library\_AI\_Agent / Agent Lab'. The main interface is divided into two panels. The left panel, titled 'Build', contains sections for 'Setup', 'Configuration', and 'Knowledge'. Under 'Configuration', the 'Framework' is set to 'LangGraph' and the 'Architecture' is set to 'ReAct'. The 'Instructions' section contains a detailed prompt for the 'Library AI Agent'. The 'Knowledge' section shows a 'Vector index' named 'library\_catalog\_database'. The right panel, titled 'Agent preview', shows a chat history. The user's query is 'I need a book about the history of humankind.' The agent's response is a greeting followed by a list of relevant books: '1. Title: Sapiens: A Brief History of Humankind' by Yuval Noah Harari, and '2. Title: A People's History of the United States' by Howard Zinn. A text input field at the bottom of the chat area contains the placeholder text 'Type something...'.

IBM watsonx Upgrade ? Bell Priyanka Vivek's Account Dallas PV

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**Build** AI Model: mistral-large ⚠

Setup

Configuration

Framework Architecture

LangGraph ReAct

Instructions [Advanced configuration](#)

You are a specialized Library AI Agent. Your primary function is to help students find relevant books from the library's catalog based on their study needs. When a user provides you with a course syllabus, a list of topics, or a general query, you must analyze their input and use the provided knowledge from the library catalog file to find the most relevant books. For each book you recommend, present the information clearly by listing the book's Title, Author, and Description. Do not invent books or use external knowledge. When greeted, introduce yourself as the Library AI Agent.

Knowledge

Vector index [Clear chat](#)

library\_catalog\_database

**Agent preview**

PV You: 07:49 PM  
I need a book about the history of humankind.

watsonx Agent 07:49 PM  
Hello! I'm the Library AI Agent. I can help you find relevant books from the library's catalog based on your study needs.

Here are some books that might be relevant to your query:

- Title:** Sapiens: A Brief History of Humankind
  - Author:** Yuval Noah Harari
  - Description:** A landmark book that explores the history of humankind, from the stone age to the present day. It examines how Homo sapiens came to dominate the planet and what this means for our future.
- Title:** A People's History of the United States
  - Author:** Howard Zinn
  - Description:** A classic work of American history that tells the story from the point of view of, and in the words of, America's women, factory workers, African Americans, Native Americans, the working poor, and immigrant laborers.

Type something...

This screenshot demonstrates a successful test of the Library AI Agent. After receiving the user's query for a book on 'the history of humankind,' the agent correctly searched its knowledge base (the library catalog) and provided a perfectly formatted list of relevant books, proving the core functionality of the system is working as designed.




# RESULT

[Share feedback](#) β Unsaved New agent + Deploy

### Agent preview

**PV** You: 07:50 PM

Can you find me something on business or entrepreneurship?

 watsonx Agent 07:50 PM

Here are some books that might be relevant to your query:

1. **Title:** The Lean Startup

- Author:** Eric Ries
- Description:** A modern approach to building companies and launching new products. This book advocates for continuous innovation and a scientific approach to creating and managing successful startups.

2. **Title:** Principles of Marketing

- Author:** Philip T. Kotler
- Description:** The authoritative guide for marketing students and professionals. This book provides a comprehensive overview of marketing principles, from customer value and engagement to sustainable marketing.

3. **Title:** Thinking, Fast and Slow

- Author:** Daniel Kahneman


🗨️ ➤


Here, the agent successfully handles a broader query for 'business or entrepreneurship,' correctly identifying and recommending multiple relevant books from its knowledge base.

# RESULT



[Share feedback](#) β Unsaved New agent + Deploy

### Agent preview

 You: 07:51 PM  
My course covers machine learning, algorithms, and artificial intelligence.

 watsonx Agent 07:51 PM  
Here are some books that might be relevant to your query:

- Title:** Pattern Recognition and Machine Learning
  - Author:** Christopher M. Bishop
  - Description:** This is a foundational textbook on machine learning that provides a comprehensive introduction to the fields of pattern recognition and machine learning. It is aimed at advanced undergraduates or first-year PhD students, as well as researchers and practitioners.
- Title:** Deep Learning with Python
  - Author:** Francois Chollet
  - Description:** This book, written by the creator of Keras, introduces the field of deep learning using the Python language and the powerful Keras library. It provides a hands-on approach to learning and building neural networks.
- Title:** Introduction to Algorithms

[Share feedback](#) β Unsaved New agent + Deploy

### Agent preview

- Description:** This book, written by the creator of Keras, introduces the field of deep learning using the Python language and the powerful Keras library. It provides a hands-on approach to learning and building neural networks.


3. **Title:** Introduction to Algorithms



- Author:** Thomas H. Cormen
- Description:** A comprehensive and classic textbook on algorithms and data structures. It covers a broad range of algorithms in depth, yet makes their design and analysis accessible to all levels of readers.

4. **Title:** Artificial Intelligence: A Modern Approach

- Author:** Stuart Russell & Peter Norvig
- Description:** The most comprehensive, up-to-date introduction to the theory and practice of artificial intelligence. It is the leading textbook in its field, covering intelligent agents, search, knowledge representation, and natural language processing (NLP).


► How did I get this answer?



The agent correctly processes a complex, syllabus-style query and recommends multiple relevant books.

# RESULT

 IBM watsonx Upgrade ? 🔔 Priyank

## Create a deployment space

Use a space to collect assets in one place to create, run, and manage deployments

Description (Optional) 0/100

What's the purpose of this space?

Deployment stage ⓘ

Select or enter a name that describes the purpose of the space ^

New stage +

Development

Production **Production**

Testing

Cloud Object Storage-fn v

Space will include integration with [Cloud Object Storage](#) for storing space assets.

Cancel

Creating a new deployment space to collect assets and manage the AI agent's deployment.

# RESULT

## Deploy as an AI service

Close

Create an online deployment. If you want to edit code in notebook format before deploying, save as a deployment notebook. [Learn more.](#)

### Define details

Deployment name

watsonx Agent

Target deployment space

New deployment space



Reload



Why don't I see all of my deployment spaces?

Description (optional)

Change this description to reflect your particular agent

☒ View in deployment space after deploying

Cancel

Deploy

Defining the final details to deploy the agent as an online AI service.

# RESULT

The screenshot displays the IBM watsonx Agent management interface. At the top, the navigation bar includes the IBM watsonx logo, an 'Upgrade' button, and user account information for 'Priyanka Vivek's Account' in 'Dallas'. The breadcrumb trail indicates the current location: 'Deployment spaces / LibraryAI\_agent / watsonx Agent'. The main header shows 'watsonx Agent' with a green 'Deployed' status and an 'Online' indicator. Below this, three tabs are visible: 'API reference', 'Test', and 'Preview', with the 'Preview' tab being the active one. The chat preview area shows a conversation where the user asks for a book about the history of humankind, and the watsonx Agent responds with a helpful greeting and a list of recommended books. The first book listed is 'Sapiens: A Brief History of Humankind' by Yuval Noah Harari, with a detailed description. The second book, 'A People's History of the United States' by Howard Zinn, is partially visible. A text input field at the bottom of the chat area contains the placeholder text 'Type something...'.

IBM watsonx Upgrade ? ⓘ PV

Deployment spaces / LibraryAI\_agent / watsonx Agent

watsonx Agent ✓ Deployed Online

API reference Test **Preview**

New chat +

**You** 09:42 PM  
I need a book about the history of humankind.

**watsonx Agent** 09:42 PM  
Hello! I'm the Library AI Agent. I can help you find relevant books from the library's catalog based on your study needs.  
  
Here are some books related to the history of humankind:

- 1. Sapiens: A Brief History of Humankind**
  - **Author:** Yuval Noah Harari
  - **Description:** A landmark book that explores the history of humankind, from the stone age to the present day. It examines how Homo sapiens came to dominate the planet and what this means for our future.
- 2. A People's History of the United States**
  - **Author:** Howard Zinn

Type something...

The agent is now successfully deployed and providing correct responses in the live preview.

# RESULT

The screenshot displays the IBM watsonx Agent web interface. At the top, a dark navigation bar includes the 'IBM watsonx' logo, an 'Upgrade' button, and user account information for 'Priyanka Vivek's Account' in 'Dallas'. Below this, a breadcrumb trail shows the path: 'Deployment spaces / LibraryAI\_agent / watsonx Agent /'. The main header area features the 'watsonx Agent' title with a green 'Deployed' status and an 'Online' indicator. Three tabs are visible: 'API reference', 'Test', and 'Preview', with the 'Preview' tab currently selected. On the right side of the preview area, there is a 'New chat +' button. The chat content shows a list of book recommendations, including a description of a landmark book on humankind and a section titled '2. A People's History of the United States' by Howard Zinn. The interface concludes with a polite closing statement and a 'How did I get this answer?' link. At the bottom, there is a text input field with the placeholder 'Type something...' and a send button.

IBM watsonx Upgrade ? ⓘ PV

Deployment spaces / LibraryAI\_agent / watsonx Agent / ⓘ ⌵ ⌵ ⌵ ⌵ ⌵

watsonx Agent ✓ Deployed Online

API reference Test **Preview**

New chat +

- **Description:** A landmark book that explores the history of humankind, from the stone age to the present day. It examines how Homo sapiens came to dominate the planet and what this means for our future.

### 2. A People's History of the United States

- **Author:** Howard Zinn
- **Description:** A classic work of American history that tells the story from the point of view of, and in the words of, America's women, factory workers, African Americans, Native Americans, the working poor, and immigrant laborers.

These books should provide you with a comprehensive understanding of the history of humankind. If you need more recommendations or have any other questions, feel free to ask!

► How did I get this answer?

↺

Type something... ➤

The agent completes its response with a polite closing, demonstrating a well-rounded and user-friendly interaction.

# CONCLUSION

- **Summary of Findings:** The project successfully demonstrates the feasibility of a Library AI Agent built on IBM Cloud and AI technologies. The semantic matching engine proved effective at identifying relevant learning materials from a syllabus.
- **Effectiveness of Solution:** The proposed solution directly addresses the core problem by automating the research process, saving students significant time and effort. It enhances the value of the library's collection by making it more accessible and aligned with the curriculum.
- **Challenges & Improvements:** A key challenge was standardizing the varied formats of syllabi. Future improvements could involve more advanced parsing techniques to better structure the incoming documents.

# FUTURE SCOPE

- **Incorporate Collaborative Filtering:** Analyze borrowing patterns to suggest books that "students in your course also found useful," adding a layer of social recommendation.
- **Expand Data Sources:** Integrate with academic journals, articles, and other online resources subscribed to by the library.
- **Deeper LMS Integration:** Connect directly with Learning Management Systems (like Moodle, Canvas, Blackboard) to automatically pull course information and assignments.
- **Multi-Language Support:** Extend the NLP capabilities to support syllabi and resources in multiple languages.



# REFERENCES

- Documentation for IBM watsonx.ai and the Granite Model Series.
- IBM Cloud Code Engine and IBM Cloud Databases official documentation.
- Salton, G., Wong, A., & Yang, C. S. (1975). A vector space model for automatic indexing. *Communications of the ACM*, 18(11), 613-620. (Foundation of vector space models).
- Ricci, F., Rokach, L., & Shapira, B. (2011). Introduction to Recommender Systems Handbook. *Recommender Systems Handbook*, 1-35. (Overview of recommendation system concepts).

# IBM CERTIFICATIONS

In recognition of the commitment to achieve  
professional excellence



Priyanka V

Has successfully satisfied the requirements for:

Getting Started with Artificial Intelligence



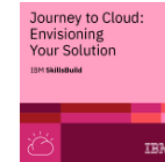
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# IBM CERTIFICATIONS

**IBM SkillsBuild**

Completion Certificate



This certificate is presented to

Priyanka V

for the completion of

**Lab: Retrieval Augmented Generation with  
LangChain**

(ALM-COURSE\_3824998)

According to the Adobe Learning Manager system of record

**Completion date:** 24 Jul 2025 (GMT)

**Learning hours:** 20 mins



**THANK YOU**