

IBM SkillsBuild Agentic AI Internship

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Report

**Title: Development of a Personalized Learning Pathway
Recommender**

Introduction:

The rapid expansion of online education platforms has created an abundance of learning resources, but also introduced a new challenge: information overload. Learners are often overwhelmed by choices, lacking clear guidance on which courses to pursue for efficient skill acquisition. This project aims to address this issue by developing a personalized learning pathway recommender system using machine learning, deployed through IBM Cloud and Watson Studio.

Problem Statement:

The key challenge lies in providing learners with structured, relevant, and personalized course recommendations across multiple online platforms. Existing solutions often focus on single platforms or offer generic guidance, making it difficult for users to follow a logical skill-building roadmap.

Objective:

To develop a hybrid recommender model capable of generating personalized, multi-platform learning paths based on user goals, course metadata, and skill progression requirements. The system will help users make informed decisions and enhance learning efficiency.

Why This Problem?

In the era of lifelong learning and digital transformation, individuals constantly need to upgrade their skills. However, the unstructured nature of online courses makes it difficult for learners to know what to learn next. Solving this problem promotes decent work, economic growth, and effective career transitions, aligning with SDG 8.

Solution:

The proposed solution involves a hybrid recommender model that aggregates course data from various platforms, cleans and standardizes it, and recommends a step-by-step roadmap based on prerequisites and skill adjacency. The solution ensures:

- **Personalized Learning Paths:** Tailored roadmaps for each user profile.
- **Multi-Platform Aggregation:** Combines resources from multiple providers like Coursera, Udemy, edX.
- **Scalable & Efficient:** Designed for integration into apps or web platforms.
- **Data-Driven Recommendations:** Learns and improves with user feedback.

Overview:

In today's digital learning landscape, the explosion of online educational resources across platforms such as Coursera, Udemy, edX, and others has created an overwhelming volume of content. While this abundance offers immense opportunities for skill development, it also introduces a significant challenge: information overload. Learners—whether students, professionals, or career changers—often struggle to identify the right sequence of courses to follow for mastering a particular skill or transitioning into a new domain.

Traditional career counseling methods or single-platform learning paths often fail to consider personalized needs, learning pace, or cross-platform opportunities. To address this gap, our project proposes the development of a Personalized Learning Pathway Recommender. This machine learning-powered system analyzes user goals, skill levels, and course metadata to suggest a logical, step-by-step roadmap for effective skill acquisition.

Features:

Our solution leverages a Hybrid Recommender System integrated with IBM Cloud and Watson Studio to generate personalized learning paths for users. This system intelligently curates and sequences courses across multiple platforms, taking into account key learning attributes such as prerequisites, course ratings, difficulty levels, and skill dependencies.

Key Features:

- **Multi-Platform Course Aggregation:** Collects and consolidates course metadata from various providers, ensuring wide coverage and diverse learning content.
- **Personalized Skill Mapping:** Uses user profile data and learning goals to recommend targeted courses in a logical, progressive order.
- **Smart Path Generation:** Constructs clear roadmaps using techniques like skill adjacency scores and path completion probabilities to guide users through optimal learning sequences.
- **Cold-Start Handling:** Incorporates strategies to recommend paths for new users or lesser-known courses, improving model robustness.
- **User-Friendly Integration:** Designed to be deployed via APIs or embedded in web/mobile applications, making it highly accessible and scalable.
- **Continuous Improvement:** Learns from user behavior and feedback, refining recommendations over time for better personalization and accuracy.

By combining AI and educational data in a structured, actionable format, our solution aims to eliminate the guesswork from online learning and support lifelong learners with clarity, confidence, and consistency.

Technical Implementation

Data Collection and Preprocessing:

- Course metadata collected from **Kaggle**.
- Skill tags standardized, missing values handled.
- Stored as the **first Agentic AI node** (Data Ingestion Node).

Model Development:

- Workflow managed by **Agentic AI** with **three interconnected nodes**, built using **LangChain** and orchestrated via **LangGraph**.
- **First Node** → Holds dataset from Kaggle.
- **Second Node** → Performs data cleaning, formatting, and feature engineering.
- **Third Node** → Accepts user profile/goal as input.
- **Skill Gap Detection** → Done by calling the **embedding model function** to compare user skills with target role requirements.
- **Learning Path Generation** → Done by calling the **Gemini LLM** model, which uses the detected skill gap to design an adaptive, multi-platform, career-focused roadmap.

Implementation and Validation:

- Executed in a local and API-based environment.
- **Codebase pushed to GitHub** for version control, collaboration, and open access.
- Supports dynamic updates based on new course data and learner feedback.

Why IBM Resources and Tools?

IBM Cloud and Watson Studio provide a scalable, secure, and user-friendly environment for model development and deployment. Watson Studio enables efficient data analysis and model evaluation, while IBM Cloud ensures seamless deployment and data integrity.

Conclusion

The proposed solution successfully integrates embedding models for precise skill gap detection and Agentic AI for generating adaptive, multi-platform learning pathways. By structuring the workflow into interconnected nodes using LangChain and LangGraph, the system autonomously analyzes user profiles, identifies missing skills, and curates a progressive, career-focused roadmap powered by the Gemini LLM.

This approach addresses the core challenge of information overload in online education by delivering personalized, data-driven, and dynamically updated recommendations. The use of open-source tools and deployment through GitHub ensures scalability, transparency, and continuous improvement.

Future enhancements can include integrating more niche learning platforms, applying deep learning for improved personalization, and linking pathways to high-demand career opportunities.