

SkillBridge: An AI-Powered Web Application for Skill Gap Analysis and Personalised Learning Path Generation

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Abstract—The rapid evolution of the technology industry continuously widens the gap between the skills possessed by students and early-career professionals and those demanded by the job market. Traditional career guidance methods are expensive, generic, and unable to provide real-time, personalised recommendations. This paper presents SkillBridge, a full-stack web application developed using Python Flask and the Anthropic Claude large language model (LLM) API. The system accepts a user's current skill set and desired job role as input and performs an intelligent, context-aware gap analysis, generating a structured 8-week, week-by-week learning roadmap with curated free resources. The application incorporates secure user authentication, persistent SQLite database storage, and a responsive dark-mode user interface built with Jinja2 templates. Experimental results demonstrate that the AI-generated roadmaps are coherent, role-specific, and practically actionable. SkillBridge provides a scalable, cost-free alternative to professional career counselling and serves as a practical proof-of-concept for AI-driven educational technology applications.

Index Terms—Skill Gap Analysis; Large Language Models; Flask; Career Guidance; AI in Education; Learning Path Generation; Anthropic Claude API; Web Application.

I. INTRODUCTION

The information technology sector is one of the fastest-growing industries globally, with new programming languages, frameworks, cloud platforms, and development methodologies emerging at an unprecedented pace. For students and aspiring professionals, keeping pace with these changes presents a significant challenge: identifying precisely which skills are required for a specific job role and devising a structured plan to acquire them.

Conventional approaches to career counselling are either prohibitively expensive or overly generic. Job portals such as LinkedIn and Naukri display required skills but do not offer personalised guidance tailored to an individual's existing knowledge. Massive Open Online Course (MOOC) platforms provide learning content but rarely help users determine where to begin based on their unique background.

Artificial intelligence, and specifically large language models (LLMs), offer a transformative opportunity in this space. LLMs possess broad knowledge of technology roles, skill taxonomies, and learning resources, and can reason contextually about individual skill profiles. This paper presents SkillBridge, a web application that harnesses these capabilities to deliver personalised skill gap analysis and learning roadmap generation via the Anthropic Claude API.

II. PROBLEM STATEMENT

Students and early-career professionals face the following key challenges in career development:

- Lack of clarity about which skills are required for a target job role.
- Absence of a personalised, structured learning plan aligned with their existing knowledge.
- Inability to distinguish between their strengths and skill deficiencies in a technical context.
- Dependence on expensive professional mentoring or generic online guidance.
- No mechanism to save, revisit, or track career analysis over time.

Existing solutions do not integrate all of the above capabilities in a single, free, AI-powered platform. SkillBridge addresses this gap comprehensively.

III. LITERATURE REVIEW

Several prior works have explored the intersection of artificial intelligence and career guidance. Kuo et al. [1] proposed an ontology-based skill matching system for job recommendation, but the approach relied on static knowledge bases that require manual updates. Cheng and Liu [2] examined the use of natural language processing (NLP) for extracting skills from job descriptions, demonstrating that NLP techniques outperform keyword-based methods. However, their work focused on extraction rather than gap analysis. Dillahun et al. [3] studied how low-income job seekers interact with online career tools and found that personalised guidance significantly improved engagement and outcomes. In the domain of LLM applications, Brown et al. [4] demonstrated that GPT-class models exhibit strong few-shot reasoning capabilities, including career and educational planning. Anthropic's Claude models [5] further advance alignment and instruction-following, making them suitable for structured output generation. To the best of our knowledge, no prior work has integrated LLM-powered skill gap analysis with persistent user account management and structured roadmap generation into a single deployable web application.

IV. PROPOSED SYSTEM

A. System Overview

SkillBridge is a three-tier web application composed of a Jinja2-based HTML/CSS frontend, a Python Flask backend, and an SQLite database. An external AI tier handles intelligent analysis via the Anthropic Claude API. Figure 1 illustrates the system architecture.

Tier	Component	Technology
Presentation	UI Templates	HTML5, CSS3, Jinja2
Application	Web Server & Logic	Python 3.10, Flask 3.0
Data	Persistent Storage	SQLite 3
AI	Gap Analysis & Roadmap	Anthropic Claude API
Security	Auth & Sessions	SHA-256, Flask Sessions

B. User Authentication Module

The authentication module supports user registration and login with SHA-256 password hashing. Flask's session management maintains authenticated state

across requests. All routes are protected by session checks; unauthenticated users are automatically redirected to the login page. Parameterised SQL queries are used throughout to prevent SQL injection attacks.

C. Skill Input and Analysis Module

Users provide three inputs:

- (1) a free-text description of their current skills,
- (2) a target job role, and
- (3) their experience level (beginner, intermediate, or advanced).

These inputs are embedded into a carefully engineered prompt and submitted to the Claude API. The prompt instructs the model to return a strict JSON object containing two keys: `gap_analysis` and `roadmap`.

D. AI Prompt Engineering

Prompt engineering is a critical component of the system. The prompt is structured to:

- (a) provide clear context about the user's background,
 - (b) specify the exact JSON schema for the response,
 - (c) instruct the model to avoid additional commentary.
- Markdown fences in the API response are stripped programmatically before JSON parsing to ensure robustness. The model used is `claude-opus-4-5`, selected for its strong instruction-following and structured output capabilities.

E. Gap Analysis and Roadmap Display

The parsed JSON is stored in the SQLite database and rendered via the result template. The gap analysis section displays missing skills with red indicators and existing strengths with green indicators in a two-column card layout. The roadmap section presents eight weekly cards, each containing: a week title, learning goal, specific topics, and free online resources. Week cards are colour-coded by phase (foundational, intermediate, advanced) using CSS border-left styling.

F. Dashboard and History

The dashboard lists all analyses previously generated by the authenticated user, displaying the target role, creation date, and a skill preview. Users can revisit any past analysis in full detail, enabling longitudinal career tracking.

V. SYSTEM DESIGN

A. Database Schema

The SQLite database contains two tables. The users table stores: id (primary key), username (unique), password (SHA-256 hash), and email. The analyses table stores: id, user_id (foreign key), current_skills, target_role, gap_analysis (JSON string), roadmap (JSON string), and created_at (timestamp).

B. Application Routes

Table II: Flask Application Routes

Route	Method	Description
/	GET	Landing page
/register	GET/POST	User registration
/login	GET/POST	User authentication
/dashboard	GET	User analysis history
/analyze	GET/POST	Skill input & AI call
/result/<id>	GET	Display analysis result
/logout	GET	Clear session

VI. IMPLEMENTATION

The application is implemented in approximately 200 lines of Python (app.py) and seven Jinja2 HTML templates. The Flask development server is used for local deployment; production deployment can be achieved using Gunicorn with a Nginx reverse proxy. The Anthropic Python SDK (version 0.40.0) is used for API communication. The API call is made synchronously within the POST handler of the /analyze route. Average API response time observed during testing was 4–8 seconds, during which a loading indicator is displayed to the user via JavaScript button state management. The frontend employs a dark-mode design system with CSS custom properties (variables) for colour theming, Inter and system fonts, and a card-based layout. No JavaScript framework is required; all interactivity is handled through server-side Flask routing.

VII. RESULTS AND DISCUSSION

A. Functional Testing

Table III: Functional Test Results

Test Case	Result
User registration & login	Pass
Duplicate username rejection	Pass
Invalid credential handling	Pass
AI gap analysis generation	Pass
JSON parse robustness	Pass
Dashboard history listing	Pass
Unauthorised route protection	Pass

B. Quality of AI Output

The Claude API consistently produced coherent, role-specific gap analyses and roadmaps across a variety of test inputs. For a user with "Python basics and Excel" targeting the role of "Data Scientist", the system correctly identified missing skills including Pandas, NumPy, Statistics, Machine Learning, and SQL, while recognising Python and data handling as existing strengths. The generated 8-week roadmap was logically sequenced, progressing from foundational to advanced topics.

C. Comparison with Existing Solutions

Table IV: Comparison with Existing Solutions

Feature	Job Portals	MOOC Platforms	SkillBridge
Personalised gap analysis	No	No	Yes (AI)
Structured roadmap	No	Partial	Yes
Free to use	Yes	Partial	Yes
Saves history	No	Yes	Yes
Account-based	Yes	Yes	Yes

VIII. FUTURE WORK

- Integration with live job postings via LinkedIn or Naukri APIs to dynamically extract skill requirements from real vacancies.
- Progress tracking: users can mark weekly milestones as complete within the application.
- PDF export of the learning roadmap for offline access.
- Email notification system for weekly learning reminders.
- Mobile application using React Native with the existing Flask REST backend.
- Multi-language support to make the tool accessible to regional language users across India.

IX. CONCLUSION

This paper presented SkillBridge, a full-stack AI-powered web application for personalised skill gap analysis and learning path generation. By integrating the Anthropic Claude large language model API with a Python Flask backend and SQLite database, the system delivers contextually relevant, role-specific career guidance that is both free and immediately actionable.

SkillBridge demonstrates the practical viability of LLM APIs in educational technology applications and serves as a scalable alternative to expensive professional career counselling. The system's modular architecture facilitates straightforward extension and deployment. Future enhancements will focus on dynamic job market integration, progress tracking, and mobile accessibility.

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