

UnitEd: An ML-Assisted Platform for Academic Team Formation

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Abstract - Team formation in academic environments such as colleges and universities is often inefficient due to limited visibility of individual skills, interests, and availability. Existing collaboration platforms primarily support communication after teams are formed and provide minimal assistance during the critical pre-team formation stage. This paper presents UnitEd, a college-centric, ML-assisted academic collaboration platform designed to address this gap by enabling opportunity-driven team formation for projects, research, and hackathons. UnitEd allows students and faculty to create structured opportunity posts specifying required skills and team composition. Using natural language processing and similarity-based ranking techniques, the system recommends suitable candidates and personalizes opportunity feeds for users. The platform further supports application management, invitations, real-time notifications, and dedicated collaboration chatrooms, thereby managing the complete collaboration lifecycle from discovery to execution. Experimental evaluation through case-based analysis demonstrates that UnitEd improves relevance in team matching and reduces manual effort in collaborator discovery. The proposed system highlights how applied machine learning can effectively enhance academic collaboration within institutional environments

Key Words: Academic collaboration, team recommendation, skill matching, machine learning, student-faculty networking.

1. INTRODUCTION

Collaboration is a core component of modern academic activities, including final-year projects, hackathons, research initiatives, and interdisciplinary learning. Despite its importance, students and faculty often struggle to identify suitable collaborators due to fragmented information about skills, interests, and prior experience. Team formation is frequently carried out through informal networks, personal contacts, or manual searches, which limits diversity, efficiency, and fairness in collaboration.

Existing platforms such as professional networking sites, messaging applications, and project repositories primarily focus on enabling communication and coordination after teams are formed. These platforms provide limited support for identifying the right collaborators based on opportunity-specific requirements

such as required skills, number of roles, and project objectives. As a result, the process of forming effective teams remains time-consuming and largely unstructured.

To address these limitations, this paper proposes UnitEd, an ML-assisted academic collaboration platform specifically designed for institutional environments. UnitEd emphasizes pre-team formation by introducing opportunity-centric recommendations that match users to projects based on skills and experience.

The key contributions of this work are:

- An opportunity-driven framework for academic team formation.
- Integration of machine learning-based skill matching and candidate ranking.
- Support for end-to-end collaboration lifecycle management for both students and faculty within a single platform

2. RELATED WORK

Academic collaboration and team formation have gained significant attention with the increasing need for interdisciplinary projects, research initiatives, and hackathons. Several studies have explored the development of digital platforms to facilitate collaboration among students and professionals. One such system, Collab Campus, provides a centralized platform for project sharing, event discovery, and communication, enabling students to collaborate more effectively within an academic ecosystem [3]. The platform improves visibility of opportunities and supports knowledge sharing; however, it lacks intelligent, AI-driven mechanisms for forming teams based on specific project requirements.

Similarly, Project Mate focuses on professional networking and collaboration by enabling users to search for potential collaborators using keyword-based matching and mutual interest mechanisms [2]. The system also incorporates real-time chat functionality to support communication after connections are established. While this approach simplifies networking and interaction, it primarily relies on user-driven discovery and does not provide automated or context-aware team formation based on defined opportunities.

Several project-sharing platforms have also been proposed to enhance collaboration and knowledge exchange among students by providing centralized repositories and structured project management systems [5]. These systems improve project visibility and access to academic work; however, they mainly focus on content sharing and lack intelligent recommendation mechanisms for team formation.

Recent advancements have introduced artificial intelligence techniques to improve recommendation and matching processes. The AI-Driven Student Networking Portal (Campus Core) utilizes machine learning approaches such as collaborative filtering, content-based filtering, and NLP-based search to recommend connections based on user profiles, skills, and interests [4]. While this enhances recommendation quality, the system remains profile-centric and does not align recommendations with specific project requirements.

A more advanced approach is presented in the ULTRA system, which applies a data-driven methodology for team formation in response to proposal calls [1]. The system uses natural language processing techniques to extract and normalize skills from multiple sources and match them with opportunity requirements under defined constraints. This demonstrates the effectiveness of opportunity-driven team formation but is primarily designed for research funding scenarios rather than student-level collaboration.

Despite these contributions, existing systems either focus on networking, project sharing, or recommendation independently, without addressing the complete lifecycle of collaboration. Most platforms do not support opportunity-driven team formation, nor do they provide integrated workflows for application management and team communication. To address these limitations, the proposed UnitEd platform introduces an AI-assisted, opportunity-centric approach that combines intelligent candidate recommendation, structured opportunity posts, application handling, and dedicated collaboration chatrooms within a unified system.

3. SYSTEM ARCHITECTURE OVERVIEW

UnitEd follows a layered and modular system architecture that clearly separates user interaction, application logic, machine learning-based recommendation, and data management. This design supports the complete academic collaboration lifecycle, ranging from opportunity discovery and team formation to communication and coordination. As illustrated in Figure 1, the overall architecture is composed of four primary components: the frontend architecture, backend architecture, machine learning model architecture, and database architecture.

3.1 Frontend Architecture

The frontend layer provides a web-based interface for students and faculty members, enabling intuitive interaction with the platform. It supports role-based access by presenting personalized views such as dashboards, opportunity feeds, post creation and management interfaces, application and invitation workflows, real-time chatrooms, and discussion forums. This layer is responsible for dynamic content rendering and securely communicates with backend services through RESTful APIs. Personalization is reflected in skill-matched recommendations, candidate views, and notification displays.

3.2 Backend Architecture

The backend layer implements the core application logic and manages all request-response interactions. It is organized into an HTTP and middleware layer, a routes layer, and a services layer. The middleware layer handles authentication, authorization, request validation, and error management. The routes layer defines API endpoints and directs requests to appropriate handlers. The services layer encapsulates business logic such as opportunity lifecycle management, application and invitation processing, notification generation, chatroom coordination, and data preparation for the recommendation engine. This separation of concerns improves scalability, maintainability, and extensibility.

3.3 ML Model Architecture

The UnitEd recommendation system is designed as a modular pipeline that transforms heterogeneous user and opportunity data into meaningful, ranked recommendations. The architecture consists of four primary stages: data representation, feature extraction, similarity computation, and ranking, with additional support for model management and seamless system integration.

Data Representation Layer:

The system begins by structuring raw data into well-defined entities representing students and opportunity posts. A student profile encapsulates attributes such as academic department, technical skills, interests, programming languages, research domains, and graduation year. These attributes collectively describe the student's competency and preferences. An opportunity post represents collaboration or project offerings and includes attributes such as required skills, preferred skills, department, purpose (research or project), and descriptive keywords. This structured representation ensures consistency and enables downstream processing for similarity-based matching.

Feature Extraction Module:

To enable machine learning operations, textual and categorical attributes are transformed into numerical feature vectors. A global vocabulary is constructed from all unique terms extracted across student profiles and opportunity posts, including skills, interests, and keywords. Each entity is then mapped into a high-dimensional vector space based on this vocabulary. A weighted term encoding strategy is employed to reflect the relative importance of different attributes. For student profiles, technical skills are assigned the highest weight, followed by interests and department. Similarly, for opportunity posts, required skills are prioritized over preferred skills and descriptive metadata. This weighting mechanism ensures that critical matching factors such as required competencies have a stronger influence on the final recommendation.

Similarity Computation:

Once vector representations are generated, the system computes the relevance between a student profile and an opportunity post using cosine similarity

$$Similarity = \frac{A \cdot B}{|A||B|}$$

Here, A and B denote the vector representations of the student profile and opportunity post, respectively. This metric measures the angular similarity between the two vectors in the feature space, making it robust to differences in magnitude.

Similarity scores range from 0 to 1, where higher values indicate stronger alignment between a student’s profile and the opportunity requirements.

Ranking Engine:

Following similarity computation, the system ranks all available opportunities for a given student. The process involves computing similarity scores for each opportunity, sorting them in descending order, and selecting the top-K results. This produces a prioritized list of recommendations tailored to the student’s profile. The same mechanism is applied in reverse for candidate recommendation, where student profiles are ranked against a given opportunity to identify the most suitable applicants.

3.4 Database Architecture

The database layer stores structured data required for user management, opportunity handling, and collaboration workflows. It includes entities for users, posts, applications, invitations, chatrooms, messages,

notifications, and forums. The schema follows an opportunity-centric design in which the post entity acts as the central node connecting users and collaboration artifacts, enabling efficient querying and maintaining referential integrity across the system.

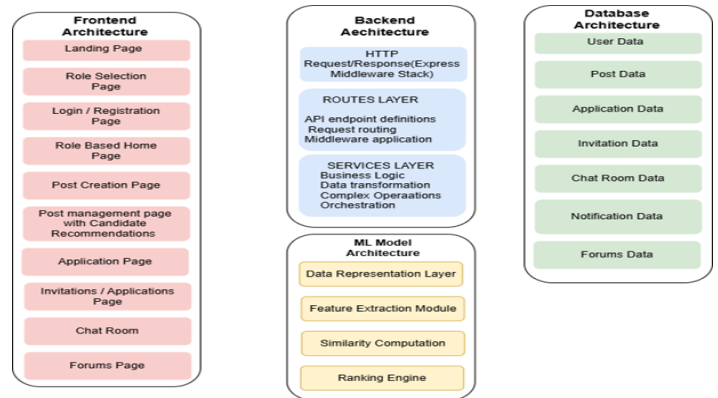


Fig-1: UnitEd Project Architecture

4. USER ROLES AND WORKFLOWS

UnitEd supports role-based interaction to enable structured academic collaboration. The primary roles are students and faculty, while administrative functions are limited to system maintenance. Users register through a multi-step process, selecting roles and providing academic and skill-based profile information. Authentication is enforced using secure credential storage and token-based session management, after which users access role-specific dashboards.

Both students and faculty can create collaboration opportunities by specifying project details, required skills, and timelines. However, only students can apply to opportunities or be invited as candidates. Opportunity creators manage applications, send invitations, and coordinate team formation. Selected students are added to project teams with access to dedicated chatrooms for collaboration.

As illustrated in Fig. 2, this opportunity-centric workflow ensures transparency, reduces manual coordination, and supports efficient team formation and collaboration.

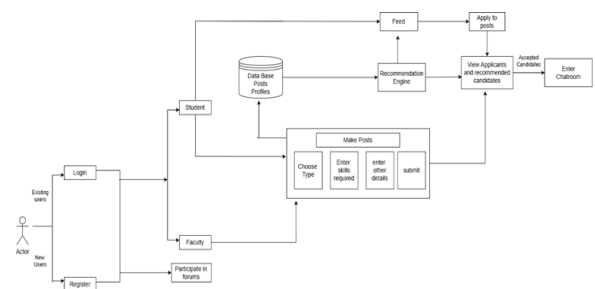


Fig-2: UnitEd user workflow

5. RESULTS

Here a few outcomes from the UnitEd application:

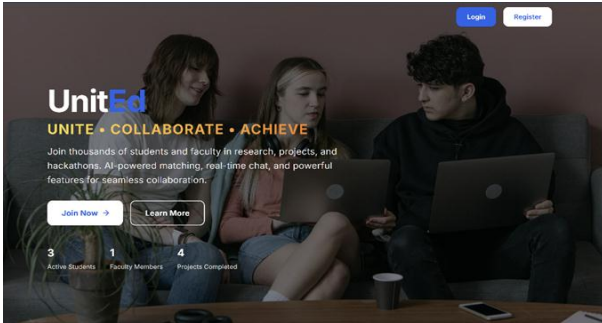


Fig-3: Landing Page

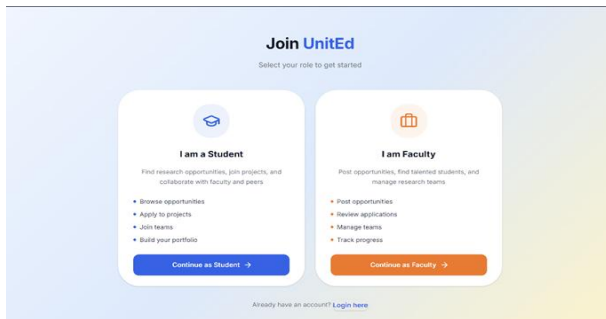


Fig-4: Role Selection Page during registration

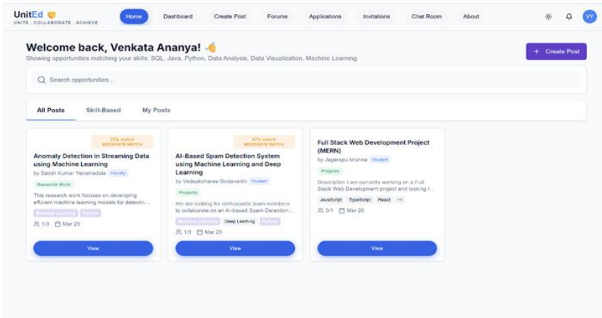


Fig-5: Home Page

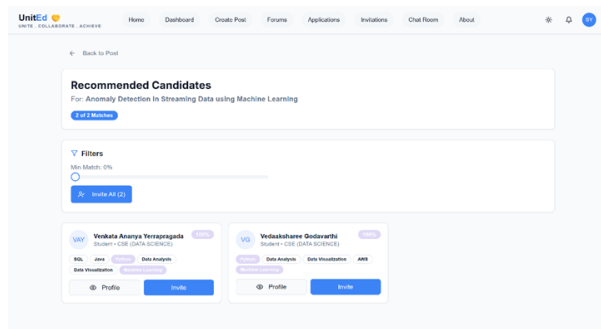


Fig-6: Recommended Candidates Page

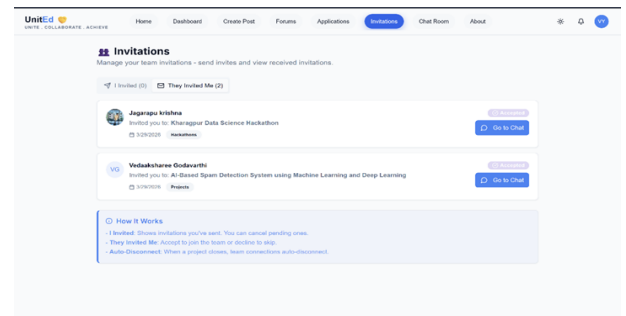


Fig-7: Invitations Page

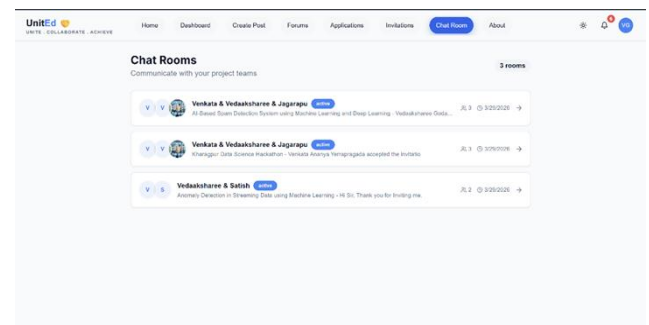


Fig-8: Chat Room Page

6. FUTURE SCOPE

Future versions of the UnitEd platform can be enhanced by integrating video conferencing functionality within the collaboration chatroom, enabling team members to conduct meetings, discussions, and project reviews directly without relying on external tools. The system can also be extended to include a GitHub-like project collaboration environment, allowing users to upload files, manage versions, and collaboratively work on code or documents, thereby improving project organization and efficiency. Additionally, the platform can be expanded to support cross-institution collaboration, enabling students and faculty from multiple universities to participate in joint projects and research initiatives. Gamification features such as badges, leaderboards, and achievement points can be introduced to increase user engagement and motivate active participation. Further improvements may include the integration of advanced machine learning models for recommendation and ranking, considering factors such as user preferences, collaboration history, and project outcomes to provide more accurate and personalized suggestions. Moreover, the platform can be extended to support faculty-to-faculty collaboration, allowing faculty members to connect based on research interests, co-author publications, share ideas, and collaborate on funded projects, thereby promoting interdisciplinary research and strengthening academic networks.

CONCLUSION

UnitEd is an AI-assisted academic collaboration platform designed to simplify team formation for projects, research, and hackathons. It replaces informal collaboration methods with a structured system that enables opportunity posting, personalized recommendations, candidate matching, and communication through dedicated chatrooms. By combining secure authentication, profile management, and intelligent matching, UnitEd improves visibility of opportunities, supports interdisciplinary teamwork, and enables efficient academic collaboration.

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