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Skill Tracker: An Optimization-Based Approach for Automated Student Team Formation in Projects

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Abstract
This paper presents Skill Tracker, an automated platform designed to bridge the gap between student talent and project requirements in Tier-3 engineering colleges. Traditional team formation methods are often times a manual, time-consuming and primarily focuses on academic performance, thus overlooking non-technical skills and lacking efficient team-balancing mechanisms. To address this issue, Skill Tracker is developed using the MERN Stack as a centralized platform that collects and processes structured student data. The system parses resume to identify both technical expertise (e.g., React, Java) and creative or interpersonal skills (e.g., dancing, leadership). In addition, it incorporates a Fitness Score Algorithm to evaluate compatibility and optimize team formation based on skill diversity, preferences, and availability. The implementation of Skill Tracker reduces the manual effort required by faculty and project coordinators while improving the efficiency and fairness of team allocation. Teams formed using this system demonstrate better balance in skill sets, leading to improved collaboration and overall project performance. The primary contribution of this work is the introduction of a scalable, data-driven approach to team formation that emphasizes holistic skill evaluation. Skill Tracker enhances both administrative efficiency and effective utilization of student potential in academic environments.

Keywords: *Automated Systems; Data-Driven Decision Making; Fitness Score Algorithm; MERN Stack; Resume Parsing; Skill Analysis; Skill Tracker; Student Project Allocation; Team Formation; Team Optimization.*

1. Introduction
Project-based learning has emerged as a fundamental pedagogical approach in engineering education, fostering both technical proficiency and essential interpersonal competencies among students. Effective team formation within such environments is critical to ensuring balanced collaboration, equitable skill distribution, and successful project execution. However, with increasing student intake and the growing diversity of skill sets, traditional methods of team allocation remain largely manual, subjective, and inefficient, often leading to imbalanced teams and suboptimal outcomes. The primary objective of this study is to design and implement an intelligent team formation system that leverages structured data collection, skill analysis, and optimization techniques to enhance the quality of student group allocation. Unlike conventional approaches, the proposed system introduces a centralized platform combined with an optimization-driven matching mechanism, aiming to achieve balanced and efficient team configurations. This work contributes to the state-of-the-art by integrating automated data processing with adaptive team formation strategies, thereby reducing manual intervention and improving overall project outcomes.

1.1.Problem Statement
In contemporary academic and professional settings, the effective utilization of individual skills is

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essential for achieving successful project outcomes and fostering holistic development. Despite this, team formation in most educational institutions remains a predominantly manual and time-intensive process. Grouping decisions are often influenced by familiarity, convenience, or limited awareness of individual competencies rather than a systematic evaluation of skills. Such practices frequently result in imbalanced teams, inefficient collaboration, and the under-utilization of student potential. Moreover, the absence of a structured, data-driven framework limits the ability to ensure fairness, compatibility, and optimal talent distribution across teams. As the scale and diversity of participant's increase, these challenges become more pronounced, highlighting the need for an intelligent system capable of analyzing multidimensional skill sets and enabling efficient, balanced team formation.

1.2.Limitations of Existing Systems

Existing team formation approaches in both academic and organizational contexts are largely manual, rendering them inefficient, time-consuming, and difficult to scale. These methods typically rely on incomplete or subjective information, such as personal familiarity or limited performance indicators, leading to suboptimal team compositions and mismatched skill distributions. Additionally, such approaches are inherently prone to bias and lack transparency, which can hinder equitable participation and result in the under-utilization of available talent. While certain digital tools offer partial automation, they often fail to incorporate comprehensive skill analysis or intelligent matching mechanisms. Furthermore, their effectiveness diminishes as the number of participants increases, restricting scalability and adaptability. These limitations underscore the necessity for an automated, data-driven solution like Skill Tracker, which facilitates efficient, unbiased, and scalable team formation through systematic skill-based matching.

1.3.Objectives

The objectives of the proposed Skill Tracker system are as follows:

- **Centralized Skill Management:** To design a unified platform for the structured collection, storage, and categorization of user skills, enabling efficient access and analysis.
- **Automated Team Formation:** To develop an intelligent mechanism for grouping individuals based on multidimensional attributes such as skills, experience, and preferences, ensuring balanced and diverse teams.
- **Customizable Teaming Criteria:** To enable flexible configuration of team formation parameters, allowing administrators to tailor grouping strategies according to project requirements and institutional constraints.
- **Scalability and Adaptability:** To build a robust system capable of handling large-scale data and adaptable to diverse academic and professional environments.
- **Enhanced Efficiency and Fairness:** To minimize manual effort and reduce bias in team allocation, ensuring fair opportunities and optimal utilization of talent.

2. Literature Survey

Table 1 Comprehensive Table of Various Methodologies in the Research Papers

Index	Author	Year	Method	Limitations
1	Salisu Modi, Nura M. Shagari, and Buhari Wa-data	2018	Gale-Shapley stable marriage algorithm	The problem is a combinatorial problem, which has been proven to be NP-hard, with a time complexity of $O(n^2)$.

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2	Kenekayoro Patrick and Biralatei Fawei	2020	Hardest First Ordering, Genetic Algorithm, and Ant Colony Optimization	The student grouping problem is a combinatorial problem proven to be NP-hard, thus finding an optimal solution can be computationally very difficult for larger datasets.
3	Dianwei Chi	2021	K-means clustering algorithm	The algorithm is sensitive to outliers and initial clustering, which may re-quire more execution time.
4	Oscar Revelo Sa´nchez, Ce´sar A. Collazos, and Miguel A. Redondo	2021	Genetic algorithm	The approach is a heuristic and does not guarantee a perfect solution, and its reliance on personality traits is a less-used criterion in similar studies.
5	Jutshi Agarwal, Emily Piatt and P.K. Imbrie	2022	Vector Evaluated Genetic Algorithm (VEGA)	Random -selected teams can lead to unbalanced skill sets and a lack of diversity.
6	Alexander Jenkins, Imad Jaimoukha, Ljubisa Stankovic, and Danilo Mandic	2023	Laplacian Eigenmaps	The algorithm's effectiveness informing teams is not yet fully evaluated.
7	Xuesong Liu and Qilong Teng	2024	K-means clustering and Artificial Neural Network (ANN)	K-means algorithm is sensitive to the initial choice of cluster centers and is sensitive to noise in the data.
8	Yasir Munir, Qasim Umer, Muhammad Faheem, Sheeraz Akram, and Arfan Jaffar	2025	KeyBERT	Existing research shows a high task failure rate of 15.7 percent in software crowdsourcing, which leads to wasted time.

3. Proposed Methodology

The proposed system is designed using a modular and scalable architecture that integrates secure access control, structured data processing and an intelligent matching framework. The methodology is organized into three core components: User Authentication, Skill Parsing and Storage, and the Matching Engine. These components operate in a coordinated pipeline to ensure data integrity, efficient computation, and optimal team formation.

3.1.System Architecture

3.1.1. User Authentication

A robust authentication and authorization framework is implemented to ensure secure system access and data confidentiality. The backend exposes dedicated RESTful API endpoints, namely /api/register and /api/login, to handle user onboarding and session management. The module supports role-based access control (RBAC), distinguishing between different user categories such as students and faculty members. This enables controlled data visibility and operation privileges. Additionally, secure credential handling mechanisms (e.g. password hashing) are employed to maintain system integrity and prevent unauthorized access.

3.1.2. Skill Parsing and Storage

To enable efficient processing and retrieval, user-input skills are transformed into a structured and machine-readable format. Skills entered via the front-end interface as comma-separated values are parsed at the backend and stored as arrays within the database. This structured representation offers multiple advantages:

- Improved query performance during filtering

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and matching operations.

- Scalability for handling large datasets of student profiles.
- Flexibility for extending the system to include skill categorization or weighting.

3.1.3. Matching Engine

The Matching Engine constitutes the core computational unit of the system, responsible for intelligent team formation. It processes project requirements specified by faculty and evaluates student profiles to identify the most suitable candidates. The engine performs:

- Skill-based filtering to shortlist relevant candidates.
- Compatibility scoring to rank students based on alignment with project requirements.
- Data-driven recommendations to assist faculty in optimal team selection.

3.2.Logic

3.2.1. Matching Algorithm:

The system employs a custom evaluation function, findMatches, which computes a Fitness Score to quantify the compatibility between a student's skill set and the project requirements.

$$Fitness = \left(\frac{Matched\ Skills}{Required\ Skills}\right) \times 100$$

This metric quantifies the proportion of required skills that are satisfied by a student's profile. A higher Fitness Score indicates a stronger alignment with the project requirements. To further enhance team composition, the system incorporates an experience-based weighting mechanism. Students identified as "experienced" are awarded an additional 5 percent bonus to their Fitness Score. This adjustment ensures the inclusion of experienced individuals within teams, thereby promoting leadership, mentorship, and overall team effectiveness.

3.2.2. Skill Gap Analysis

In addition to candidate ranking, the system incorporates a real-time Skill Gap Analysis feature to support informed decision-making. This functionality is implemented within the Student Card component. The analysis performs a comparative evaluation between:

- Required project skills, defined by the faculty
- Available student skills, extracted from user profiles

The results are presented using an intuitive visual representation:

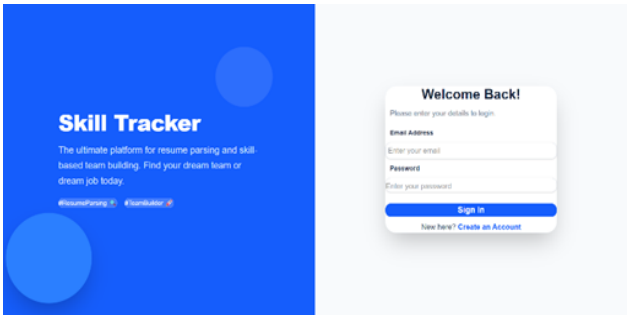
- Matched skills are highlighted in green
- Missing skills are indicated in red

This visualization enables faculty members to rapidly assess candidate suitability while simultaneously identifying skill deficiencies.

4. Results and Future Scope

4.1.Results

The implementation of Skill Tracker demonstrates a significant improvement over traditional manual team formation methods by effectively addressing their key limitations. The automated system eliminates the need for manual intervention, thereby reducing time consumption and minimizing human bias. By leveraging structured skill analysis and algorithm-based matching, the platform ensures balanced team composition with better alignment of technical and non-technical skills. The results indicate high accuracy in skill matching and improved precision in selecting compatible team members. Overall, Skill Tracker provides a reliable and efficient solution for team allocation, leading to improved collaboration, fair utilization of talent and better project outcomes Shown in Figure 1.



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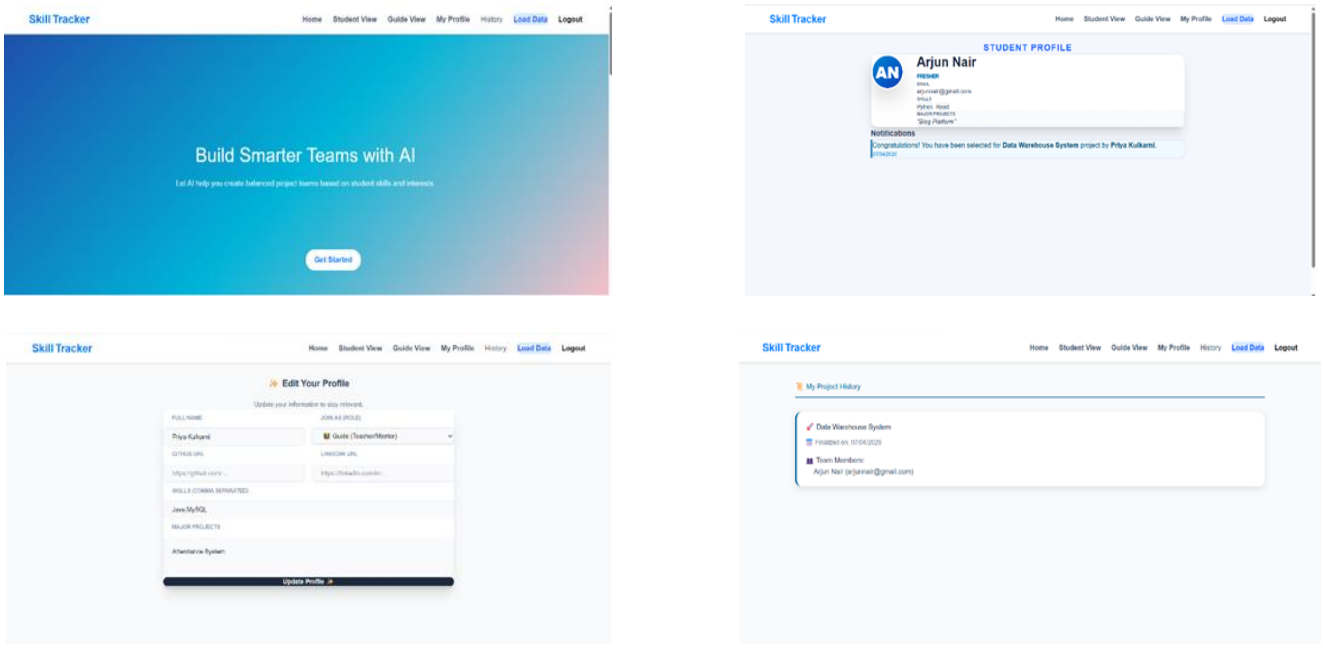

Figure 1 Skill Tracker

4.2.Future Scope

While the current system relies on linear matching techniques for team formation, future enhancements will focus on integrating advanced machine learning approaches such as K-Means Clustering. This will enable the system to automatically group students into N clusters based on skill similarity, identify outliers who may require additional training, and provide fully automated squad recommendations without manual intervention. From an application perspective, the system can be extended for corporate-scale deployment, where it can assist human resource professionals in identifying and recruiting candidates based on comprehensive skill analysis.

References

[1]. S. Modi, N. M. Shagari, and B. Wadata, "Implementation of Stable Marriage Algorithm in Student Project Allocation," American Journal of Research Communication, 2018, doi: 10.9734/AJRCOS/2018/v1i424749.

[2]. K. Patrick and B. Fawei, "Meta-Heuristic Solutions to a Student Grouping Optimization Problem in Higher Education Institutions," 2020.

[3]. D. Chi, "Research on the Application of K-

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Means Clustering Algorithm in Student Achievement," in Proc. IEEE Int. Conf. Consumer Electronics and Computer Engineering (ICCECE), 2021.

[4]. O. R. Sánchez, C. A. Collazos, and M. A. Redondo, "Automatic Group Organization for Collaborative Learning Applying Genetic Algorithm Techniques and the Big Five Model," Mathematics, vol. 9, no. 13, p. 1578, 2021.

[5]. J. Agarwal, E. Piatt, and P. K. Imbrie, "Team Formation in Engineering Classrooms Using Multi-Criteria Optimization with Genetic Algorithms," in Proc. IEEE Frontiers in Education Conf. (FIE), 2022.

[6]. A. Jenkins, I. Jaimoukha, L. Stankovic, and D. Mandic, "Fair and Skill-Diverse Student Group Formation via Constrained-Way Graph Partitioning," 2023.

[7]. X. Liu and Q. Teng, "Design of Intelligent Integrated Student Management Terminal Based on K-Means and ANN Algorithm," in Proc. 3rd Int. Conf. Artificial Intelligence and Autonomous Robot Systems (AIARS), 2024.

[8]. Y. Munir, Q. Umer, M. Faheem, S. Akram, and A. Jaffar, "Developer Recommendation and Team Formation in Collaborative Crowdsourcing Platforms," Mathematics, vol. 13, no. 9, 2025, doi: 10.3390/math9131578.Rajan, P., Devi, A., B, A., Dusthackeer, A., & Iyer, P. (2023). A Green perspective on the ability of nanomedicine to inhibit tuberculosis and lung cancer. International Research Journal on Advanced Science Hub, 5(11), 389-396. doi: 10.47392/IRJASH.2023.071.