A Project Report

On

OmniRank: One Handle To Rule Them All

For The Course

3rd Year 1st Semester Final Project

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Declaration

We hereby declare that the project titled **"OmniRank: One Handle To Rule Them All"** submitted to the Department of Information and Communication Technology, Mawlana Bhashani Science & Technology University, is a record of original work done by us under the supervision of **Dr. Ziaur Rahman**. This project has not been submitted previously for the award of any other degree or diploma to this or any other university.

SignatureofSupervisor

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Abstract

In the modern era of computer science education, competitive programming (CP) plays a pivotal role in developing problem-solving skills and algorithmic thinking. However, the CP ecosystem is highly fragmented, with students practicing across multiple isolated platforms such as Codeforces, LeetCode, AtCoder, CodeChef, and CSES. This fragmentation makes it difficult for students to track their cumulative progress and for recruiters to assess a candidate's holistic potential.

OmniRank is a centralized web-based aggregation system designed to solve this problem. It serves as a unified dashboard that fetches, normalizes, and visualizes user submission data from five major coding platforms. The system utilizes a hybrid data acquisition strategy, combining public REST/GraphQL APIs with secure web scraping (Jsoup) to ensure comprehensive coverage.

Key features include a ”Glassmorphism” UI for analytics, an automated activity streak tracker, and a rule-based AI recommendation engine that suggests problems based on the user’s historical performance. Built using **Java Spring Boot, MySQL, and Thymeleaf**, OmniRank provides a robust, scalable solution for tracking academic and professional growth in programming.

Acknowledgement

First and foremost, we express our deepest gratitude to the Almighty for giving us the strength and ability to complete this project successfully.

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We also thank our parents and friends for their encouragement and support during the difficult phases of this work.

Contents

Abbreviations & Acronyms

Acronym	Definition
API	Application Programming Interface
CSS	Cascading Style Sheets
DOM	Document Object Model
HTML	HyperText Markup Language
HTTP	Hypertext Transfer Protocol
ICT	Information and Communication Technology
IDE	Integrated Development Environment
JPA	Java Persistence API
JSON	JavaScript Object Notation
JWT	JSON Web Token
MCQ	Multiple Choice Question
ORM	Object-Relational Mapping

REST	Representational State Transfer
SPA	Single Page Application
SQL	Structured Query Language
UI/UX	User Interface / User Experience

Chapter 1

Introduction

1.1 Background of the Study

Competitive programming has evolved from a niche hobby to a critical component of the modern technical interview process and skill development framework. Industry giants like Google, Meta, and Amazon routinely use problems from platforms like LeetCode in their hiring. This has led to an explosion in user bases, with LeetCode alone hosting over 10 million users and Codeforces holding regular contests with 30,000+ global participants.

However, this proliferation has created a **fragmented digital identity** for the aspirant. A student may have a ”Candidate Master” rating on Codeforces, a ”Knight” badge on LeetCode, and a 3-star rating on CodeChef—each representing a different facet of their problem-solving ability, scattered across disparate ecosystems. There is no holistic, verifiable, and standardized ”GitHub for Competitive Programming” that aggregates a user’s entire journey, skill matrix, and intellectual growth across these siloed platforms. This fragmentation obscures a true understanding of one’s comprehensive strengths and weaknesses.

1.2 Problem Statement

The current ecosystem for competitive programmers suffers from three interconnected and critical deficiencies:

1. **Operational Inefficiency & Context Switching:** Users are forced to manually log in, navigate, and maintain profiles on 4-5 different websites, each with its own UI, rating system, and tracking methodology. This constant context

switching drains cognitive resources and discourages comprehensive progress tracking.

2. **Incomplete Professional Portrait:** For recruiters and technical interviewers, assessing a candidate's true algorithmic prowess is a manual, investigative process. A candidate with 300 solved problems across 3 platforms is objectively more experienced than one with 200 on a single platform, but this is not immediately apparent. There is a clear market need for a unified, shareable "CP Resume".

3. **Blind Spots in Skill Development:** Without cross-platform analytics, learners operate with an incomplete diagnostic. A user might be strong in Dynamic Programming on LeetCode but weak in its graph-based applications on Codeforces. This lack of a centralized heatmap of skills leads to unconscious neglect of certain topics.

1.3 Objectives

Primary Objectives

- To design and develop a full-stack, responsive web application using Spring Boot (Backend) and React/Vue.js (Frontend) that serves as a unified dashboard for competitive programmers.

- To create a robust, modular data aggregation layer that integrates with native APIs (LeetCode, Codeforces) and implements efficient web scrapers using Jsoup and Selenium for platforms without public APIs.

- To architect a Unified Database Schema that normalizes key entities—User, Problem, Submission, and Contest—enabling consistent querying.

- To implement a data-driven, intelligent recommendation engine that analyzes a user's historical performance to suggest personalized practice problems.

Secondary Objectives

- To incorporate social and comparative features, such as the ability to follow other users.

- To provide advanced visual analytics, including interactive charts for rating trends over time.
- To ensure system scalability and performance through strategic caching mechanisms.

1.4 Scope of the Project

In-Scope

- **Platforms:** Aggregation from five core platforms: Codeforces, LeetCode, AtCoder, CodeChef, and CSES Problem Set.
- **Core User Journey:** Registration, secure OAuth/linking of profiles, automated data synchronization, and personalized dashboards.
- **Core Analytics:** Unified problem counts, rating graphs, topic-wise breakdown.
- **Recommendation System:** A foundational content-based model.
- **Deployment:** Functional web application deployed on a cloud service.

Out-of-Scope

- Development of native mobile applications (iOS/Android).
- Real-time contest simulation or integrated IDE.
- Direct hosting of contests.
- Support for niche regional platforms beyond the initial five.

Future Scope

- **Mobile App:** Development of React Native/Flutter applications.
- **Expanded Platform Support:** Integration with HackerRank, TopCoder, etc.
- **Smart Notifications:** Alerts for upcoming contests and practice goals.
- **Advanced AI Features:** Predictive analytics for rating forecasts.

Chapter 2

Literature Review

2.1 Existing Systems

Several platforms currently exist that aggregate competitive programming data and track users' problem-solving activity across online judges. One such popular tool is **StopStalk**, which allows users to monitor the submissions and ratings of their friends. While effective for basic tracking, StopStalk's user interface is relatively outdated and primarily emphasizes social comparison and "stalking" behavior rather than providing meaningful personal analytics.

Another notable platform is **Kenkoooo's AtCoder Problems**, which offers indepth analysis, problem statistics, and progress tracking for AtCoder users. Although it excels in its domain, it is limited to a single platform and does not support other widely used online judges such as LeetCode, CodeChef, or Codeforces.

2.2 Limitations of Existing Systems

Despite their usefulness, most existing competitive programming aggregators suffer from several common limitations. A major issue is frequent downtime or inconsistent data availability, often caused by strict API rate limits imposed by online judges. Many systems lack robust fallback mechanisms. Additionally, these platforms often fail to provide a modern, responsive, and user-friendly interface. More importantly, current solutions generally lack personalized analytics and intelligent problem recommendations.

2.3 Proposed Solution

To address these challenges, **OmniRank** is proposed as a unified and intelligent competitive programming analytics platform. OmniRank introduces a modern, responsive user interface built with Tailwind CSS. At its core, OmniRank employs a Hybrid Fetching Engine designed to handle API rate limits gracefully by combining scheduled data fetching, caching, and fallback mechanisms. Furthermore, OmniRank

focuses on personal growth rather than social comparison, offering AI-driven problem recommendations tailored to the user's strengths.

Chapter 3

System Analysis

3.1 Functional Requirements

3.1.1 User Module

- The system shall allow new users to register using their email address and a secure password.
- The system shall allow registered users to log in with their credentials.
- The system shall allow users to connect and unlink external competitive programming accounts (Codeforces, LeetCode, etc.).
- The system shall allow users to update their basic profile information.

3.1.2 Dashboard & Analytics Module

- The system shall display a unified summary card showing the aggregated total of solved problems.
- The system shall provide a platform-wise breakdown showing solved count, rating, and rank. • The system shall display an interactive activity graph visualizing daily submission counts.
- The system shall present detailed topic-wise analysis.

3.1.3 Data Aggregation Module

- The system shall automatically fetch and synchronize user data upon login.
- The system shall perform scheduled background synchronization.
- For platforms with a public API, the system shall fetch data via HTTP requests (JSON).

- For platforms without a public API, the system shall fetch data via web scraping (HTML parsing).
- The system shall clean, normalize, and store all fetched data.

3.1.4 AI Recommendation Module

- The system shall analyze the user's history to identify strong and weak topics.
- The system shall generate personalized lists of recommended problems.
- The system shall allow filtering by target platform, topic, or difficulty.

3.2 Non-Functional Requirements

3.2.1 Performance & Scalability

- The backend, built with Spring Boot, shall handle concurrent requests efficiently via multi-threading.
- The dashboard page shall load within 3 seconds under normal load.
- The system shall implement caching (Redis/In-memory) to reduce database load.

3.2.2 Security

- Passwords shall be encrypted using a strong hashing algorithm (e.g., BCrypt).
- The system shall use parameterized queries via JPA to prevent SQL injection.
- API keys shall be managed using environment variables.

3.2.3 Availability & Reliability

- The core application shall remain functional even if external platforms are down.
- Aggregation processes shall feature retry logic and fallback mechanisms.

3.2.4 Usability

- The interface shall be responsive for desktop, tablet, and mobile.
- The UI shall be intuitive with clear navigation.

Chapter 4

System Design

4.1 System Architecture

The architecture follows the Model-View-Controller (MVC) pattern. The Client (Browser) sends requests to the Spring Boot Controller. The Controller calls the Service Layer (Aggregator), which fetches data from External APIs and stores it in the MySQL Database. The View is rendered using Thymeleaf.

4.2 Entity Relationship (ER) Diagram

Entities: User (id, name, password), PlatformHandle (user id, platform name, handle), UnifiedProblem (id, title, difficulty, link).
Relationships: One User has Many PlatformHandles (1:N).

4.3 Database Schema

Table 4.1: Users Table

Field	**Type**	**Constraint**
id	BIGINT	PRIMARY KEY, AUTO INCREMENT
username	VARCHAR	UNIQUE, NOT NULL
password	VARCHAR	NOT NULL

Table 4.2: Platform Handle Table

Field	**Type**	**Constraint**
id	BIGINT	PRIMARY KEY
user_id	BIGINT	FOREIGN KEY (Users)
platform	VARCHAR	(e.g., ”Codeforces”)
handle	VARCHAR	(e.g., ”It22032”)

Chapter 5

Implementation & Technology

5.1 Technology Stack

The application is built using a modern, robust, and layered technology stack designed for reliability, maintainability, and performance.

Core Language & Runtime

Java 17 (LTS): Selected as the primary programming language for its strong, static type system, which enhances code safety and maintainability.

Application Framework

Spring Boot 3.4.1: The foundation of the backend application. Enables rapid development and production-ready setups with minimal configuration.

Presentation Layer (Frontend)

Thymeleaf: A modern, server-side Java template engine for rendering dynamic HTML content.
Tailwind CSS: A utility-first CSS framework used for styling.

Data Persistence

MySQL 8.0: Chosen for its proven reliability and efficient handling of structured data.
Hibernate (JPA): Simplifies database interactions by mapping Java objects to database tables.

Build & Utilities

Maven: Project build automation and dependency management.
Jsoup: Utilized for web scraping and parsing HTML documents.
Project Lombok: Reduces boilerplate code via annotations.

5.2 Key Algorithms & Core Logic

5.2.1 The Hybrid Scraper (CodeforcesService.java)

This component is responsible for fetching a user's submission history from the Codeforces API.

- **API Request:** Uses Spring's RestTemplate to send an HTTP GET request.
- **Streaming Parsing:** JSON is parsed in a streaming fashion to prevent memory issues with large payloads.
- **Data Filtering:** Retains only submissions with a "verdict" of "OK".
- **Optimization:** Processes only the most recent 2000 submissions to prevent timeouts.

5.2.2 The Recommendation Engine

This is the core intelligence module that analyzes a user's history.

1. **Retrieve Solved Problems:** Fetches all problems previously solved by the user.
2. **Calculate Proficiency Baseline:** Calculates the "Recent Average Rating" of the user's N most recently solved problems.
3. **Determine Target Difficulty:** $TargetRating = RecentAverageRating + \Delta$ (where Δ is typically 200).
4. **Query for Candidates:** Finds problems where $rating \geq TargetRating$ and the problem ID is NOT in the user's solved list.
5. **Result Delivery:** Returns the recommended problem to the dashboard.

Chapter 6

Results & Discussion

This section details the key features of the implemented system and provides a performance analysis to validate its operational efficiency.

6.1 User Interface

Unified Dashboard

The unified dashboard serves as the primary user interface. It consolidates data into a single view. The **Total Solved Problems Card** prominently displays the aggregated count (e.g., ”770 Solved Problems”), validating the backend aggregation algorithms.

Detailed Analytics View

This view allows users to drill down into their submission history.

- **Submissions Data Table:** Lists Problem Name, Platform, Date, Rating, and Verdict.
- **Advanced UI/UX:** Features pagination, dynamic sorting, and ”Glassmorphism” styling for a modern aesthetic.

6.2 Performance Testing

A structured performance test was conducted to evaluate the system’s stability.

- **Load Simulation:** Simulated 5 concurrent users performing typical dashboard actions.
- **Caching Strategy:** The analysis showed minimal impact from external API latency (400ms) due to the multi-tiered caching mechanism (Database persistence and Application-level caching).
- **Conclusion:** The system meets design objectives for responsiveness, with sub50ms database queries.

Chapter 7

Conclusion & Future Scope

7.1 Conclusion

OmniRank successfully achieves its primary objective of creating a centralized platform for competitive programming analytics. The project eliminates cumbersome manual tracking and provides a unified interface.

- **Centralization:** Aggregates statistics from structured APIs and unstructured web sources.
- **Personalized Guidance:** Implements an adaptive recommendation engine based on recent performance.
- **Technical Proficiency:** Demonstrates robust full-stack development using Spring Boot, JPA, and Thymeleaf.

7.2 Future Work

1. **Mobile Application:** Develop a cross-platform mobile app using Flutter/React Native for push notifications and offline viewing.
2. **Intelligent Contest Integration:** Integrate with Google Calendar API to automatically schedule upcoming contests.
3. **Advanced Recommendation Engine:** Enhance the heuristic engine with Machine Learning (Collaborative Filtering).
4. **Social Features:** Introduce ”Classrooms” for group analytics and competitive leaderboards.
5. **Additional Integrations:** Add support for HackerRank and TopCoder.

Bibliography

[1] Walls, C. (2022). *Spring Boot in Action* (6th ed.). Manning Publications.

[2] Codeforces. (2024). *Codeforces API Documentation*. Retrieved from https://codeforces.com/api/help

[3] Jsoup Project. (2024). *Jsoup: Java HTML Parser*.Retrieved from https://jsoup.org/

[4] Myers, B. (2023). *Tailwind CSS: From Zero to Hero*. O'Reilly Media.

[5] Oracle Corporation. (2021). *Java Platform, Standard Edition 17 API Specification*.

[6] Bauer, C., King, G., & Gregory, G. (2020). *Java Persistence with Hibernate* (3rd ed.). Manning Publications.

[7] Microsoft. (2023). *MySQL 8.0 Reference Manual*. Retrieved from https://dev.mysql.com/doc/refman/8.0/en/

Appendix

Source Code

The complete source code for the OmniRank project can be found at the following GitHub repository:

https://github.com/ShouravMallik/Project-3.1--OmniRank_IT22032_Shourav_Mallik-