National University
Of Computer and Emerging Sciences

Final Report

An Assignment presented to

Sir Basharat Hussain

In partial fulfillment
of the requirement for the course of

Software Engineering

By

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BS(CS)
SECTION-E

CodeFast Web Documentation

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1. Project Introduction

1.1 Introduction

The purpose of this document is to define clearly the scope, vision, functionality, and specifications of the **CodeFast Web Application**, a robust and interactive online coding platform for FAST University students and industry representatives.

1.2 Project Vision

CodeFast aims to bridge the gap between academia and industry by offering a centralized platform for interactive learning, skill evaluation, career readiness, and direct industry engagement through internships and job opportunities.

1.3 Intended Use of the System

1.3.1 Users and Usage

• **Students:** Access learning materials, enroll in courses, participate in quizzes and coding contests, and apply for internships or jobs.

• **Industry Representatives:** Post internships/jobs, evaluate student performance, send interview invitations, and manage applicants.

• **Administrators:** Manage users, course enrollments, requests, system analytics, and overall platform operations.

1.3.2 Stakeholders and Their Interests

Stakeholders	Identified Needs
University Students	Practical coding exercises, performance feedback, internships/jobs, certifications
Industry Representatives	Easy talent discovery, managing interns/applicants, performance insights
System Administrators	Effective platform management, user control, data security
University Management	Improved student career readiness and academic performance tracking

1.4 Features and Overall Functionality

CodeFast Web Application offers:

- User registration and secure login
- Interactive course content and enrollment management
- Automated quizzes and competitive coding challenges
- Real-time performance analytics and leaderboards
- Industry engagement via internship/job postings and interview invites
- Premium membership benefits and gamification features
- Robust administrative controls and user management
- Secure data handling and user profile customization

This functionality enhances user efficiency, promotes active learning, and streamlines industry-academia collaboration.

2. System Requirements

2.1 Functional Requirements

The functional requirements of the **CodeFast Web Application** define the specific behaviors and functionalities that the system must support in order to meet the business and user needs. These are outlined as follows:

1. **User Authentication and Authorization**
    - The system shall allow users (students, industry representatives, and administrators) to register, log in, log out, and reset passwords securely.
    - The system shall support role-based access control, granting specific permissions based on user roles.
2. **Profile Management**
    - Users shall be able to view and update their personal profiles, including profile pictures, bio, contact information, and password.
3. **Course Management**
    - Students shall be able to view available courses, enroll in them, and access course content such as videos, assignments, and quizzes.
    - Administrators shall approve or reject course enrollment requests.
    - Upon course completion, the system shall generate and issue a downloadable certificate.
4. **Quiz and Contest Participation**
    - Students shall be able to participate in quizzes and contests associated with their enrolled courses.
    - The system shall automatically evaluate quiz responses and contest submissions, providing immediate feedback and scores.
5. **Performance Analysis and Feedback**
    - The system shall generate detailed performance reports based on student activity in quizzes and contests.
    - Students shall be able to view their feedback and leaderboard rankings, while admins and industry users can analyze performance metrics.
6. **Industry Engagement**
    - Industry users shall be able to post internship/job opportunities and manage applications.
    - Students shall be able to apply for these opportunities and track their application status.
    - Industry users shall be able to send interview invites to selected candidates.
7. **Gamification and Premium Membership**
    - The system shall implement a badge and reward system to encourage user engagement.
    - Students with premium memberships shall have access to exclusive learning materials.
8. **Admin Panel and Request Handling**
    - Administrators shall manage user data, approve/reject requests, view platform statistics, and oversee all operations.
9. **Notification and Alerts**
    - The system shall notify users about upcoming contests, new internships, application status, and other relevant events.
10. **Support and Issue Tracking**
    - Users shall be able to report bugs or issues through a dedicated support section.

2.2 Non-Functional Requirements

The non-functional requirements describe the system's quality attributes and constraints. These are categorized into product, organizational, and external requirements.

2.2.1 Product Requirements

1. **Performance**
    - The system shall respond to user actions (e.g., loading dashboard or course content) within 1 second.
    - The system shall support a minimum of 200 concurrent users without performance degradation.
2. **Reliability**
    - The platform shall maintain an uptime of at least 99.8% during operational hours.
    - The system shall ensure data consistency during concurrent operations such as quiz submissions or profile updates.
3. **Usability**
    - The interface shall be user-friendly and require minimal training.
    - The system shall provide visual feedback for all actions (e.g., successful form submission, error messages).
4. **Scalability**
    - The system architecture shall be designed to scale horizontally to support increased user load and additional features.
5. **Security**
    - User credentials and sensitive data shall be stored using secure encryption protocols (e.g., SHA-256).
    - All data exchanges between client and server shall be secured with SSL/TLS.
    - Role-based access shall prevent unauthorized access to restricted features.
6. **Portability**
    - The web application shall be accessible from all major browsers and operating systems (Windows, macOS, Linux).
    - The system shall be responsive and fully functional across desktop and mobile devices.
7. **Maintainability**
    - The system codebase shall follow modular design principles to facilitate easy debugging, testing, and future updates.
    - Clear documentation and naming conventions shall be maintained throughout the code.
8. **Accessibility**
    - The platform shall support accessibility standards (e.g., keyboard navigation, color contrast) to cater to diverse user needs.
    - Dark mode shall be available as an optional user preference.

2.2.2 Organizational Requirements

1. **Development Process**
    - The system shall be developed using the Scrum methodology with defined sprints, daily stand-ups, and sprint retrospectives.
    - All project-related activities shall be tracked using Trello, and version control shall be managed via GitHub.
2. **Team Collaboration**

- Team communication shall occur primarily over WhatsApp (instant updates), with formal discussions via email and weekly in-person meetings.
- Branching strategies and code reviews shall be enforced through GitHub workflows to ensure collaboration and quality assurance.

3. **Deployment & Maintenance**
   - The system shall be deployed on a secure cloud hosting platform supporting Node.js, MongoDB, and scalable backend services.
   - Scheduled maintenance shall be communicated in advance, and system updates shall be versioned and documented.

2.2.3 External Requirements

1. **Regulatory Compliance**
   - The system shall comply with academic data privacy policies set by FAST University.
   - The platform must ensure that user data is not shared with third parties without consent.
2. **Integration Interfaces**
   - The system shall integrate with external email APIs for notifications and password resets.
   - External collaboration tools or APIs (e.g., calendar for interviews, file upload for resume sharing) may be integrated as needed.
3. **Browser and Device Compatibility**
   - The application must be compatible with major browsers (Chrome, Firefox, Safari, Edge) and support responsive behavior on mobile and tablet devices.
4. **Backup and Recovery**
   - The database shall have daily automated backups and support recovery in the event of data loss or system crash.

3. User Stories

3.1 User Stories List

Story ID	User Story Title	Priossrity
1	User Registration	High
2	User Login	High
3	Password Reset	Medium
4	Profile Management	Medium
5	Course Enrollment	High
6	Course Completion Certification	Medium
7	Quiz Participation	High
8	View Performance Leaderboard	Medium
9	Provide Student Feedback	High
10	Analyze Student Performance	High
11	Offer Internship	High
12	Manage Internship/Job Students	Medium
13	Manage Registrations	High
14	View CodeFast Analytics	Medium
15	View Course Content	High

16	Report Bugs and Issues	Medium
17	Premium Membership Access	High
18	Store User Credentials Securely	Low
19	Enable Dark Mode	Low
20	Manage Users	High
21	Student Filtering	Medium
22	Manage a New Internship	Medium
23	Send Interview Invitation	High
24	View Applied Jobs	Medium

3.2 Structured User Stories

User Story 1: User Registration

- **Description:** As a new user (student or industry), I want to register an account so that I can access the platform's features.
- **Priority:** High
- **Acceptance Criteria:**
  - User provides valid details (name, email, password).
  - User confirms their password.
  - System creates the account.
  - Confirmation email sent to the user's email address.

User Story 2: User Login

- **Description:** As a user, I want to log into my account to access my profile and courses.
- **Priority:** High
- **Acceptance Criteria:**
  - User enters valid credentials (email, password).
  - System grants access upon successful authentication.
  - User redirected to their personalized dashboard.

User Story 3: Password Reset

- **Description:** As a user, I want to reset my password so that I can regain account access if forgotten.
- **Priority:** Medium
- **Acceptance Criteria:**
  - User selects "Forgot Password."
  - User provides their registered email.
  - System sends a password reset link via email.
  - User successfully sets a new password.

User Story 4: Profile Management

- **Description:** As a user, I want to update my profile information to keep details current.
- **Priority:** Medium
- **Acceptance Criteria:**
    - User edits information (name, bio, profile picture).
    - Changes are saved successfully.
    - Updated information reflected immediately.

User Story 5: Course Enrollment

- **Description:** As a student, I want to enroll in a course to access its content and assignments.
- **Priority:** High
- **Acceptance Criteria:**
    - User clicks "Enroll" on a course page.
    - User confirms enrollment.
    - Access to course content is granted immediately.

User Story 6: Course Completion Certification

- **Description:** As a student, I want to receive a certificate upon course completion to showcase my achievements.
- **Priority:** Medium
- **Acceptance Criteria:**
    - User completes all modules and assessments.
    - System generates a digital certificate.
    - User can download the certificate from their profile.

User Story 7: Quiz Participation

- **Description:** As a student, I want to participate in quizzes to improve my skills.
- **Priority:** High
- **Acceptance Criteria:**
    - User selects a quiz and completes it.
    - System evaluates responses immediately.
    - Quiz results displayed instantly.

User Story 8: View Performance Leaderboard

- **Description:** As a user, I want to view the performance leaderboard to see student rankings.
- **Priority:** Medium
- **Acceptance Criteria:**
    - Leaderboard accessible from the performance page.
    - Rankings clearly displayed based on scores.
    - Updated dynamically with each quiz and contest.

User Story 9: Provide Student Feedback

- **Description:** As a student, I want feedback on performance to improve my skills.
- **Priority:** High
- **Acceptance Criteria:**
    - User navigates to the feedback tab.
    - Personalized feedback displayed based on quiz or contest performance.
    - General guidance provided if no recent activities found.

User Story 10: Analyze Student Performance

- **Description:** As an admin or industry representative, I want to analyze student performance to provide feedback or make hiring decisions.
- **Priority:** High
- **Acceptance Criteria:**
    - Performance analytics accessible via admin or industry dashboard.
    - Detailed performance reports generated.
    - Informative message displayed if no data available.

User Story 11: Offer Internship

- **Description:** As an industry representative, I want to offer internships to recruit potential talent.
- **Priority:** High
- **Acceptance Criteria:**
    - User selects student(s) from the internship/job tab.
    - Internship offer sent directly through the system.
    - Student notified and able to accept or reject the offer.

User Story 12: Manage Internship/Job Students

- **Description:** As an industry representative, I want to manage hired students for tracking purposes.
- **Priority:** Medium
- **Acceptance Criteria:**
    - Industry user views the list of hired students.
    - User can remove students from their internship/job.
    - Removed students lose access and cannot reapply.

User Story 13: Manage Registrations

- **Description:** As an admin, I want to manage registration requests efficiently.
- **Priority:** High
- **Acceptance Criteria:**
    - Admin views all pending registration requests.
    - Admin can approve or reject registrations.
    - System notifies users about the approval or rejection.

User Story 14: View CodeFast Analytics

- **Description:** As an admin or industry representative, I want insights into platform activity.
- **Priority:** Medium
- **Acceptance Criteria:**
    - Dashboard displays detailed platform analytics.
    - Data visualizations provided via bar and pie charts.
    - Error handling for any data retrieval issues.

User Story 15: View Course Content

- **Description:** As a student, I want to access course materials to meet learning objectives.
- **Priority:** High
- **Acceptance Criteria:**
    - Course contents (videos, readings, assignments) displayed upon selection.
    - Content organized clearly and sequentially.

User Story 16: Report Bugs and Issues

- **Description:** As a user, I want to report platform issues for prompt resolution.
- **Priority:** Medium
- **Acceptance Criteria:**
    - Bug reporting available in a dedicated support area.
    - Issue reports assigned priority levels by severity.
    - Admin notified immediately upon submission.

User Story 17: Access Study Material with Premium Membership

- **Description:** As a premium student, I want exclusive study materials to enhance learning.
- **Priority:** High
- **Acceptance Criteria:**
    - Exclusive materials accessible only to premium members.
    - Non-premium users prompted to upgrade membership.

User Story 18: Store User Credentials Securely

- **Description:** As a user, I want secure credential storage to simplify repeated logins.
- **Priority:** Low
- **Acceptance Criteria:**
    - Secure encryption of stored credentials (e.g., cookies).
    - Persistent login until manual logout or cookie deletion.

User Story 19: Enable Dark Mode

- **Description:** As a user, I want a dark mode option to minimize eye strain.
- **Priority:** Low
- **Acceptance Criteria:**
    - Dark mode toggle available in settings.
    - User preference remembered across sessions.

User Story 20: Manage Users

- **Description:** As an admin, I want to add/remove users to maintain platform integrity.
- **Priority:** High
- **Acceptance Criteria:**
    - User management controls provided.
    - Ability to remove users, updating database immediately.
    - Archived data of removed users for security.

User Story 21: Student Filtering

- **Description:** As a user, I want leaderboard filters for refined performance views.
- **Priority:** Medium
- **Acceptance Criteria:**
    - Leaderboards filterable by course, contest, or global rankings.
    - Rankings updated dynamically per selected filter.

User Story 22: Manage a New Internship

- **Description:** As an industry representative, I want internship posting management.
- **Priority:** Medium
- **Acceptance Criteria:**
    - Ability to create and list new internships.
    - Details include role, duration, and requirements clearly displayed.

User Story 23: Send Interview Invitation

- **Description:** As an industry representative, I want to invite candidates for interviews.
- **Priority:** High
- **Acceptance Criteria:**
    - Interview invites include scheduling details (date, time, meeting link).
    - Notifications sent instantly to candidates.

User Story 24: View Applied Jobs

- **Description:** As a student, I want to track my job applications.
- **Priority:** Medium
- **Acceptance Criteria:**
  - "My Applications" section displays status clearly (Pending, Accepted, Rejected).

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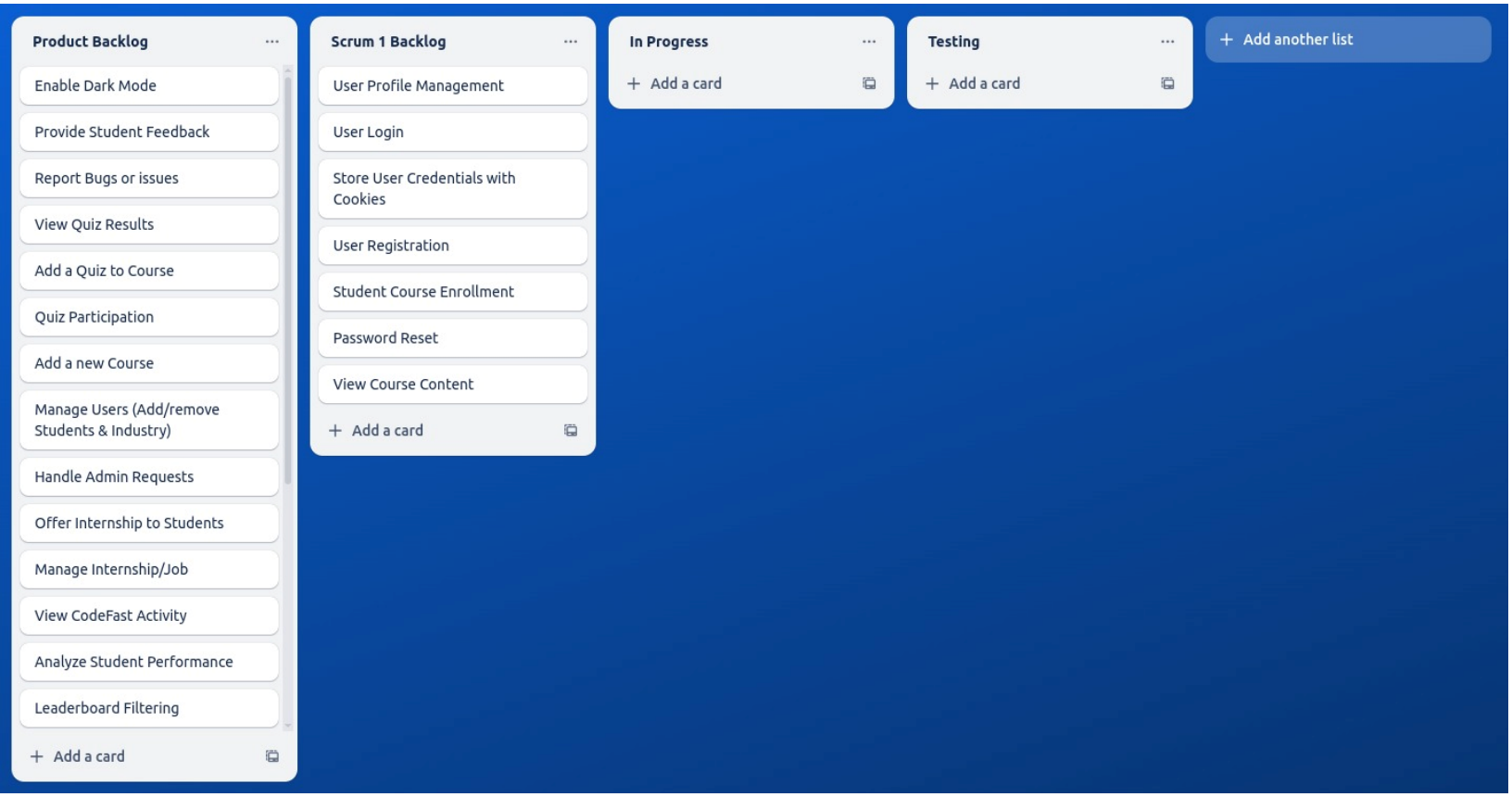
4. Project Product Backlog Phases

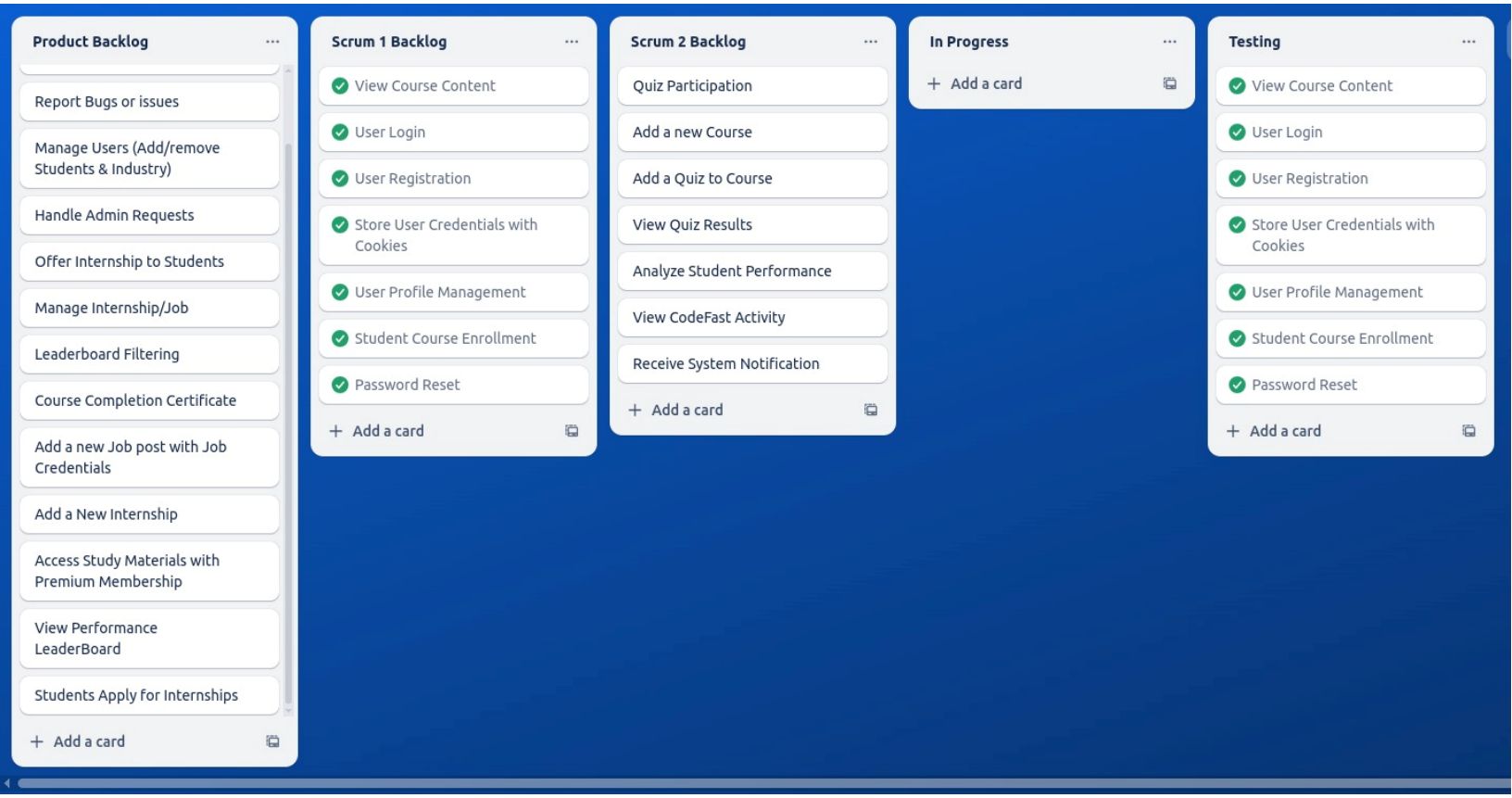
4.1 Initial Product Backlog

Story ID	User Story Title	Priority
1	**User Registration**	*High*
2	**User Login**	*High*
3	**Password Reset**	*Medium*
4	**Profile Management**	*Medium*
5	**Course Enrollment**	*High*
6	**Course Completion Certification**	*Medium*
7	**Quiz Participation**	*High*
8	**View Performance Leaderboard**	*Medium*
9	**Provide Student Feedback**	*High*
10	**Analyze Student Performance**	*High*
11	**Offer Internship**	*High*
12	**Manage Internship/Job Students**	*Medium*
13	**Manage Registrations**	*High*
14	**View CodeFast Analytics**	*Medium*
15	**View Course Content**	*High*
16	**Report Bugs and Issues**	*Medium*
17	**Access Study Material with Premium Membership**	*High*
18	**Store User Credentials Securely**	*Low*
19	**Enable Dark Mode**	*Low*
20	**Approve Course Enrollment Requests**	*Medium*
21	**Manage Users**	*High*
22	**Student Filtering**	*Medium*
23	**Manage a New Internship**	*Medium*
24	**Send Interview Invitation**	*High*
25	**View Applied Jobs**	*Medium*

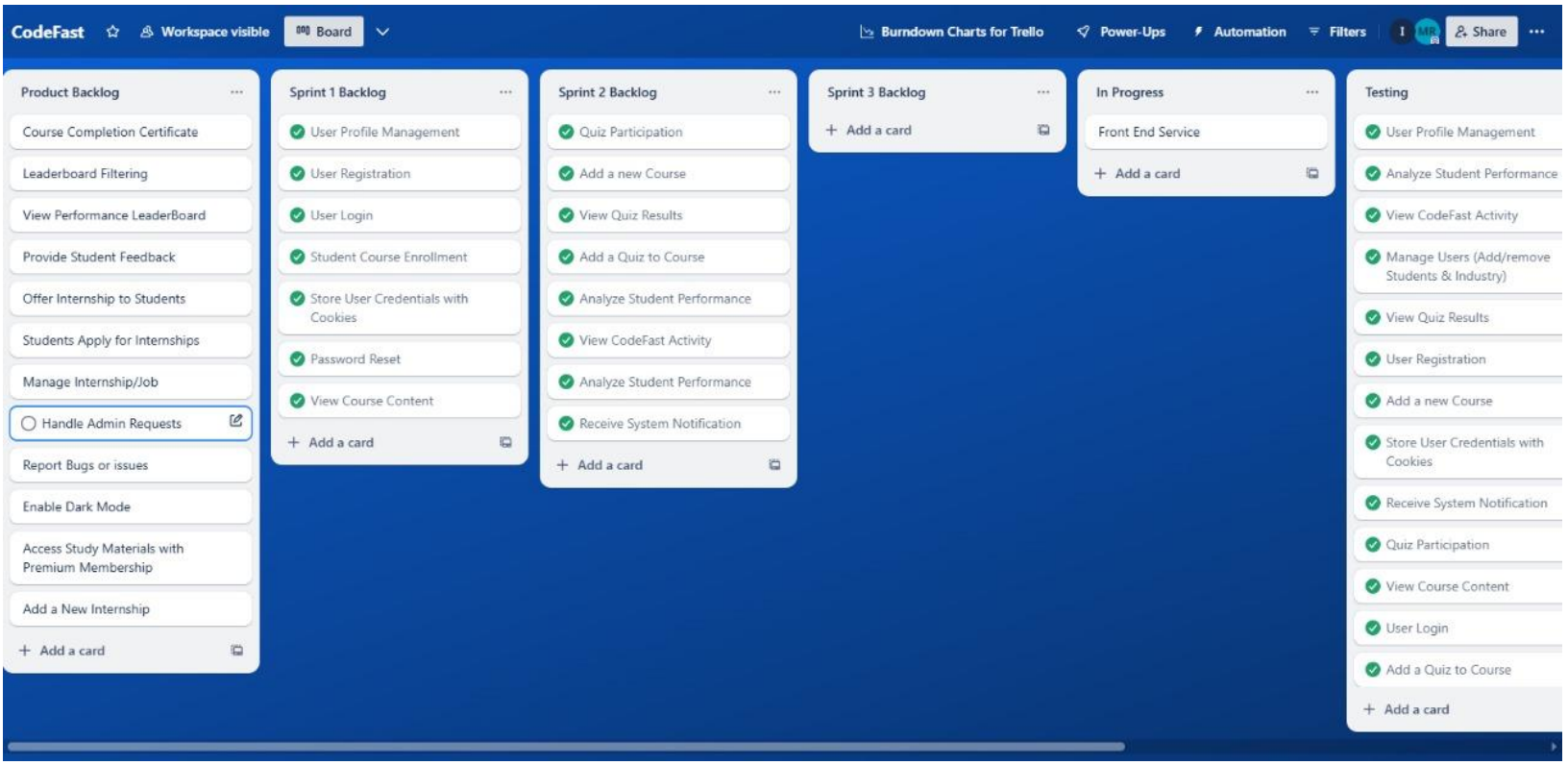
4.2 Sprint 1 Product Backlog



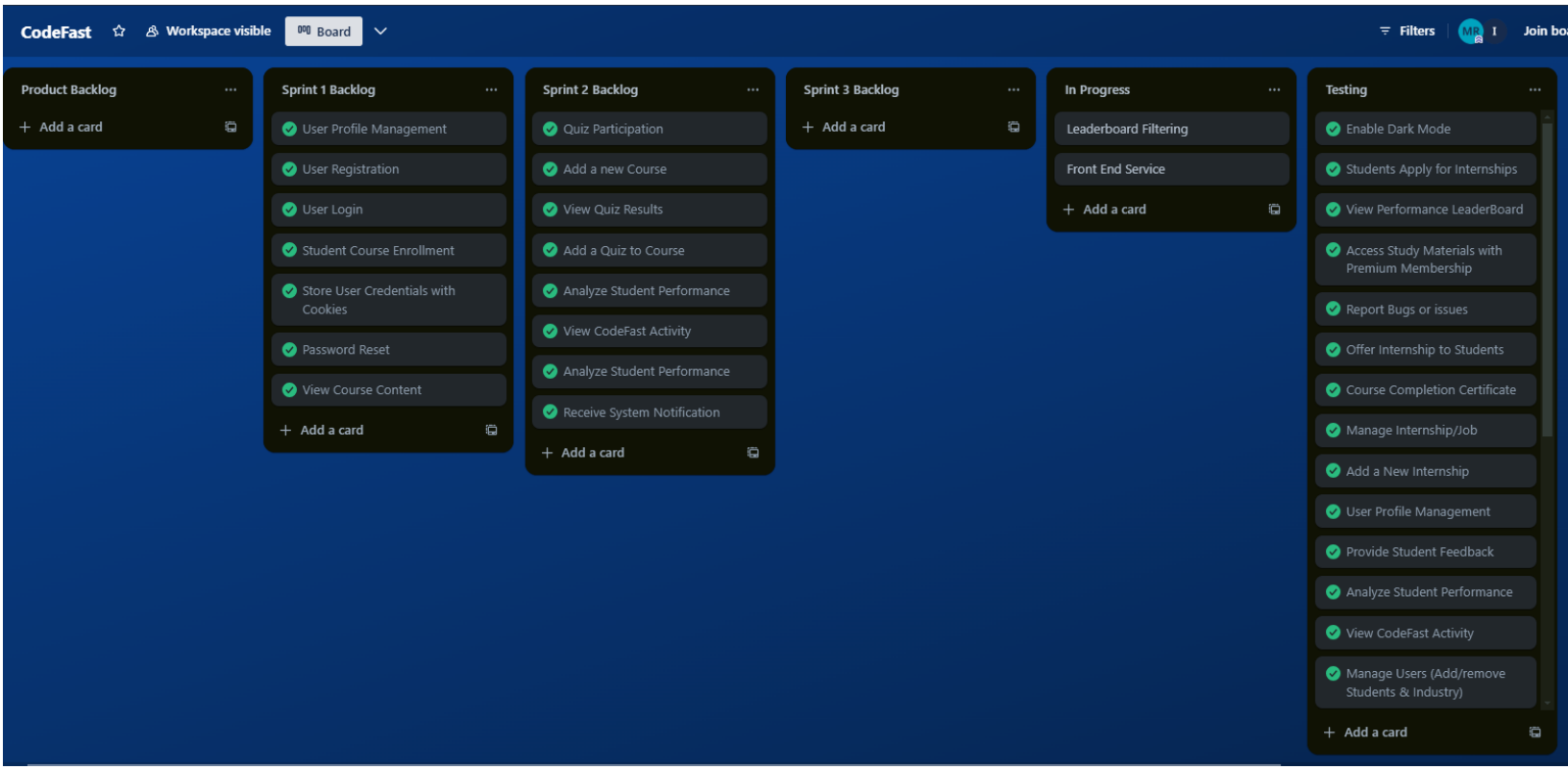
4.3 Sprint 2 Product Backlog



4.4 Sprint 3 Product Backlog

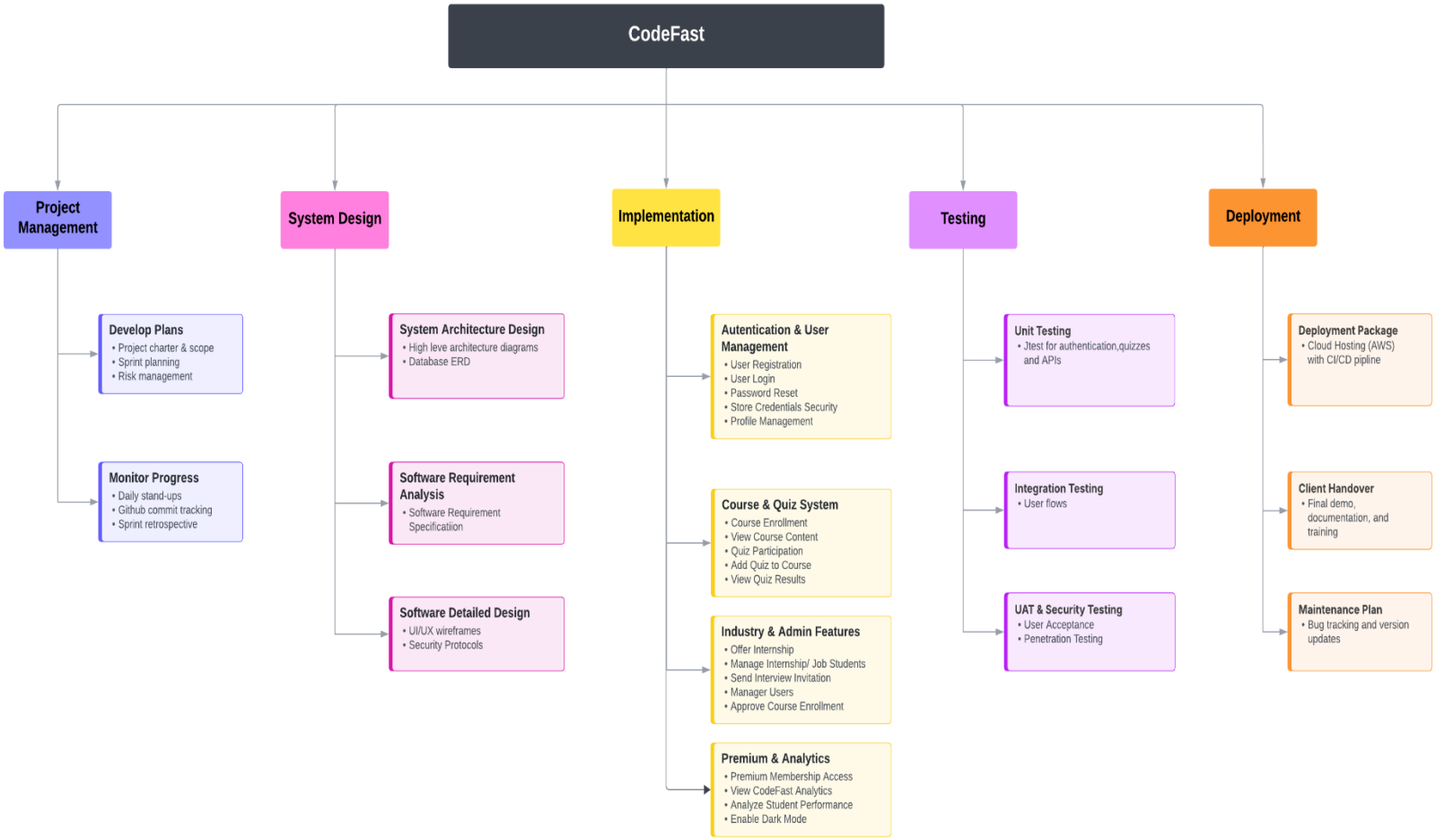


4.5 Final Trello View



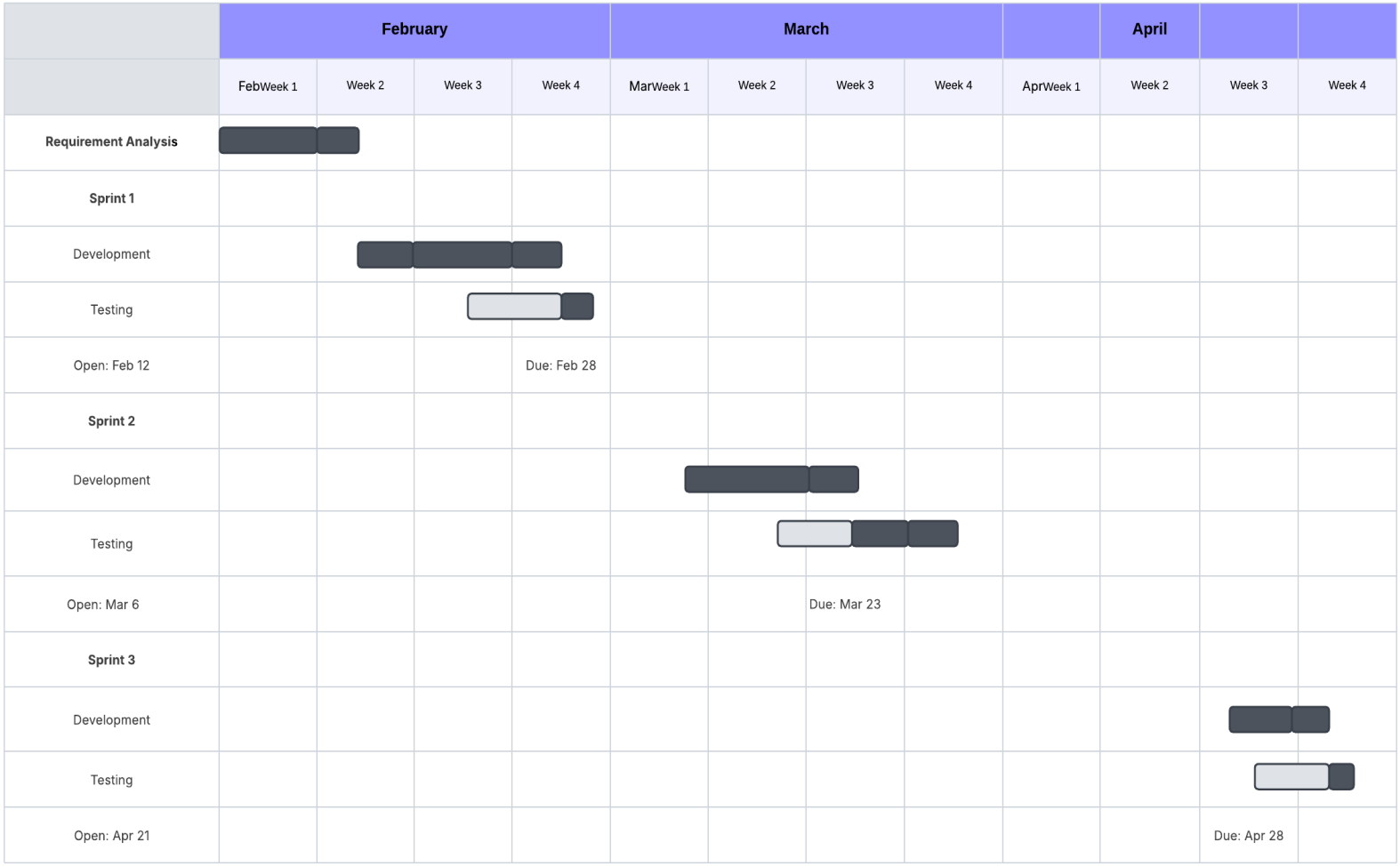
5. Project Plan

5.1 Work Breakdown Structure



5.2 Gantt Chart

CodeFast



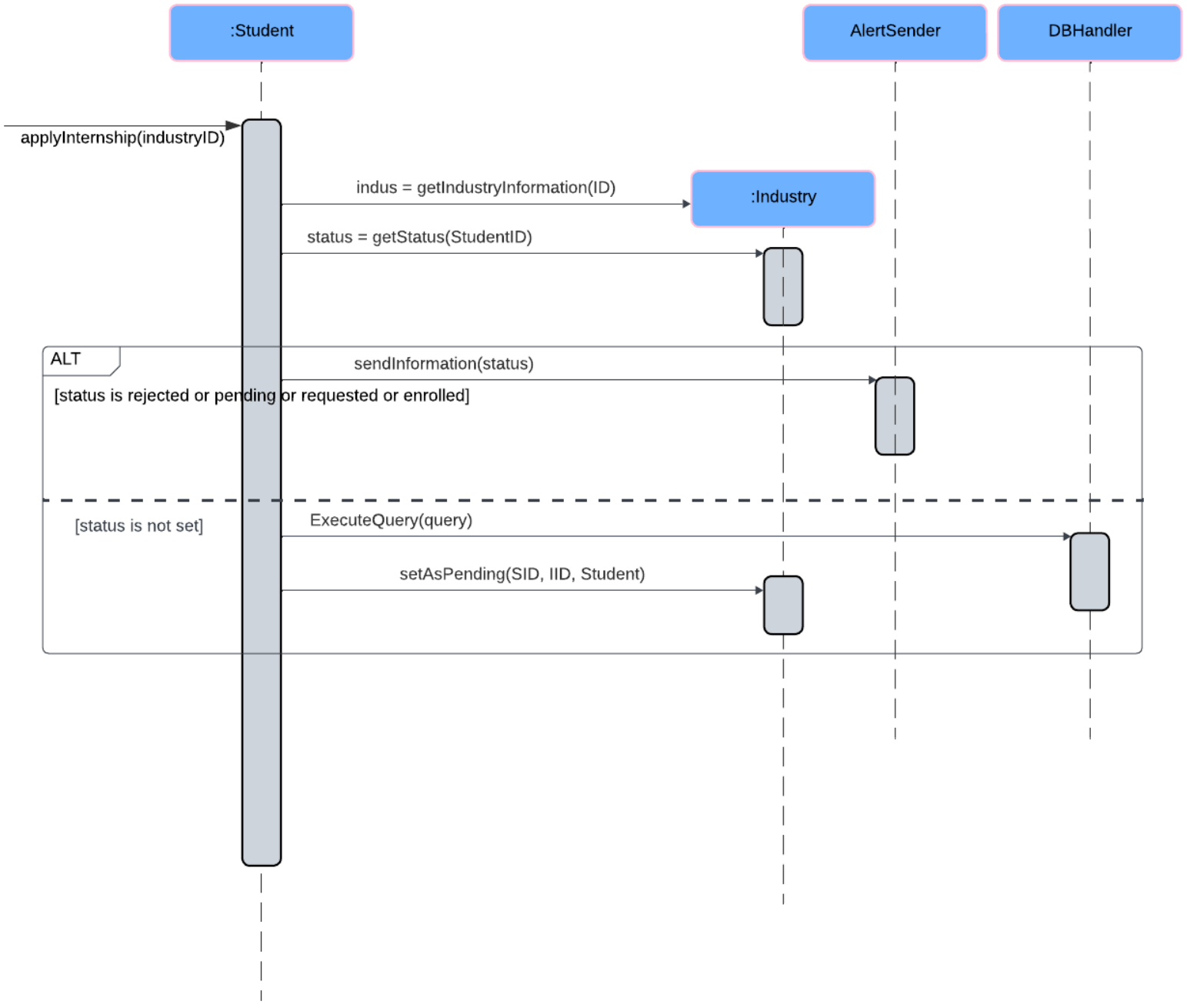
Key

- ▓▓▓▓ **= Active work.**
- ▒▒▒▒ **= Overlap/transition.**
- **Testing is included in each sprint (last 30-40% of duration).**

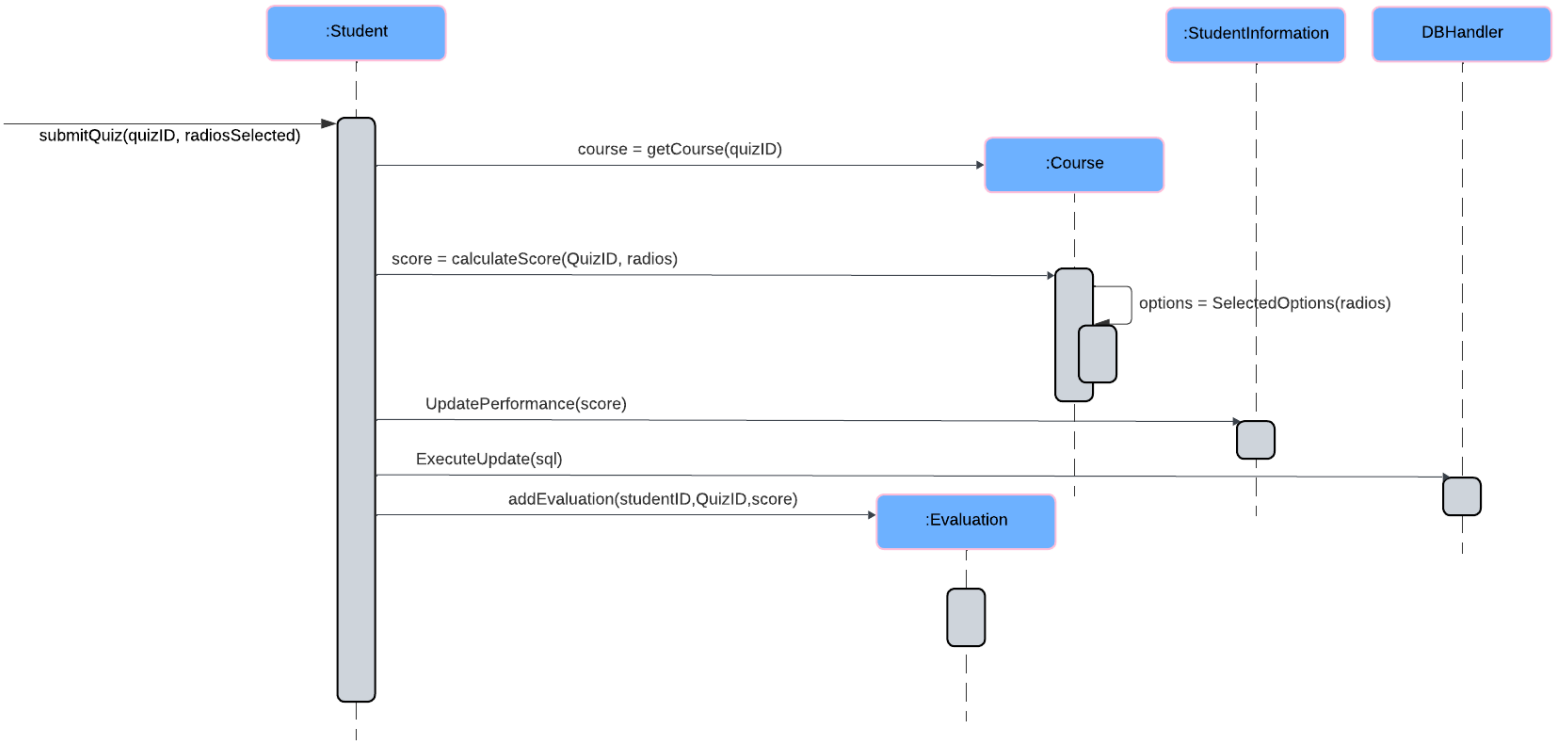
6. Architecture Diagrams

6.1 Sequence Diagrams

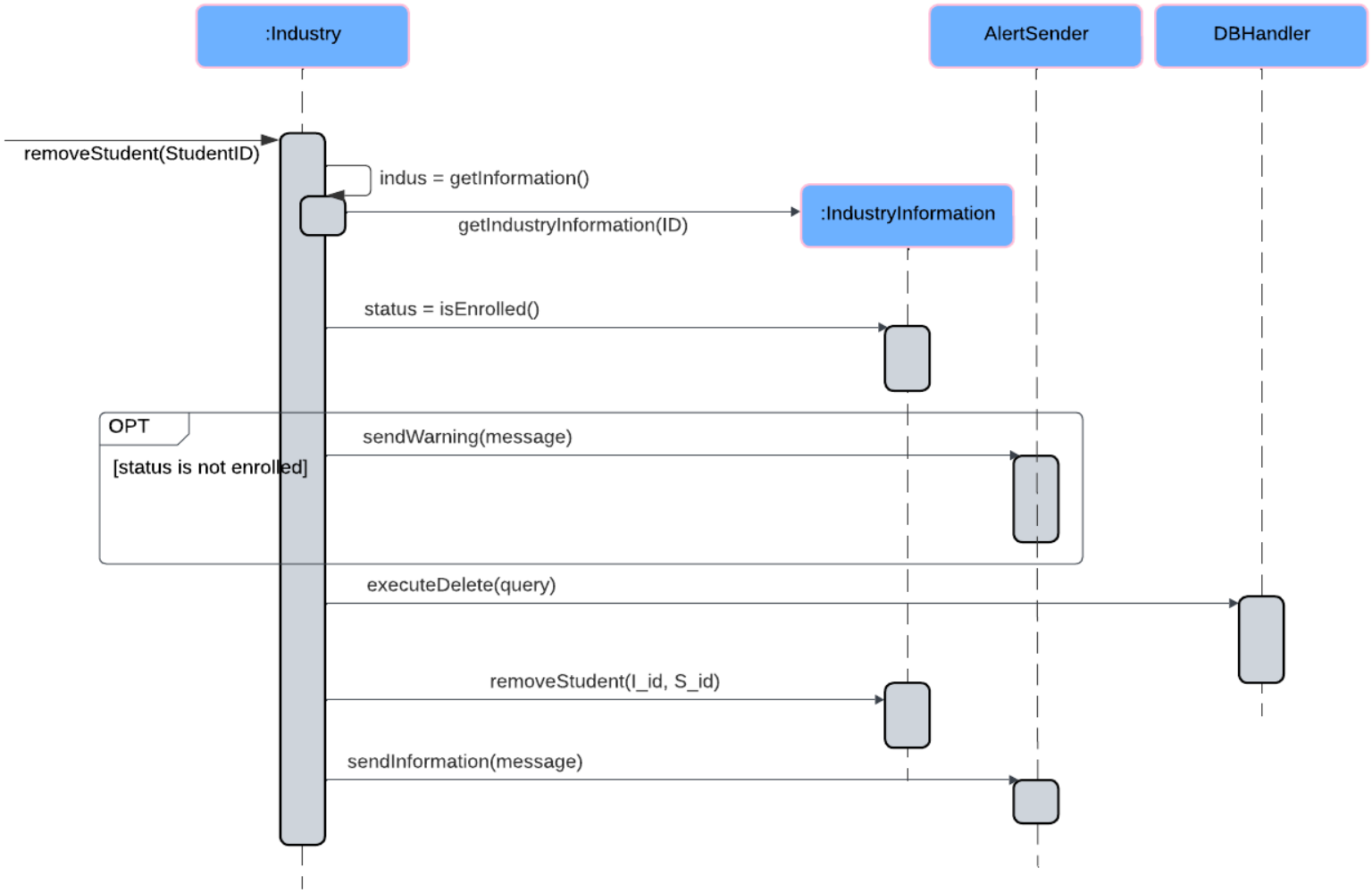
6.1.1 Apply for Internships



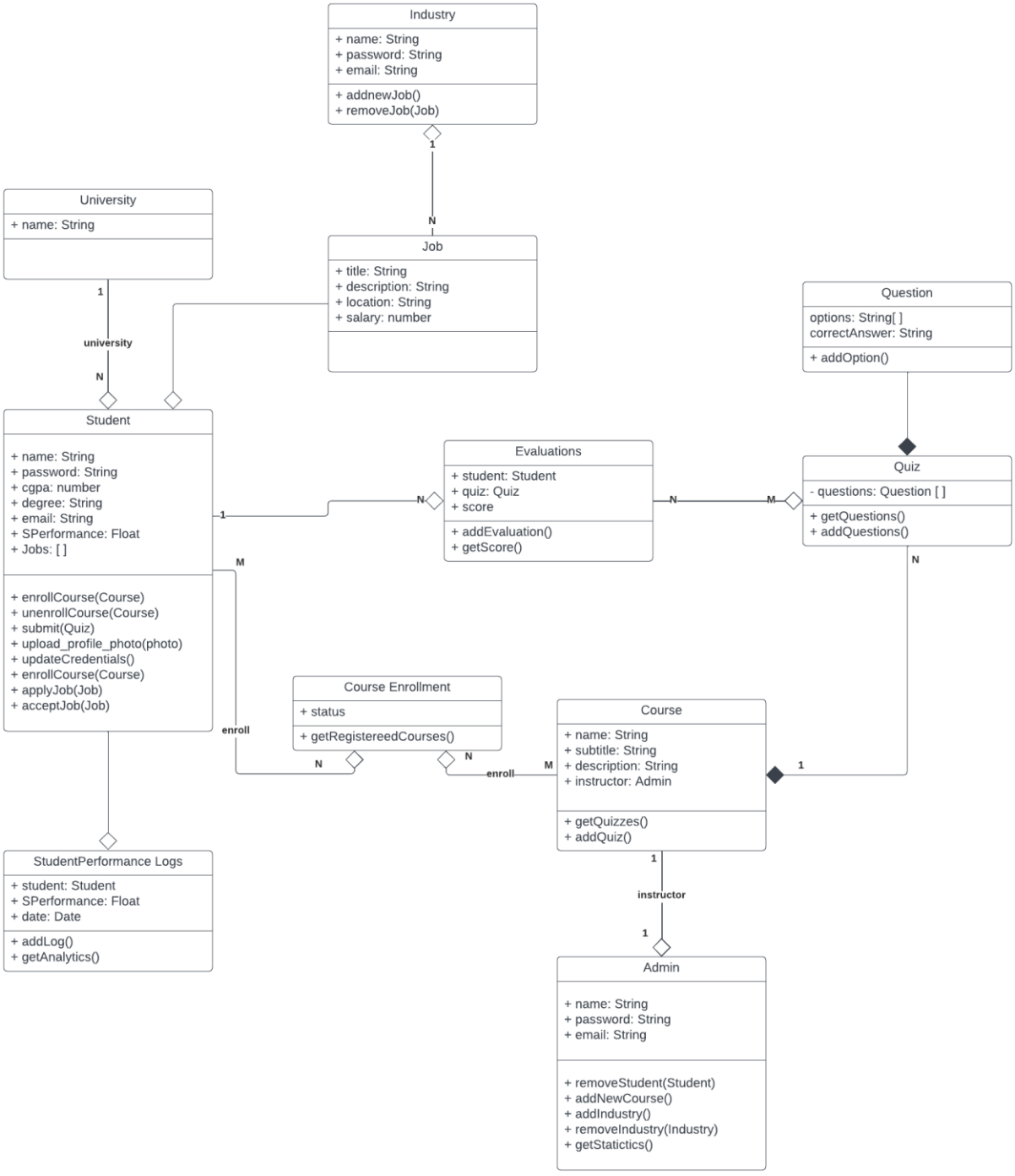
6.1.2 Submit Quiz



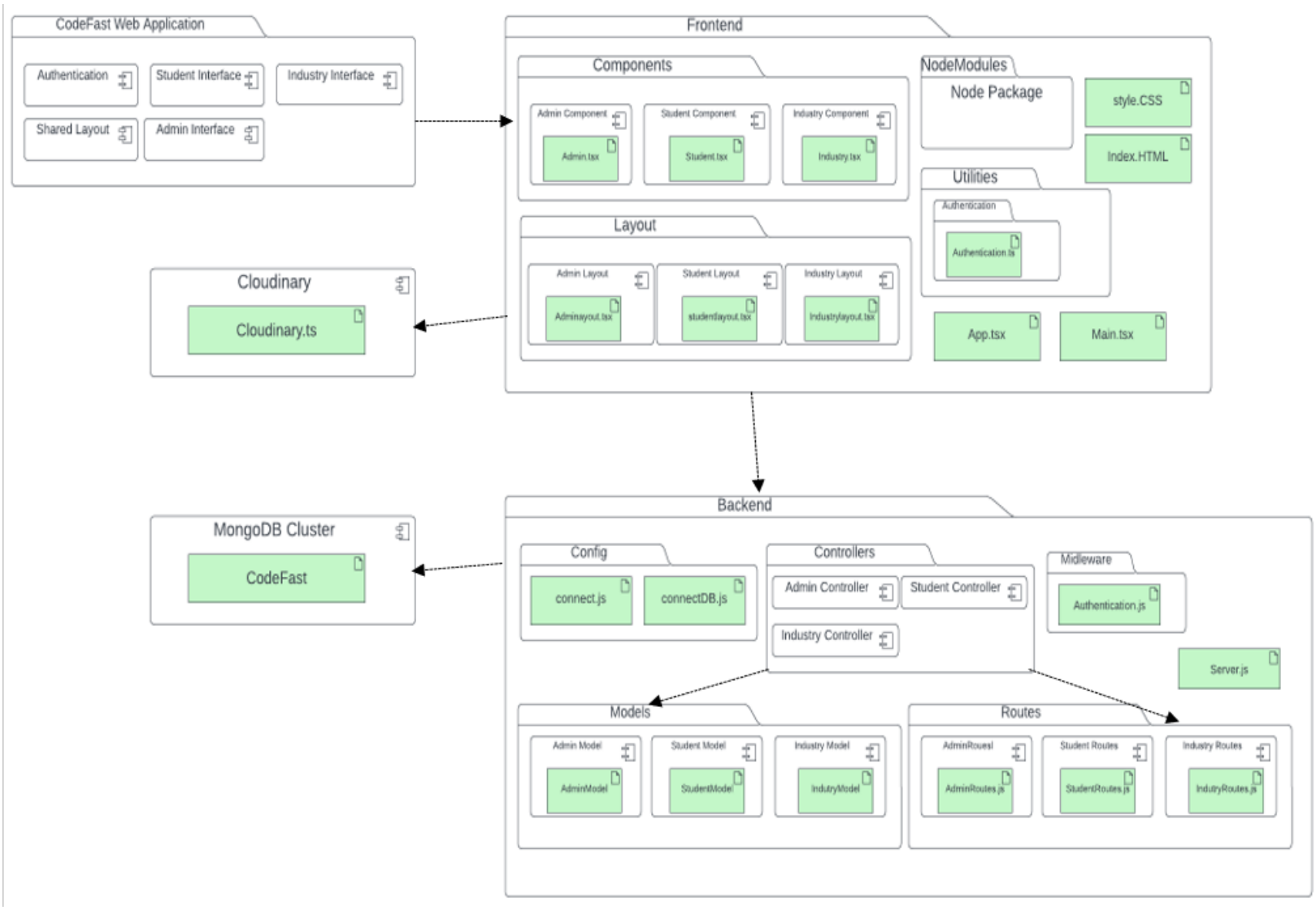
6.1.3 Remove Students



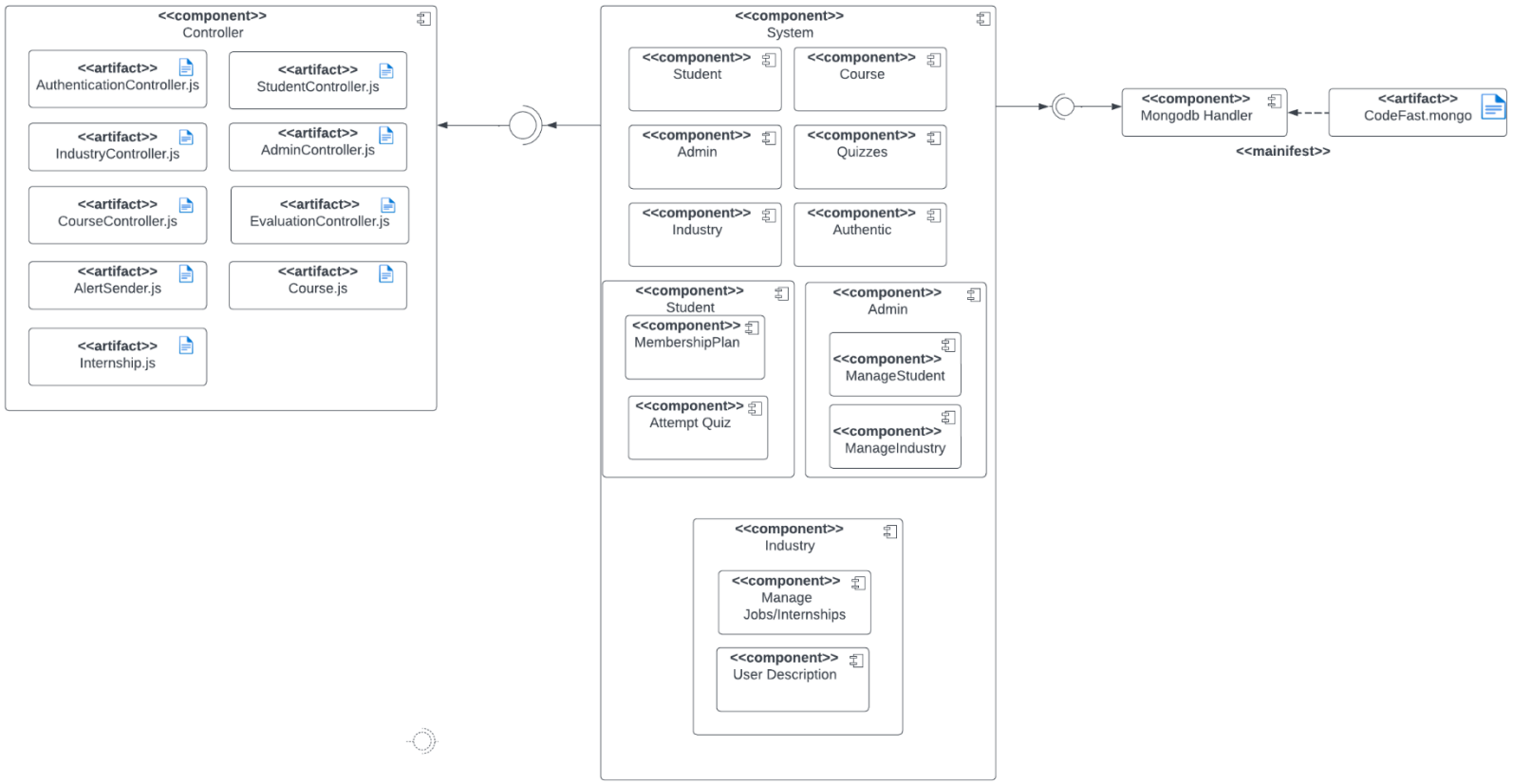
6.2 Class Diagram



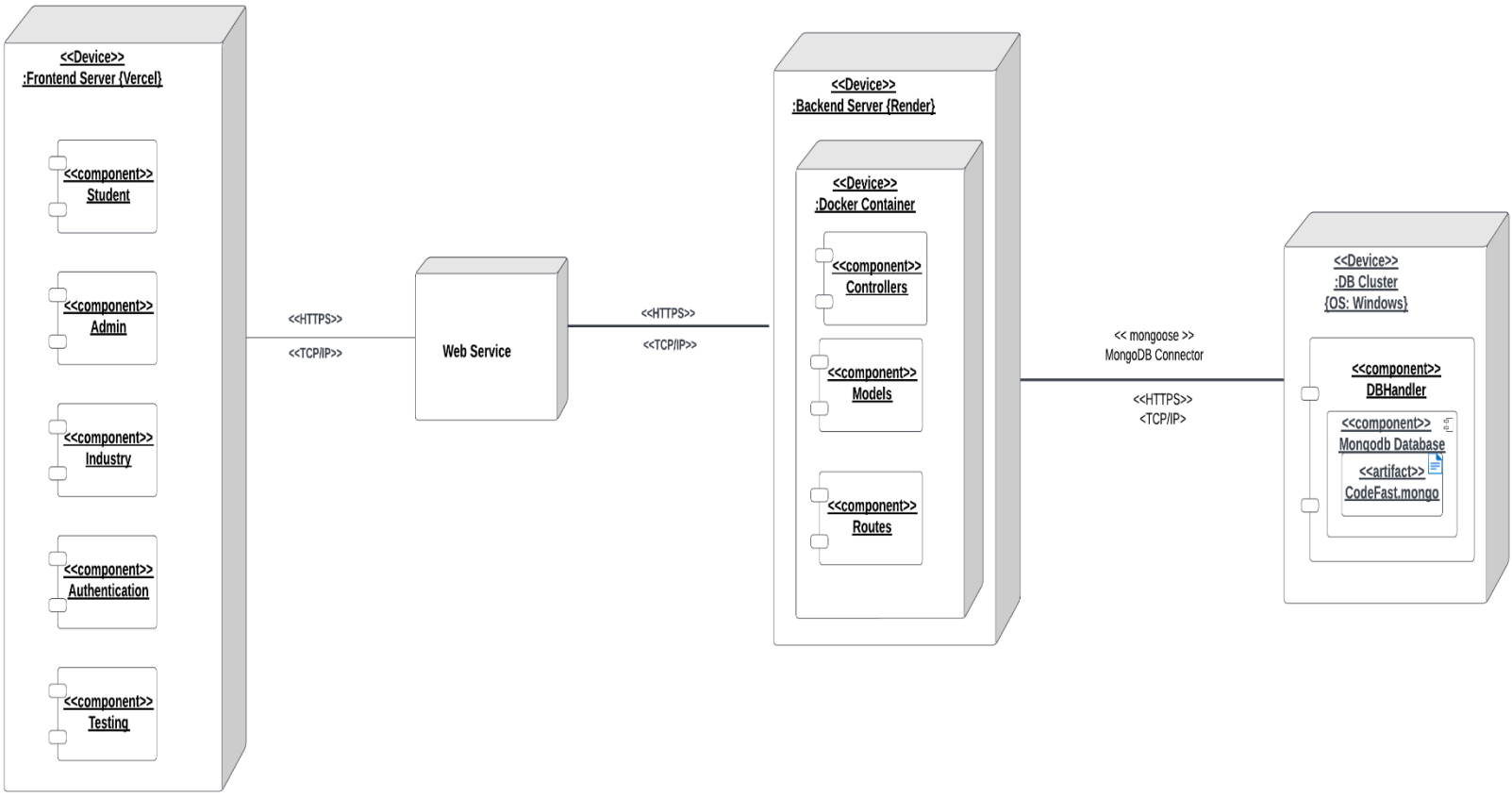
6.3 Package Diagram



6.4 Component

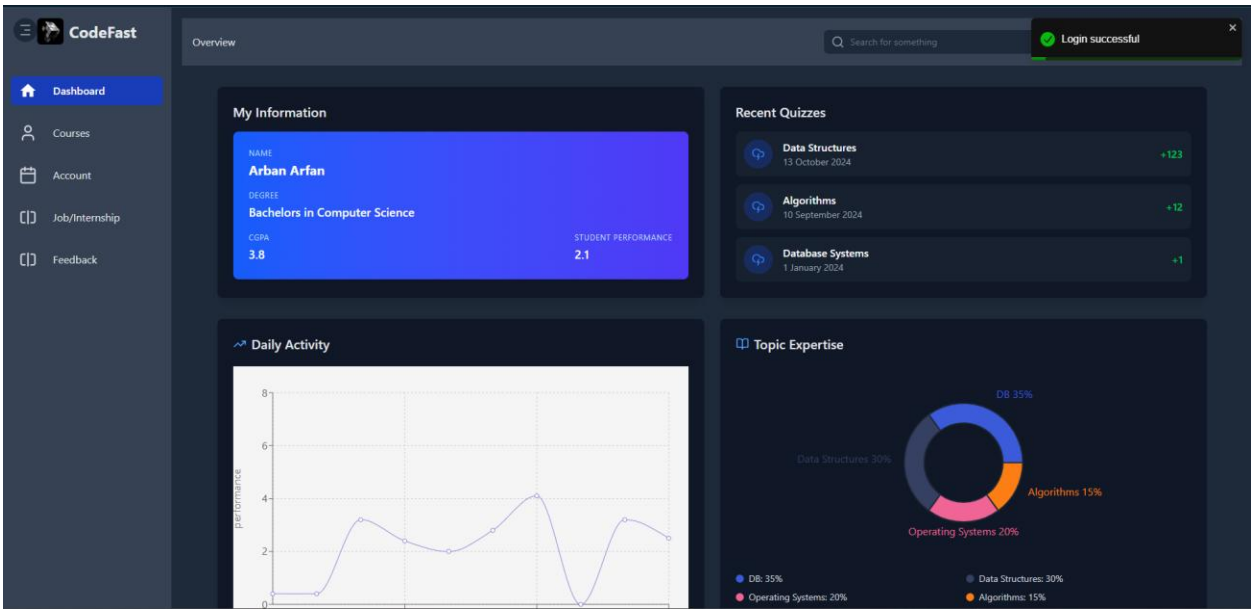


6.5 Deployment Diagram

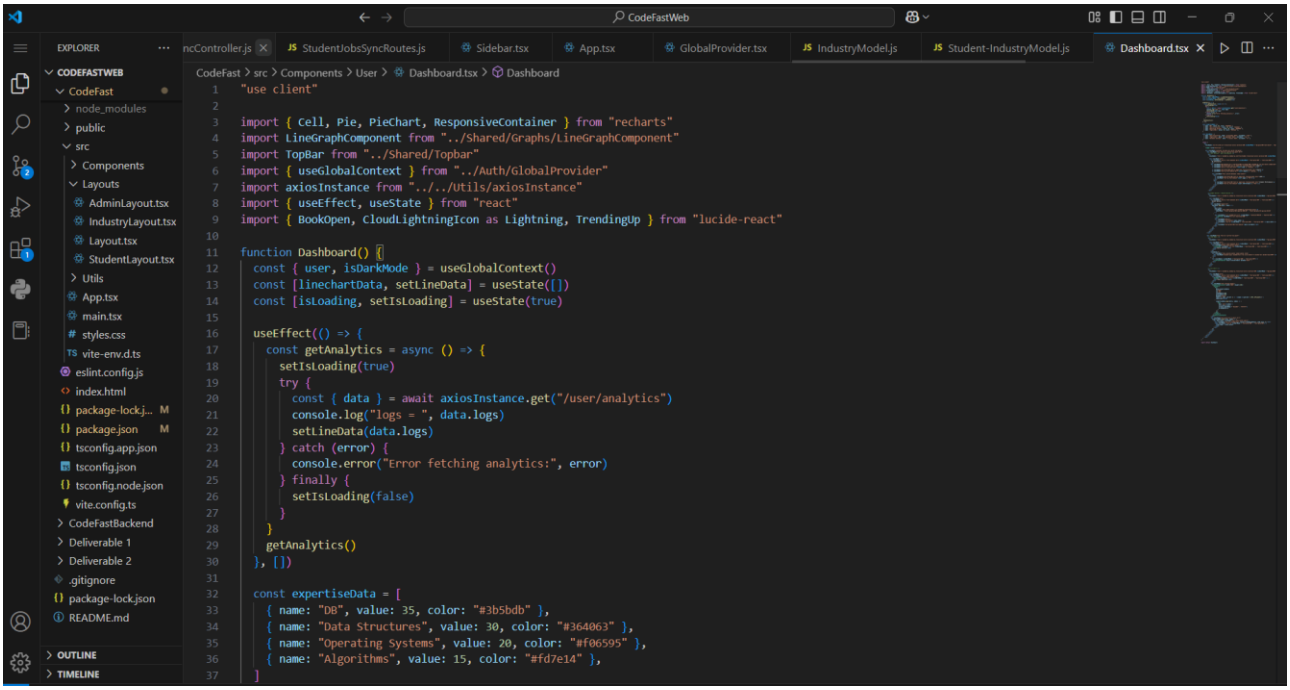


7. Design and Implementation

7.1 Design of Web Application

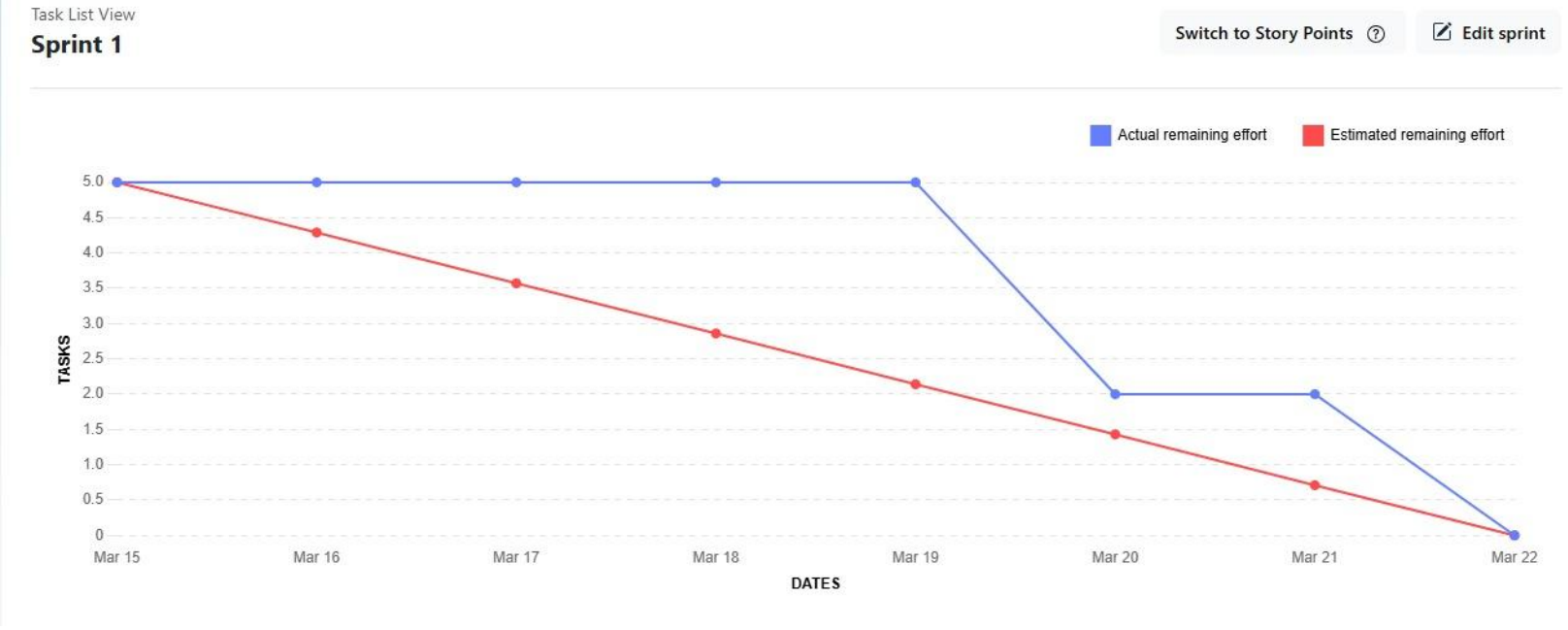


7.2 Implementation

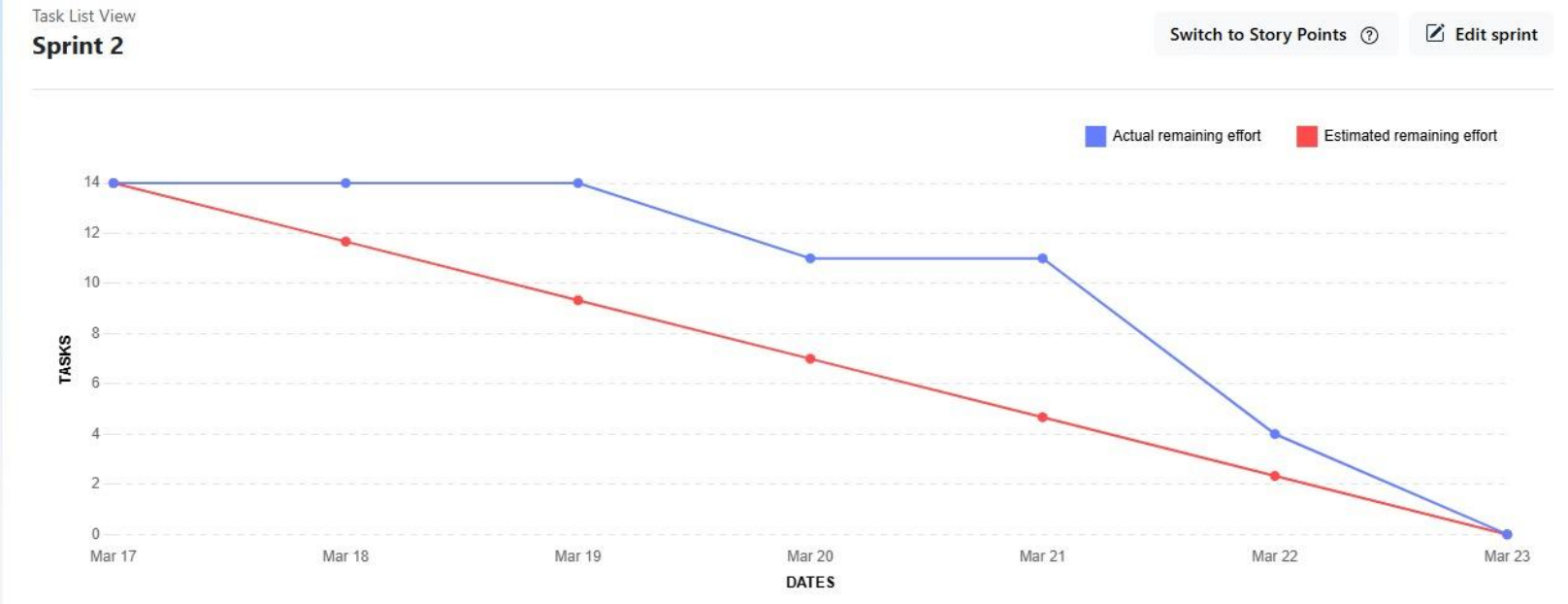


8. Product Burndown Chart

8.1 Sprint 1 Burndown Chart



8.2 Sprint 2 Burndown Chart

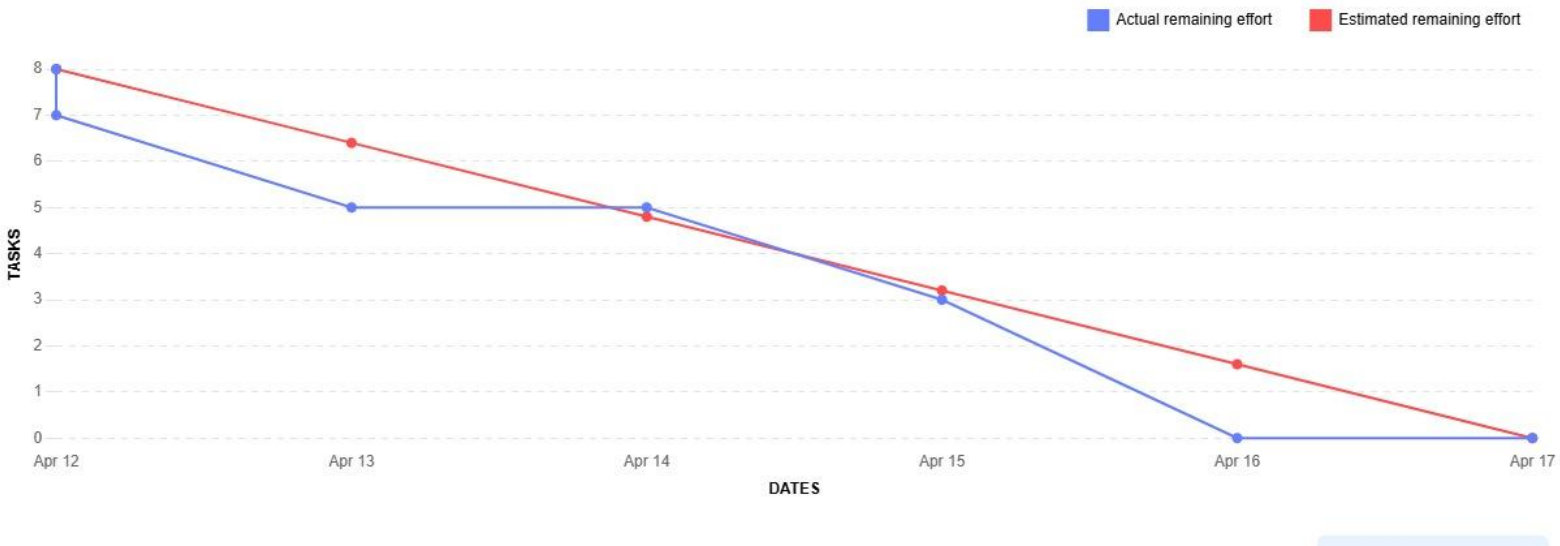


8.3 Sprint 3 Burndown Chart

Task List View

Sprint 3

Switch to Story Points | Edit sprint



9. Testing

9.1 Black Box Testing

Batch	Module Tested	Number of Test Cases	Pass Rate	Common Scenarios Covered
Batch 1	Authentication & Security	6	100%	Valid/invalid registration, login, password reset scenarios
Batch 2	Profile Management & Dark Mode	2	100%	Profile update, invalid image format
Batch 3	Courses Module	5	100%	Course enrollment, access control, admin approvals
Batch 4	Internships, Jobs, Interviews	2	100%	Internship offering and validation of creation
Batch 5	Admin Operations	3	100%	Approving/rejecting registrations, handling data retrieval failures
Batch 6	Premium Membership & Study Material Access	1	100%	Access restriction for non-premium users
Batch 7	Bug Reporting	1	100%	Validation for mandatory bug report fields
Total		**20**	**100%**	All modules behaved as expected under tested conditions

The black box testing conducted across all major functional modules of the system—including authentication, profile management, course handling, internships, admin operations, and premium feature access—demonstrated a **100% pass rate** for all 20 executed test cases. Each test case was designed to verify both valid and invalid input scenarios, ensuring that the system handles expected behavior as well as edge cases effectively.

The testing outcomes affirm that:

- **All core functionalities** are implemented correctly and respond with appropriate success or error messages.
- **Input validations** are in place, preventing erroneous or malicious data entry.
- **User experience flows** such as registration, login, course enrollment, and profile management function smoothly and reliably.
- **Admin-side operations** are robust, with successful execution of approval workflows and proper error handling.
- **Access control mechanisms** are functioning as intended, especially concerning premium features and course content protection.

In summary, the system exhibits strong reliability and readiness from a black-box perspective, indicating that its external behavior aligns precisely with functional requirements.

9.2 White Box Testing

All files

82.14% Statements 5044/6143 **85%** Branches 240/283 **80.68%** Functions 117/145 **82.14%** Lines 5044/6143

Press *n* or *j* to go to the next uncovered block, *b*, *p* or *k* for the previous block.

Filter:

File	Statements		Branches		Functions		Lines	
src	88%	63/72	79%	6/7	83%	2/3	88%	63/72
src/Components/Admin	72%	1108/1540	78%	74/94	71%	37/52	72%	1108/1540
src/Components/Auth	85%	79/93	82%	14/17	80%	8/10	85%	79/93
src/Components/Industry	72%	482/670	78%	10/13	71%	7/9	72%	482/670
src/Components/Shared	74%	778/1051	80%	17/21	77%	10/13	74%	778/1051
src/Components/Shared/Graphs	78%	133/171	85%	6/7	75%	3/4	78%	133/171
src/Components/User	72%	1658/2303	77%	82/106	71%	29/41	72%	1658/2303
src/Layouts	74%	64/87	83%	5/6	75%	3/4	74%	64/87
src/Tests	100%	24/24	100%	1/1	90%	3/3	100%	24/24
src/Utils	80%	106/132	81%	9/11	75%	5/6	80%	106/132

The white-box testing conducted through structured code coverage analysis reflects a **strong level of test reliability and internal software integrity**. With an **overall statement coverage of 82.14%**, and **branch and function coverage above 80%**, the test suite demonstrates consistent and meaningful execution across the codebase.

Key insights:

- **High coverage in authentication and shared components** ensures that core application logic is secure and stable.
- **All test-related files report 100% coverage**, indicating a thorough implementation of test procedures and validation tools.
- **Admin, Industry, and User modules**, while moderately covered, present opportunities for increasing the depth of condition and loop testing.
- **Utility and layout files** show good structural testing, minimizing layout rendering and helper logic errors.

This level of white-box testing coverage **significantly reduces the risk of runtime bugs** and bolsters maintainability and future scalability. It complements black-box testing by validating that **internal mechanisms function as intended**, not just from an external interface perspective but also within the deeper layers of the application logic.

10. Work Division

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10.1 Roles & Responsibility

Team Member	Roles	Responsibilities
Zakariya Abbas	Product Owner, Analyst/Architect	Requirements management, system design, project vision
Arban Arfan	Scrum Master, UI/UX Designer	Scrum adherence, UI/UX design, team coordination
Messam Raza	Developer, Tester	Feature implementation, code testing, debugging

10.2 Team Agreement

5.1 Methods of Communication
• **Primary:** WhatsApp (for real-time updates and quick discussions)
• **Formal:** Email (for official communications, records, and notifications)
• **In-Person Meetings:** Scheduled weekly at FAST University campus
• **Task & Workflow Tracking:** Trello and GitHub (version control)

5.2 Communication Response Times
• **WhatsApp:** Within 2 hours
• **Email:** Within 24 hours
• **Urgent Issues:** Immediate response via phone call or direct meeting

5.3 Meeting Attendance
• **Weekly Stand-ups:** Every Monday at 10:00 AM
• **Sprint Planning & Retrospectives:** Mandatory, held at the beginning and end of sprints
• **Mandatory Attendance:** All meetings required unless emergency circumstances occur

5.4 Running Meetings
• **Meeting Type:** Hybrid (Face-to-face and online as required)
• **Agenda:** Distributed beforehand by Scrum Master
• **Minutes & Notes:** Documented and shared post-meeting by Scrum Master

5.5 Meeting Preparation
• **Tasks Review:** Members must review Trello tasks before meetings
• **Progress Updates:** Each member provides updates and communicates blockers clearly
• **Technical Issues:** Report issues prior to meetings for prompt resolution

5.6 Version Control (GitHub)
• **Branching Strategy:** Utilize feature branches exclusively for feature development

• **Commit Messages:** Structured clearly (e.g., feat:, fix:, docs:) and descriptive of changes
• **Pull Requests:** Require at least one peer review before merging
• **Sensitive Information:** Never commit sensitive data (e.g., passwords, keys, credentials)

5.7 Division of Work
• **Scrum Master (Arban):** Workflow efficiency, blocker removal, Scrum compliance
• **Product Owner (Zakariya):** Requirements definition, backlog prioritization
• **Developer (Messam):** Feature implementation, code quality, software testing
• **Task Assignments:** Decided collaboratively during sprint planning; documented and tracked in Trello

5.8 Submitting Assignments
• **Deadline:** Submission finalized at least 24 hours before official deadline
• **Responsible Party:** Scrum Master (Arban Arfan) submits after group review
• **Peer Review:** Mandatory for all members ensuring completeness and correctness

5.9 Contingency Planning
• **Member Drop-out:** Redistribute tasks, escalate if additional support is required
• **Attendance Issues:** Address promptly; escalate to the instructor if unresolved
• **Academic Dishonesty:** Immediate reporting to instructor; potential removal from team

11. Challenges Faced & Lessons Learned

11.1 Challenges Faced

1. **Scope Creep and Requirement Clarification**
   Early in the project, the team encountered ambiguity in stakeholder expectations, leading to evolving feature requests and adjustments in functionality. This required realignment of deliverables and frequent refinement of the product backlog.
2. **Integration of Role-Based Access Control**
   Implementing and maintaining distinct access levels for students, administrators, and industry representatives posed technical and logical challenges, especially during backend route validation and UI rendering.
3. **Maintaining Consistent UI/UX Across Modules**
   Ensuring uniformity in design and responsiveness across all user roles proved difficult due to the breadth of functionalities and user journeys. This necessitated multiple iterations of front-end refactoring.
4. **Testing Complex Workflows**
   Thoroughly testing interconnected modules (e.g., course enrollment → quiz participation → performance analytics) required detailed test case design and frequent mock data usage to simulate user behavior.
5. **Git Merge Conflicts During Collaboration**
   With multiple contributors working concurrently on features, several merge conflicts occurred—particularly during sprint integration phases. This disrupted momentum and demanded synchronized version control practices.

6. **Time Constraints and Task Overlaps**
   Balancing academic workload with iterative development often led to deadline pressure, especially during sprint ends. Overlapping responsibilities sometimes hindered task ownership clarity.

11.2 Lessons Learned

1. **Importance of Clear Initial Planning**
   Investing sufficient time in defining scope, refining user stories, and identifying dependencies upfront proved essential for reducing ambiguity and enhancing team alignment throughout sprints.
2. **Effective Communication Enhances Productivity**
   Regular stand-ups, use of Trello for tracking, and responsive WhatsApp communication helped minimize blockers and ensured everyone remained on the same page.
3. **Early Testing Prevents Later Failures**
   By incorporating unit tests, component testing, and both black-box and white-box methodologies during development, the team significantly reduced post-deployment issues and maintained high code quality.
4. **Documentation Accelerates Team Onboarding**
   Maintaining detailed API, component, and workflow documentation allowed smoother collaboration, especially when modules were transferred between members or restructured.
5. **Version Control Discipline Is Critical**
   Adhering to a disciplined Git strategy—featuring feature branches, peer-reviewed pull requests, and descriptive commits—minimized integration issues and enhanced code maintainability.
6. **Adaptability Is a Core Agile Strength**
   Embracing flexibility in task assignment, learning on the go, and revising strategies mid-sprint underscored the value of Agile methodologies in student-led software projects.