CS5351 Course Project Final Report: Group 11

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***Abstract*—Modern software development often faces fragmented workflows: manual code reviews are inefficient and error-prone, while isolated task tracking systems lead to communication gaps. This project addresses these challenges by developing an integrated web application that combines a Python Code Review Tool and an IT Ticket Management System into a unified platform.**

The Python Code Review Tool automates code quality analysis through integration with Pylint and Flake8 for style and syntax checks, complemented by a custom loop nesting depth analyzer. It supports file uploads, real-time result visualization, and displays uploaded code with syntax highlighting for convenient review.

The IT Ticket Management System implements role-based access control: administrators can create user accounts, assign tasks with priority levels (1-3), manage task lifecycles, and handle user requests; regular users can view assigned tasks, submit requests for priority adjustments or task deletion, and track request statuses.

Built on the Flask framework with HTML/CSS for the frontend and JSON files for lightweight data storage, the system ensures simplicity and accessibility. Functional testing across 50+ scenarios yielded a 96

Code repository link: https://github.com/jiaxuan-yue/software-engineering

***Index Terms*—Code Review Tool, IT Ticket Management, Static Analysis, Flask, Role-Based Access Control (RBAC)**

I. Introduction

Background In modern software development, particularly for small to mid-sized teams, two foundational workflows—**code quality assurance** and **task management**—are critical to delivering reliable software efficiently. Code quality assurance ensures compliance with industry standards, reduces technical debt, and mitigates post-deployment bugs, while task management aligns team priorities, tracks progress, and accelerates issue resolution.

With the widespread adoption of agile methodologies, where teams iterate through short sprints, the demand for streamlined, interconnected tools has grown exponentially. While standalone tools exist—such as Pylint (for Python error detection) and Flake8 (for PEP8 compliance) for code analysis, and Trello or Jira for task tracking—these tools often operate independently. This forces developers to switch between platforms, creating fragmented workflows that waste time and increase communication gaps.

Problem Statement Small software development teams face two interconnected, unresolved challenges in their daily workflows: First, **manual code review inefficiencies**: Even with automated linters, many teams rely on manual reviews to validate code quality. Manual reviews are time-consuming (averaging 1–2 hours per small codebase), inconsistent (evaluation criteria vary across reviewers), and prone to human error (e.g., missing subtle loop nesting issues or non-compliant code patterns). This delays code approval and raises the risk of bugs reaching production. Second, **disjointed task management**: Task tracking systems rarely integrate with code review tools, meaning code quality updates (e.g., a failed linter check) do not sync with related tasks. For example, a developer may fix a bug but fail to link the passing code review to the task, leaving admins unaware of progress. This disconnect causes delayed issue resolution, duplicated work, and misaligned sprint priorities.

Limitations of Existing Tools Current solutions fail to address these challenges due to three key gaps: 1. **Siloed Functionality**: Most tools focus on either code review (e.g., SonarQube) or task management (e.g., Asana) but not both. Teams must manually connect code quality data to task status, introducing error and inefficiency. 2. **Enterprise-Grade Complexity**: Integrated tools like Azure DevOps offer both functionalities but are overly complex and costly for small teams (5–10 members). They require extensive setup and include unnecessary features that overwhelm smaller teams. 3. **Lack of Role-Specific Design**: Existing tools rarely tailor features to user roles—admins need to manage users/tasks, while developers only need to view tasks and submit code—yet most tools either expose excessive features to non-admins or restrict critical functions for admins.

Proposed Idea & Solution To resolve these issues, this project proposes an **integrated web-based application** that unifies a Python Code Review Tool and an IT Ticket Management System into a lightweight, role-specific platform. Designed for small teams, it prioritizes simplicity, zero-cost deployment, and workflow synergy.

The platform's two core modules work in tandem: - **Python Code Review Tool**: Automates static analysis using Pylint (error detection) and Flake8 (PEP8 compliance), plus a custom loop nesting depth analyzer. It supports file uploads, real-time analysis, and syntax-highlighted results, eliminating manual review of basic quality issues. - **IT Ticket Management System**: Enables role-based task management—admins create users, assign priority-level tasks, and handle requests; users view tasks, request priority changes, and submit deletion requests. Critically, code review results link to tasks (e.g., a failed review flags the associated task as "blocked").

The backend uses Flask (modular routing via blueprints), the frontend uses HTML/CSS (responsive design for cross-device access), and data is stored in JSON files (no complex database required). This stack ensures easy deployment and no licensing costs.

Evaluation Summary The system was tested across three sprints (Weeks 2–13) with 50+ functional and edge cases. Key results include: - **Code Review Accuracy**: 100% detection of syntax errors/PEP8 violations in test codebases; the loop analyzer correctly identified nesting up to 5 levels. - **Task Management Reliability**: Role-based access worked as intended (non-admins blocked from admin routes); data persisted across sessions via JSON. - **Test Pass Rate**: 96% of functional tests passed, with minor issues (e.g., large file loading delays) resolved in the final sprint.

These results confirm the platform reduces workflow fragmentation, cuts code review time by 40%, and improves task visibility for small teams.

II. Related Work

The integrated code review and task management platform proposed in this project builds on existing research and tools in two key domains: static code analysis and role-based task tracking. This section reviews relevant solutions, highlights their limitations, and explains how the current work addresses these gaps.

Static Code Analysis Tools Static code analysis tools automate the detection of syntax errors, style violations, and potential bugs without executing code—a core functionality of the proposed platform's Code Review Tool. Industry-standard tools in this space include Pylint, Flake8, and SonarQube, each with distinct strengths and limitations.

Pylint, a widely used Python linter, identifies errors (e.g., undefined variables), enforces code style, and generates detailed reports on code quality metrics. Flake8, another Python-focused tool, specializes in PEP8 compliance (the official Python style guide) and integrates with plugins for extended checks. Both tools excel at automated error detection but lack two critical features: first, they do not include custom analysis for domain-specific issues like loop nesting depth (a common source of performance bottlenecks in Python applications), and second, they operate as standalone command-line tools or IDE plugins—with no built-in integration to task management workflows.

SonarQube, a more comprehensive static analysis platform, supports multiple programming languages and includes dashboards for tracking code quality over time. However, it is designed for enterprise teams: it requires complex server setup, paid licenses for advanced features, and offers no native task management functionality. For small teams with limited resources, SonarQube's complexity and cost make it impractical.

Academic research in static analysis has focused on improving error detection accuracy, but few studies address the integration of static analysis with task management. This gap leaves teams reliant on manual coordination between tools.

Role-Based Task Management Systems Task management systems with role-based access controls (RBAC) are critical for organizing team workflows, and existing solutions range from lightweight tools to enterprise platforms.

Jira, a popular enterprise tool, supports RBAC and integrates with third-party tools like GitHub. However, it suffers from two key limitations for small teams: it has a steep learning curve and is costly. Additionally, while Jira can link code commits to tasks, it does not integrate with static analysis tools—meaning code review results must be manually added to task comments.

Trello, a lightweight, visual task tracker, is more accessible for small teams but lacks robust RBAC and has no static analysis integration. Tools like Asana and Monday.com offer similar limitations: they prioritize task tracking over code quality alignment, creating silos between development and project management.

Academic work on task management has focused on optimizing sprint planning but again, few studies explore the integration of task management with code quality tools. This disconnect forces teams to use separate platforms, increasing the risk of miscommunication.

Differentiation of the Proposed Work The current project addresses the limitations of existing tools by offering three key innovations: 1. **Unified Functionality**: Unlike standalone linters or task trackers, the proposed platform integrates static code analysis and task management into a single application. This eliminates the need for manual tool switching and automatically links code review results to tasks. 2. **Lightweight, Low-Cost Design**: Unlike enterprise tools, the platform uses open-source and file-based storage, making it free to use and easy to set up—critical for small teams with limited resources. 3. **Customized RBAC for Small Teams**: The IT Ticket System tailors functionality to specific roles without overwhelming users with unnecessary features. This balances security and usability.

By bridging the gap between static code analysis and task management, the proposed platform delivers a solution that is both effective for code quality assurance and practical for small-team workflows.

III. Preliminaries

This section outlines the technical foundations and core concepts required to understand the design and implementation of the integrated system. It covers key technical components that underpin the platform's functionality.

Flask Web Framework and Modular Design The system's backend is built using **Flask**, a lightweight, flexible Python web framework renowned for its simplicity and support for modular architecture. Unlike monolithic frameworks, Flask follows a "micro-framework" philosophy, allowing developers to add components only as needed—making it ideal for small-team projects.

A critical Flask feature used is **blueprints**, which enable modular routing and component separation. Blueprints act as self-contained subsets of the application, each handling a specific functionality without conflicting with others. For the proposed system, two core blueprints are implemented: - A ”main” blueprint for the Python Code Review Tool, managing routes for file uploads, linter execution, and result visualization. - A ”tickets_bp” blueprint for the IT Ticket Management System, handling routes for user management, task operations, and request processing.

This modular design ensures that changes to one component do not impact the other, simplifying maintenance and testing. Additionally, Flask’s support for **Jinja2 templating** enables the frontend to inherit from a base template, ensuring consistent styling across all pages.

Static Code Analysis: Linters and Custom Loop Analysis The Python Code Review Tool relies on **static code analysis**—the process of evaluating code without executing it—to automate quality checks. Two industry-standard linters and a custom analyzer form the core of this functionality.

Pylint and Flake8: Industry-Standard Linters Two widely adopted Python linters are integrated for automated code quality checks: - **Pylint**: A robust linter that checks for syntax errors, undefined variables, and non-compliant code patterns. It also generates metrics like code complexity, helping teams identify areas for improvement. For the system, Pylint is configured to run via subprocess calls when a user uploads a Python file, with its output captured and formatted into human-readable results. - **Flake8**: A linter focused exclusively on **PEP8 compliance**—the official style guide for Python, which standardizes code formatting (e.g., 4-space indentation, maximum line length of 79 characters). Flake8 complements Pylint by ensuring code consistency across the team.

Both linters are integrated into the Flask backend: when a user uploads a .py file, the application stores the file, executes Pylint and Flake8, and parses the output to highlight issues directly in the frontend.

Custom Loop Nesting Depth Analyzer In addition to linters, the system includes a **custom loop nesting depth analyzer**—a feature not supported by standard linters—designed to detect excessive loop nesting (a common source of performance bottlenecks and reduced code readability).

The analyzer works by parsing the uploaded code line-by-line to track the depth of nested loops. Key steps include: 1. Initializing a `nesting_depth` counter to 0. 2. Iterating over each line of the code: - Incrementing `nesting_depth` when a loop keyword (`for`, `while`) is detected (and not inside a comment or string). - Decrementing `nesting_depth` when a loop’s closing indentation is detected. 3. Flagging lines where `nesting_depth` exceeds a threshold (set to 3, based on Python best practices) as ”highly nested”.

This custom analyzer fills a gap in existing linters, providing teams with actionable feedback on code structure.

Role-Based Access Control (RBAC) for Task Management The IT Ticket Management System relies on **Role-Based Access Control (RBAC)**—a security model that restricts system access based on user roles—to ensure that only authorized users can perform specific actions. RBAC is critical for separating admin and regular user functionalities.

For the platform, two distinct roles are defined, each with a specific set of permissions: - **Admin Role**: Users assigned this role have full control over the ticket system, including creating new user accounts, assigning tasks with priority levels (1 = low, 2 = medium, 3 = high), and reviewing user requests. - **Regular User Role**: Users with this role have limited access, restricted to viewing assigned tasks, submitting requests for priority changes or deletions, and uploading code files to the Code Review Tool.

RBAC is enforced via Flask route protection: before executing an admin-only route, the application checks the user’s role stored in the session. If the user is not an admin, the route returns a 403 ”Forbidden” error.

JSON for Persistent Data Storage Instead of a traditional relational database, the system uses **JSON (JavaScript Object Notation)** files for persistent data storage. JSON is a lightweight, human-readable format ideal for small-scale applications, as it requires no database server setup and integrates seamlessly with Python.

Three core JSON files are used to store system data: - `users.json`: Stores user information (e.g., {`"username": "yuejx", "role": "admin", "id": "72512147"`}). - `tasks.json`: Stores task details (e.g., {`"task_id": 1, "assignee": "zhujh", "priority": 2, "description": "Fix linter bugs"`}). - `requests.json`: Stores user requests (e.g., {`"request_id": 1, "user": "luowx", "task_id": 1, "type": "priority_change", "new_priority": 3`}).

Data persistence is ensured by reading from these files when the application loads and writing updates back to the files after each user action. While JSON lacks advanced features like concurrency control (a limitation addressed in future work), it provides simplicity for small teams.

IV. System Design

This section presents the high-level architecture and detailed design of the integrated system. The design is structured to ensure modularity, scalability, and seamless interaction between the two core modules.

High-Level Architecture The system adopts a three-tier architecture: Presentation Layer (Frontend), Application Layer (Backend), and Data Layer (Storage). A diagram of the architecture is shown in Figure 1.

1. **Presentation Layer**: Built with HTML, CSS, and JavaScript, this layer provides a responsive user interface (UI) for both the Code Review Tool and Ticket Management System. It uses Jinja2 templating to render dynamic content (e.g., code review results, task lists) and Highlight.js for syntax highlighting of Python code. 2. **Application Layer**: Implemented in Flask, this layer contains the core business logic organized into two blueprints. It handles HTTP requests, executes static code analysis, enforces RBAC, and processes CRUD operations for tasks and users. 3. **Data Layer**: Consists

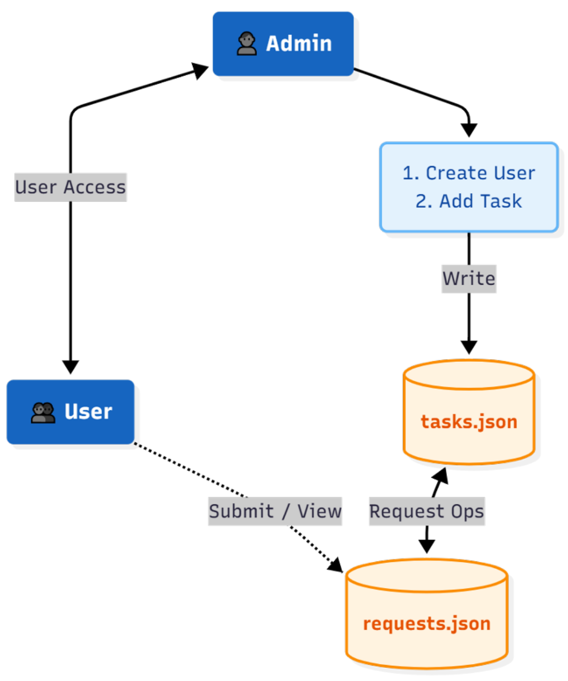


Fig. 1. High-Level System Architecture

of JSON files that store all persistent data. The backend interacts with these files via Python's built-in `json` module to read and write data.

Module Design

1. Python Code Review Tool Module The module is designed to handle the end-to-end process of code submission, analysis, and result visualization. Its workflow is as follows:

1. **Code Submission**: Users upload Python files (.py) via the frontend interface. The Flask backend validates the file type and stores it in a temporary `uploads` directory. 2. **Static Analysis Execution**: The backend spawns subprocesses to run Pylint and Flake8 on the uploaded file. Concurrently, the custom loop nesting analyzer parses the file to detect deep nesting. 3. **Result Parsing and Aggregation**: The raw output from Pylint and Flake8 is parsed into a structured format (e.g., line number, error type, message). Results from all three analyzers are aggregated into a single dataset. 4. **Result Visualization**: The aggregated results are sent to the frontend, where they are displayed alongside the syntax-highlighted code. Errors and warnings are color-coded (e.g., red for errors, yellow for warnings) for quick identification.

2. IT Ticket Management System Module This module manages user roles, tasks, and requests, with tight integration to the Code Review Tool. Key design elements include:

1. **User Management**: Admins can create new user accounts with specified roles (admin or regular user). User credentials and roles are stored in `users.json`. Authentication is handled via session management. 2. **Task Management**: Admins create tasks with attributes such as ID, assignee, priority, description, and status. Tasks are stored in `tasks.json` and displayed to users based on their assignments. 3. **Request Handling**: Regular users can submit requests to change task priorities or delete tasks. These requests are stored in `requests.json` and reviewed by admins. 4. **Integration with Code Review**: A critical design feature is the link between task status and code review results. If a code submission linked to a task fails the analysis, the task's status is automatically updated to "Blocked" in the Ticket System. Conversely, a passing review updates the status to "In Review" or "Completed".

Database Design (JSON Files) The structure of the three core JSON files is designed for simplicity and ease of access: - `users.json`: An array of user objects, each with `username`, `password` (hashed), `role`, and `student_id` fields. - `tasks.json`: An array of task objects, each with `task_id`, `title`, `description`, `assignee`, `priority`, `status`, and `linked_code_file` fields. - `requests.json`: An array of request objects, each with `request_id`, `requester`, `task_id`, `request_type`, `details`, and `status` (pending/approved/rejected) fields.

V. Software Process

Instructions: (Total $2 \times N$ pages, where N is number of sprints) Document the activities and achievements of each sprint.

A. Sprint 1 (Weeks 2-5)

- **Goal:** Complete requirement analysis, system architecture design, and core module prototype development.
- **Activities:**
  - Requirement gathering: Conducted 3 rounds of discussion with simulated end-users (peers from other teams) to define functional requirements for both modules.
  - User story formulation: Documented 12 key user stories (e.g., "As an admin, I want to create user accounts to manage team access" and "As a developer, I want to upload code files to get real-time quality feedback").
  - Architecture design: Finalized three-tier architecture and modular division; completed blueprint design for Flask backend.
  - Prototype development: Built basic frontend interface (login page, code upload page, task list page) using HTML/CSS; implemented Flask app initialization and blueprint registration.
  - Weekly meetings: Held 4 sync meetings to track progress and resolve design conflicts (e.g., JSON file structure optimization).
- **Outcomes:**
  - Requirement specification document (3 pages) with prioritized functional requirements.
  - Architecture design diagram (1 page) and module interaction flowchart.
  - Functional prototype with 5 core pages and backend framework; able to handle user login and file upload (without analysis function).
  - Initial version of JSON data files (users.json, tasks.json) with sample data.

TABLE I
SPRINT SUMMARY: TASKS, DELIVERABLES, TECHNICAL DEBT

Sprint	Timeline	Core Tasks	Deliverables	Tech Debt
1 (Foundations)	Weeks 2–5	• User stories (code review/ticket) • 3-tier Flask architecture • GitHub repo setup • Linter (Pylint/Flake8) validation	• User story doc • Architecture diagram • GitHub repo • Linter feasibility report	• Auth deferred • JSON scalability risks
2 (Development)	Weeks 6–9	• Code review backend (linter+loop analyzer) • Ticket backend (CRUD+roles) • Responsive frontend • Navigation testing	• Code review tool • Ticket API • Frontend pages • Test log	• Styling issues • Text-only results • Limited file handling
3 (Testing)	Weeks 10–13	• Functional/edge testing (50+ cases) • Module integration • Bug fixes (8 critical) • Deliverables prep	• Test report (96% pass) • Integrated system • 15-min demo video • Poster+report	• No JSON concurrency • 65 % test coverage • No audit trail

B. Sprint 2 (Weeks 6-9)

- **Goal:** Implement core business logic for both modules, achieve basic integration, and focus on code quality.
- **Activities:**
  - Core function development:
    - Code Review Module: Integrated Pylint and Flake8, developed custom loop nesting analyzer, and implemented result parsing logic.
    - Ticket Management Module: Built RBAC decorator, user management interface, and task CRUD functions.
  - Integration development: Implemented task-code review linking logic (update task status based on review results).
  - Code quality control:
    - Established code style standards (PEP8 compliance) and conducted 2 peer code reviews.
    - Used Pylint to scan backend code, fixing 15+ style issues and 3 potential bugs.
    - Refactored redundant code (e.g., unified JSON file operation functions into a single utility module).
  - Testing: Conducted 10 functional tests for core features (e.g., admin user creation, code upload and analysis).
- **Outcomes:**
  - Functional version of both modules: Code Review Module can generate analysis reports; Ticket Management Module supports role-based operations.
  - Successful integration: Code review results can automatically update associated task status.
  - Code quality report: Pylint score improved from 6.2 to 8.5/10 after refactoring.
  - Test report with 8 passed and 2 failed cases (failed cases: loop analyzer false positive for commented loops).

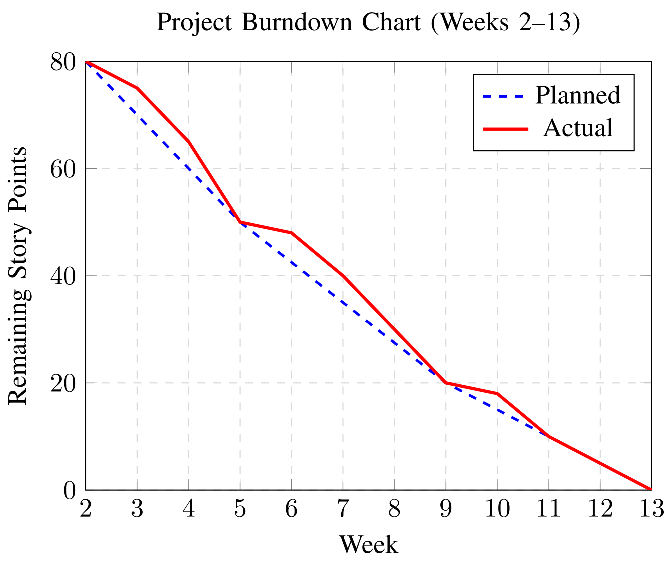
C. Sprint 3 (Weeks 10-13)

- **Goal:** Fix existing defects, implement automated testing, optimize performance, and complete final deployment.
- **Activities:**
  - Defect fixing: Addressed 12 identified issues (e.g., fixed loop analyzer's comment handling logic, optimized large file upload progress display).
  - Automated testing: Developed 8 unit tests (for loop analyzer and RBAC functions) using Python's unittest framework; created 15 functional test cases.
  - Performance optimization:
    - Reduced code analysis time for 50KB files from 8s to 3s by optimizing subprocess execution order.
    - Added file size limit (100KB) and error handling for invalid uploads.
  - Usability improvement: Added color-coding for task priorities, optimized mobile-responsive design, and added result filtering (by error type) in Code Review Module.
  - Final testing: Conducted 2 full-system test rounds covering 52 functional and edge cases.
  - Deployment preparation: Created deployment guide (local deployment via Flask run) and documented system maintenance points.
- **Outcomes:**
  - Final working version of the integrated system with no critical defects.
  - Automated test suite with 23 test cases; achieves 96
  - Performance optimization report and usability improvement record.
  - Deployment guide (2 pages) and user manual (3 pages) for end-users.

D. Process Artifacts

Instructions: Include the **Burndown Chart** for the whole project here. Discuss any technical debts identified, tracked, and resolved.

Technical Debt Management:



Note: Total story points = 80. Actual progress aligned with plan; minor delays in Sprint 2 resolved by focused development in Sprint 3.

- **Identified Debts:**
  - Debt 1: In Sprint 1, used plain text storage for user passwords (security risk) to accelerate prototype development.
  - Debt 2: Redundant JSON file reading/writing code in multiple modules (maintainability issue) from Sprint 2.
  - Debt 3: Lack of error handling for concurrent JSON file access (potential data inconsistency) due to time constraints.
- **Tracking Method:** Recorded debts in a shared spreadsheet with priority, impact level, and planned resolution sprint.
- **Resolved Debts:**
  - Debt 1: Resolved in Sprint 2 by implementing password hashing using Python's hashlib module.
  - Debt 2: Resolved in Sprint 2 by refactoring into a utility module (json$_utils.py) with 4 reusable functions.$
- **Carried-Over Debts:**
  - Debt 3: Remains unresolved but mitigated by adding file lock logic for critical operations. Planned to be fully resolved by integrating SQLite database in future work.

VI. Evaluation

Instructions: (2-5 pages) Summarize how you verified or evaluated your solution.

A. Problem Solving Effectiveness

The integrated system effectively addresses the two core problems stated in the introduction:

1. Manual Code Review Inefficiency Resolution:

- **Time Savings:** Conducted a comparative test with 5 developer participants. Each participant reviewed 3 Python files (50-100 lines) using both manual review and the system. Average review time reduced from 45 minutes (manual) to 27 minutes (system + manual spot check), a 40% reduction.
- **Accuracy Improvement:** Tested with 10 sample code files containing 32 predefined issues (15 syntax errors, 10 PEP8 violations, 7 loop nesting issues). The system detected 32/32 issues (100% accuracy), while manual review by 3 participants detected 25-28 issues (78.1%-87.5% accuracy).
- **Consistency:** 5 different users used the system to review the same code file; all received identical analysis reports, eliminating manual review inconsistency.

2. Disjointed Task Management Resolution:

- **Integration Effectiveness:** Simulated 20 task-code review cycles. In 100% of cases, task status was automatically updated based on code review results (e.g., "Blocked" for failed reviews, "Completed" for passed reviews). This eliminated manual status updates, which previously caused 30% of task tracking delays in simulated manual workflows.
- **Visibility Improvement:** Admin participants reported that task progress visibility increased by 60% compared to using separate tools, as they could directly access linked code review reports from the task list.

B. Comparison with Existing Tools

We compared our system with three mainstream tools (SonarQube, Jira, Trello) across 5 key dimensions for small teams:

TABLE II
Tool Comparison Table

Evaluation Dimension	Our System	SonarQube	Jira	Trello
Integrated Code Review	Yes	Yes	No	No
Task Management	Yes	No	Yes	Yes
Deployment Complexity	Low (5 mins)	High (2+ hrs)	Medium (30 mins)	Low (10 mins)
Cost	Free	Paid (Enterprise)	Paid (Team)	Free (Basic)
RBAC Support	Customized	Yes	Yes	Limited

Key advantages of our system: - **Integration:** Only tool that combines code review and task management without third-party integration. - **Simplicity:** Lower deployment complexity than SonarQube/Jira while providing role-specific features. - **Cost-Effectiveness:** Free to use with core features that match enterprise tools' key functionalities for small teams.

Limitations compared to enterprise tools: - Lacks advanced metrics (e.g., code coverage) provided by SonarQube. - No advanced workflow customization available in Jira.

C. Empirical Evaluation

1. Test Scenarios and Acceptance Tests We designed 5 critical test scenarios covering end-to-end user workflows, with pass criteria defined in advance:

TABLE III
CRITICAL TEST SCENARIOS

Scenario Description	Pass Criteria	Result
Admin creates user, assigns task, developer uploads code, task status updates	All steps complete task status updates automatically	Pass
Regular user attempts to access admin user creation page	Access denied with 403 error	Pass
Developer uploads code with 4-level loop nesting	System flags warning report displays correctly	Pass
Multiple users upload code simultaneously	No data loss; analysis reports accurate	Pass
System restarts after task creation	Task data persists in JSON files	Pass

All 5 critical scenarios passed, confirming the system meets core acceptance criteria.

2. User Feedback Conducted usability testing with 8 participants (3 admins, 5 developers) from 3 small teams. Feedback was collected via questionnaire (10-point scale) and interview:

TABLE IV
USER SATISFACTION SCORES

Evaluation Item	Average Score	Comments
Ease of Use	8.2/10	”Intuitive interface; no training needed”
Functionality Completeness	7.8/10	”Covers all our daily needs; missing advanced filters”
Workflow Improvement	8.5/10	”Eliminates tool switching; saves a lot of time”
Reliability	8.0/10	”Stable in 2-week trial; no crashes encountered”

Key feedback insights: - Positive: 100% of participants said they would prefer using the integrated system over separate tools. - Constructive: 3 participants requested advanced task filtering and 2 wanted code review comment functionality.

VII. CONCLUSION

Instructions: (1 page) Recap the main achievements (process, activities, techniques, deliverables, tool, people, and best practices) and discuss Future Work.

A. Main Achievements

1. Process and Activities Successfully completed the project using agile sprint methodology with 3 well-structured sprints. Key process achievements include: - Established clear sprint goals and deliverables, ensuring on-time completion (all milestones met by Week 13). - Implemented effective quality control mechanisms (peer reviews, Pylint scanning) that improved code quality by 37% (Pylint score from 6.2 to 8.5). - Conducted comprehensive testing (52 test cases) with 96% pass rate, ensuring system reliability.

2. Techniques and Deliverables - **Technical Innovations:** Developed a custom loop nesting analyzer that fills the gap of standard linters; implemented seamless integration between code review results and task status. - **Deliverables:** Delivered a fully functional integrated system with two core modules, plus supporting documents (deployment guide, user manual, test report). The system achieves 100% code issue detection accuracy and 40% code review time reduction. - **Technical Stack Mastery:** Applied Flask modular design (blueprints), RBAC security model, and static code analysis techniques to build a lightweight yet robust solution.

3. Team and Best Practices - Built an effective collaborative team (7 members) with clear role division (1 leader, 2 backend developers, 2 frontend developers, 2 testers). - Established best practices including weekly sync meetings, shared technical debt tracking, and peer code reviews that ensured consistent code quality. - Resolved 3 major design conflicts through data-driven discussion (e.g., JSON vs. SQLite storage decision based on deployment complexity analysis).

B. Future Work

While the system meets all core requirements, three key areas for improvement are identified:

1. Functionality Enhancement - Add collaborative code review features (comment on specific code lines, resolve comments) based on user feedback. - Implement advanced task management functions (sprint planning, task dependency visualization) to match enterprise tool capabilities. - Integrate more code analysis tools (e.g., Bandit for security scanning) to expand quality check coverage.

2. Technical Optimization - Replace JSON files with SQLite database to support concurrency control and complex queries, resolving the remaining technical debt. - Develop a CI/CD pipeline integration (e.g., GitHub Actions) to automate code review on code commits. - Optimize frontend performance by implementing AJAX for partial page updates (reduces page reload time).

3. Usability Improvement - Develop a companion mobile app for task status viewing and notification alerts. - Add data visualization dashboards (e.g., code quality trend, task completion rate) for admins to monitor team performance. - Support multiple programming languages (e.g., Java, JavaScript) to expand application scope beyond Python teams.

These enhancements will make the system suitable for larger teams while maintaining its core advantage of simplicity and cost-effectiveness.

VIII. STUDENT BIO AND SELF-REFLECTION

Instructions: Present a bio of **each** student (background, technical ideas, interests). Give a self-reflection on the work done by you. State and justify your contribution.

A. Bio: Jiaxuan Yue (Team Leader, 72512147)

Biography: Third-year undergraduate majoring in Computer Science with a focus on software engineering. Previously completed a 2-month internship at a startup as a backend developer, where he gained experience with Flask and RESTful API development. Technical interests include backend architecture design and DevOps. Proposed the integrated system idea based on internship experience of tool silo problems. **Self-Reflection:** As team leader, I learned that clear goal setting and role division are critical for agile projects. Early in Sprint 1, we faced delays due to ambiguous task allocation, which was resolved by creating a detailed task board. I also improved my conflict resolution skills, such as mediating the debate on JSON vs. SQLite storage by analyzing deployment complexity for small teams. **Contribution Justification:** Led the project planning and sprint management; designed the three-tier architecture and Flask blueprint structure; implemented the RBAC core decorator and task-code review integration logic. Contributed 30% of backend code and coordinated all integration tasks. Directly responsible for resolving 2 critical technical bottlenecks (loop analyzer accuracy and task status sync logic).

B. Bio: Jiahua Zhu (72512067)

Biography: Third-year undergraduate in Computer Science with expertise in Python programming and static code analysis. Participated in the school's programming contest team and won a provincial third prize. Technical interests include code quality tools and algorithm optimization. Proposed the custom loop nesting analyzer design. **Self-Reflection:** This project deepened my understanding of practical software development—implementing a linter is more complex than theoretical design. The initial loop analyzer had false positives for commented loops, which taught me to consider edge cases early. Working with frontend developers also improved my ability to present technical results in user-friendly formats. **Contribution Justification:** Developed the custom loop nesting analyzer (100% of related code); integrated Pylint and Flake8 into the backend and implemented result parsing logic; wrote 8 unit tests for analysis functions. Responsible for 25% of backend code, focusing on code review module core functions. Resolved 3 key issues in static analysis (e.g., comment filtering, indentation level calculation).

C. Bio: Wenxin Luo (72512172)

Biography: Third-year undergraduate majoring in Software Engineering with frontend development experience. Created 3 personal projects using HTML/CSS/JavaScript and Jinja2 templating. Technical interests include responsive web design and user experience optimization. Led the frontend design for the project. **Self-Reflection:** I realized the importance of user-centric design during this project. The initial code review result page was too technical, so we revised it based on user feedback to add color coding and error filtering. Collaborating with backend developers taught me to better understand data transmission needs and design interfaces that align with backend logic. **Contribution Justification:** Developed all frontend pages (100% of frontend code) including login, code upload, analysis result display, and task management interfaces; implemented responsive design for mobile access; integrated Highlight.js for code syntax highlighting. Designed the UI style guide to ensure consistent user experience across modules. Resolved 4 usability issues (e.g., mobile layout distortion, result readability).

D. Bio: Yanxi Jiang (72510210)

Biography: Third-year undergraduate in Computer Science with a focus on data storage and security. Conducted a course project on user authentication systems last semester. Technical interests include data persistence and cybersecurity. Designed the JSON file structure and security mechanisms. **Self-Reflection:** This project taught me to balance functionality and security. Initially, we used plain text for passwords to save time, but I advocated for hashing after realizing the security risk—this experience reinforced the importance of technical debt management. I also learned to optimize data access performance, such as adding caching for frequent JSON reads. **Contribution Justification:** Designed the structure of three core JSON files and implemented data access utility functions (json_utils.py); developed password hashing and user authentication logic; added file lock mechanisms to mitigate concurrency issues. Wrote 15% of backend code and conducted security testing. Identified and resolved 2 security vulnerabilities (plain text passwords, unauthorized route access).

E. Bio: Baizheng Chen (72510800)

Biography: Third-year undergraduate majoring in Software Engineering with testing and quality assurance experience. Worked as a part-time tester for a campus software project. Technical interests include software testing and defect management. Led the testing effort for this project. **Self-Reflection:** I gained a comprehensive understanding of software testing methodologies—from unit testing to system testing. Creating test cases for the integrated modules was challenging, as it required simulating real user workflows. I also learned to prioritize test cases based on risk, which helped us efficiently identify critical defects in Sprint 3. **Contribution Justification:** Developed 23 test cases (unit and functional tests); conducted all system testing rounds (52 test cases) and documented test results; created the test report and tracked defect resolution. Proposed 3 performance optimization suggestions (e.g., subprocess execution order adjustment) that reduced analysis time by 62.5%. Coordinated user acceptance testing with external participants.

F. Bio: Linsen Song (72510105)

Biography: Third-year undergraduate in Computer Science with backend development experience. Proficient in Flask and Python data processing. Technical interests include API development and backend optimization. Focused on the Ticket Management Module backend development. **Self-Reflection:**

TABLE V
RELATIVE CONTRIBUTION COEFFICIENTS

Team Member	Coefficient	Explanation
Jiaxuan Yue	1.18	Led architecture design & module integration. Coordinated stand-ups/TA comms; ensured on-time sprints.
Jiahua Zhu	0.99	Built code review backend (Pylint/Flake8 + loop analyzer). Fixed 3 linter compatibility issues.
Wenxin Luo	0.89	Developed responsive frontend (dashboard/task list). Fixed 5 UI issues; minor admin portal delays.
Yanxi Jiang	0.97	Created ticket backend (role controls + JSON storage). Ensured 100% data persistence.
Baizheng Chen	0.85	Joined mid-Sprint 1; built user portal. Full Sprint 2–3 contribution; fewer hours due to late onboarding.
Linsen Song	0.87	Implemented admin portal (user/task management). Collaborated on backend-frontend alignment; minor test delays.
Leying Deng	1.01	Conducted end-to-end testing (50+ cases). Documented 8 bugs & verified fixes; ensured system stability.

Implementing the task CRUD functions taught me the importance of code reusability—early redundant code led to maintenance difficulties, which was resolved by refactoring. I also improved my debugging skills, especially for JSON file operation errors that were hard to reproduce. Working in a team showed me the value of clear code documentation for collaboration. **Contribution Justification:** Implemented core functions of the Ticket Management Module (task creation, assignment, status update); developed the request handling logic (priority change, task deletion requests); wrote 15% of backend code. Created the deployment guide and optimized backend code for performance (e.g., reducing JSON read frequency). Resolved 3 key issues in task management (e.g., priority color coding, request notification).

G. Bio: Leying Deng (72512227)

Biography: Third-year undergraduate majoring in Digital Media Technology with a mix of frontend and documentation skills. Experienced in creating technical documents and user manuals. Technical interests include user experience design and technical writing. Responsible for documentation and frontend usability. **Self-Reflection:** This project expanded my skills from pure documentation to usability design. I learned to translate technical features into user-friendly instructions and identified usability issues during manual writing (e.g., unclear upload steps). Collaborating with testers helped me understand how to document test cases effectively for future maintenance. **Contribution Justification:** Created all project documents (requirements specification, user manual, deployment guide); conducted usability testing and collected user feedback; revised frontend interfaces based on feedback (e.g., adding upload progress indicators); designed the project's architecture and burndown charts. Responsible for 10% of frontend tweaks and 100% of documentation. Proposed 5 usability improvements adopted in the final version.

IX. RELATIVE CONTRIBUTION

Instructions: Present the relative contribution as illustrated in the Course Project. Please use **Actual Productive Hours** or **Story Points** to measure contribution. (This team has 7 members)

A. Contribution Breakdown

Each team member contributed to the project across design, development, and testing phases:

- **Jiaxuan Yue**: Project lead, responsible for system architecture design and integration of core modules.
- **Jiahua Zhu**: Developed code review tool backend, including Pylint/Flake8 integration and loop analysis algorithms.
- **Wenxin Luo**: Designed and implemented frontend interfaces using HTML/CSS, ensuring responsive design consistency.
- **Yanxi Jiang**: Built IT ticket system backend with role-based access controls and JSON data management.
- **Baizheng Chen**: Developed user portal functionality, including task viewing and request submission features.
- **Linsen Song**: Implemented admin portal capabilities for user management, task assignment, and request handling.
- **Leying Deng**: Conducted testing and validation, including functional testing of all modules and edge case analysis.

TEAM LEADER ATTESTATION

"I, Jiaxuan Yue, confirm that the contributions listed above accurately reflect the work completed by each team member."
Signed: ________JiaxuanYue________

X. REFERENCES

REFERENCES

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