SYSTEM ANALYSIS AND DESIGN LAB

CSE 4408

CodeNex

Next Generation Coding platform

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Date of Submission:
February 6, 2024

Contents

1 Executive Summary

In today's technology-driven world, where machine learning and AI dominate system architecture, the value of human critical thinking is more important than ever. Problem-solving is key to honing this skill, yet many online platforms lack effective problem-solving trackers and up-solving(more like re-solving with new approach) methods for users to track their progress. Without external cues and triggers, it's easy to lose sight of one's problem-solving journey.

Key pain Points and Drawbacks of current systems:

- Popular online judges lack up-solving benefits of a particular problem. Learning at the initial phase comes with memorizing and certain ad hoc problems require solving the same problem multiple times with spaced repetition.
- Existing platforms have plenty of problems that often lead users to fall into the "Beginners Learning Trap" where people focus on the same genre without pushing themselves to explore a new genre of problems.
- Current systems focus more on ratings and difficulties of problems rather than specific problem type based progress graphs. We will give feedback to the user based on his desired goals to achieve and current solved problem numbers to illustrate current progress.

Our aim is to develop a tailored online judge that caters to all types of coders, including beginners. This platform will provide guidance, encourage consistency, and allow users to set specific goals based on difficulty levels. By implementing a smart up-solve and revision tracker, we ensure that users not only solve problems but also maintain quality and revisit key concepts.

Moreover, in our most advanced version, the platform will foster a sense of community, allowing users to track each other's progress and engage in healthy competition. Additional features such as event scheduling for coding events and personalized user calendars will enhance the overall learning experience.

2 Background

Current system and business process overview:

- The current online judge platform contains plethora of problems that frequently demotivate user and they feel lost while not seeing their progress.
- The user experience is not optimized, with a lack of real-time judging and upsolving tracking features, hindering user engagement and skill improvement.
- Missing of revision techniques causes a lot of effort to regain ones progress after some breaks from problem solving. Waste of time and energy is crystal clearly seen as the success curve is pretty low. Around 90-92% user fail to stick into the process in just 1 years of interval

Motivation of new system addressing the challenge:
Although our system can trigger user with effective and popular study methods like active recall and spaced repetition in a flashcard, where same problems will come repeatedly with certain time gap. People learn gradually and when a problem is encountered at first and the solution/hunch is found, it won't be lost rather will be saved and given as clue at second attempt. This process will continue and build strong concept of any Data Structure, Algorithm topic or random problem solving genre. Event scheduling and community engagement will act as a trigger and reward system will eventually help building a strong habit of regular problem solving.

3 Proposed System Functionality

Functional Requirements and specifications:

- User Registration and Authentication: Users should be able to register for an account with their handle and password. Google APIs can be used for signing up with a user email address.
- Problem Repository: Provide a vast repository of problems categorized by difficulty level, topic. Each problem should include a detailed description, input/output format, constraints, and sample test cases.

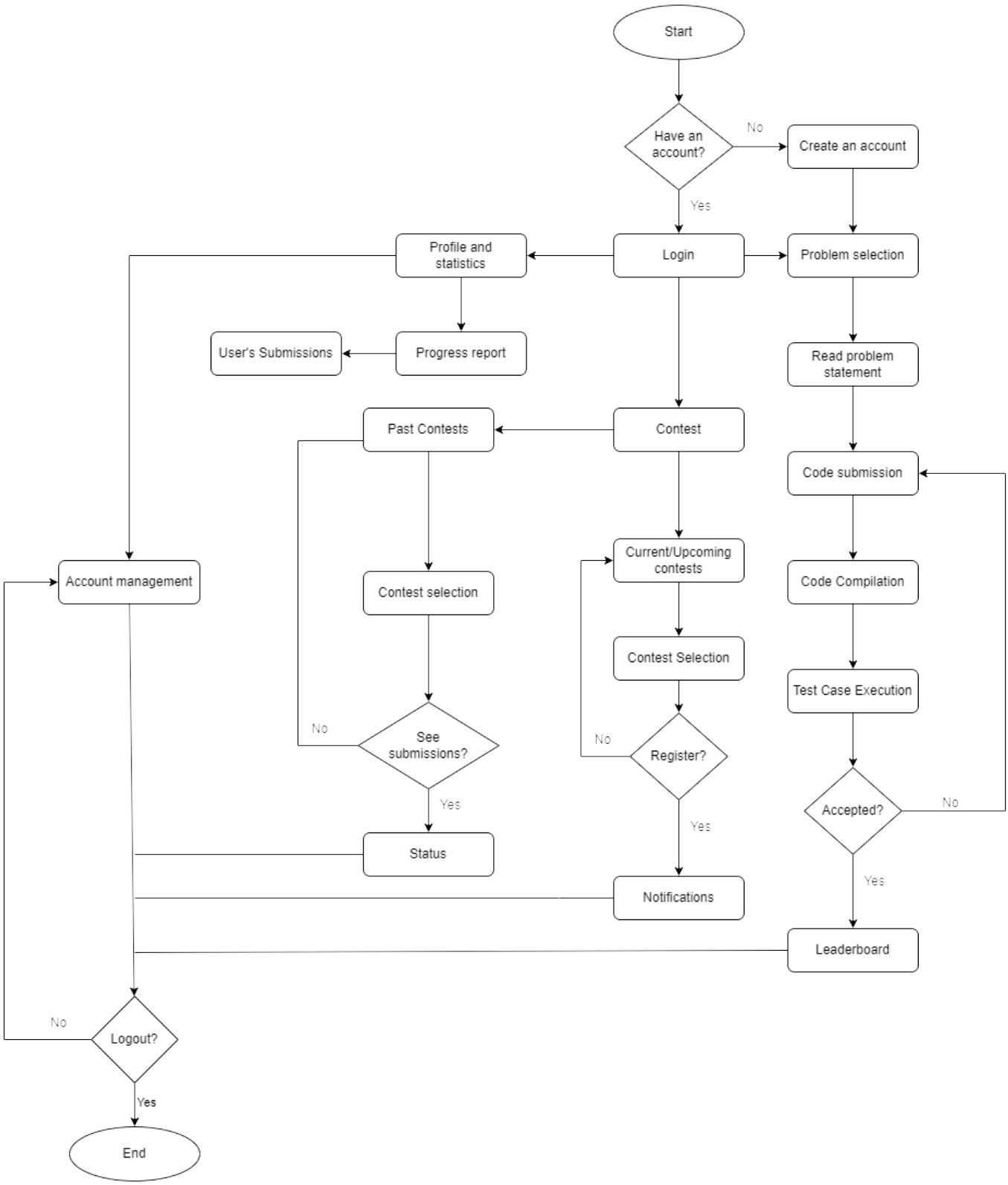

Figure 1: Current system flow chart

- Contests and Practice Mode:

  Host regular contests with predefined start and end times.

- Solution Submission: Users should be able to submit solutions in various programming languages (e.g., C++, Java, Python)
- Validate and compile submitted code before running against test cases.
- Submission History: Solved Problems version tracking with given verdict of every encountered problems
- Up-solving panel with Flashcard Integration

Personas or User Roles:

1. **Administrator (Admin):**
   - Manage user accounts and permissions.
   - Add, edit, or remove problems from the problem bank.
   - Monitor and handle any issues during contests.
2. **Contestant:**
   - Login and logout to the system.
   - Submit code solutions.
   - Register for contests and access contest details and problems and View contest results.
3. **Problem Setter (Among Contestant):**
   - Create and submit problems for contests.
   - Define test cases and constraints for problems.
   - Review and edit problem statements.

Interactions with other external systems or interfaces:

- Popular Online Judge APIs like CodeForces, AtCoder, TopCoder to fetch problem details and sample solution.
- Version Control Systems like Github linking.
- Collaboration with other platforms for certain reward and contest arrangements.

4 Technical Specifications

Key technologies and frameworks:

Backend: Express.js (Node.js) for building the backend infrastructure.

Frontend: Utilize modern JavaScript frameworks/libraries such as Angular, or Bootstrap for user interface

Database: Choose a robust database management system like PostgreSQL or MongoDB to store user data, problem details, submissions.

API Integration: APIs provided by online judges. Also, merging with compiler and interpreter APIs in various programming languages, ensuring flexibility of language

Compatibility with Existing Infrastructure:

Utilizing restAPIs and architectures following industry standards

Version control systems like GIT for codebase changes and submission history

ensuring compatibility with existing infrastructure by following standard web protocols.

Security, Access Control, and Permissions Needs:

- Duplicate login credentials checking
- Specific and separate roles for Admin activities and problem setting and stress testing.
- Contest participation restrictions based on difficulty

5 System Alternatives

Alternative systems(eg: codechef, leetcode) pros vs cons evaluation		
Points	Our System Pros	Alternative system characteristics
Smart Upsolve	Smarter upsolve using flash card technique	Inconsistency issues of user experiences and challenges
Revision Tracker	Suitable revision history enabling to track problems solved before	Limited revision history in codechef and codeforces
Performance Tracker	Performance tracker based on different parameters, not only solve count but also different categories and difficulties set	Lack of progress graphs based on a variety of parameters and limited performance analysis
Coder's Calendar	An interactive calendar to store contest events in order to provide an organized view	Contest Tracking is present but lack of a proper view in a personal scheduler
Reward System Samoa	Vouchers and merchandise to motivate users to solve more	Many of the system alternatives lack a reward or recognition system

Justification for Recommended Solution:

- **Smart Upsolve:** Cutting-edge smart upsolving system with intelligent problem recommendations based on users' submission history.
- **Robust Revision Tracker:** Allowing users to revisit and analyze their past submissions in detail, facilitating a deeper understanding of problem-solving approaches and improvements over time.
- **Coder's Calendar:** Showcasing a well-organized schedule of contests, both past and upcoming. This feature enables users to plan their participation and engage in regular competitive programming events.
- **Performance Tracker:** Users can monitor their progress, identify strengths and weaknesses, and make informed decisions for targeted improvement.

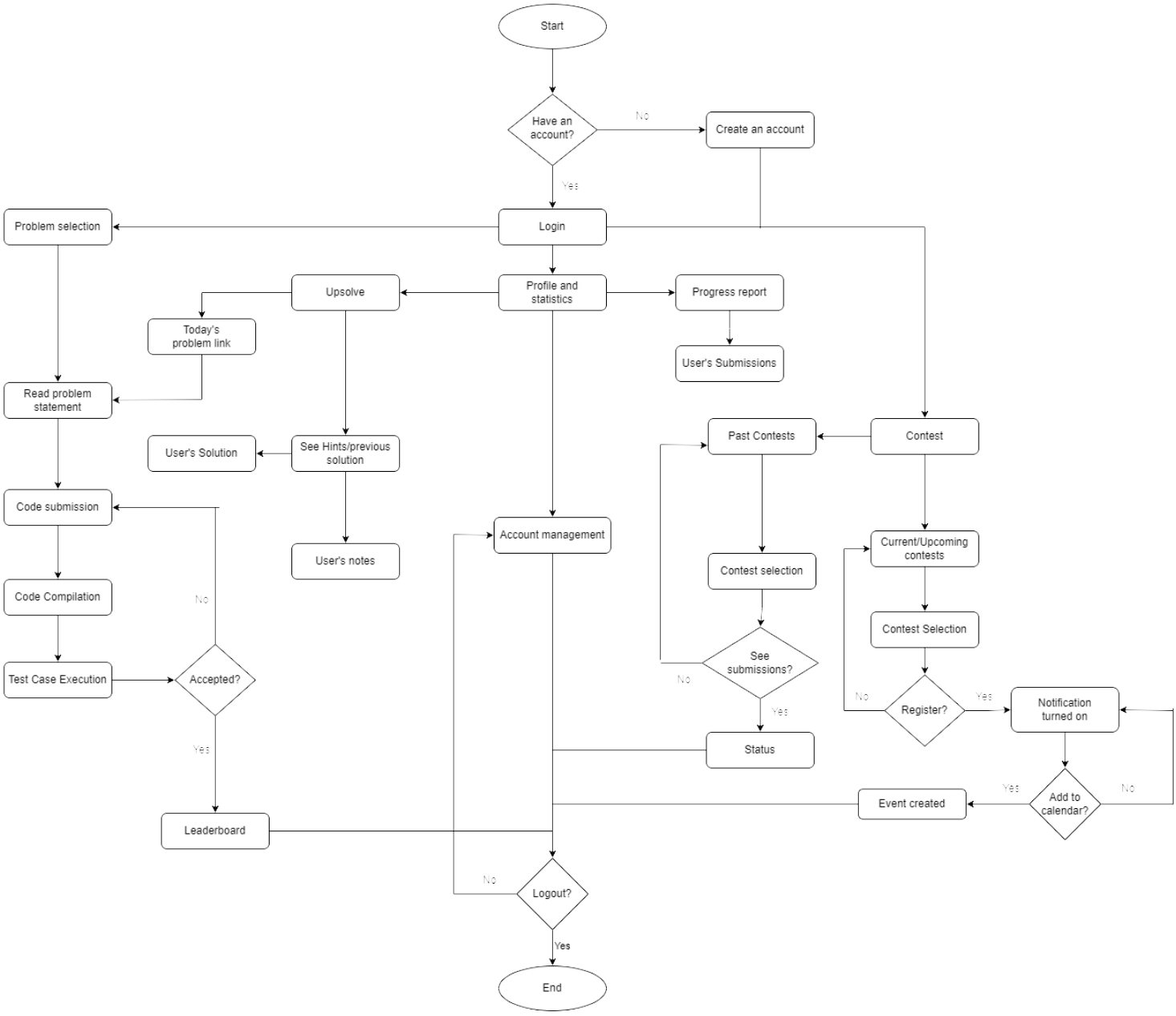

Figure 2: System flowchart of proposed system

- **Reward System:** Recognition strategies to motivate users through tangible rewards or achievements such as promo codes, merchandise, etc.

Alternative System Evaluation in a Decision Matrix

Feature	CodeChef	LeetCode	AtCoder	Codeforces
Smart Upsolve	- No triggered upsolving Feature	- No triggered Upsolving Feature	- Submission Rerun available	- Problem Solving Assistant present
Revision Tracker	- Limited Revision History	checkmark Detailed Revision Tracker	- Revision History available	- Limited Revision Tracker
CP Analysis	- Only codeChef Rating System	✓Explore Mode and Problem Sets	✓User Ratings and Contests Analysis	✓Comprehensive User and Contest Analysis
Problem Recommendation	- Limited problem recommendation	✓Explore Mode suggests problems	✓Problem Tags and Recommendations	✓Suggests Problems Based on Submissions
Interview Preparation	✓CodeChef for Schools	✓LeetCode Premium for Mock Interviews	- Limited Interview Preparation	- Limited Interview Preparation
Platform UX/UI	✓User-friendly Interface	✓Clean and Intuitive Interface	✓Minimalistic Interface	✓User-friendly and Intuitive Interface
Language Support	✓Wide Range of Programming Languages	✓Support for Multiple Languages	✓Support for C++, Python, and more	✓Extensive Language Support
Lacking Features/Notes	- Advanced problem recommendation system	- Detailed contest tracking and history	- Extensive educational content	- Limited revision tracking

Table 1: Comparison of Features across Online Judges

6 Proposal Summary

Our project aims to provide coding enthusiasts with a secure and user-friendly platform for skill enhancement through problem-solving and contest participation. With features like real-time judging, upsolving method, progress checker, event updates, the project promises to deliver a seamless experience. By emphasizing user-centric design, hope that this initiative will bring value to both users fulfilling commercial purposes with economic, operational feasibility.