

# Design Leetcode - Online Coding Judge

Practiced On: 8th feb 2025

## Qs for the interviewer

Time Taken: 65 Mins (1 Hour 5 Mins)

- 1. Do user need to sign in?
- 2. How many languages are supported?
- 3. How many DAU and total users are there on platform.
- 4. Do we need competition? How many users will be there?

Gave this mock in evening time, had low energy  
so couldn't gave my best  
I am sure could have done better if given in morning hours  
Need to work on this

## Requirements

- Functional Requirements:
- 1. User should be able to see list of coding problems
  - 2. Users should be able to click a Q(coding problem) & see its details
  - 3. User will be able to write code in their respective language and submit the same
  - 4. User will be able to participate in a competition
  - 5. User will be able to see the leaderboard in competition
  - 6. How is score for leaderboard is decided?

- Non Functional requirements:
- 1. System should have high availability (availability > consistency)
  - 2. System should show near realtime leaderboard
  - 3. System should have low latency for code submissions and get response
  - 4. System should be secure

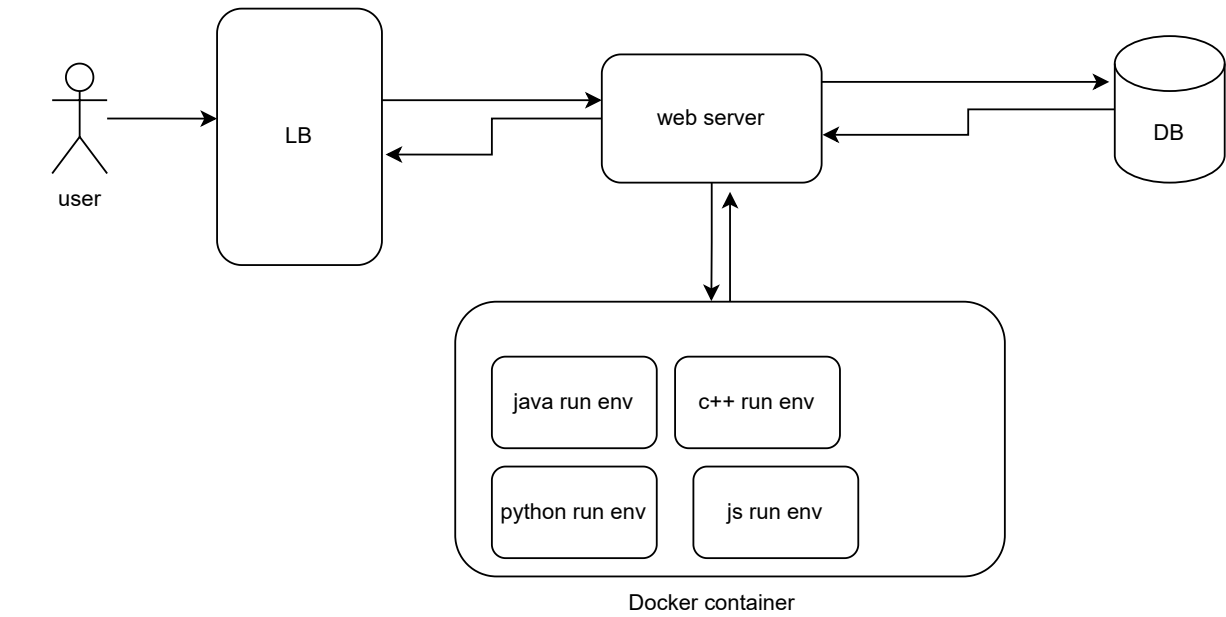
## Entity

- 1. User > user\_id, email\_id, last\_login, default\_lang
- 2. Problem > id, title, description, testCase [], diff, topic, company
- 3. User submitted solution > submitId, submittedBy, testCaseResult[], timing, lang, score
- 4. Competition > id, problem [], date, timing, leaderboard

## API design

- 1. GET list of problems  
GET HTTP/allProblems?difficulty={}?topic={}?frequency={}?company={}?page={}  
RESPONSE JSON {  
  list<problems>  
  // at the point problem obj won't have all detail, only have title,  
  //small description, topic, difficulty, frequency and company tag  
}
- 2. GET a specific problem  
GET HTTP/problem/:id  
RESPONSE JSON {  
  title: "",  
  description: "",  
  sample:"",  
  topic, difficulty, frequency, companyTag  
}
- 3. POST submit a code for a problem  
POST /problem/:id/submission  
body {  
  language:"",  
  user\_id:"",  
  code:"",  
  customeTestCase:""  
}  
RESPONSE JSON {  
  response\_object{}  
}
- 4. GET leaderboard  
GET HTTP/competition/:id/leaderboard  
RESONSE JSON {  
  List<Users> sorted by score # this will be paginated response  
}

## High Level Design - draft 1



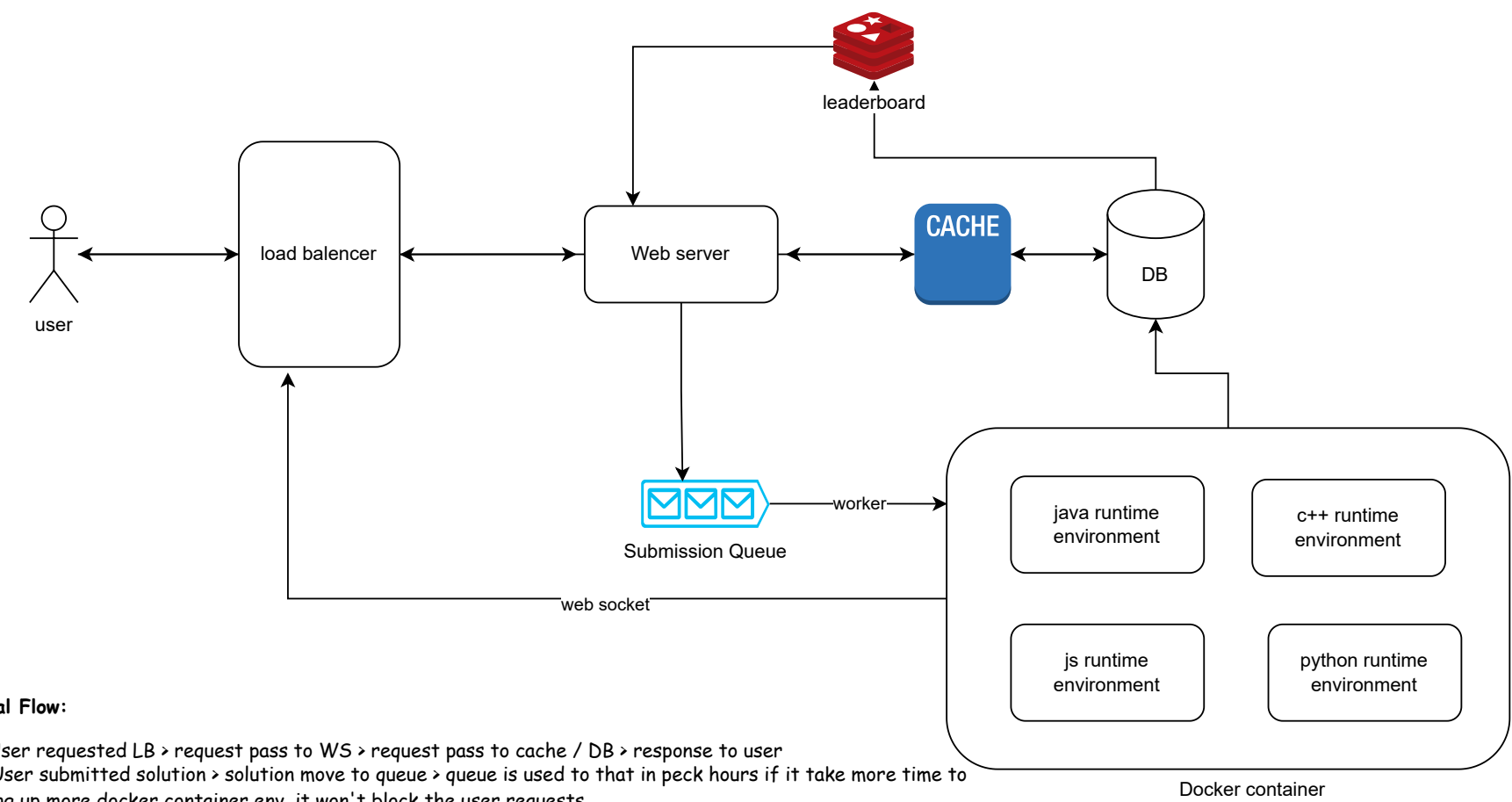
- Flow:
- 1. User request for /allProblems > passes through LB > request hit WS
  - 2. WB hit database > get all the metadata and Qs for with the filters that user have requested with
  - 3. DB return response to WS > WS return to user > user browser
  - 4. User clicked on a specific problem > id passed to WS > pass to DB > DB return details of the problem

- 5. User codes the solution and submits
- 6. code come to WS
  - > it won't be safe to run / execute an external code on our own WS
  - > for security we can run the code on VM > but VM are not lightweight, so we can use docker container
  - > code will be executed in a docker container env with diff test case
  - > response is returned back to WS > return back result to user

## Design Deep Dive

- 1. What kind to database to keep > As we need high availability and also will not be using much of the ACID properties we can have a no-SQL database
- 2. We can add cache before the DB to dec latency
- 3. To increase scalability one can add more servers
- 4. Competition: For completion, we need a leaderboard feature that can be a redis cache using sorted set

## Final High Level Design



### Final Flow:

- 1. User requested LB > request pass to WS > request pass to cache / DB > response to user
- 2. User submitted solution > solution move to queue > queue is used to that in peck hours if it take more time to bring up more docker container env, it won't block the user requests
- 3. worker can pull submission requests from queue and bring up containers and run the code
- 4. user's can be connected via web socket with container > response will be send back to user
- 5. Competition > user can vie leaderboard via redis cache that is updated by DB as user submits a solution

## Design review by ChatGPT

### Strengths:

- 1. **Well-Defined Functional & Non-Functional Requirements**
  - You have clearly outlined the key features (problem listing, submissions, competitions, leaderboard).
  - Non-functional aspects like **high availability**, **low latency**, and **security** are considered.
- 2. **Good API Design**
  - The API design follows RESTful principles, making it easy to use and extend.
  - Pagination for problem listing and leaderboard is a good choice for scalability.
  - Using query parameters for filtering problems is effective.
- 3. **Security Considerations for Code Execution**
  - Running user-submitted code in **Docker containers** instead of directly on the web server is a great approach to security.
  - You acknowledge the **resource-heavy nature of VMs** and optimize with containers.
- 4. **Scalability and Performance Considerations**
  - Load balancer** to distribute requests.
  - Submission queue** prevents request blocking during peak times.
  - Redis sorted set** for leaderboard caching reduces DB reads.
- 5. **WebSocket for Real-time Updates**
  - Using **WebSockets** to keep users updated on submission results improves UX.

### Areas for Improvement:

#### 1. Database Choice & Structure

- You mentioned using NoSQL for high availability, but do all entities fit this model?
  - Problems & Leaderboard:** NoSQL (e.g., MongoDB, Redis) makes sense.
  - Submissions & Users:** These may benefit from a **relational DB** (e.g., PostgreSQL, MySQL) because:
    - Ensuring data integrity (e.g., unique email per user).
    - Querying past submissions efficiently.
  - Consider **polyglot persistence**:
    - User, Submissions** → **SQL (ACID needed)**.
    - Problems, Leaderboard** → **NoSQL (Fast Reads)**.

#### 2. Leaderboard Updates

- How frequently does the Redis cache update from the database?
  - If real-time updates are required, you might need **event-driven processing** using **Kafka** or **Redis pub/sub**.

### 3. Handling Multiple Languages Efficiently

- **How do you decide which runtime environment to spin up?**
  - If a Java submission comes in, **do you keep Java containers always running, or create them on demand?**
  - Possible solution:
    - **Pre-warm a pool of containers** for frequently used languages.
    - **Use Kubernetes** to scale container instances dynamically.

### 4. Competition Management

- **How do you handle scoring logic?**
  - Can users submit multiple times?
  - Are scores calculated based on execution time, correctness, or both?
  - How do you handle cheating (e.g., detecting hardcoded solutions)?

### 5. Submission Processing Optimization

- **Right now, one worker pulls a submission from the queue and processes it.**
  - What if thousands of submissions come in simultaneously?
  - You may need:
    - **Multiple worker nodes** to handle high submission loads.
    - **Priority queues** for contest submissions to process them faster.

## Suggested Improvements:

#### 1. Consider Hybrid DB Approach

- NoSQL (Redis/MongoDB) for fast lookups.
- SQL (PostgreSQL/MySQL) for user/submission data consistency.

#### 2. Optimize Container Execution Strategy

- **Pre-warmed containers** for popular languages.
- **Auto-scaling workers** using Kubernetes.

#### 3. Refine Leaderboard Handling

- Use **event-driven updates (Kafka, Redis pub/sub)** for real-time ranking.
- Store **historical leaderboards** for past competitions.

#### 4. Improve Submission Processing Scalability

- Introduce **worker auto-scaling**.
- Use **priority-based queueing** for contest submissions.