# RiskHunter Detailed Design Document

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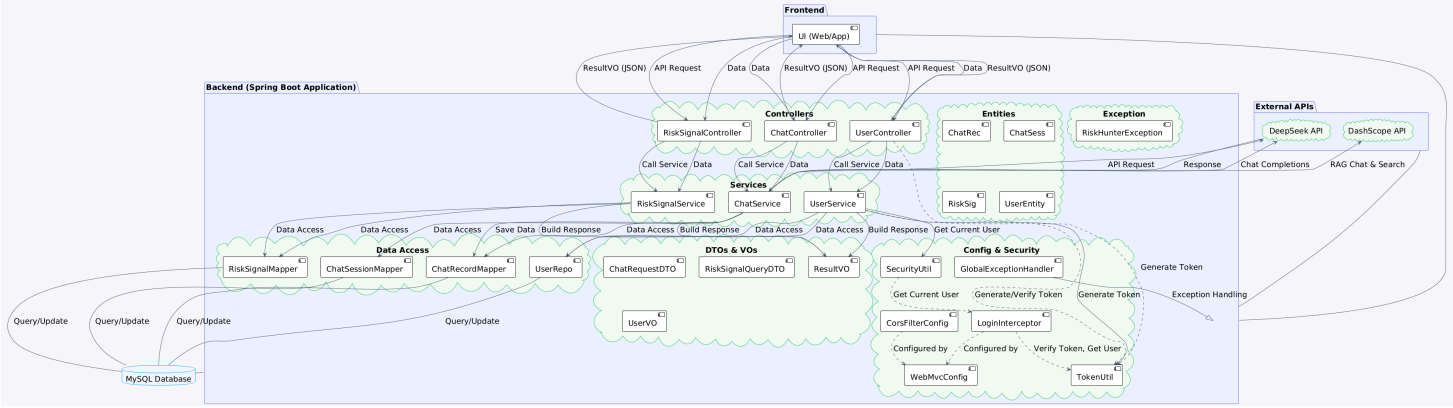
**Last Updated**: 2025.3.21



# 1. Overview

The RiskHunter backend is a Spring Boot application designed to provide risk analysis and chat functionalities. It focuses on analyzing financial risk signals and providing users with AI-powered chat

interactions. The application utilizes a MySQL database for data persistence, MyBatis-Plus for ORM, and Spring WebFlux for reactive stream processing, especially in the real-time chat feature. Security is achieved through JWT (JSON Web Tokens) for authentication and authorization.




# 2. Database Design

The database schema includes three main tables: `risk_signal`, `user`, `chat_record`, and `chat_session`.

## 2.1. Table Structure

- **`risk_signal`**: Stores historical risk signal data.

| Column Name | Data Type | Constraints | Description |
| --- | --- | --- | --- |
| `id` | BIGINT | Primary Key, Auto-increment | Primary Key |
| `base_currency` | INT | Not Null | Base Currency ID |
| `target_currency` | INT | Not Null | Target Currency ID |
| `time` | DATETIME | Not Null | Timestamp of the risk signal |
| `emp` | DOUBLE | Not Null | Employment Rate Percentage |
| `exchange_rate` | DOUBLE | Not Null | Exchange Rate |
| `interest_rate` | DOUBLE | Not Null | Interest Rate Percentage |
| `fx_reserves` | DOUBLE | Not Null | Foreign Exchange Reserves |

| Column Name | Data Type | Constraints | Description |
|---|---|---|---|
| `analysis` | VARCHAR(5000) | Not Null | Analysis of the risk signal |
| `advice` | VARCHAR(5000) | Not Null | Advice based on risk signal analysis |

- **`user`** : Stores user information.

| Column Name | Data Type | Constraints | Description |
|---|---|---|---|
| `id` | INT | Primary Key | Primary Key |
| `address` | VARCHAR(255) | Nullable | User Address |
| `username` | VARCHAR(255) | Nullable | Username |
| `password` | VARCHAR(255) | Nullable | User Password (hashed in actual application) |
| `phone` | VARCHAR(255) | Nullable | Phone Number (should be unique in practice) |
| `role` | INT | Nullable | User Role |

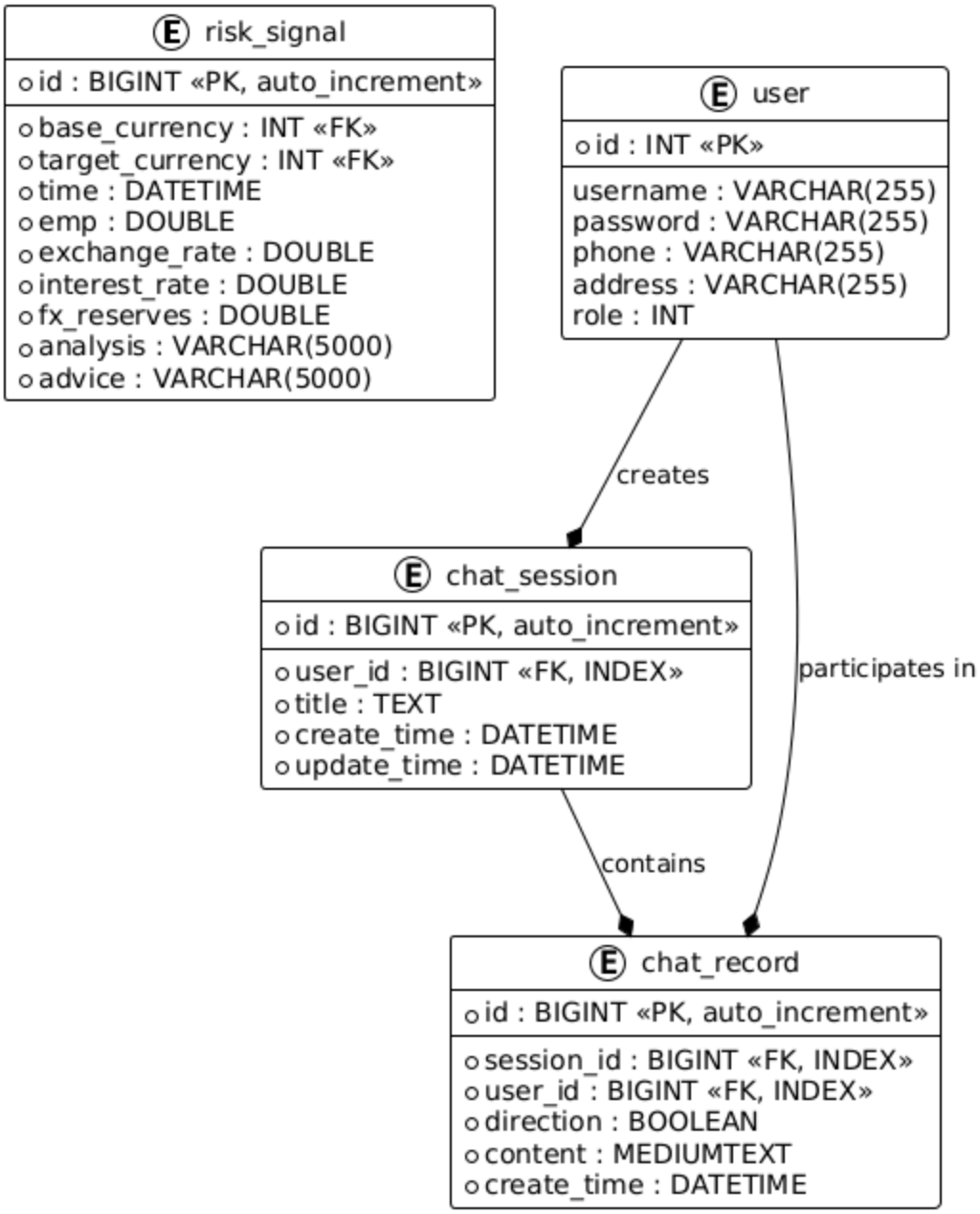
- **`chat_record`** : Stores individual chat messages within a session.

| Column Name | Data Type | Constraints | Description |
|---|---|---|---|
| `id` | BIGINT | Primary Key, Auto-increment | Primary Key |
| `session_id` | BIGINT | Not Null, Index | Foreign Key pointing to `chat_session.id` |
| `user_id` | BIGINT | Not Null, Index | User ID |
| `direction` | BOOLEAN | Not Null | Message Direction (true=User, false=AI) |
| `content` | MEDIUMTEXT | Not Null | Message Content |
| `create_time` | DATETIME | Not Null | Timestamp of message creation |

- **`chat_session`** : Stores metadata about chat sessions.

| Column Name | Data Type | Constraints | Description |
|---|---|---|---|
| `id` | BIGINT | Primary Key, Auto-increment | Primary Key |
| `user_id` | BIGINT | Not Null, Index | User ID |
| `title` | TEXT | Not Null | Session Title |
| `create_time` | DATETIME | Not Null | Timestamp of session creation |
| `update_time` | DATETIME | Not Null | Timestamp of last session update |

## 2.2. Database Class Diagram (PlantUML)




# 3. API Design

The backend exposes RESTful APIs to manage risk signals, user accounts, and chat functionality.

## 3.1. Risk Signal API ( `/api/risk-signals` )

- **`POST /api/risk-signals`** : Create a new RiskSignal.
  - Request Body: `RiskSignal` object in JSON format.
  - Response: `ResultVO<RiskSignal>` containing the created RiskSignal.
- **`GET /api/risk-signals`** : List RiskSignals with optional filters and pagination.

    - Query Parameters:
        - `startTime` (Optional, DateTime): Filter by start time.
        - `endTime` (Optional, DateTime): Filter by end time.
        - `page` (Optional, Integer, Default=1): Page number for pagination.
        - `size` (Optional, Integer, Default=10): Page size for pagination.
    - Response: `ResultVO<Page<RiskSignal>>` containing a paginated list of RiskSignals.
- **`PUT /api/risk-signals/{id}`** : Update an existing RiskSignal.
    - Path Parameter: `id` (Long): ID of the RiskSignal to update.
    - Request Body: `RiskSignal` object in JSON format containing update information.
    - Response: `ResultVO<RiskSignal>` containing the updated RiskSignal.
- **`DELETE /api/risk-signals/{id}`** : Delete a RiskSignal.
    - Path Parameter: `id` (Long): ID of the RiskSignal to delete.
    - Response: `ResultVO<Void>` indicating success.
- **`POST /api/risk-signals/search`** : Advanced search for RiskSignals based on conditions.
    - Request Body: `RiskSignalQueryDTO` object in JSON format.
    - Response: `ResultVO<Page<RiskSignal>>` containing a paginated list of matching RiskSignals.

## 3.2. User API ( `/api/users` )

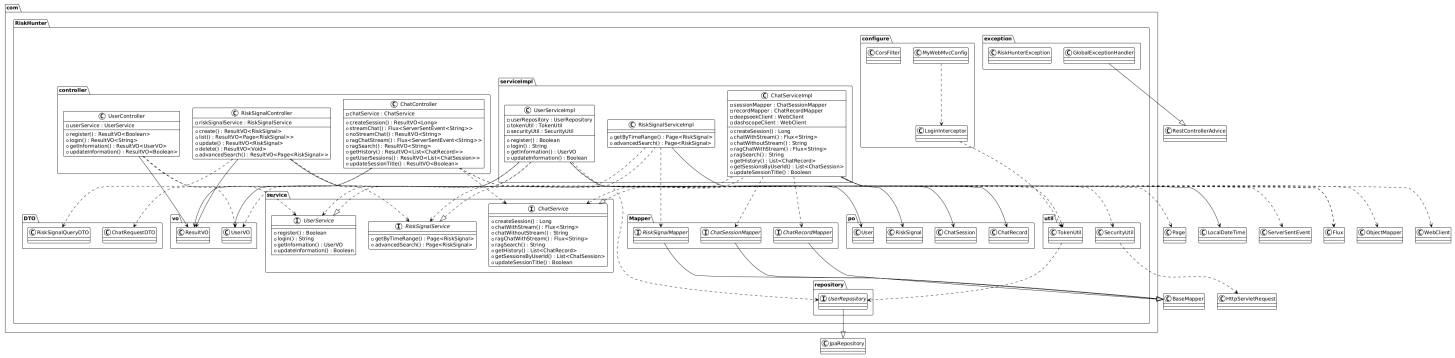
- **`POST /api/users/register`** : Register a new user.
    - Request Body: `UserVO` object in JSON format.
    - Response: `ResultVO<Boolean>` indicating successful registration.
- **`POST /api/users/login`** : Log in a user and obtain a JWT token.
    - Query Parameters:
        - `phone` (String): User's phone number.
        - `password` (String): User's password.
    - Response: `ResultVO<String>` containing the JWT token.
- **`GET /api/users`** : Get current user information. Requires authentication (JWT token).
    - Headers: `token` : JWT token.
    - Response: `ResultVO<UserVO>` containing user information.
- **`POST /api/users`** : Update current user information. Requires authentication (JWT token).
    - Headers: `token` : JWT token.
    - Request Body: `UserVO` object in JSON format containing updated user information.
    - Response: `ResultVO<Boolean>` indicating successful update.

## 3.3. Chat API ( `/api/chat` )

- **`POST /api/chat/session`** : Create a new chat session.

    - Query Parameters: `userId` (Long): User ID.
    - Response: `ResultVO<Long>` containing the new session ID.
- **`GET /api/chat/stream`** : Stream chat responses from an AI model.
    - Query Parameters:
        - `sessionId` (Long): Chat session ID.
        - `userId` (Long): User ID.
        - `message` (String): User message.
        - `modelName` (Optional, String): AI model name (e.g., `deepseek-r1` ).
    - Response: Stream of chat chunks as Server-Sent Events `Flux<ServerSentEvent<String>>` .
- **`POST /api/chat/noStream`** : Get a non-streaming chat response from an AI model.
    - Request Body: `ChatRequestDTO` object in JSON format.
    - Response: `ResultVO<String>` containing the complete chat response.
- **`GET /api/chat/ragChat`** : Stream RAG (Retrieval-Augmented Generation) chat responses from an AI model.
    - Query Parameters:
        - `sessionId` (Long): Chat session ID.
        - `userId` (Long): User ID.
        - `message` (String): User message.
    - Response: Stream of RAG chat chunks as Server-Sent Events `Flux<ServerSentEvent<String>>` .
- **`POST /api/chat/ragSearch`** : Perform a RAG knowledge base search.
    - Request Body: `ChatRequestDTO` object in JSON format.
    - Response: `ResultVO<String>` containing the search results.
- **`GET /api/chat/history/{sessionId}`** : Get the chat history for a session.
    - Path Parameter: `sessionId` (Long): Chat session ID.
    - Query Parameters: `userId` (Long): User ID.
    - Response: `ResultVO<List<ChatRecord>>` containing a list of chat records.
- **`GET /api/chat/sessions`** : Get all chat sessions for a user.
    - Query Parameters: `userId` (Long): User ID.
    - Response: `ResultVO<List<ChatSession>>` containing a list of chat sessions.
- **`PUT /api/chat/session/{sessionId}/title`** : Update the title of a chat session.
    - Path Parameter: `sessionId` (Long): Chat session ID.
    - Query Parameters:
        - `userId` (Long): User ID.
        - `title` (String): New session title.
    - Response: `ResultVO<Boolean>` indicating successful update.

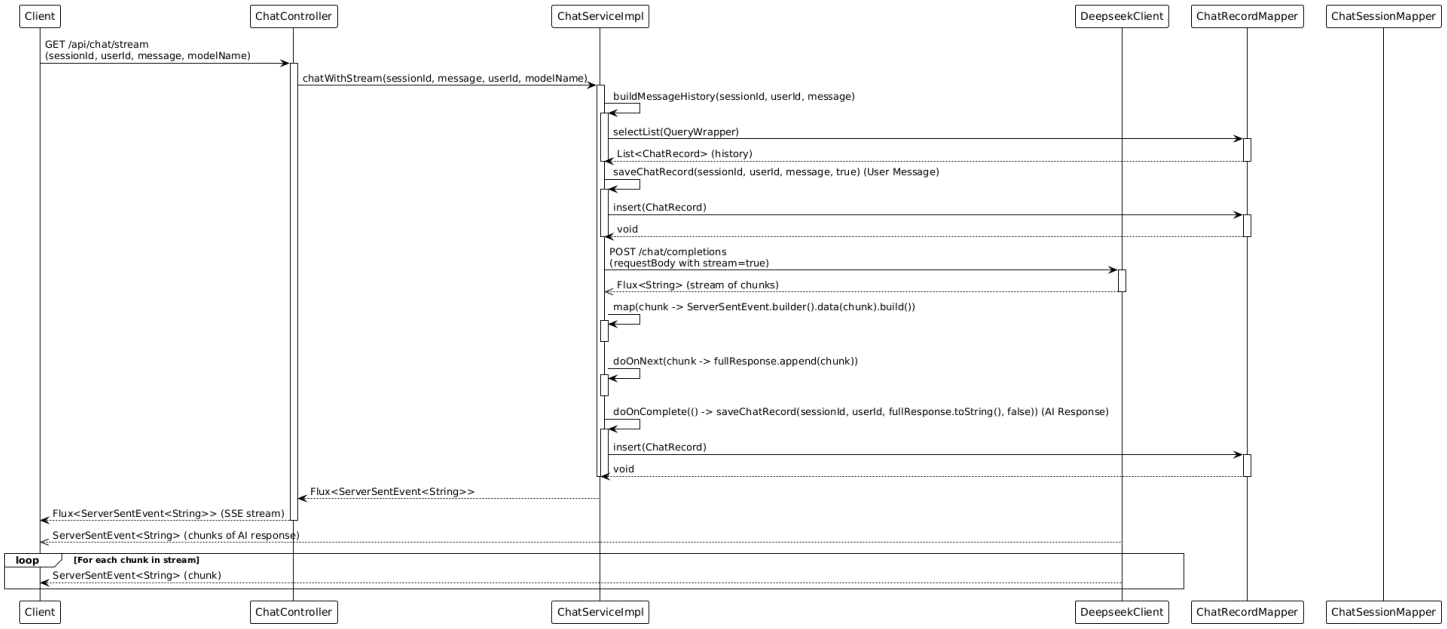
# 4. Class Diagram



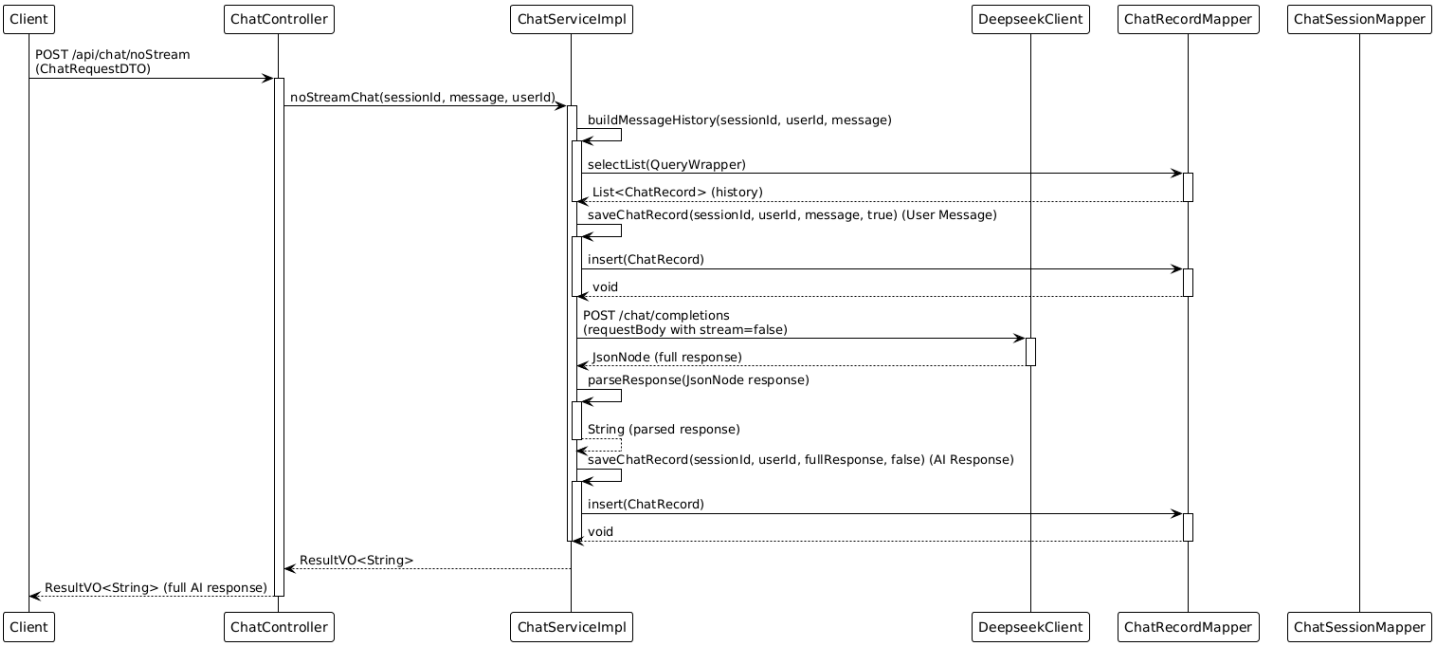

This class diagram highlights the key components in the backend application and their relationships.

# 5. Sequence Diagrams

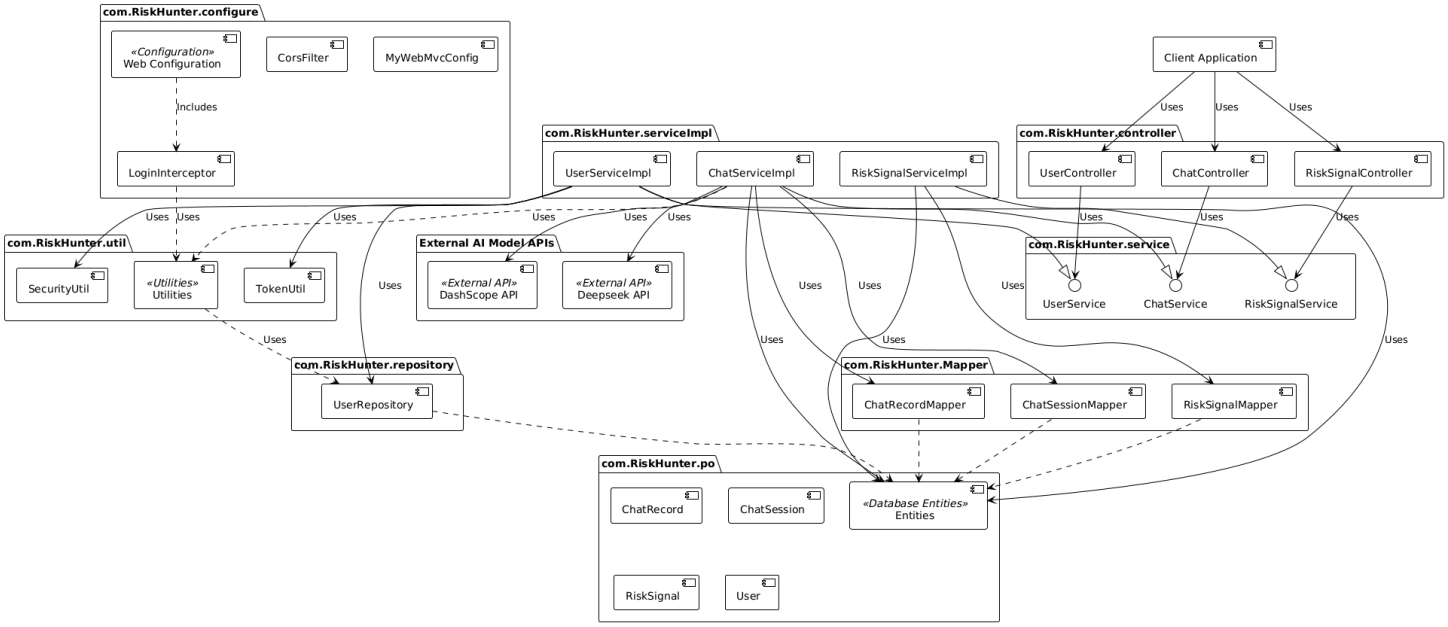
## 5.1. Streaming Chat Sequence Diagram



## 5.2. Non-Streaming Chat Sequence Diagram




# 6. Component Diagram




# 7. Technology Stack

- **Programming Language:** Java 8
- **Framework:** Spring Boot 2.3.4.RELEASE
- **Database:** MySQL
- **ORM:** MyBatis-Plus 3.5.3.1, Spring Data JPA

- **Web:** Spring Web MVC, Spring WebFlux
- **Reactive Stream:** Reactor Netty
- **JSON Processing:** Jackson
- **JWT:** java-jwt 3.10.3
- **Database Connection:** mysql-connector-j 8.0.31
- **Build Tool:** Maven
- **Logging:** Lombok, Slf4j
- **Testing:** Spring Boot Starter Test

# 8. Deployment

The RiskHunter backend is designed to be deployed as a standalone Spring Boot application. We utilize Docker for development, testing, and deployment, ensuring environment consistency. Nginx is used as a reverse proxy in front of the application servers to handle static content, SSL termination, and load balancing.

# 9. Security

RiskHunter security is primarily handled through JWT (JSON Web Tokens) for authentication and authorization:

- **Authentication:** User login is validated against the database. Upon successful login, a JWT token is generated and returned to the client.
- **Authorization:** Protected API endpoints are secured using a `LoginInterceptor`. This interceptor checks for the presence of a valid JWT token in the `Authorization` header of incoming requests. If the token is valid, the request proceeds; otherwise, the request is rejected.
- **Token Generation and Validation:** The `TokenUtil` class is responsible for generating JWT tokens upon user login and validating tokens for subsequent requests. Tokens contain the user ID and have an expiration time.
- **CORS:** `CorsFilter` is configured to handle Cross-Origin Resource Sharing, allowing requests from the frontend application (e.g., `http://localhost:3000`).