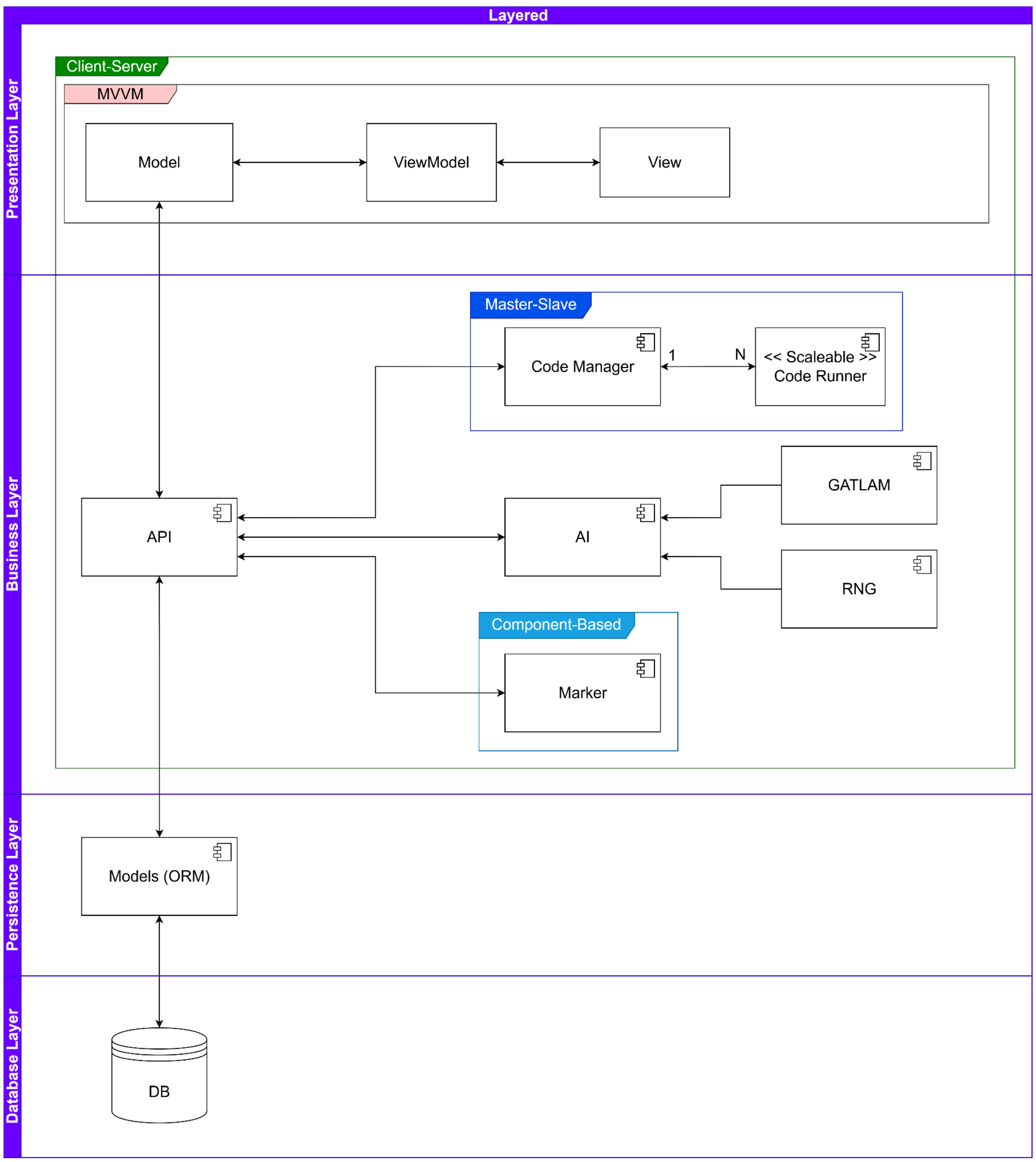
OWCA Advanced FitchFork Architectural Document

1. Overview

This system architecture diagram illustrates a four-tiered application structured into Presentation, Business, Persistence, and Database layers. It employs a Client-Server model, where an MVVM Frontend in the Presentation Layer communicates with a central API in the Business Layer.

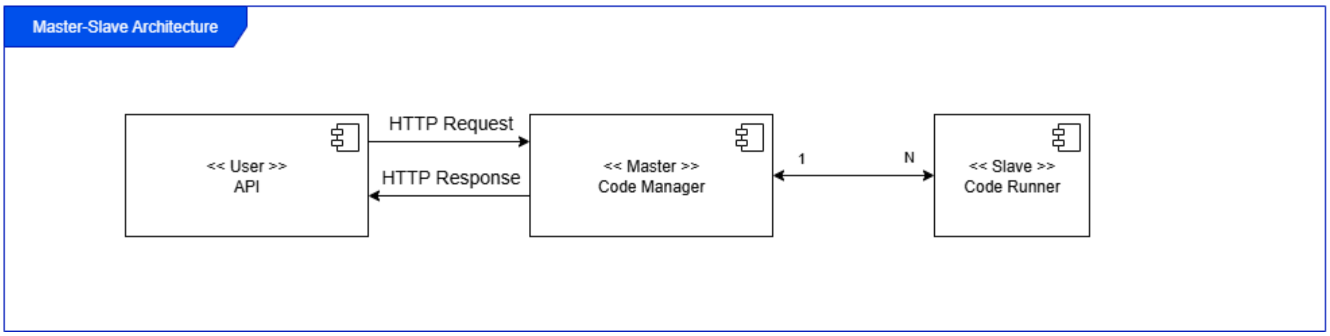
The Business Layer handles the core logic, featuring a Component-Based Marker, AI component and a scalable Master-Slave configuration (Code Manager and Code Runner) for distributed task processing.

Data management is handled by the Persistence Layer, which uses an Object-Relational Mapping (ORM) to abstract and manage interactions with the underlying database in the Database Layer, ensuring a modular, scalable, and maintainable system.



2. Master-Slave Architecture

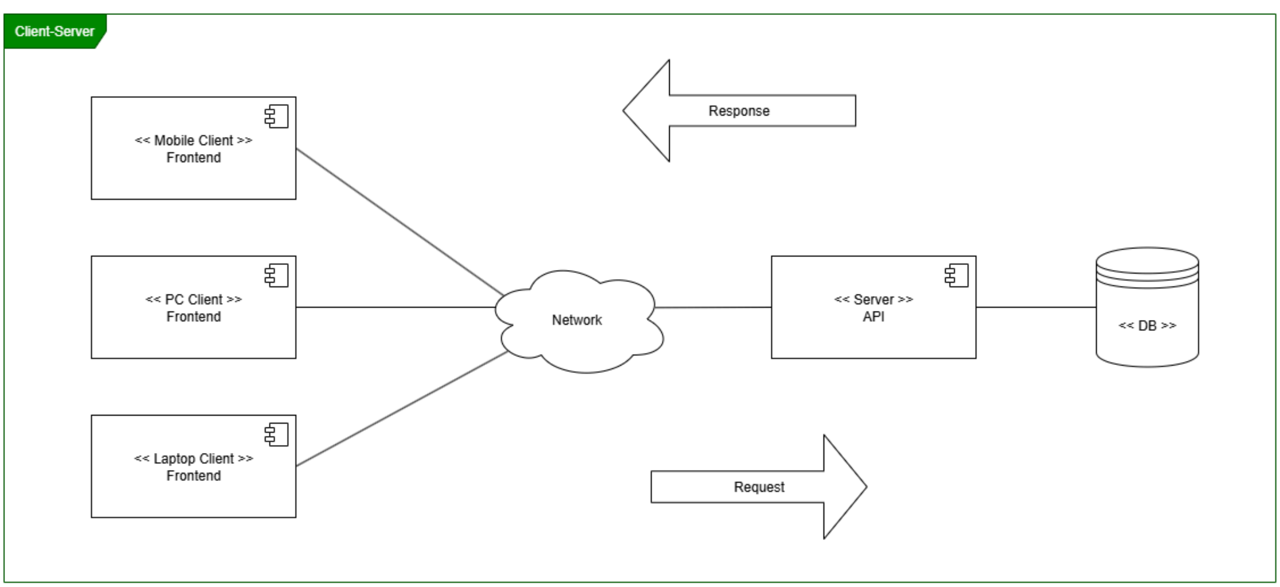
The use of a Master-Slave architecture is justified for this system as it provides an effective solution for distributing and scaling computationally intensive tasks.
By having a central Code Manager (Master) that delegates the work of code execution to multiple Code Runner instances (Slaves), the system can process numerous requests in parallel, significantly boosting performance and throughput.
This design is inherently scalable, allowing more slaves to be added to handle increased load, and it improves overall system resilience by isolating individual tasks, ensuring that the failure of one slave does not halt the entire application.



3. Client-Server Architecture

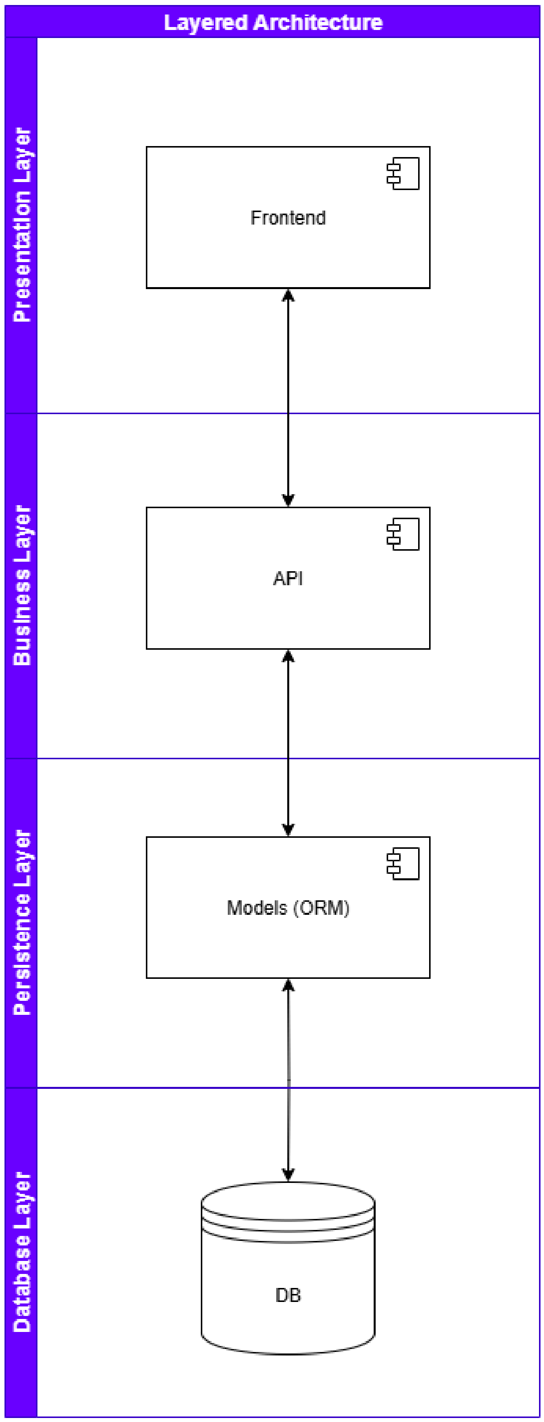
The client-server architecture is justified because it establishes a clear separation of concerns.
It allows multiple client types, such as mobile, PC, and laptop frontends, to interact with a single, centralised API server over a network.

This model centralises business logic and data management within the server, which processes all requests and interacts with the database, ensuring data consistency and security. By decoupling the user interface from the backend processing, this architecture supports independent development and scaling, allowing the application to be easily maintained and expanded to accommodate a growing number of users and diverse client platforms.



4. Layered Architecture

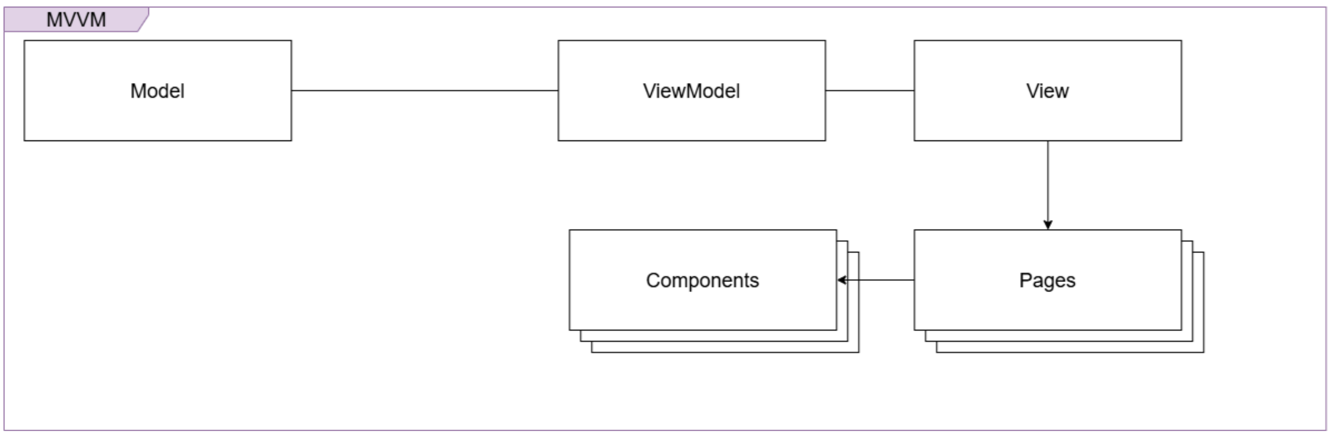
The use of a layered architecture is justified by its principle of separation of concerns, which divides the system into distinct tiers for presentation, business logic, and data management.
This modular approach significantly enhances maintainability and scalability by ensuring that changes in one layer, such as a user interface update in the Frontend, do not impact the core logic in the API or the data storage in the database.
This clear separation also facilitates parallel development, simplifies testing by allowing each layer to be tested independently, and provides the flexibility to update or replace components within a single layer with minimal disruption to the overall system.



5. MVVM Architecture

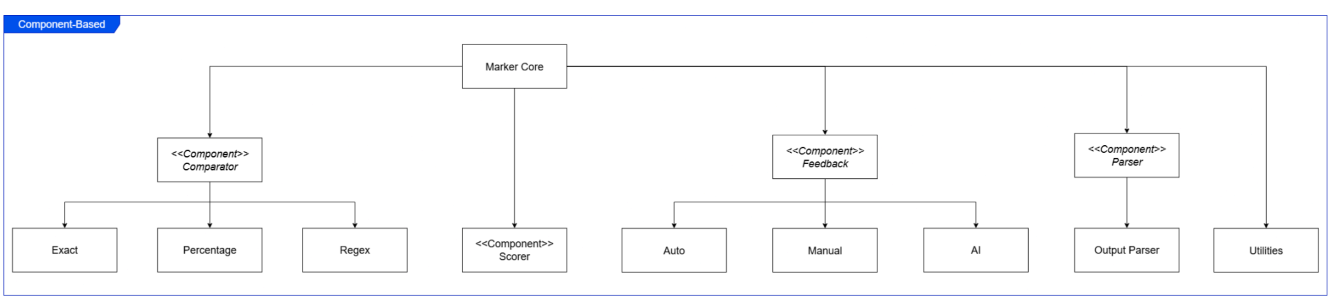
MVVM (Model-View-ViewModel) is a strong choice for frontend development because it cleanly separates concerns while still enabling rich, interactive user interfaces. The View focuses solely on presentation, the Model encapsulates the application's data and business rules, and the ViewModel acts as the binding layer that exposes data and commands in a way the View can consume without being tightly coupled.

This separation makes the codebase more maintainable, testable, and scalable, as business logic can be unit tested independently of the UI. MVVM also encourages declarative data binding, which reduces boilerplate code and minimises synchronisation issues between the UI and underlying state. As a result, teams can iterate on UI designs without risking regressions in application logic, and developers can extend or refactor functionality with less risk of introducing errors.

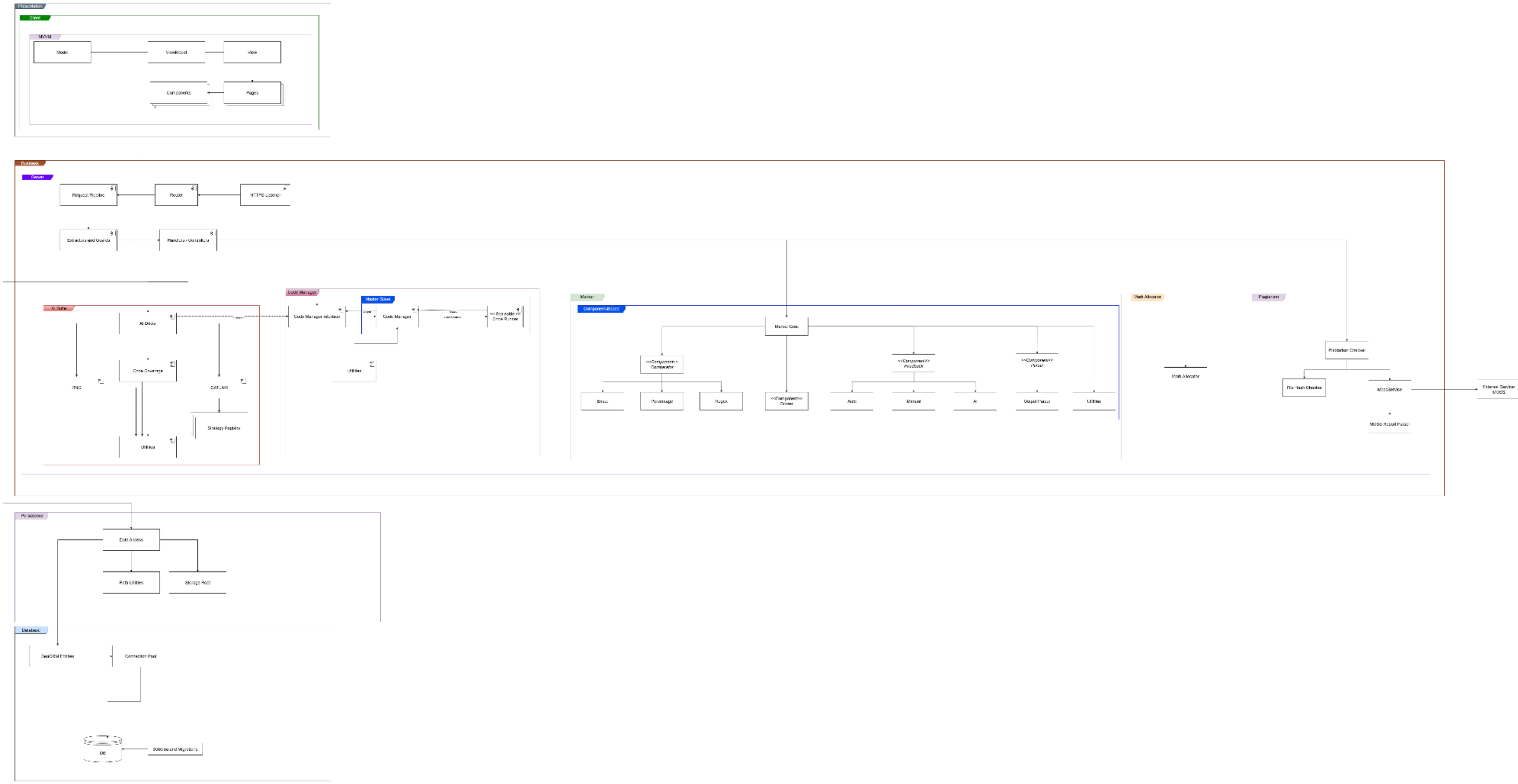


6. Component-Based Architecture

The system demonstrates a component-based architecture by defining clear, abstract interfaces that allow interchangeable implementations of core behaviours. Instead of hard-coding logic, components are wired together through dependency injection at a central composition root, which makes the system both flexible and extensible. This approach ensures that new strategies or features can be added without altering existing code, reducing the risk of regressions and adhering to the Open-Closed Principle. By decoupling high-level workflows from low-level implementations, the design promotes testability, modularity, and long-term maintainability.



7. Architectural Diagram:



https://github.com/COS301-SE-2025/Advanced-FitchFork/tree/dev/docs/demo4/architectural_diagram.png