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Backend Enginnering

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How Does the Internet Work?

The Internet is a global system of connected computers and networks that communicate with each other to share information.

Physical Infrastructure

The Internet is built on real, physical components that connect devices worldwide.
It depends on:

- Fiber optic cables
- Routers and network switches
- Data centers and servers
- Internet Service Providers (ISPs)
- Wireless towers and satellites

Most internet traffic travels through underground and underwater cables, not satellites.

IP Addresses & Ports

- Every device connected to the Internet is identified by a **unique IP address**. An IP address is a numerical label that allows devices to locate and communicate with each other over the network.
- The IP address tells us where the device is, but it does not tell us which application to talk to. On a single server, many services can run at the same time

Common Ports:

- 80 → HTTP (Web Traffic)
- 443 → HTTPS (Secure Web Traffic)
- 22 → SSH (Remote Access)
- 3306 → MySQL (Database)
- 6379 → Redis (Cache)

What is in an HTTP request?

An HTTP request is a message sent by a browser to a server to get a website or data. It travels over TCP to make sure it reaches the server correctly.

Each HTTP request made across the Internet carries with it a series of encoded data that carries different types of information. A typical HTTP request contains:

- HTTP version type
- a URL
- an HTTP method (GET, POST, PUT, DELETE)
- HTTP request headers
- Optional HTTP body.

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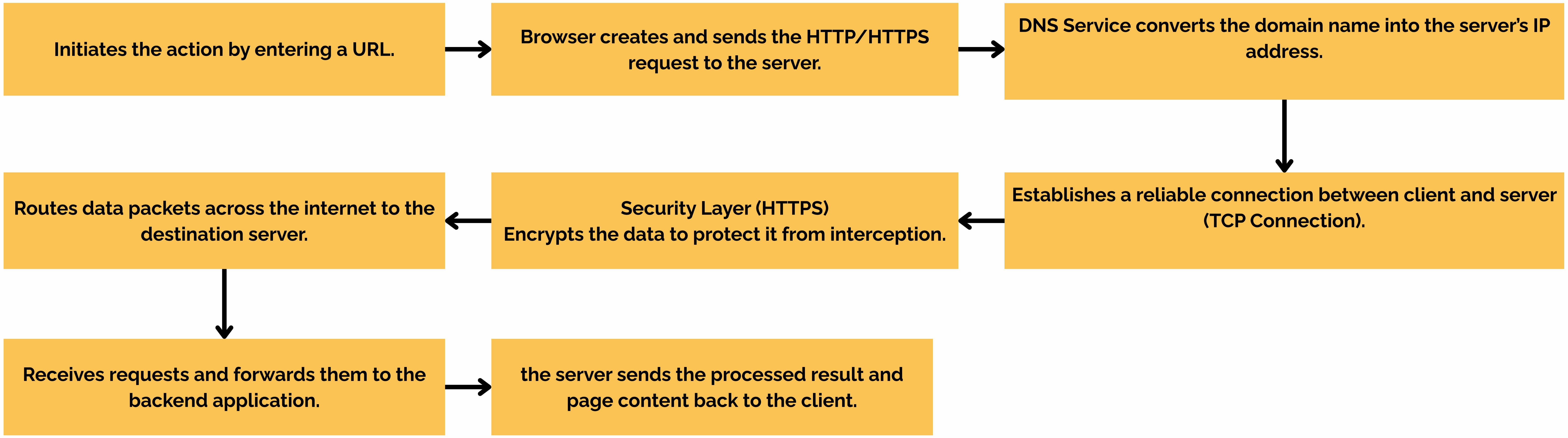
How an HTTP/HTTPS Request Goes from Client to Server?

https://www.google.com



Initiates the action by entering a URL.

Browser creates and sends the HTTP/HTTPS request to the server.

DNS Service converts the domain name into the server's IP address.

Establishes a reliable connection between client and server (TCP Connection).

Security Layer (HTTPS)
Encrypts the data to protect it from interception.

Routes data packets across the internet to the destination server.

Receives requests and forwards them to the backend application.

the server sends the processed result and page content back to the client.

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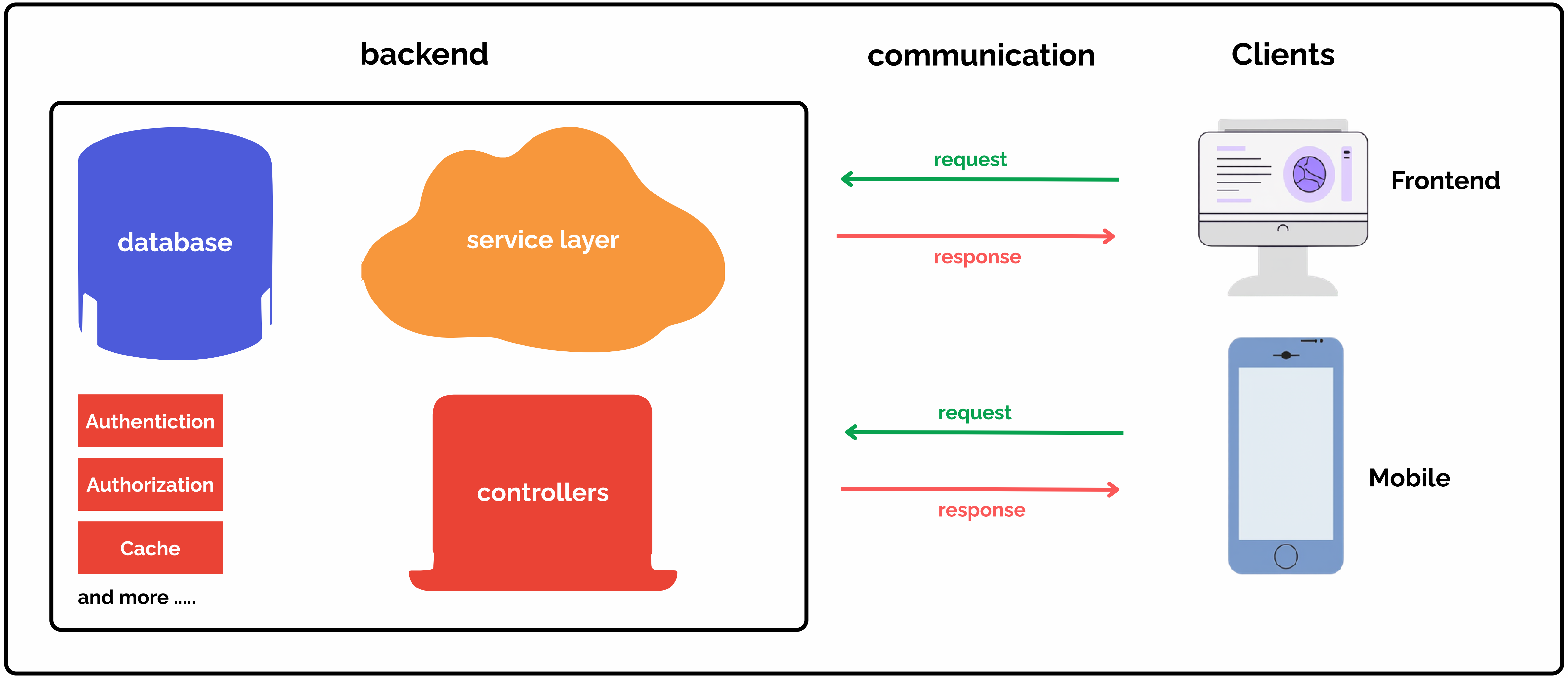
What is the backend?

The backend, often referred to as the server-side, is the backbone of any web application. It is responsible for the server, application, and database that work together to make sure the frontend works as it should. The backend processes the business logic, database interactions, authentication, and much more.



What is an API?

APIs are mechanisms that enable two software components to communicate with each other using a set of definitions and protocols

Types of API Architectures

1. **REST** (Representational State Transfer):
   - REST is a simple, flexible API architecture that uses HTTP methods (GET, POST, PUT, DELETE) for communication.
   - Data Format: JSON, XML.
2. **SOAP** (Simple Object Access Protocol):
   - SOAP is a more rigid protocol that requires XML based messaging for communication. Strict and secure protocol using XML for structured messaging.
   - Data Format: XML
3. **GraphQL**:
   - Modern query language that lets clients fetch only the data they need.
   - Data Format: JSON
4. **gRPC**:
   - High performance framework using Protocol Buffers (Protobuf).
   - Data Format: Binary

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What We Are Building

During this workshop, we will build:

User Management Backend System

A real-world backend service that allows:

- User Registration
- User Login
- Profile Management
- Secure API Access
- Database Storage

Technology Stack

- Programming language: **Python**
- Framework: **FastAPI**
- Database: **SQL / SQLite**
- API Format: **JSON (REST APIs)**
- ORM: **sqlalchemy**

What Is Software Architecture?

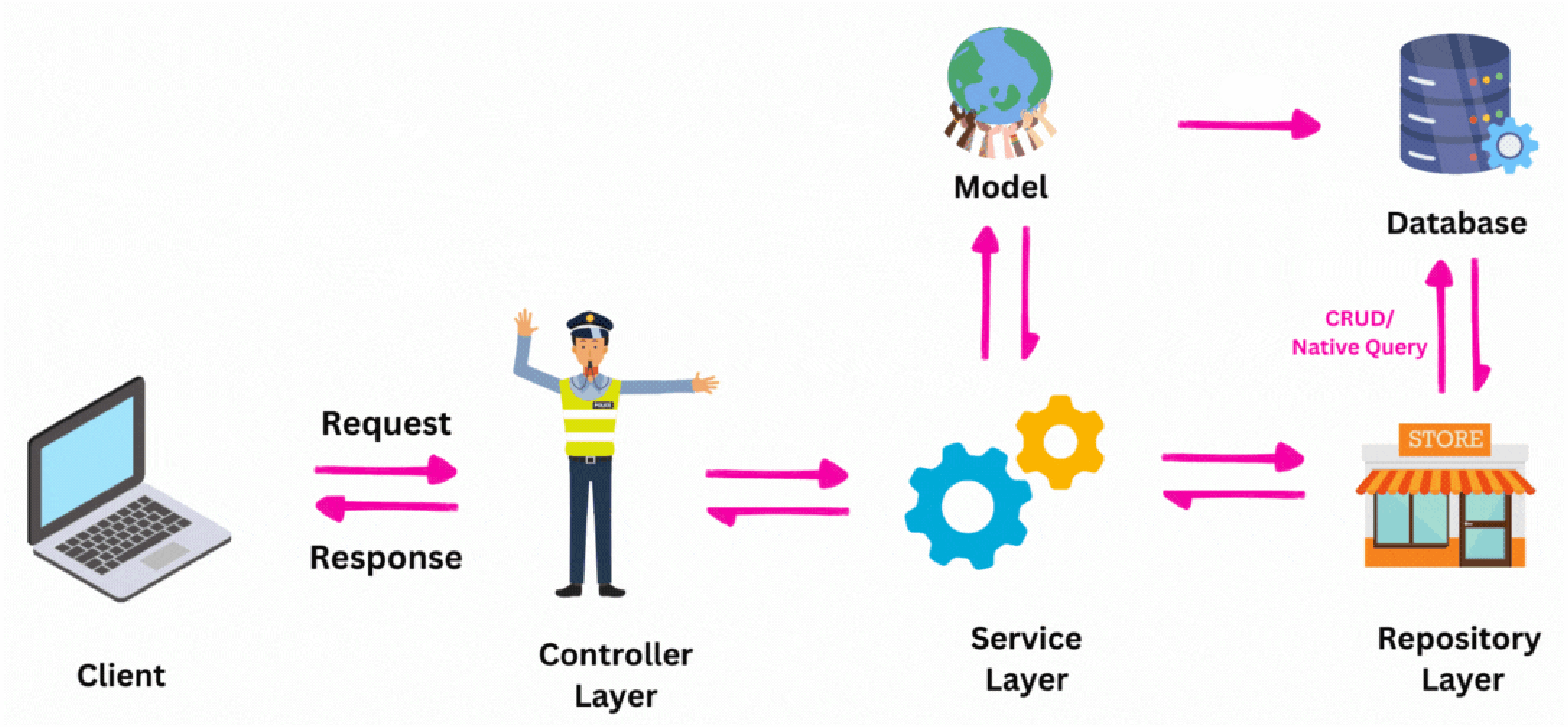
Software Architecture is the overall structure of the system.

Common Software Architecture Patterns

- Layered Architecture (N-Tier Architecture)
- Microservices Architecture
- Monolithic Architecture
- Service-Oriented Architecture (SOA)
- Event-Driven Architecture (EDA)
- Hexagonal Architecture (Ports and Adapters)
- CQRS (Command Query Responsibility Segregation)

Layered Architecture

Divide the system into clear roles so parts can evolve independently and remain easy to maintain.



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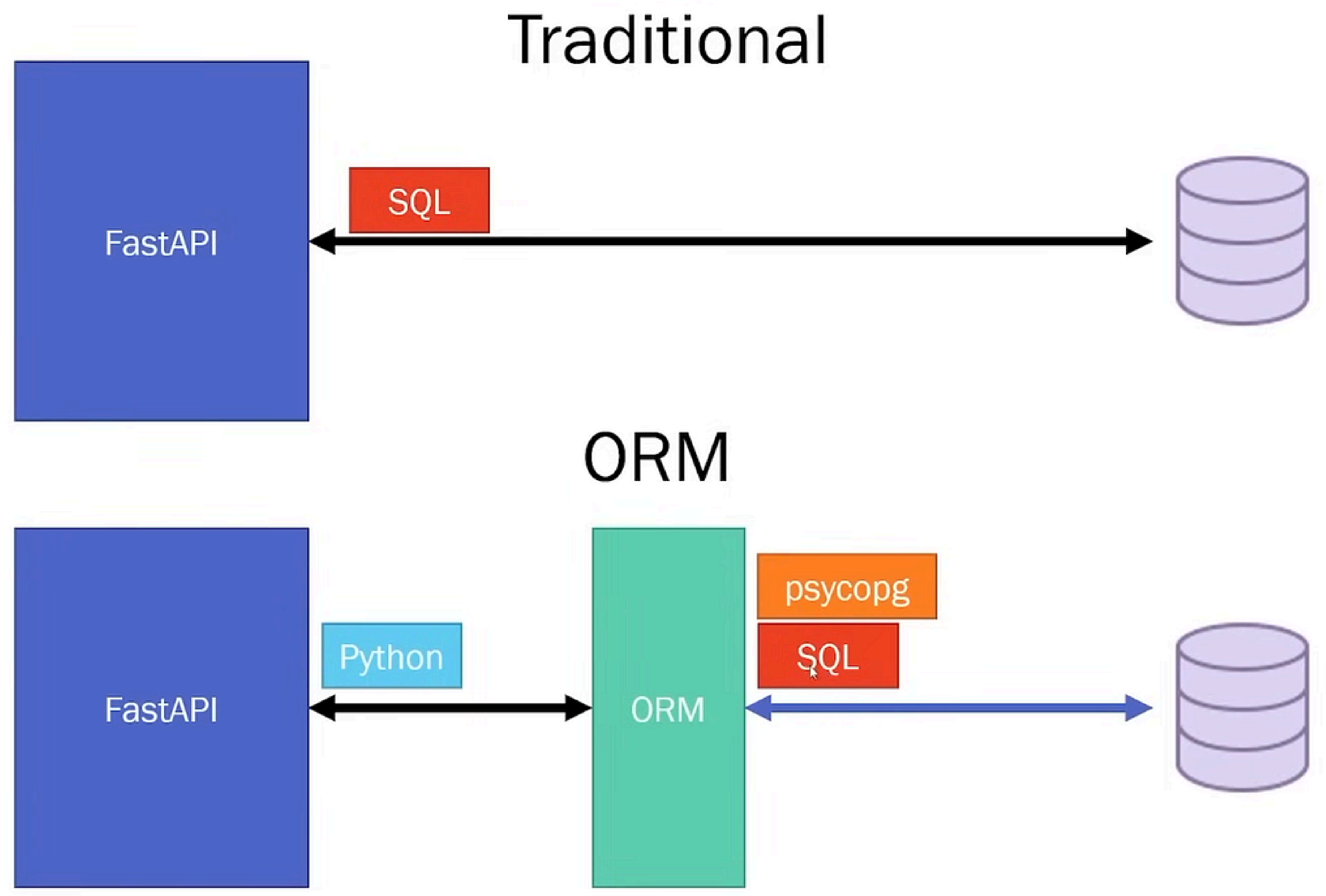
ORM (Object Relational Mapping)
ORM is a technique that lets developers work with databases using programming objects instead of writing raw SQL.

Benefits of ORM
- Less SQL writing
- Faster development
- Better readability
- Security (SQL Injection protection)
- Easy database switching

Popular ORM Examples
- SQLAlchemy (Python)
- Django ORM (Python)
- Hibernate (Java)
- Entity Framework (.NET)



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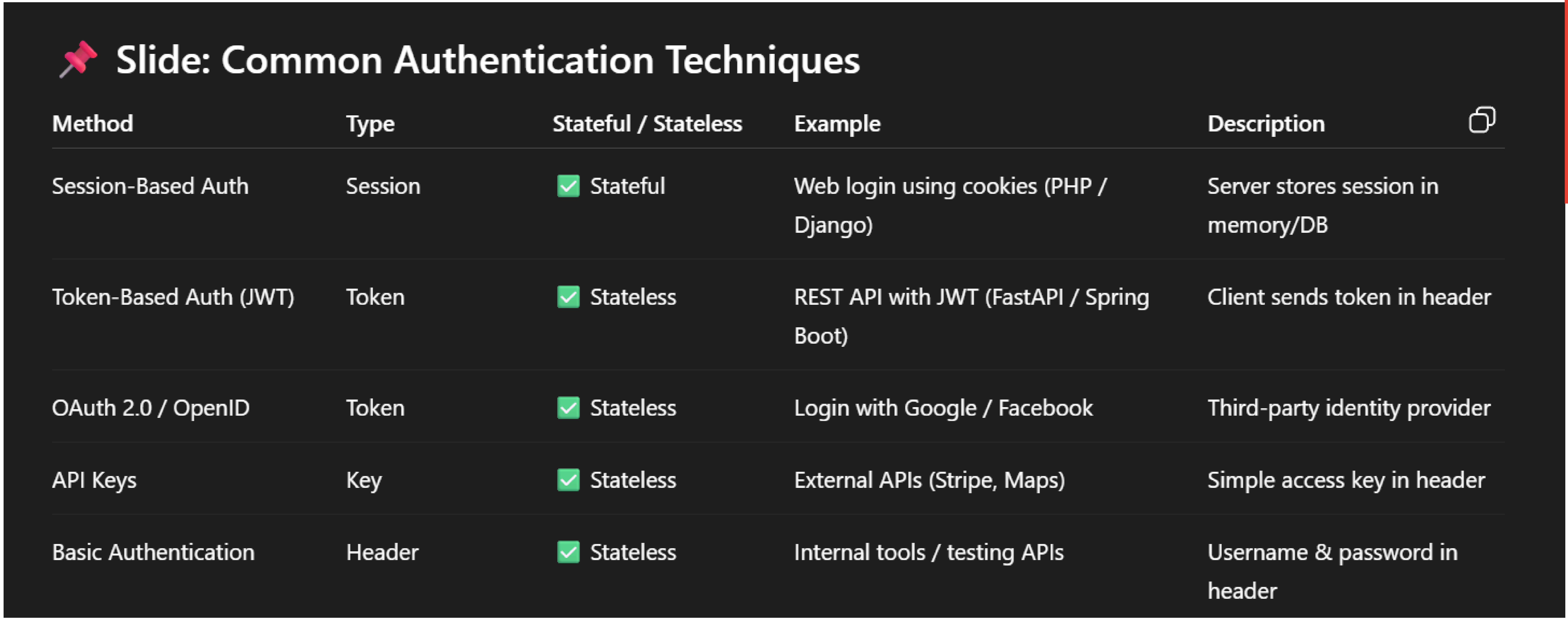
What Is Authentication?

Authentication is the process of verifying: “Who is this user?”

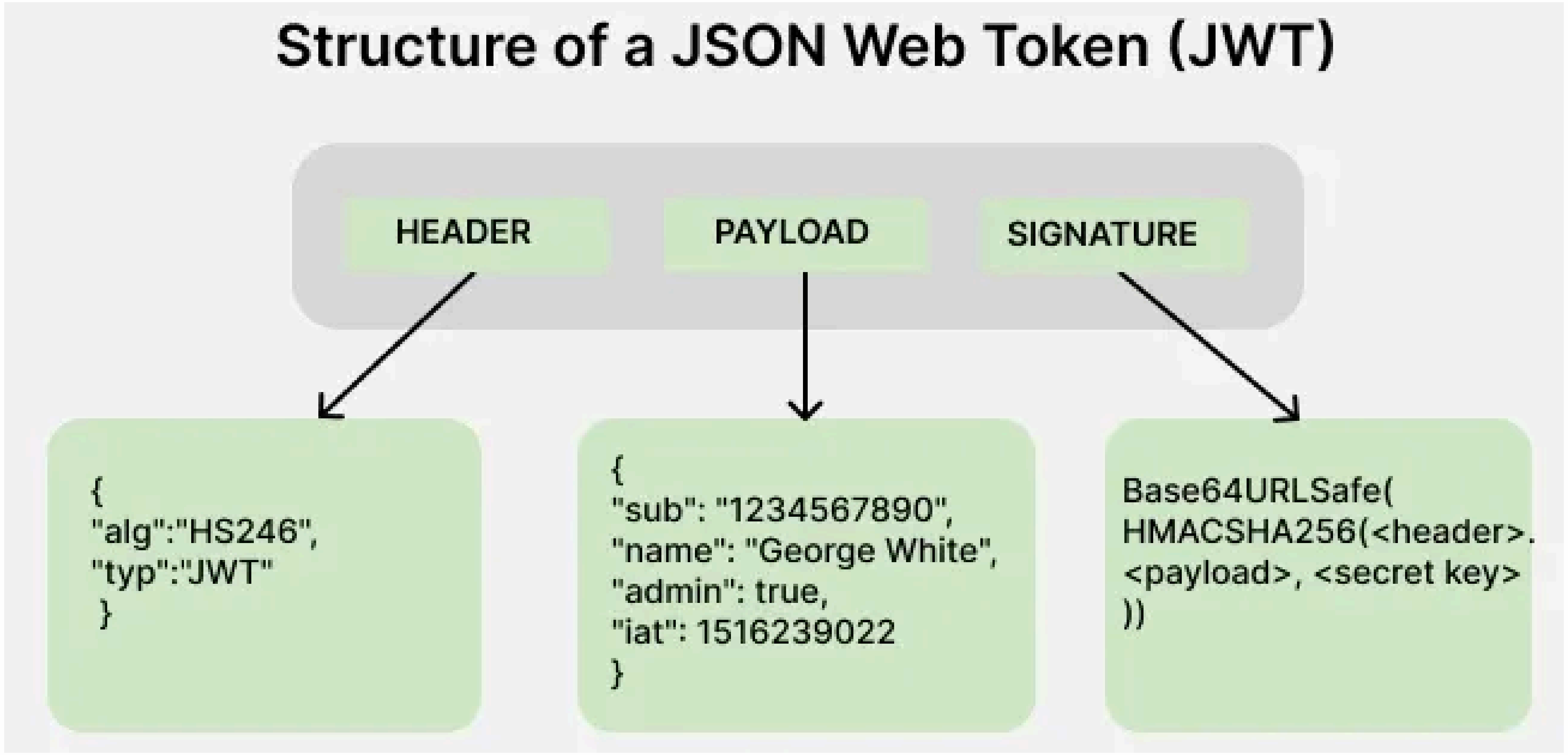


📌 Slide: Common Authentication Techniques

Method	Type	Stateful / Stateless	Example	Description
Session-Based Auth	Session	✅ Stateful	Web login using cookies (PHP / Django)	Server stores session in memory/DB
Token-Based Auth (JWT)	Token	✅ Stateless	REST API with JWT (FastAPI / Spring Boot)	Client sends token in header
OAuth 2.0 / OpenID	Token	✅ Stateless	Login with Google / Facebook	Third-party identity provider
API Keys	Key	✅ Stateless	External APIs (Stripe, Maps)	Simple access key in header
Basic Authentication	Header	✅ Stateless	Internal tools / testing APIs	Username & password in header

What Is JWT?

JWT (JSON Web Token) is a token-based authentication method used in modern APIs.
It allows users to prove their identity without storing sessions on the server.
JWT is Stateless Authentication



```
{
"alg":"HS246",
"typ":"JWT"
}
```

```
{
"sub": "1234567890",
"name": "George White",
"admin": true,
"iat": 1516239022
}
```

```
Base64URLSafe(
HMACSHA256(<header>.
<payload>, <secret key>
))
```

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QUESTIONS ?

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Time To Code

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Thanks!