National University of Computer and Emerging Sciences

Software Design and Architecture

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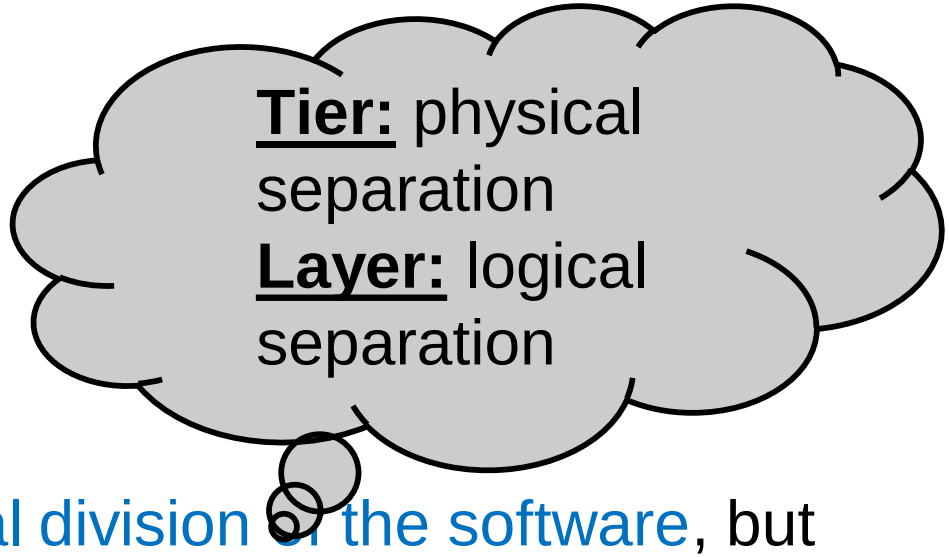
Lecture # 5 Three-tier Architecture

3-tier Architecture

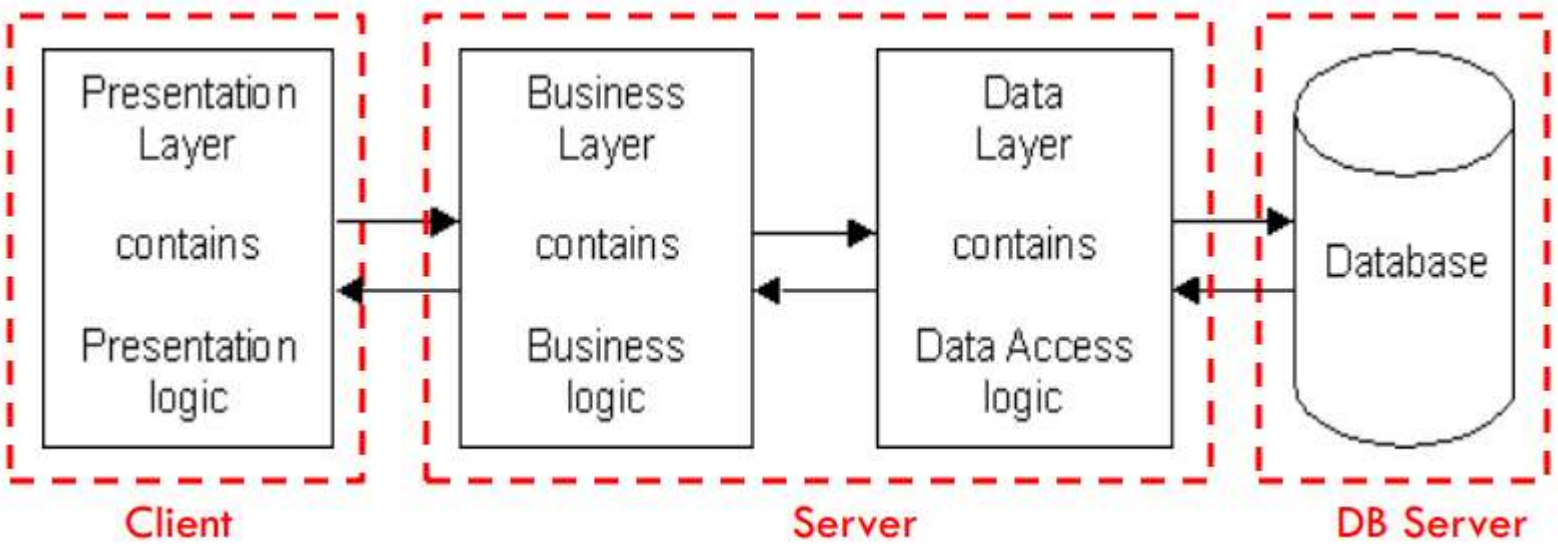
- A software architecture that organizes applications into three logical and physical computing tiers:
  1. **Presentation tier,** or user interface;
  1. **Application tier,** where data is processed;
  1. **Data tier,** where the data associated with the application is stored and managed.

Tier vs Layer



- They aren't the same.
- A 'layer' refers to a functional division of the software, but a 'tier' refers to a functional division of the software that runs on separate hardware
- The Contacts app on your phone, for example, is a three-layer application, but a single-tier application, because all three layers run on your phone.
- The difference is important, because layers can't offer the same benefits as tiers.

3-Tier Architecture

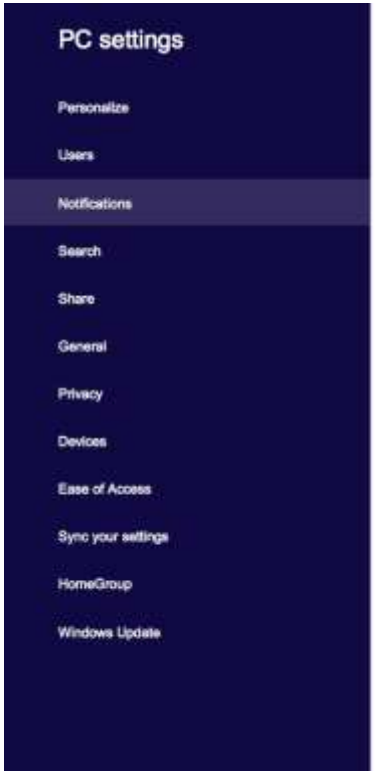


- Each layer runs on a different machine
- Presentation, logic, data layers disconnected

Presentation Tier

- The user interface and communication layer of the application, where the end user interacts with the application.
- Its main purpose is to display information to and collect information from the user.
- This top-level tier can run on a web browser, as desktop application, or a graphical user interface (GUI), for example.

Presentation Tier



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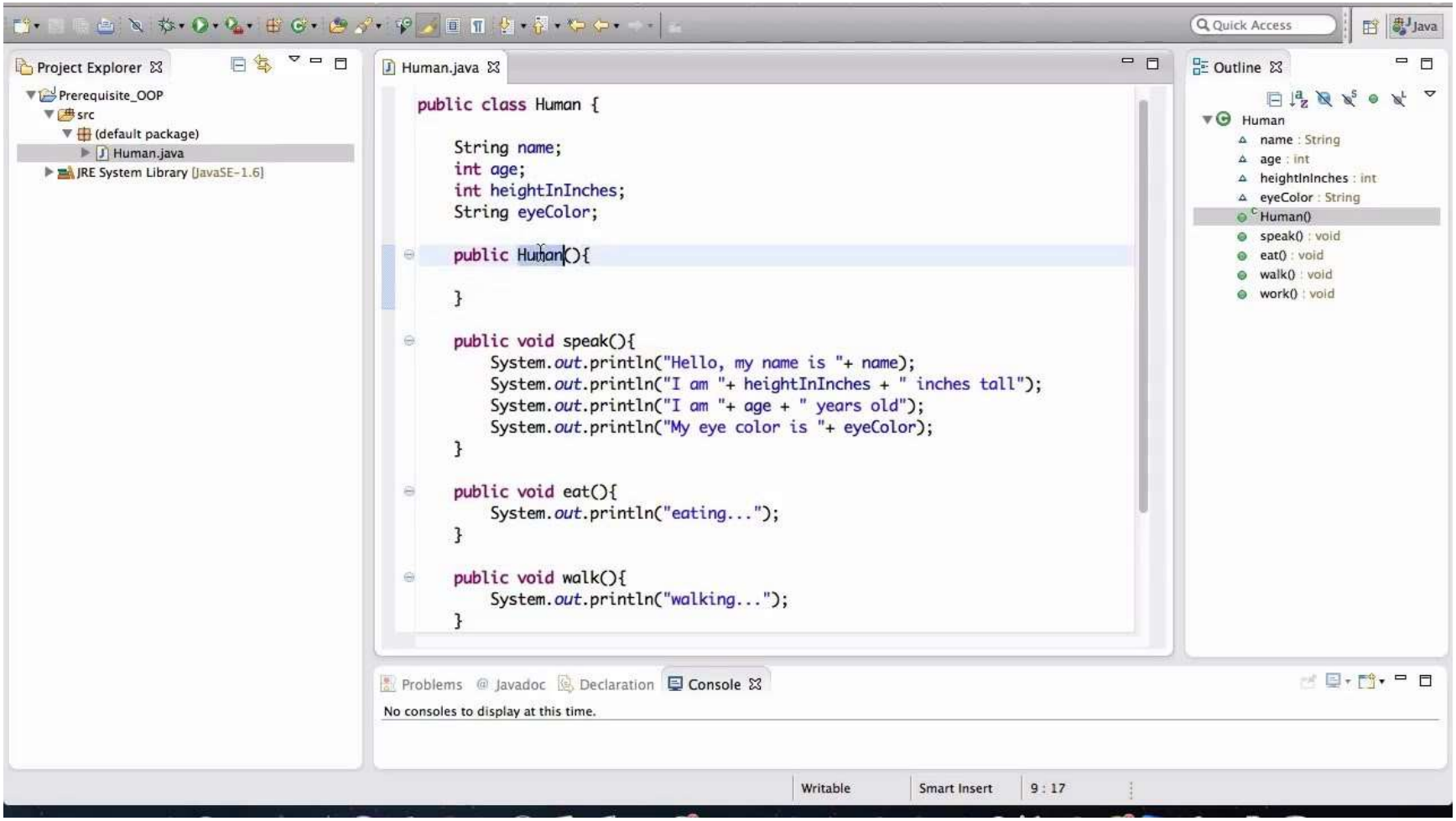
Application Tier

- a.k.a the business logic tier, is the heart of the application
- In this tier, information collected in the presentation tier is processed - using business logic, a specific set of business rules.
- The application tier can also add, delete or modify data in the data tier.
- The application tier is typically developed using Python, Java, Perl, PHP or Ruby, and communicates with the data tier using API calls.

Application Tier



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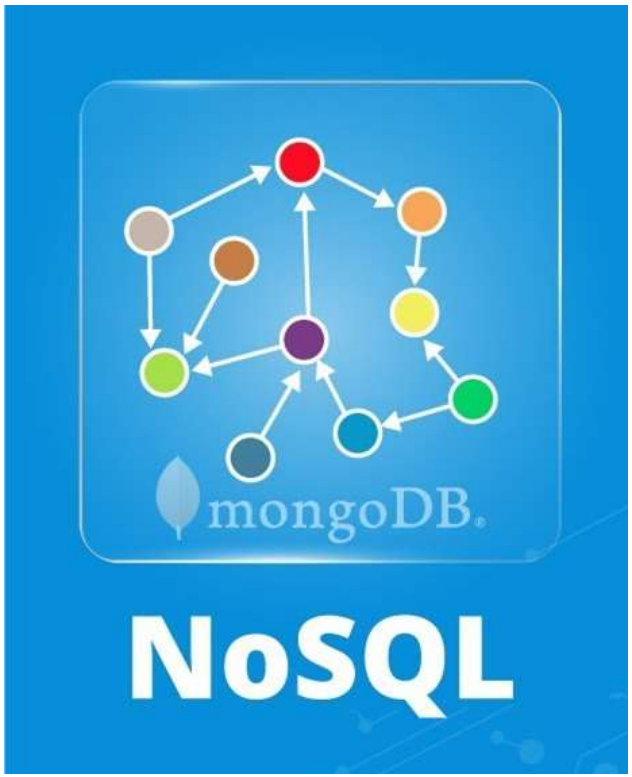
Data Tier

- Also called database tier, is where the information processed by the application is stored and managed.

- This can be a relational database management system such as MySQL, Oracle or a NO-SQL database like MongoDB, Hadoop etc.

Data Tier



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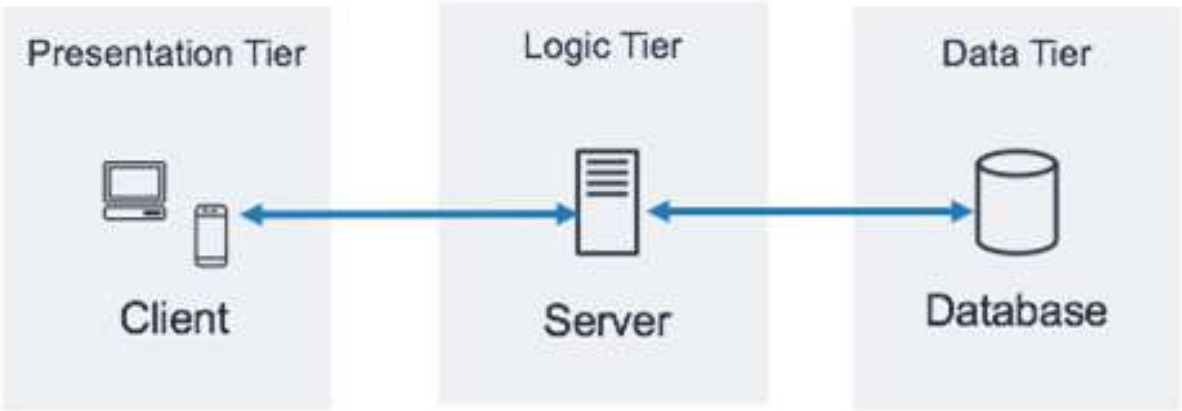
Three-Tier Architecture

- In a three-tier application, all communication goes through the application tier

- The presentation tier and the data tier cannot communicate directly with one another



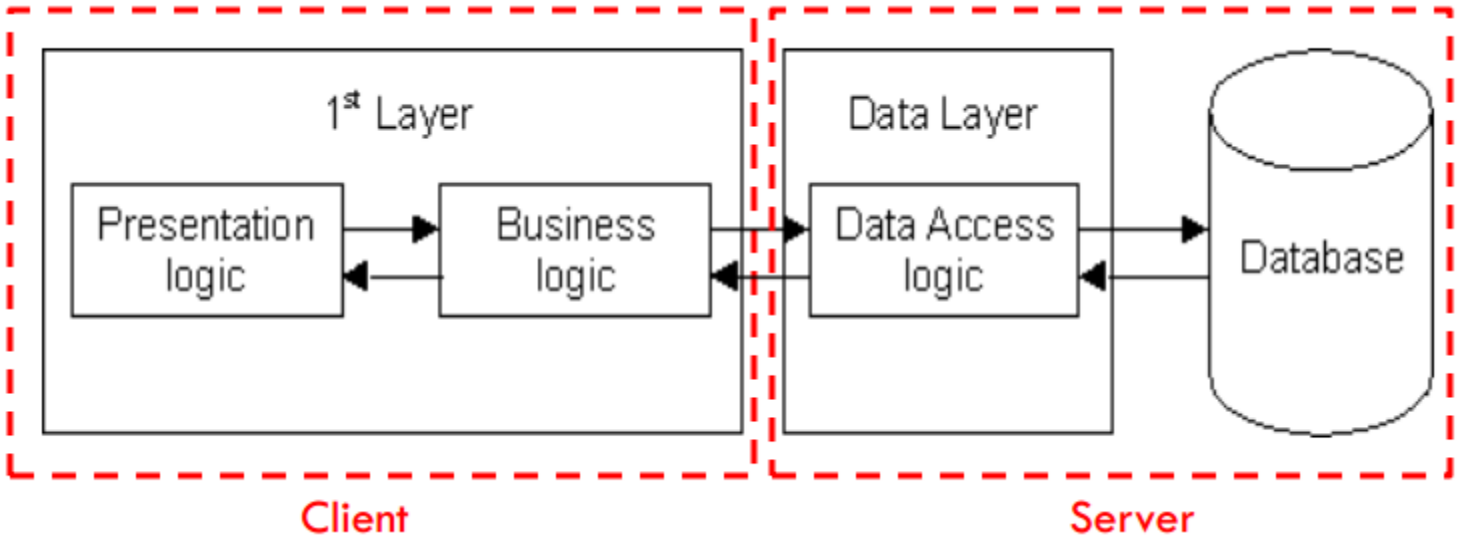
N-tier Architecture

- While three-tier architecture is easily the most widely-adopted multi-tier application architecture, there are others also

- **N-tier architecture** - refers to any application architecture with more than one tier

- **Two-tier architecture** is the original client-server architecture, consisting of a presentation tier and a data tier; the business logic lives in either the presentation tier or the data tier

2-Tier Architecture



Database runs on Server

- Separated from client
- Easy to switch to a different database

Presentation and logic layers still tightly connected (coupled)

- Heavy load on server
- Potential congestion on network
- Presentation still tied to business logic

Benefits of Three-Tier Architecture

- Logical and physical separation of functionality
- Each tier can run on a separate operating system and server platform - e.g., web server, application server, database server - that best fits its functional requirements.
- Each tier runs on at least one dedicated server hardware, so the services of each tier can be customized and optimized without impact the other tiers

Benefits of Three-Tier Architecture

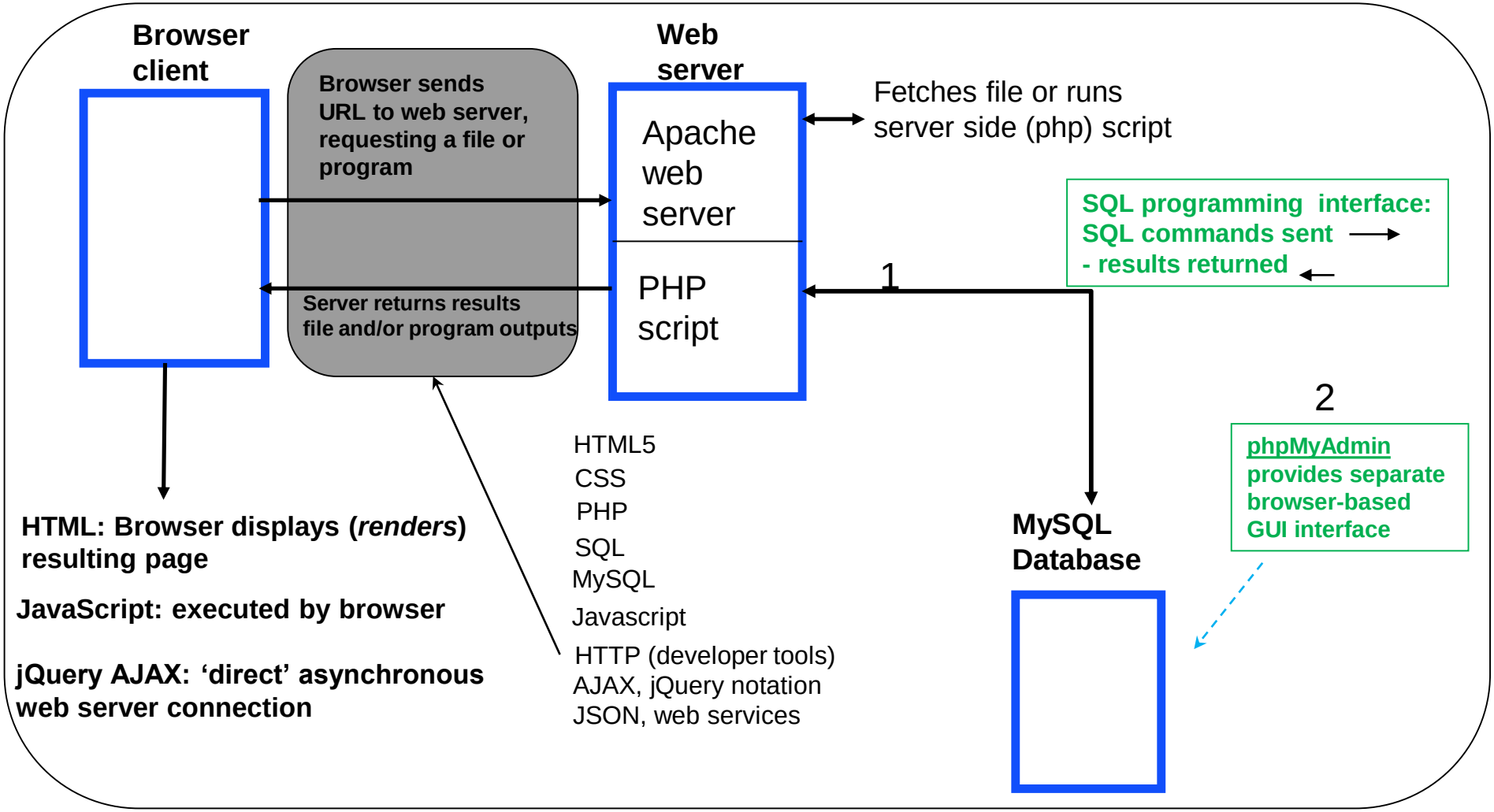
- **Faster development:** Because each tier can be developed simultaneously by different teams, an organization can bring the application to market faster, and programmers can use the latest and best languages and tools for each tier.

- **Improved scalability:** Any tier can be scaled independently of the others as needed.

- **Improved reliability:** An outage in one tier is less likely to impact the availability or performance of the other tiers.

- **Improved security**: Because the presentation tier and data tier can't communicate directly, a well-designed application tier can function as a sort of internal firewall, preventing SQL injections and other malicious exploits.

Example of 3-Tier Architecture (web-based applications)



Facebook also uses Three-tier Architecture

- The presentation tier of the Facebook is made up of the Web servers that create the Web pages that users see
- The middle tier consists of all the business logic and data requests
- The data tier consists of a database server application. This tier stores all the data about every object in the database, such as a person, photo, or event.

3-Tier Architecture Demo