

Web Applications

# Architecture of a Web Application

Slide a cura di Giovanni Grasso/Kristian Reale



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THE INTERNET IN **2023** EVERY MINUTE

# 2023

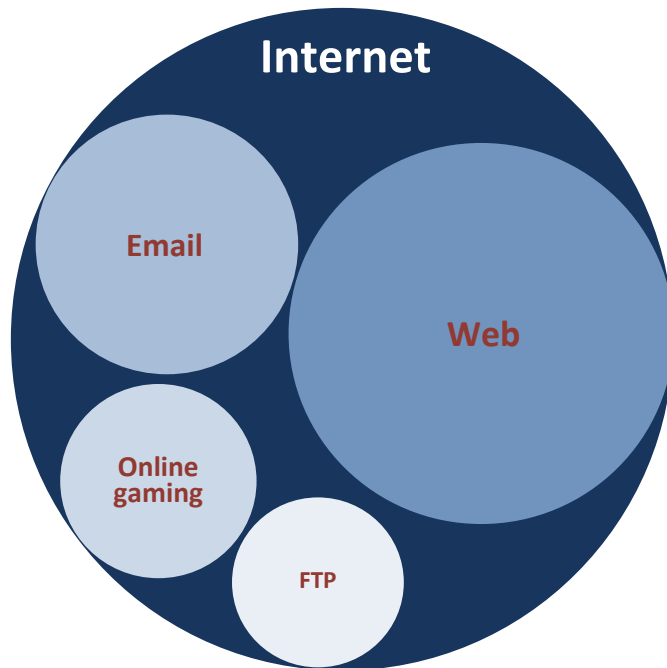
This is what happens  
in an Internet Minute



# Internet = Web?

The Answer is no

The World-Wide Web (WWW or simply the Web) is certainly what most people think of when they see the word 'internet.' However, the WWW is just a part of the Internet.



*“The Internet is the **global system of interconnected** mainframe, personal, and wireless computer networks that use the Internet protocol suite (TCP/IP) to link billions of devices worldwide.*

*The Internet carries an extensive range of information resources and services, such as the World Wide Web (WWW), electronic mail, Usenet newsgroups, telephony, and peer-to-peer networks for file sharing.”*

# Tim Berners-Lee

The invention of the WWW is usually attributed to the British scientist Tim Berners-Lee. In 1990, while working at CERN, he proposed a distributed hypertext system.

- Hypertext = non-linear text
- Distributed = spread across network nodes

The growth of the web was facilitated by CERN's decision not to patent the work and ideas of its employees, making both the code and protocols public without restrictions.

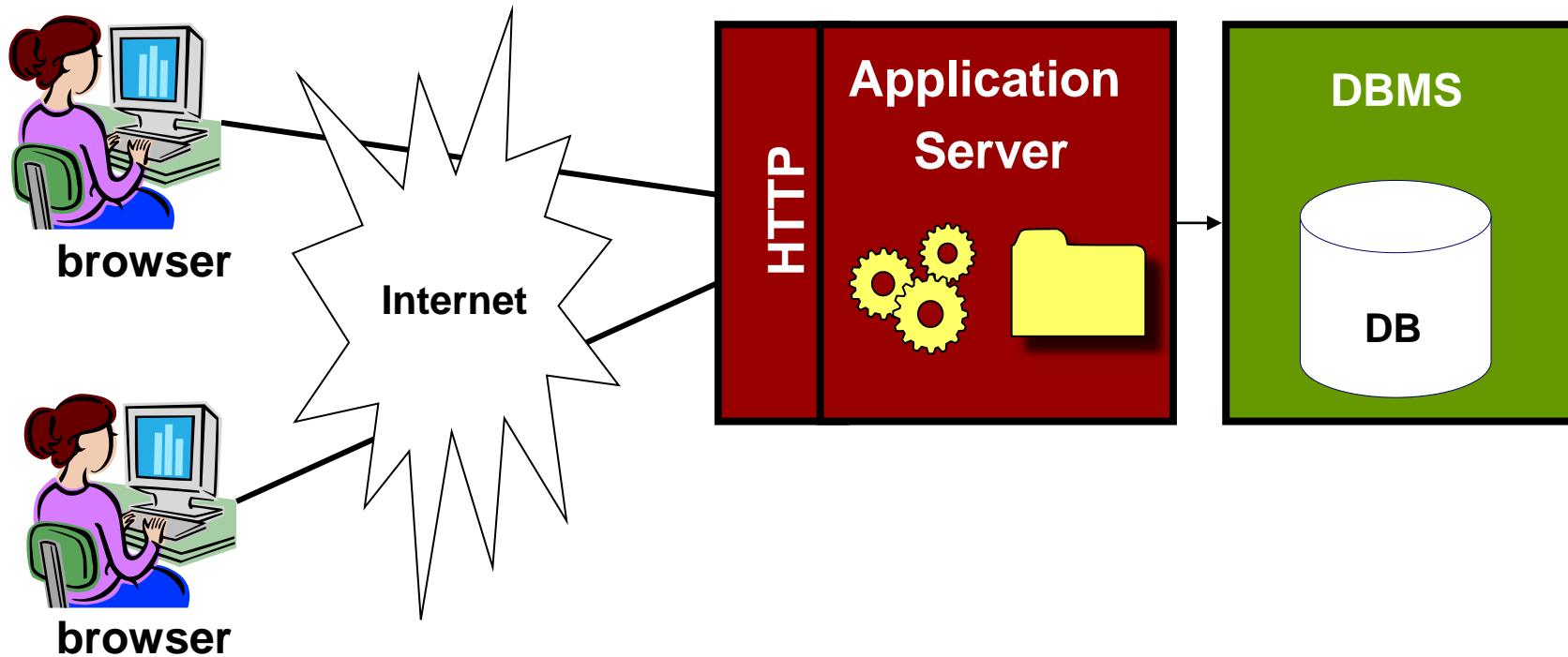
# Characteristics of the Web

After his initial proposal, Berners-Lee developed what were to be the key features of the Web:

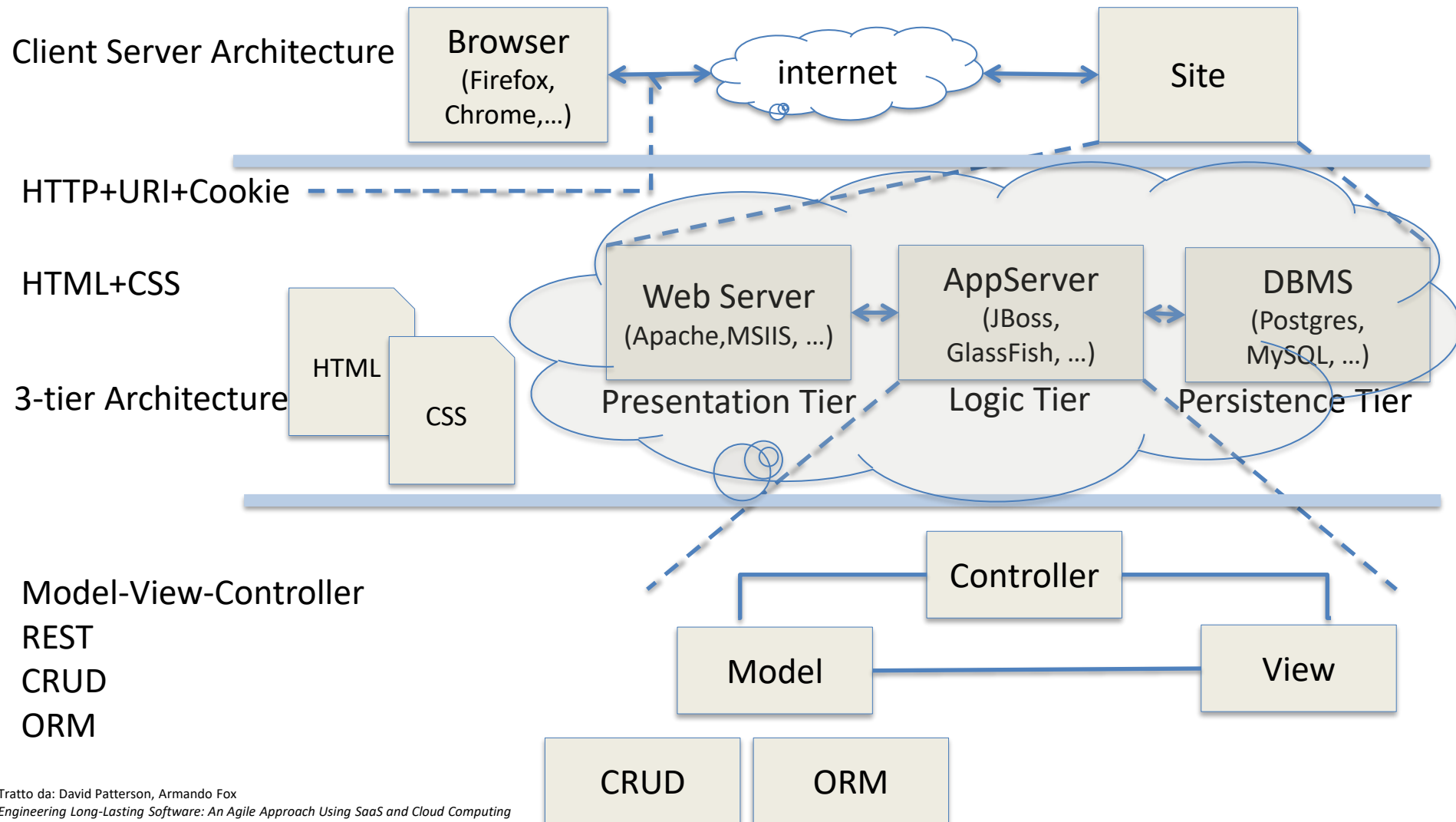
1. A **URL** to uniquely identify a **resource** on the Web.
2. The **HTTP protocol** to describe how requests and responses operate.
3. Software (later called a **web server**) that **responds** to HTTP requests.
4. A language for document publication: **HTML**.
5. A program (later called a browser) to make HTTP requests from URLs and display the HTML code received in response.

# Architecture of a Web Application

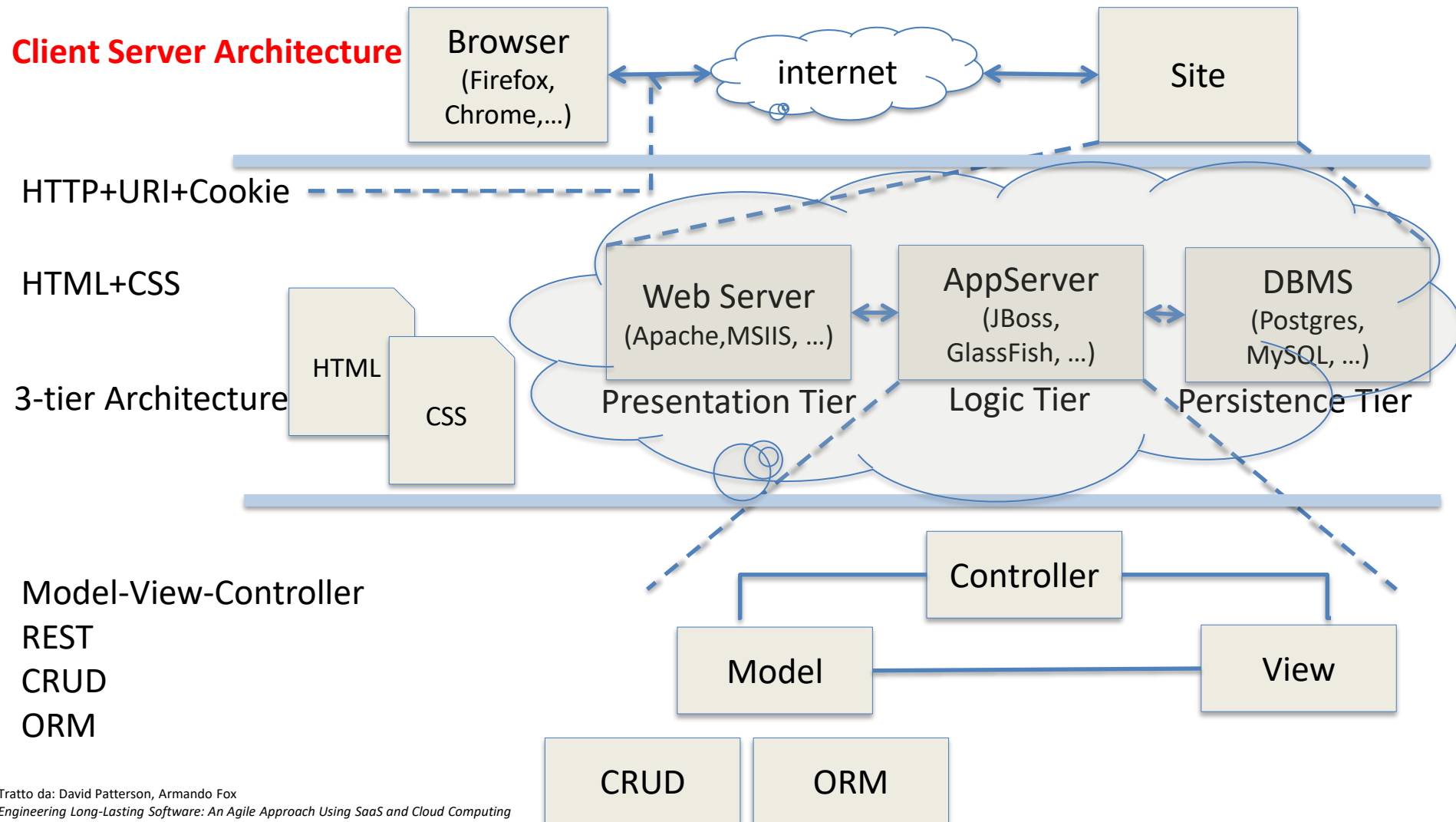
## 3-Tier Architecture



# Architecture of a Web Application



# Architecture of a Web Application





# Client-Server Architecture

- World Wide Web
  - an application service of the Internet based on a client/server architecture
  - but it is not the only client/server service
- In the case of the Web
  - resources: documents, images, and other media, as well as interactive services.
  - client: typically the browser or an app.
  - server: a server for accessing Web resources.

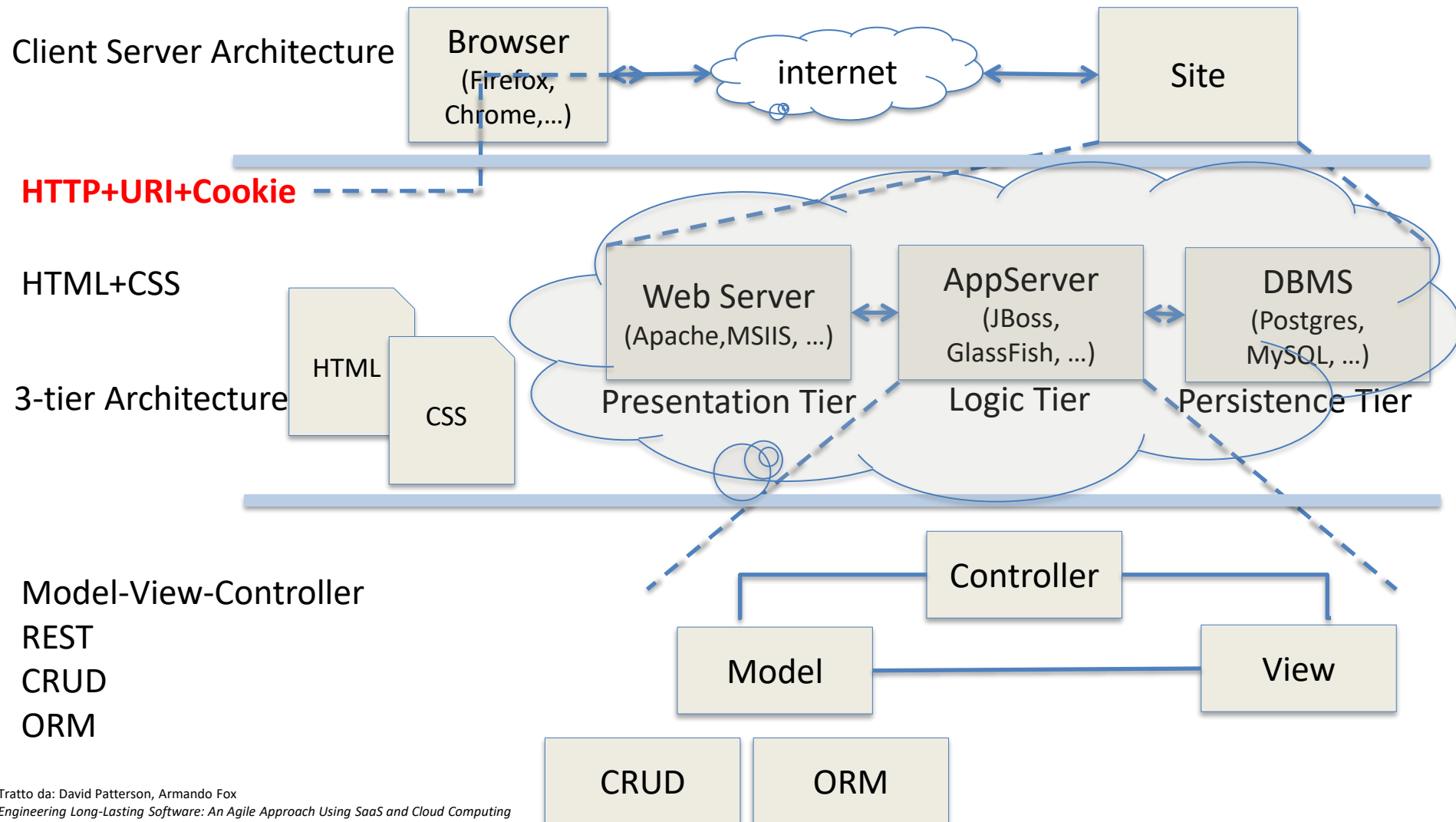
# Client-Server Architecture

- Let's consider the website of a degree program
  - It is an example of a Client-Server architecture
- The browser is an example of a client
  - It is a specialized program for requesting information from a server and allowing the user to interact with that information
- The program that responds on the course website is an example of a server
  - it is a specialized application that waits for requests from clients and provides a response.

# Client-Server

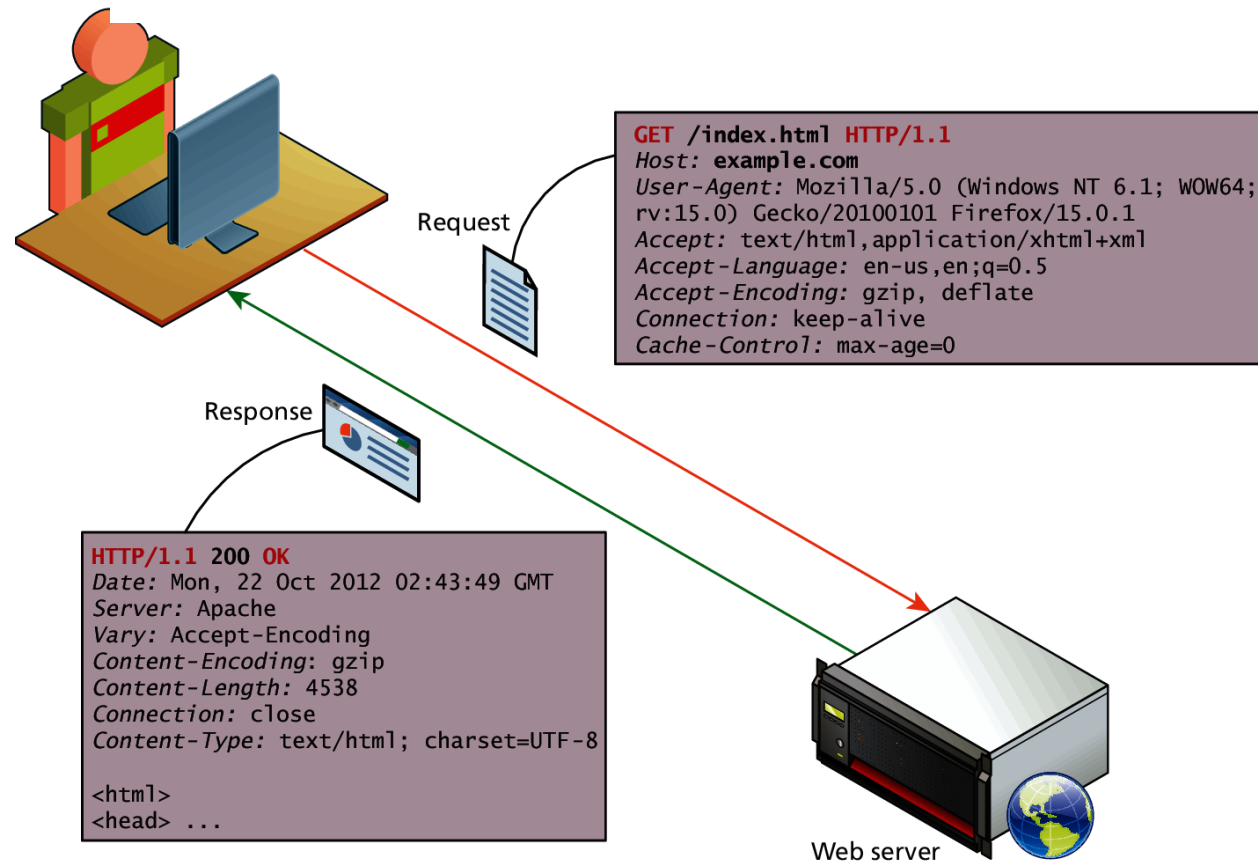
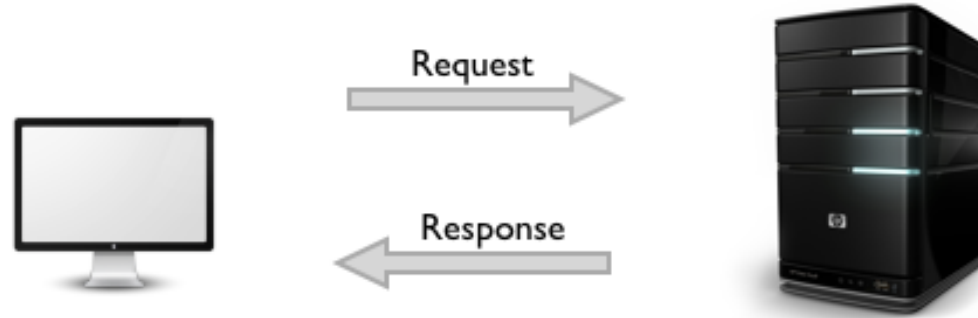
- The client makes a request.
- The server invokes an application to fulfill the request and sends the output of the application as a response to the client.
- The client displays the response to the user.

# Architecture of a Web Application



# The HTTP Protocol

- Client and server communicate through a network protocol
  - It is a set of shared rules or conventions that the participating agents follow to exchange information effectively
- Browsers and web servers communicate using the HTTP (Hypertext Transfer Protocol)
  - HTTP is based on TCP/IP (Transmission Control Protocol/Internet Protocol)
  - It has 4 main commands: GET,POST,PUT,DELETE



# HTTP

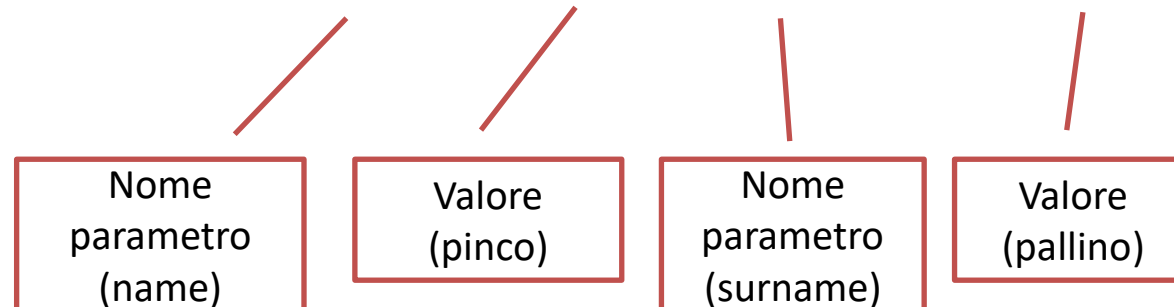
- In a TCP/IP network, each computer (host) has an IP address and listens on a port
  - Eg. 193.205.219.57:8080
  - The IP address identifies a computer on the network
  - The port identifies a specific server program
    - Typically, a web server is configured to listen on port :80

# Uniform Resource Identifier

<http://www.people.it:80/search?name=pinco&surname=pallino>

is a Uniform Resource Identifier (URI)

- Protocollo name (http://)
- Hostname (www.people.it)
- Port number, opz: default port :80
- Resource requested from the host (/search)
  - Image, HTML page, etc.
- Query string ?name=pinco&surname=pallino

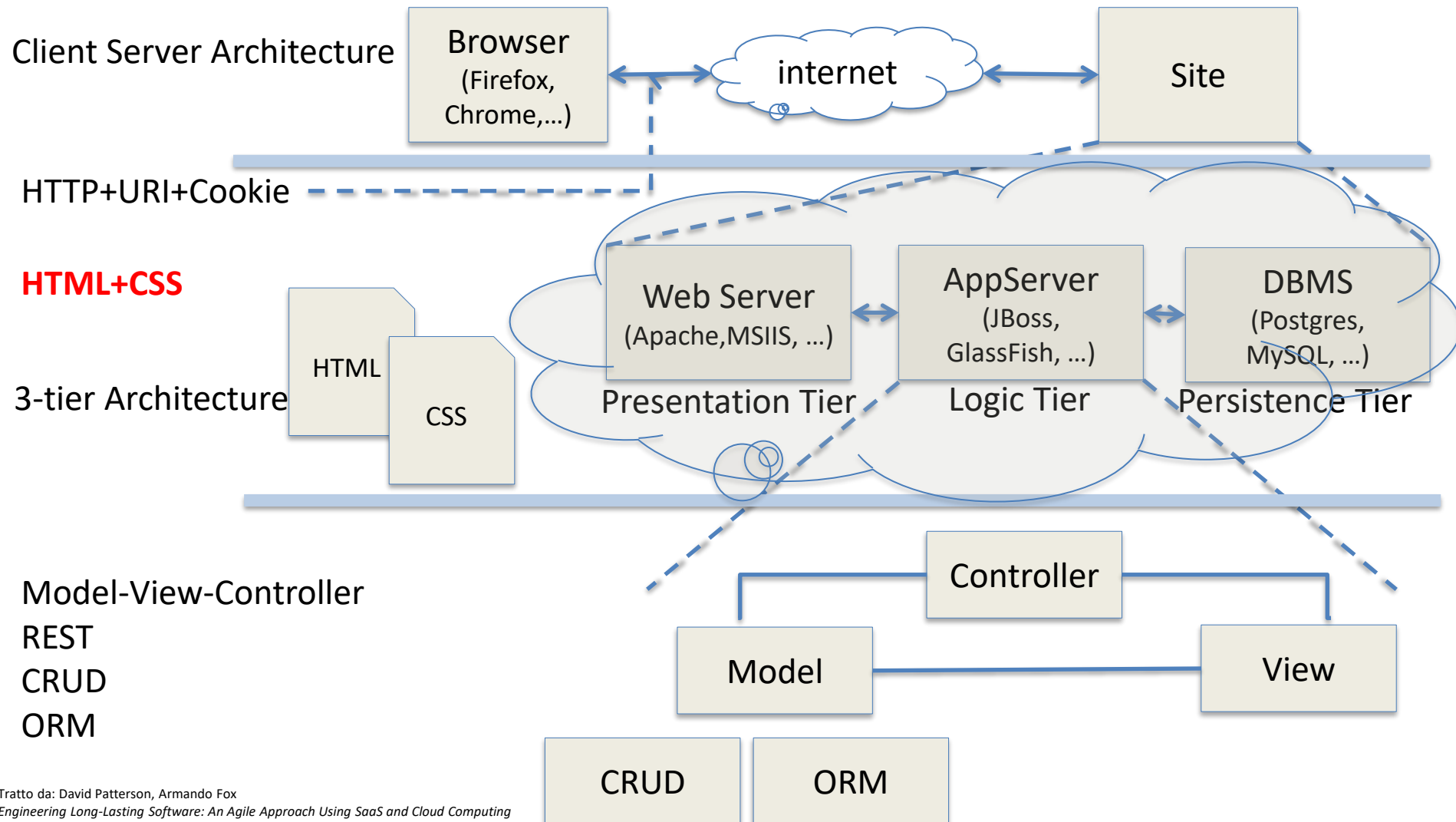




# Cookie

- The HTTP protocol is "stateless"
  - each request doesn't have memory of previous ones
  - To maintain the state or session between requests, mechanisms like session cookies are used
    - Session Cookies
- Persistent Cookies
  - Tracking habits
  - personalizing content
  - keeping the user logged

# Architecture of a Web Application



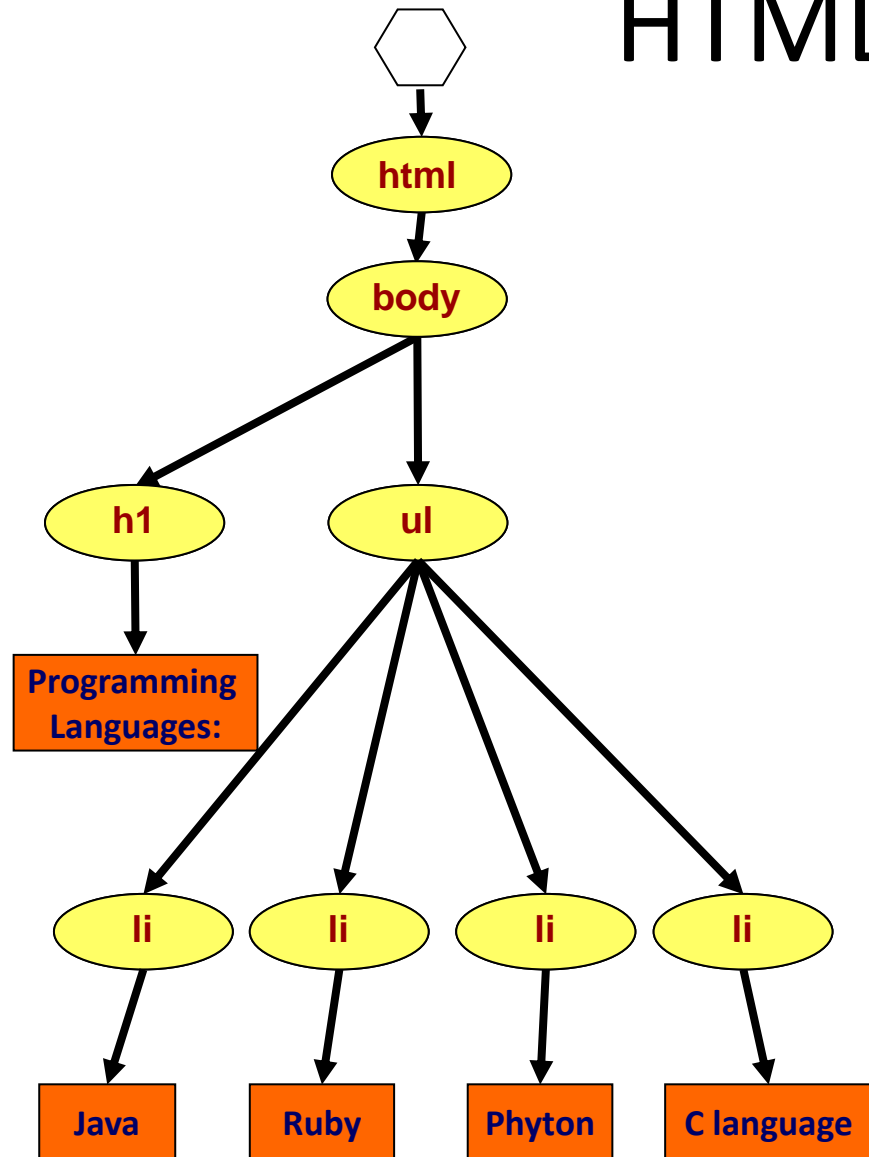
# HTML+CSS

- User interaction occurs through web pages
- The core technologies for coding web pages are HTML, CSS, and JavaScript
  - **HTML**: Defines the content of the page.
  - **CSS**: Defines the presentation of the content on the page.
  - **JavaScript**: Defines the behavior and interactivity of the page.

# HTML+CSS

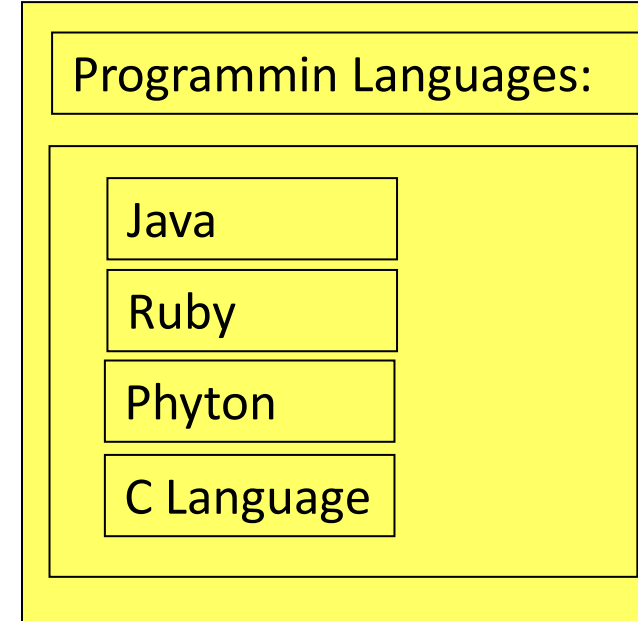
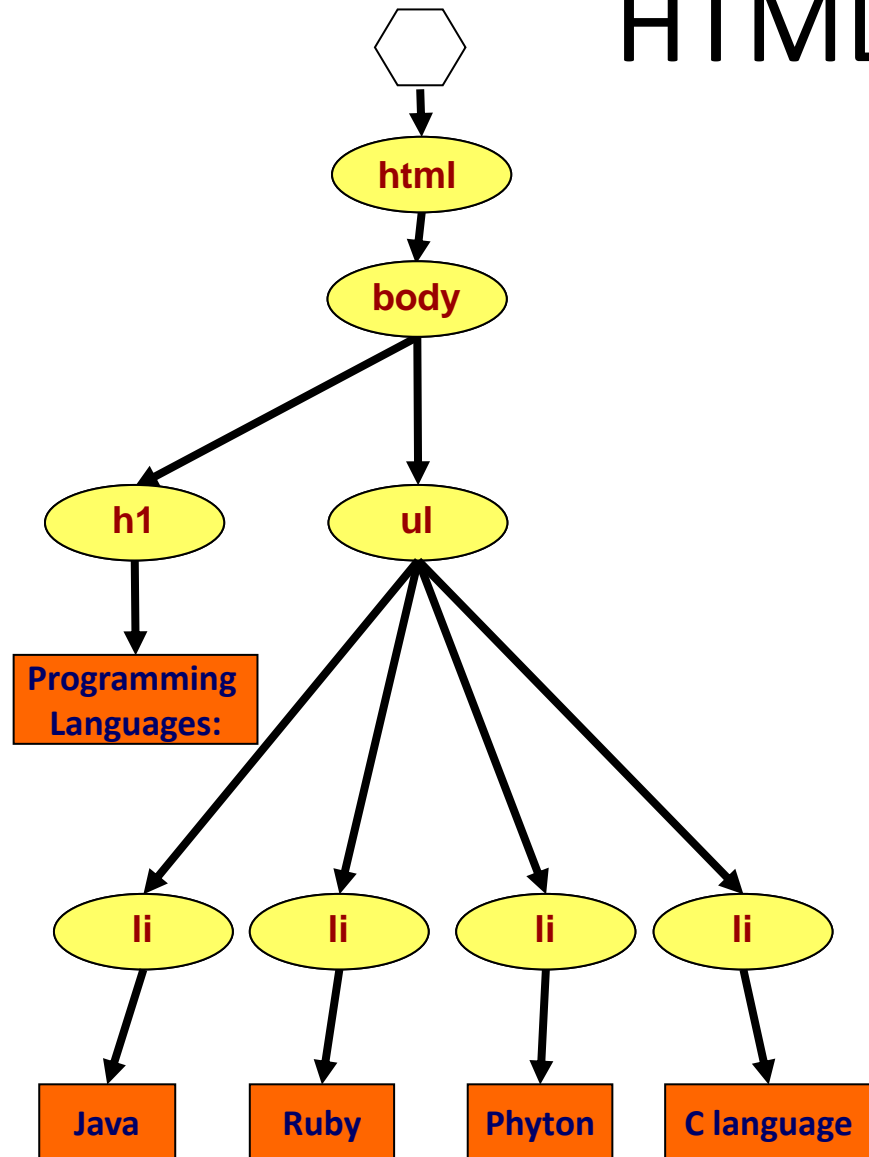
- HTML: is a markup language for defining hypertextual pages
  - HTML has a hierarchical structure, represented as nodes in a tree-like fashion
- CSS: is a language for associating presentation directives with elements in the hierarchical structure of an HTML document
- Javascript: is indeed the programming language of the web.

# HTML+CSS



```
<!DOCTYPE HTML>
<html>
  <body>
    <h1>Programming Languages:</h1>
    <ul>
      <li>Java</li>
      <li>Ruby</li>
      <li>Phyton</li>
      <li>C language</li>
    </ul>
  </body>
</html>
```

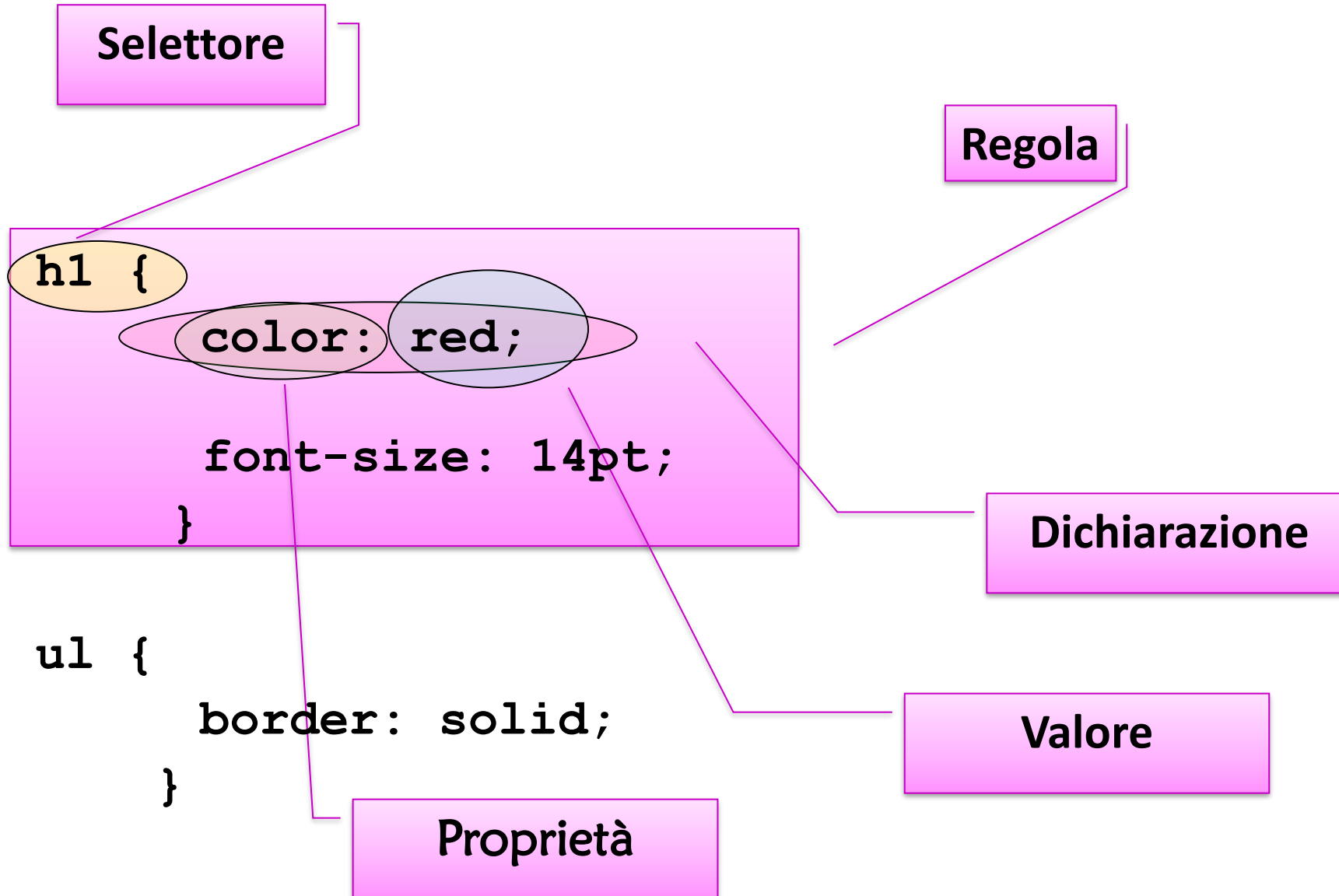
# HTML+CSS



# HTML+CSS

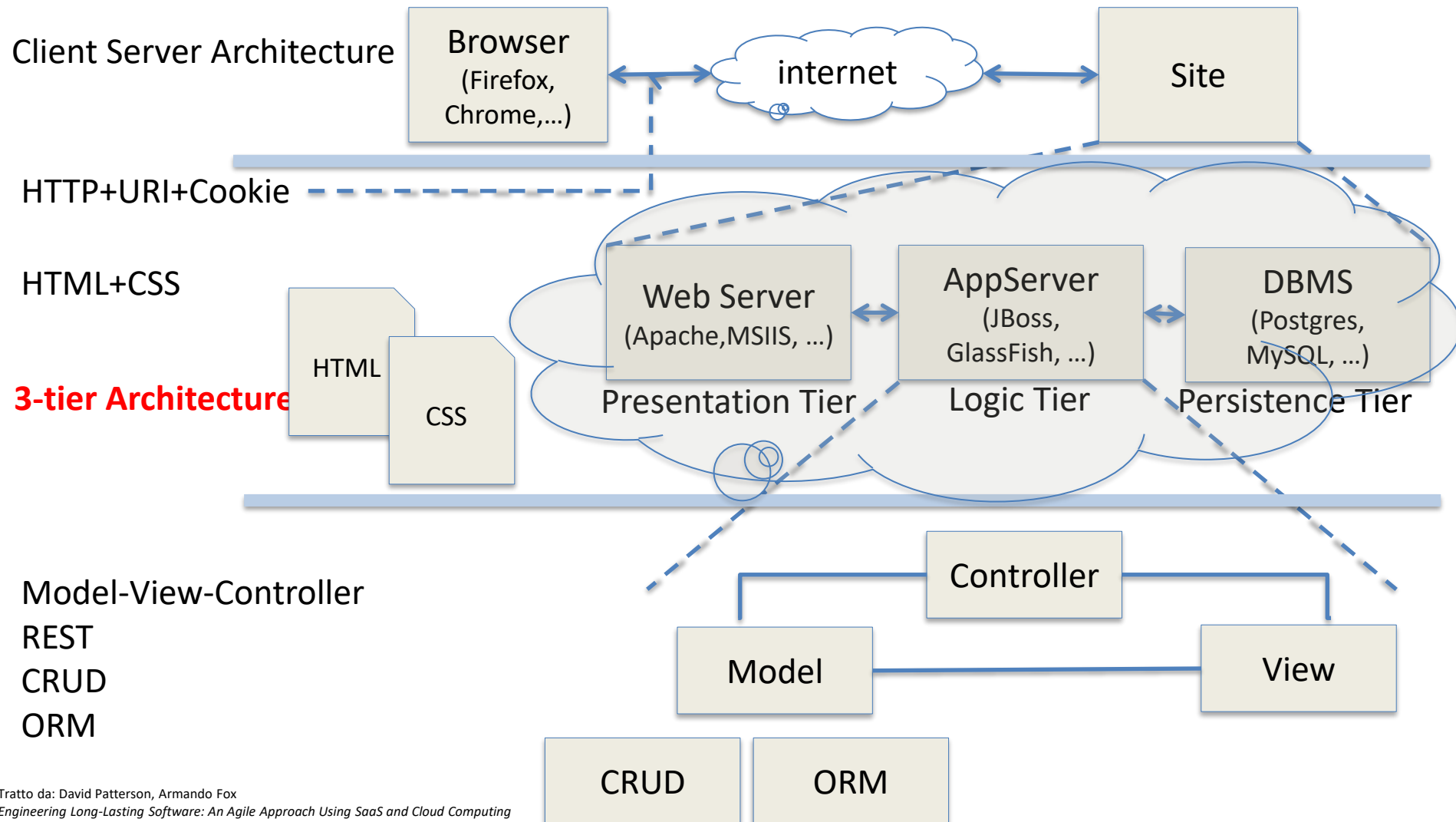
- Formatting the document corresponds to defining formatting rules for each of its boxes
- To specify how to format each box, we need:
  - mechanism to *select* the various boxes
  - a set of formatting *declarations* to associate with each box
- To make the mechanism effective
  - Some properties (e.g., font) should be able to *inherit* from the outer (parent) box
  - Some properties can be refined with *cascading* rules applied.

# HTML+CSS





# Architecture of a Web Application



# 3-Tier Architecture

- Web applications are generally structured in a *3-tier* architecture.
  - Presentation Tier
  - Logic Tier
  - Persistence Tier

# 3-Tier Architecture

- Presentation Tier
  - An HTTP server (Web server) that accepts requests and serves static contents (CSS, images, etc.)
  - forwards requests for dynamic content to the Logic Tier

# 3-Tier Architecture

- Logic Tier
  - here, the application that generates dynamic content runs
  - usually, this application is supported by an *Application Server*

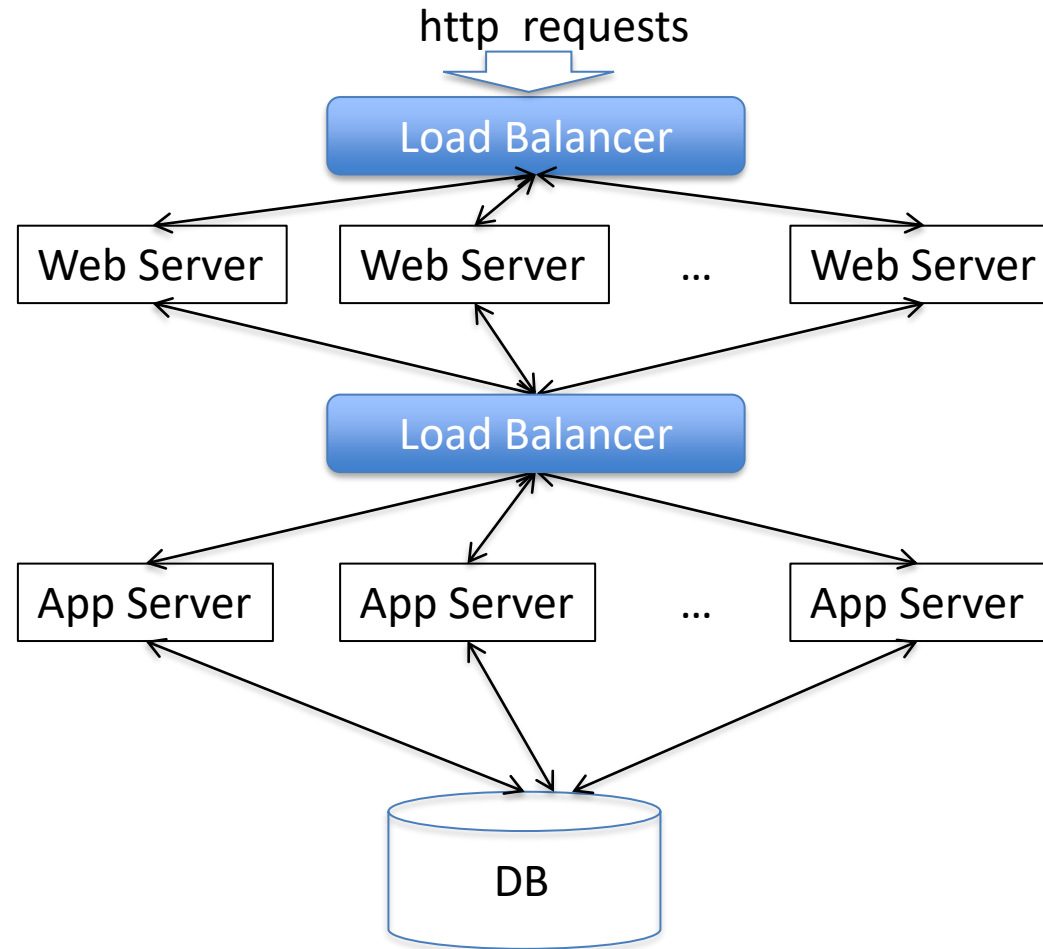
# Application Server

- It offers services for managing and running complex web apps
  - Efficiency (in application execution)
    - Caching, clustering, load balancing
    - Filesystem resource management
    - Transaction management
    - Security
  - Effectiveness (in software development)
    - Decoding client requests (HTTP)
    - Application lifecycle management
    - Session management (e.g., transparent cookie usage)
    - Shared information management
    - Support for producing HTTP responses

# Application Server

- Examples
  - Java (Spring, Jboss, Glassfish, ...)
  - Ruby on Rails
  - LAMP (Linux Apache MySQL PHP)
  - Microsoft Internet Information Services
  - Node.js
  - and more

# 3-Tier Architecture

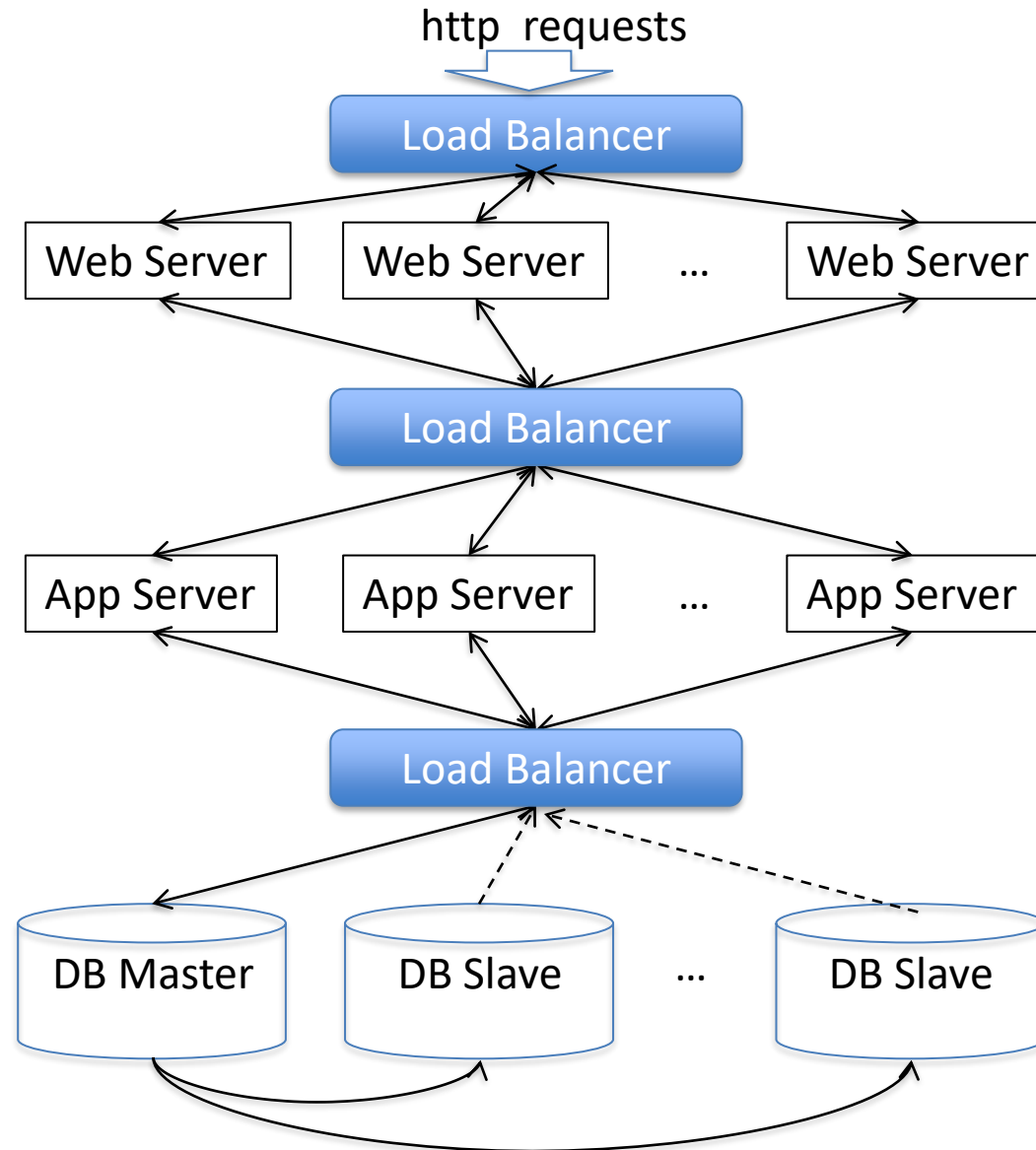


# 3-Tier Architecture

- Persistence Tier
  - It has the responsibility of managing data persistence
  - Both relational databases and NoSQL systems (e.g., MongoDB, Elasticsearch, etc.) can be used
  - For efficiency reasons, if the web application involves significantly more read operations than write operations, master-worker architectures are applied
    - any *worker* can handle read requests
    - only the *master* can handle write requests (and it is responsible for propagating updates to the *workers*)

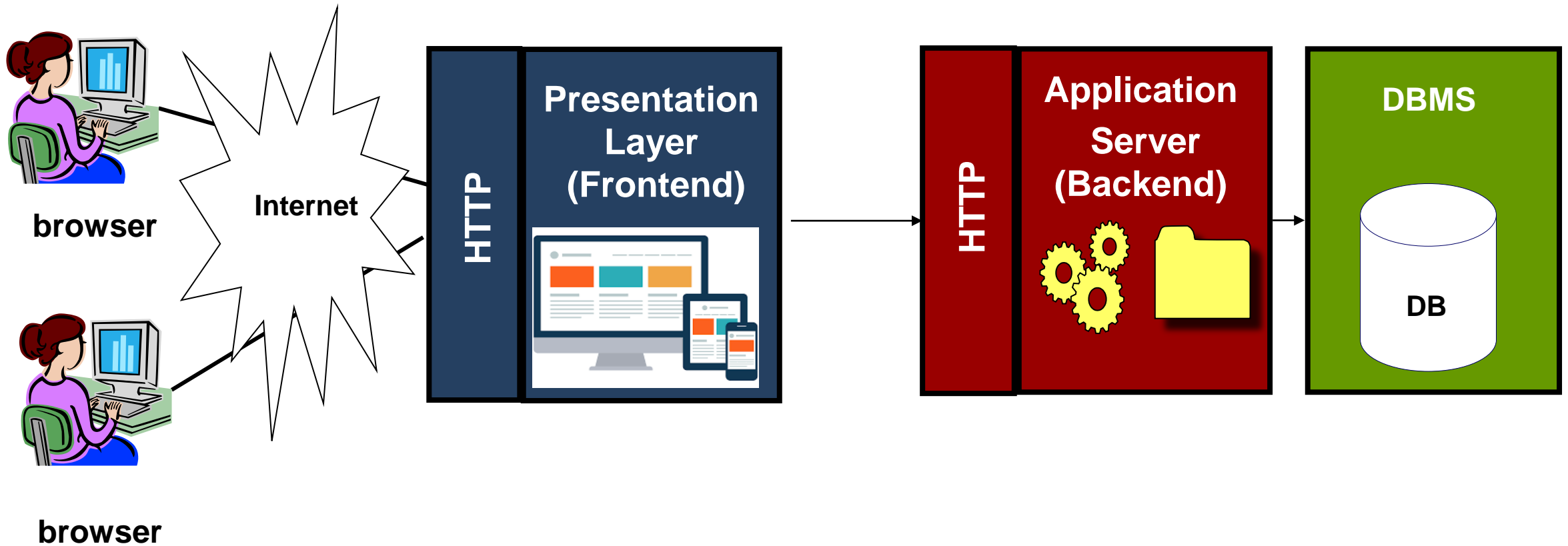


# Architettura 3-Tier



# 4-Tier Architecture? Possible?

In modern Web Applications is common



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