

Internet Technologies

Setting up a Local Web Development Environment:
Browser / Web Server / Database Server / PHP / PhpMyAdmin /
Web Development IDE (editor)



University of Cyprus
Department of Computer
Science

Lab Objectives

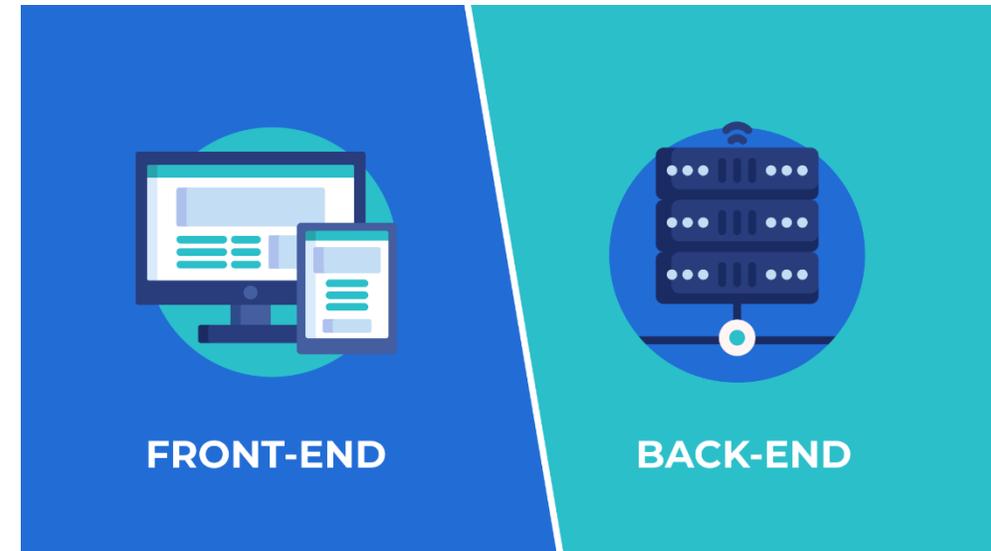


- Implement web applications from scratch
- By learning and using languages such as HTML, CSS, JavaScript, PHP, Python and Java for web development
- By using databases for storing and retrieving data, supporting web applications

Web Applications



- Web application is interactive, server-hosted software, delivered on the World Wide Web (WWW) that can be accessed through a web client
- Web apps consist of **frontend** (client-side) and **backend** (server-side) software layers
- Frontend includes everything the user sees and experiences directly
- Backend is invisible to the user; “behind the scenes” part of app
- Frontend communicates with backend using HTTP methods (e.g. GET, POST) to send/receive data

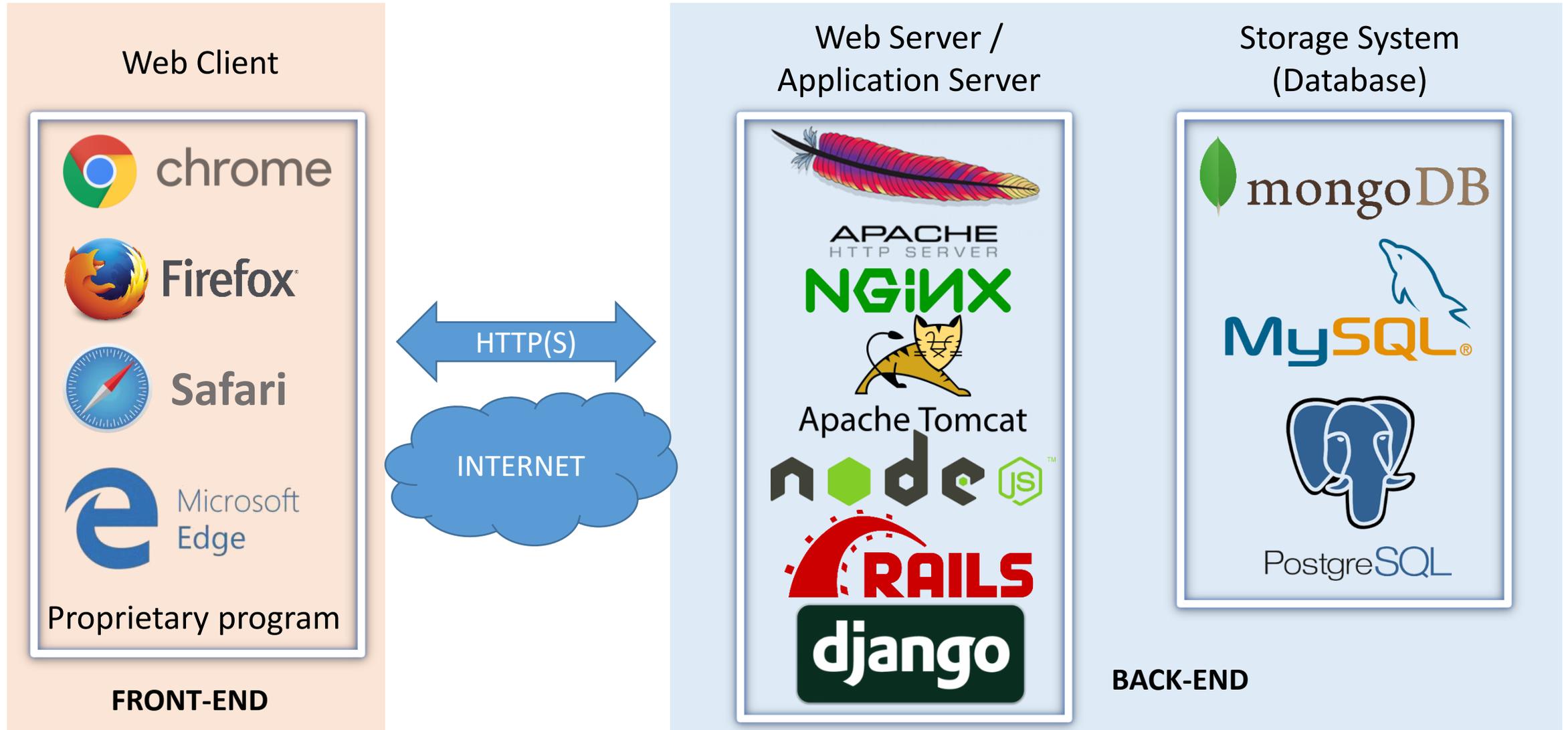


Web Applications Examples

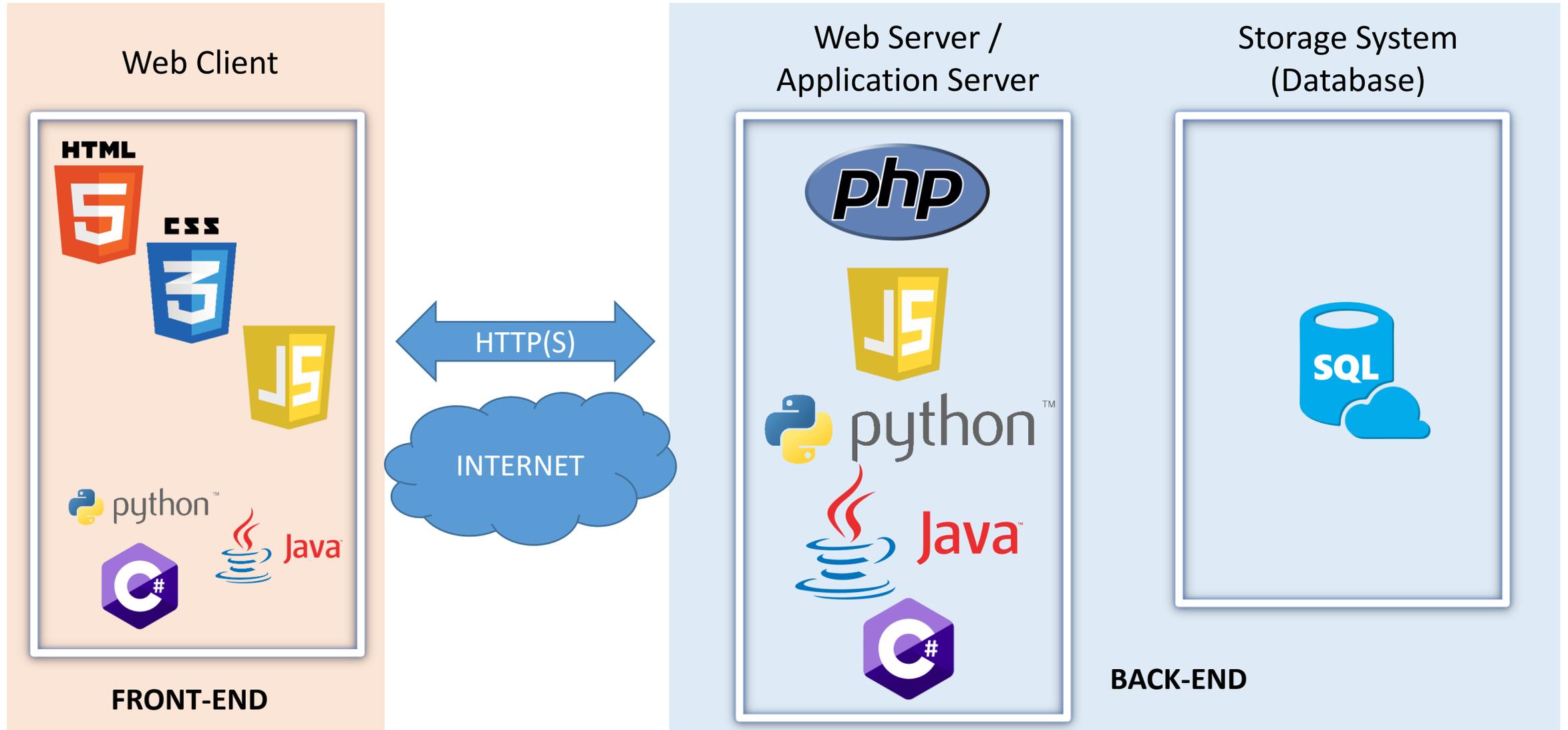


- **Website** is a collection of publicly accessible web pages containing either documents, images, audio, video, text, or other files that users can access
 - **Static:** Built using front-end languages like HTML, CSS, and JavaScript. They do not involve a database which a user can interact with. They display same content for every user who accesses them.
 - **Dynamic:** In addition to the front-end languages like HTML, CSS, and JavaScript, dynamic websites involve back-end languages such as PHP, JavaScript, Python, ASP to interact with DBs. They are able to display different content for each user
- **RESTful API** is back-end software (written in PHP, Java, Python) that accepts HTTP msgs (e.g. GET) sent by users that want to access remote resources
 - e.g. [OpenWeatherMap REST API](#) allows users retrieve weather data for any location

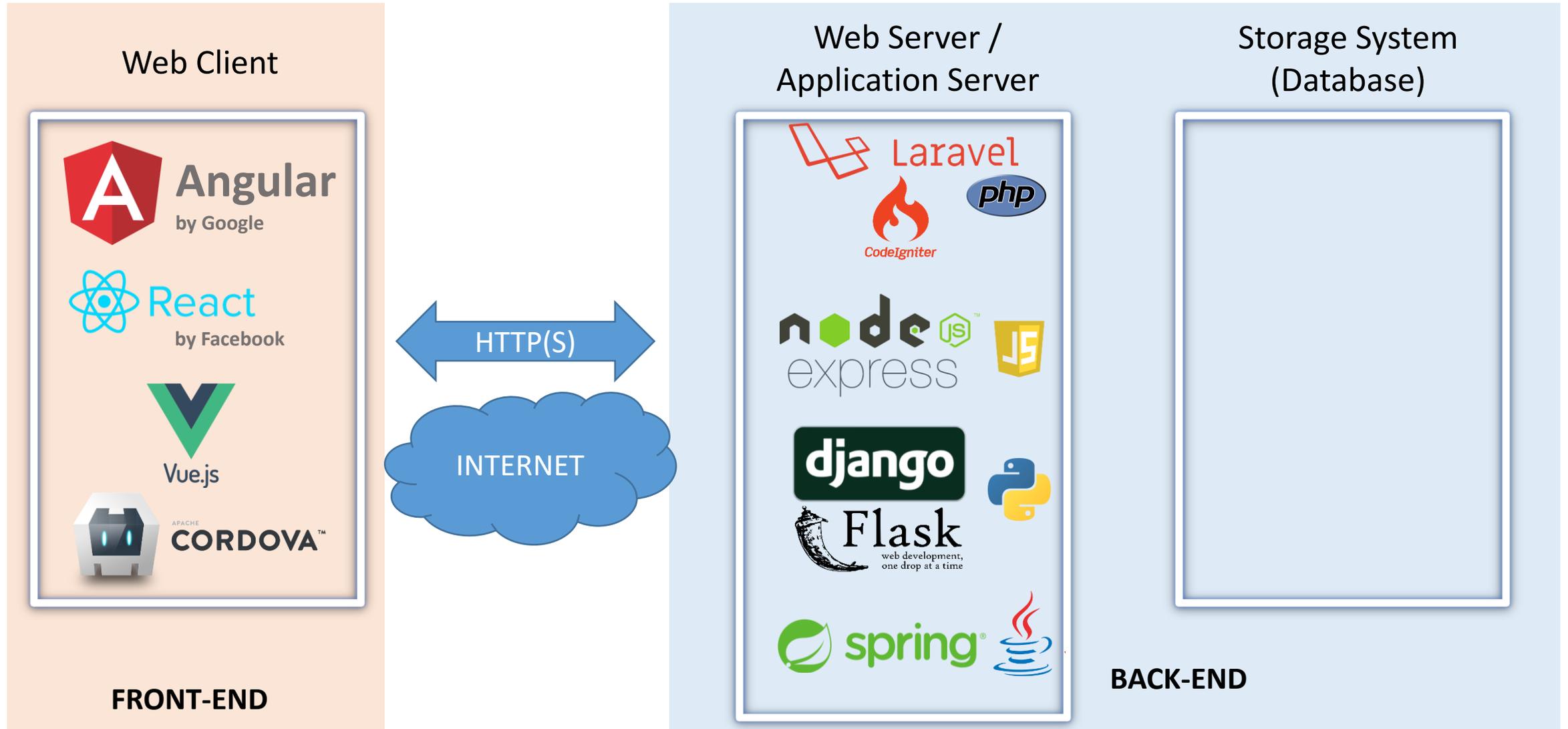
Entities in Web Application Development



Languages in Web Application Development



Frameworks in Web Application Development



Servers: Web vs Database vs Application



- **Web server:** Hosts HTML/PHP documents, handles HTTP requests (e.g. GET, POST) for static & dynamic websites sent by users via browser
 - Example web servers: Apache, Nginx, Microsoft IIS
- **Database server:** Stores data and handles database queries (e.g. SELECT)
 - Example database servers: MySQL, MariaDB, PostgreSQL, MongoDB
- **Application server:** Sits mainly in front of a database server and basically exposes data from databases. Application server hosts applications (e.g. written in Java, PHP, .NET) that are accessed using APIs. Exposed data is returned in JSON, XML and HTML format.
 - Example application servers: Apache Tomcat, Jetty, Websphere, Jboss, Glassfish (Java), Zend Server (PHP), Mono (.NET)

XML vs JSON



- Both used to **format data exchanged** between client and server
- XML was developed in 1997 and uses identifying tags similar to HTML
- JSON was developed in 2001, derived from JavaScript and can be condensed with less characters to be very lightweight

XML

```
<employees>
  <employee>
    <firstName>John</firstName>
    <lastName>Doe</lastName>
  </employee>
  <employee>
    <firstName>Anna</firstName>
    <lastName>Smith</lastName>
  </employee>
  <employee>
    <firstName>Peter</firstName>
    <lastName>Jones</lastName>
  </employee>
</employees>
```

```
{"employees": [
  { "firstName": "John", "lastName": "Doe" },
  { "firstName": "Anna", "lastName": "Smith" },
  { "firstName": "Peter", "lastName": "Jones" }
]}
```

JSON

Apache HTTP Server



- Free, open-source HTTP Server.
- Developed and maintained by Apache Group – first released in 1995.
- Its name comes from the Indian tribe famous for their strength and endurance in battle.
- Provides load balancing and caching.
- Runs on UNIX and Windows platforms. UNIX version is the most stable and most widely used.
- Installing and maintaining is easy; low complexity & low difficulty of administration.
- <https://httpd.apache.org/>

NGINX HTTP Server



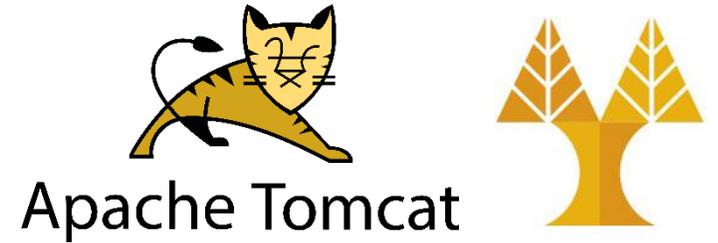
- Free, open-source, high-performance Web Server and reverse proxy, as well as an IMAP/POP3 proxy server.
 - Commercial support and training available
- Provides load balancing and HTTP caching.
- Unlike traditional servers, NGINX doesn't rely on threads to handle requests. Instead, it uses a much more scalable event-driven (asynchronous) architecture.
- Predictable performance (RAM usage, CPU usage, latency) under high loads.
- <https://www.nginx.com/>

Node.js



- Open-source and **cross-platform JavaScript** runtime **environment for developing** custom **server-side** network applications in JavaScript:
 - Web Server just like Apache or Nginx, TCP server, DNS server, Web chat app, online games, collaboration tools or anything which sends updates to the user in real time
- Node.js runs the V8 JavaScript engine (written in C++), the core of Google Chrome, and executes JavaScript code outside of the browser
- NPM (Node Package Manager) comes bundled with Node.js installation and it is the default package manager for Node.js
 - Manages dependencies for an application
 - Allows users to install Node.js applications that are available on the npm registry
- <https://nodejs.org/en/download/>

Apache Tomcat

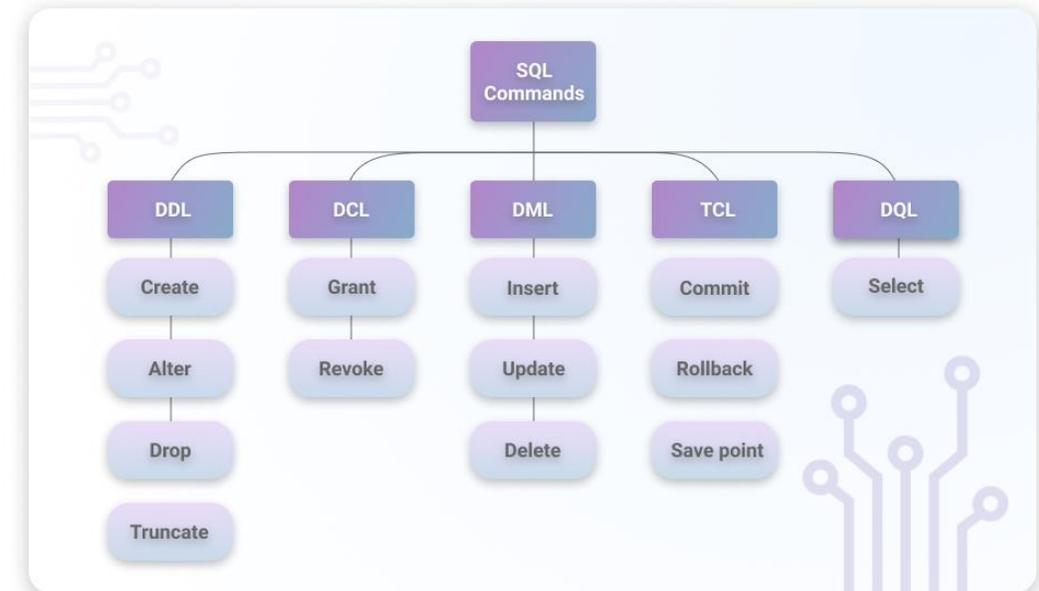


- Free, open-source, Web Application container
- Written in Java (OS independent)
- Tomcat is used to run Servlet and Java Server Pages (JSP) web applications
 - Servlet is a server-side Java program (.java) that handles client requests (HTTP GET, POST, etc.).
 - JSP allows for inserting Java code into HTML pages. JSP files have the .jsp extension.
- <https://tomcat.apache.org/>

Databases: **Relational** vs NoSQL



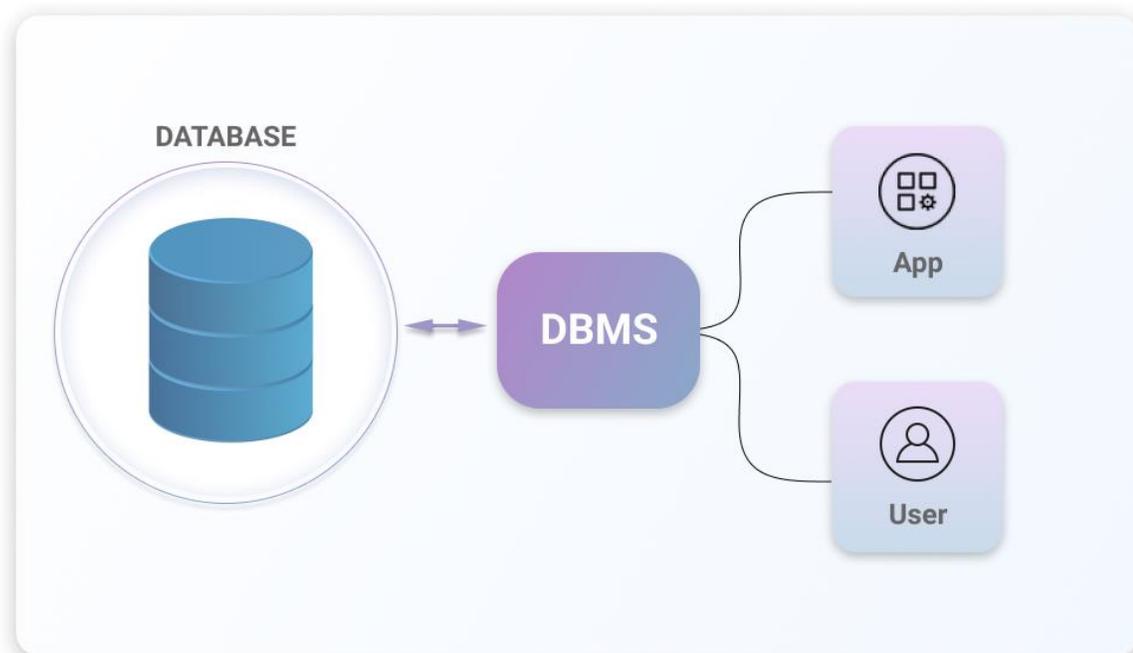
- **Relational databases** store data in a structured tabular (schema-based) format: using rows and columns
- Why 'relational' though? Because tables in a relational database can be linked or joined or related based on common data (public/private keys).
- **SQL** is a computer language used by most relational database management systems (RDBMS) to store, manipulate, and retrieve data stored in the tabular format.





Databases: **Relational** vs NoSQL

- RDBMS stands for Relational Database Management System and represents software that is used to manage, manipulate, query, and retrieve data stored in a relational database.



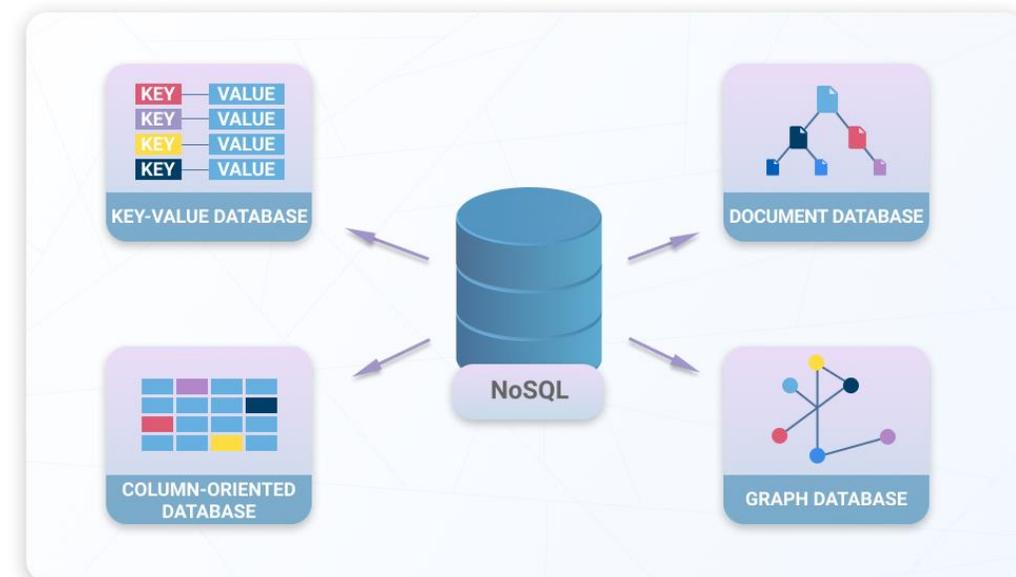
Popular RDBMS



Databases: Relational vs NoSQL



- Aka "**Not only SQL**"
- Non-tabular (schema-less) databases
- Without concept of relationships (joins)
- Store data differently than relational DBs
 - Store data in documents similar to JSON
 - Store data in key-value pairs
 - Store data in tables, rows, and dynamic columns
 - the names and the format of the columns can vary from row to row within the same table
 - Store data in nodes and edges as a graph
 - Nodes typically store information about people, places, and things, while edges store information about the relationships between the nodes.



Databases: Relational vs NoSQL

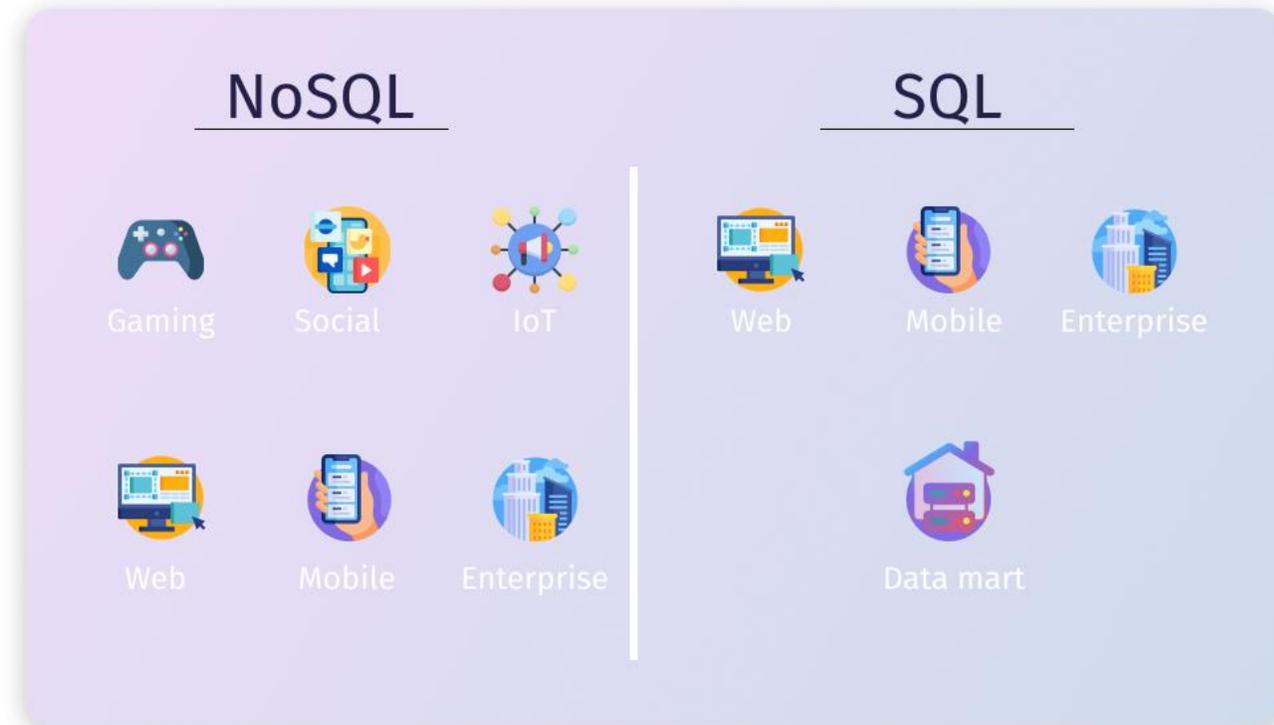


- **Document databases:** MongoDB, CouchDB.
- **Key-value stores:** Cassandra, Azure, Redis, DynamoDB, LevelDB, Riak.
- **Wide-column stores:** HBase, BigTable, HyperTable.
- **Graph databases:** Amazon Neptune, Polyglot, Neo4J.

Databases: Relational vs NoSQL – When to use each?



- Depends on the type of data you're going to store and how you're going to store it
- If your data is generally structured, a relational database is likely the best choice.
- Non-relational databases are primarily used to store and process Big Data for real-time web apps.



MySQL



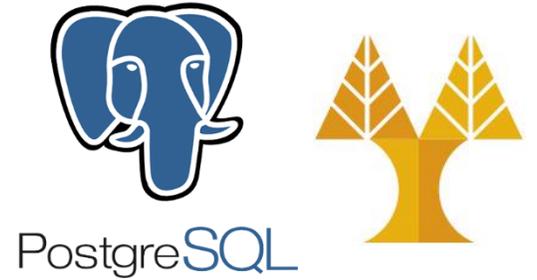
- Open-source, enterprise-level, multi-threaded database management system
 - commercial license available (MySQL is now owned by Oracle)
- MySQL Document Store allows developers to work with both **SQL relational tables** and **schema-less (No-SQL) JSON collections** (as of MySQL 8.0).
- Works on many different platforms (UNIX, Windows, SaaS on Cloud).
- Handles large databases.
- <https://www.mysql.com/>

MariaDB



- Open-source, community-developed, free relational database management system
- Development is led by some of the original developers of MySQL, who forked it due to concerns over its acquisition by Oracle Corporation in 2009
- Intended to maintain compatibility with MySQL – however, new features are diverging
- <https://mariadb.com/> (enterprise server) and <https://mariadb.org/> (community server)

PostgreSQL



- Open-source, enterprise-level, multi-process, **relational** database management system
- Supports SQL querying
- Supports native JSON data type (within a relational table) since version 9.2
 - Provides many functions and operators for manipulating JSON data.
- Works on many different platforms (UNIX, Windows, SaaS on Cloud).
- Most **geospatial** features of any open-source database
 - Geographic objects, geographic queries
- Designed for high volume environments
- <https://www.postgresql.org/>

MongoDB



- Open-source, scalable, document-oriented (No-SQL) database
- Documents stored in collections (a collection is similar to a table in relational databases)
 - Created on the fly when referenced for the first time
- Rich document-based queries
- No joins and no multi-document transactions
- Provides geospatial features
- <https://www.mongodb.com>

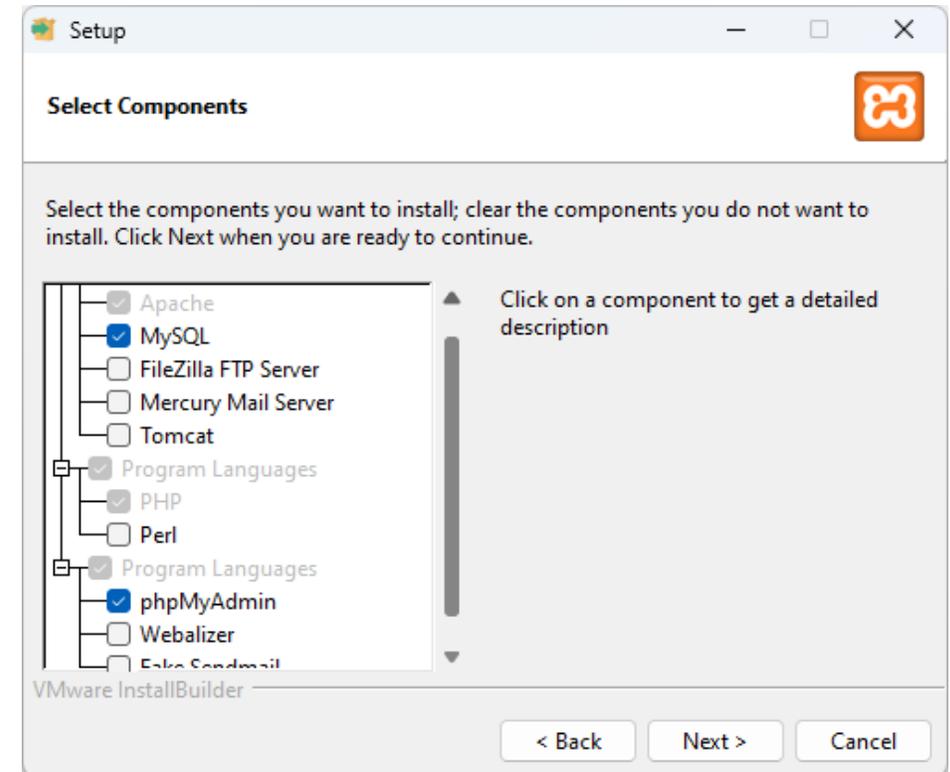
Web Application Stack Frameworks

-  XAMPP
 - **X** ("cross-platform"), **A**pache, **M**ariaDB, **P**HP, **P**erl
 - MySQL was replaced with MariaDB in 2015
 - Download: [XAMPP home](#)
- LAMP
 - **L**inux, **A**pache, **M**ySQL, **P**HP / Perl / Python
- WAMP
 - **W**indows, **A**pache, **M**ySQL, **P**HP / Perl / Python
 - Download : [WampServer](#), [easyPHP](#)
- MAMP
 - **M**acOS, **A**pache, **M**ySQL, **P**HP / Perl / Python

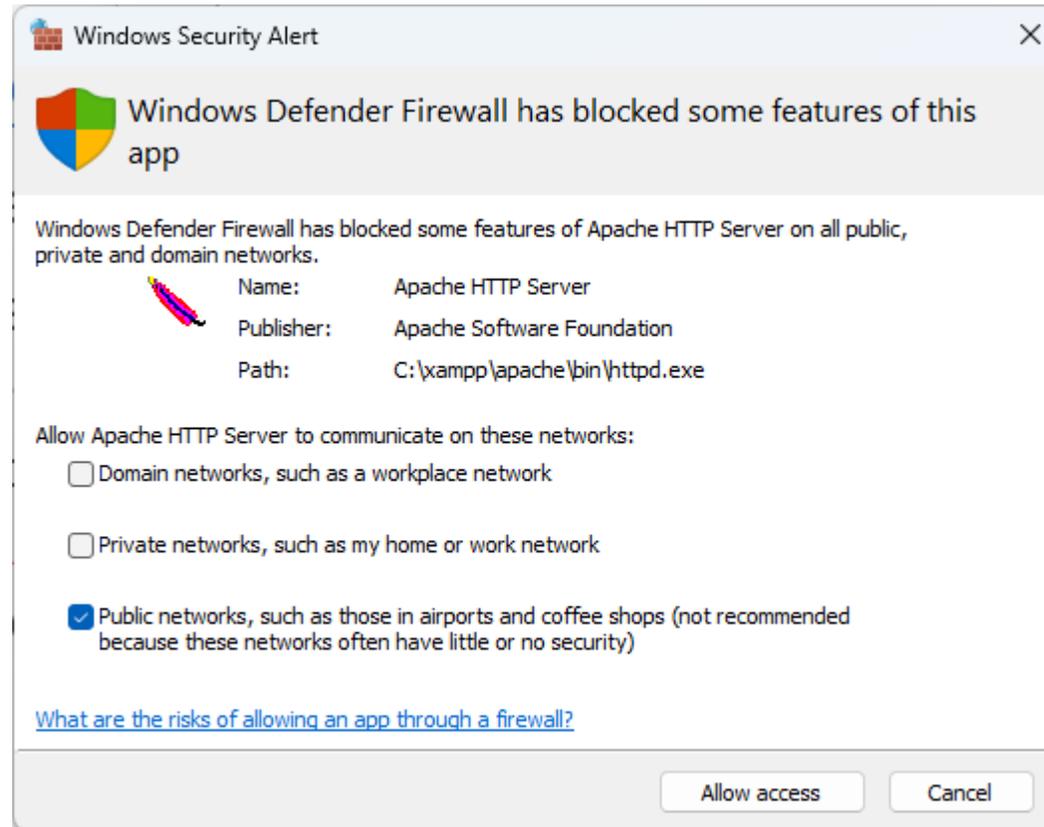
Install XAMPP Stack on your machine



- Go to <https://www.apachefriends.org/>
- Download the appropriate installer based on your OS
- Install Apache, MySQL, PHP and phpMyAdmin only
 - No need for Filezilla FTP Server, Mercury Mail Server, Apache Tomcat, Perl language, Webalizer, Fake Sendmail
 - For Windows install on C:\xampp



Allow access to Apache HTTP Server





XAMPP Control Panel

- Start Apache
- Start MySQL

Service	Module	PID(s)	Port(s)	Actions
<input type="checkbox"/>	Apache	38608 33740	80, 443	Stop Admin Config Logs
<input type="checkbox"/>	MySQL	6152	3306	Stop Admin Config Logs
<input type="checkbox"/>	FileZilla			Start Admin Config Logs
<input type="checkbox"/>	Mercury			Start Admin Config Logs
<input type="checkbox"/>	Tomcat			Start Admin Config Logs

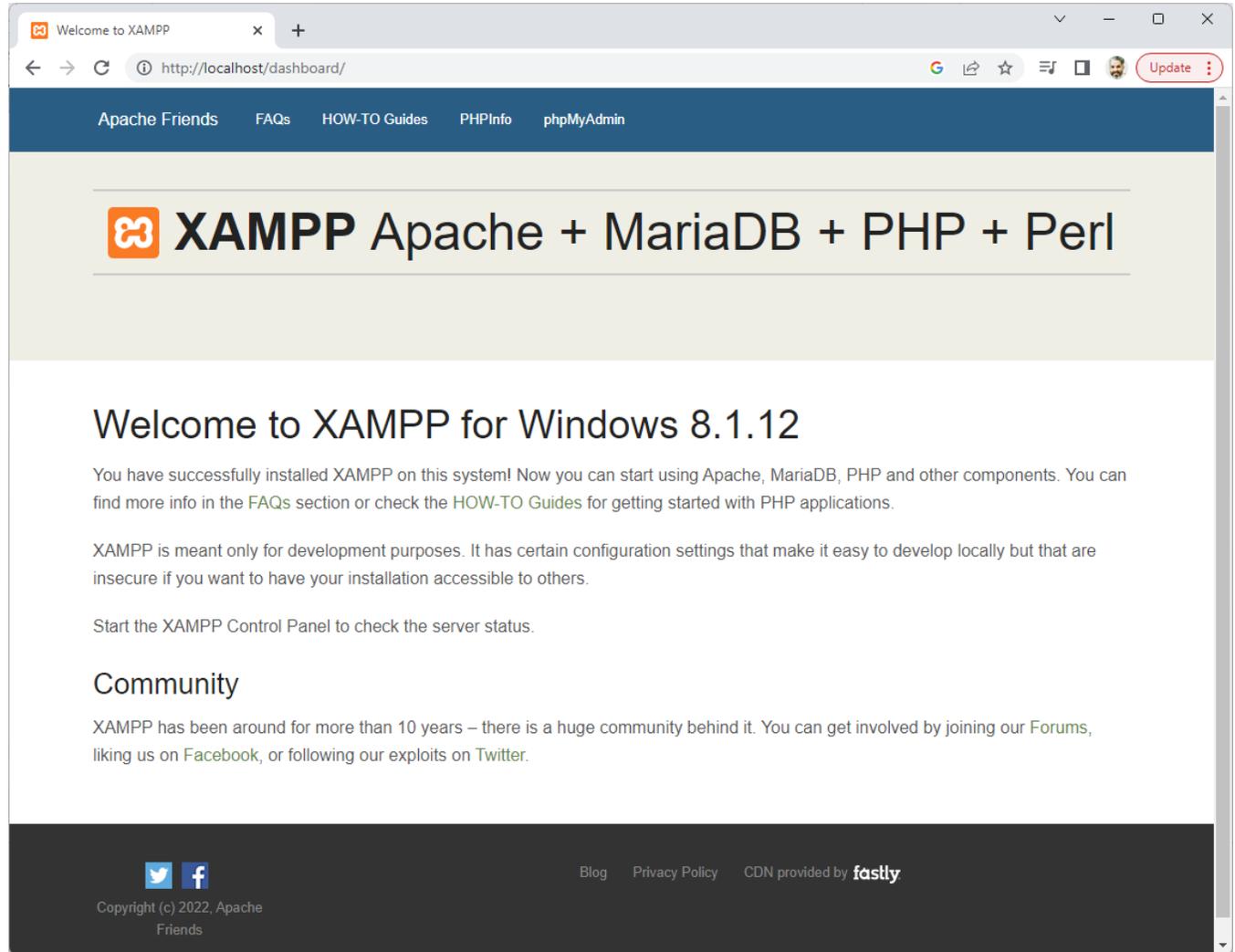
12:03:53 μμ [main] The Mercury module is disabled
12:03:53 μμ [main] The Tomcat module is disabled
12:03:53 μμ [main] Starting Check-Timer
12:03:53 μμ [main] Control Panel Ready
12:14:09 μμ [Apache] Attempting to start Apache app...
12:14:09 μμ [Apache] Status change detected: running
12:14:42 μμ [mysql] Attempting to start MySQL app...
12:14:42 μμ [mysql] Status change detected: running

Check if local Web Server is running...



- Open browser
- Navigate to <http://127.0.0.1> or <http://localhost>
- We can use https instead of http but we need to setup a trusted certificate to remove the “Not secure” message

 Not secure | <https://localhost/dashboard/>



The screenshot shows a web browser window with the address bar displaying `http://localhost/dashboard/`. The page title is "Welcome to XAMPP". The navigation menu includes "Apache Friends", "FAQs", "HOW-TO Guides", "PHPInfo", and "phpMyAdmin". The main heading is "XAMPP Apache + MariaDB + PHP + Perl". Below this, the text reads "Welcome to XAMPP for Windows 8.1.12" and "You have successfully installed XAMPP on this system! Now you can start using Apache, MariaDB, PHP and other components. You can find more info in the FAQs section or check the HOW-TO Guides for getting started with PHP applications." It also states "XAMPP is meant only for development purposes. It has certain configuration settings that make it easy to develop locally but that are insecure if you want to have your installation accessible to others." and "Start the XAMPP Control Panel to check the server status." There is a "Community" section mentioning "XAMPP has been around for more than 10 years – there is a huge community behind it. You can get involved by joining our Forums, liking us on Facebook, or following our exploits on Twitter." The footer contains social media icons for Twitter and Facebook, a "Blog" link, a "Privacy Policy" link, and "CDN provided by fastly". Copyright information for Apache Friends is also present.

Create a simple web page in local Web Server



- Go to `C:\xampp\htdocs`
- Create an html file called `myfirstwebpage.html` with the following content:

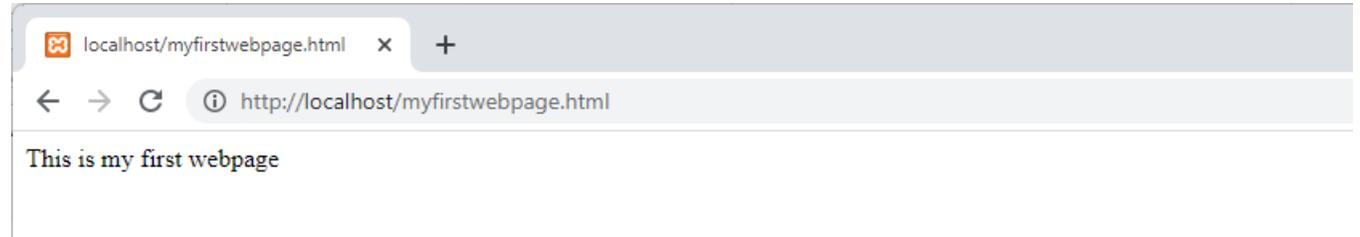
```
<p>This is my first webpage</p>
```
- Files can be created using notepad command or a dedicated IDE (see next slides)
- Navigate to this webpage using your browser

Create a simple web page in local Web Server



- Open browser
- Navigate to

<http://localhost/myfirstwebpage.html>



Check if local MySQL is running...



- Use phpMyAdmin tool
- Open browser
- Navigate to <http://127.0.0.1/phpmyadmin> or <http://localhost/phpmyadmin>

The screenshot displays the phpMyAdmin web interface in a browser window. The address bar shows the URL <http://localhost/phpmyadmin/>. The interface includes a navigation menu on the left with options like 'New', 'information_schema', 'mysql', 'performance_schema', 'phpmyadmin', and 'test'. The main content area is divided into several panels: 'General settings' (Server connection collation: utf8mb4_unicode_ci), 'Appearance settings' (Language: English, Theme: pmahomme), 'Database server' (Server: 127.0.0.1 via TCP/IP, Server type: MariaDB, Server version: 10.4.27-MariaDB), 'Web server' (Apache/2.4.54 (Win64) OpenSSL/1.1.1p PHP/8.1.12), and 'phpMyAdmin' (Version information: 5.2.0). A 'Console' tab is visible at the bottom left.

phpMyAdmin



- Free software tool written in PHP, intended to handle the administration of MySQL or MariaDB via a browser
- Frequently used operations (managing databases, tables, columns, relations, indexes, users, permissions, etc) can be performed via the graphical user interface, while you still have the ability to directly execute any SQL statement

Gain access to remote Web servers

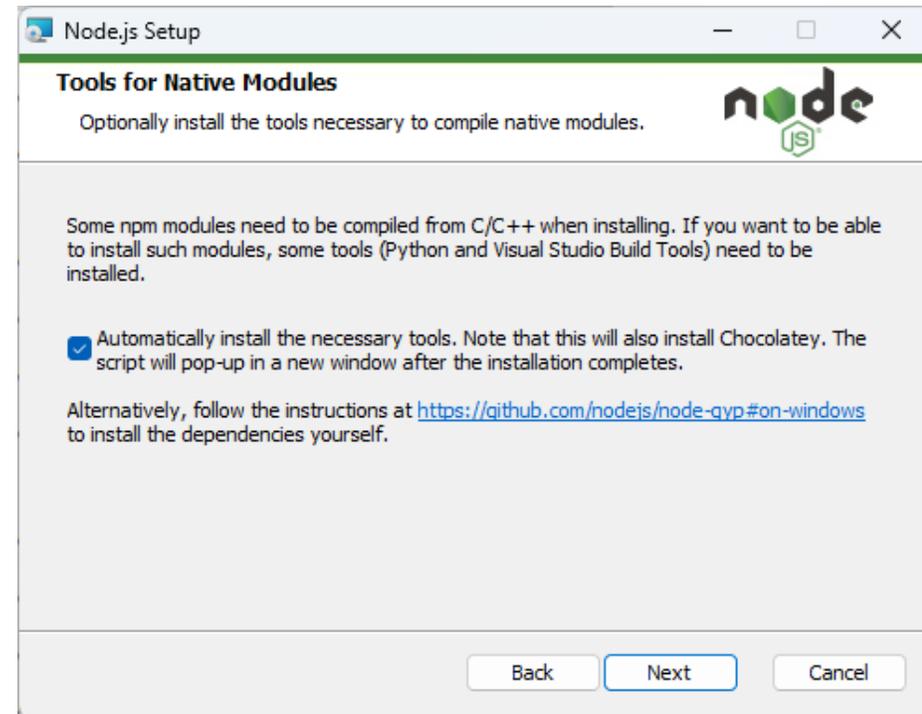


- Normally, a real-life web application is running on a remote server
- **Command-line (terminal) access** on a remote server is obtained via SSH (secure shell)
 - Usage: create folders, change permissions on files/folders, configure web server
 - Available tools: putty, X2Go (includes GUI), Remote Desktop Connection (Windows)
- **Access to upload/download** data on a remote server is obtained via (secure) FTP (File Transfer Protocol)
 - Usage: create/delete/update folders, upload/download folders & files
 - Available tools: FileZilla, WinSCP
- **Recommended (Windows OS) tool for both tasks: [MobaXterm](#) (free)**

Install Node.js on your machine (optional)



- Go to <https://nodejs.dev/en/download/>
- Download the appropriate installer based on your OS
- Double click the executable
 - Opt-in for installing the tools for native (C++) modules that come along with Node.js
 - To check if Node is installed, open the Windows Command Prompt (cmd), Powershell or a similar command line tool, and type `node -v`
This should print a version number, so you'll see something like this v18.13.0



Web Development IDEs



- Visual Studio Code  (HTML, CSS, JavaScript, PHP) ← recommended
- Sublime Text 3  (HTML, CSS, JavaScript, PHP)
- PHPStorm  (HTML, CSS, JavaScript, PHP, and more)
- WebStorm  (HTML, CSS, JavaScript, React, and more)
- NetBeans  (HTML, JavaScript, PHP)

Online Development Tools

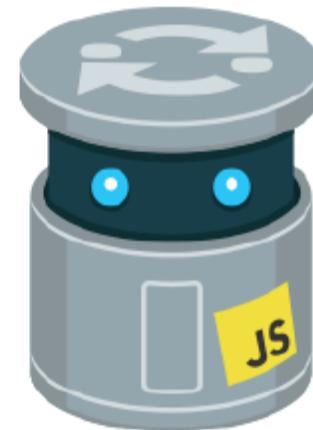


- Provide ease of access and development ready environment for front end web development. Most widely used are:

- Codepen.io
- CSSDesk
- JS Bin
- JSFiddle
- Dabblet
- D3 Playground



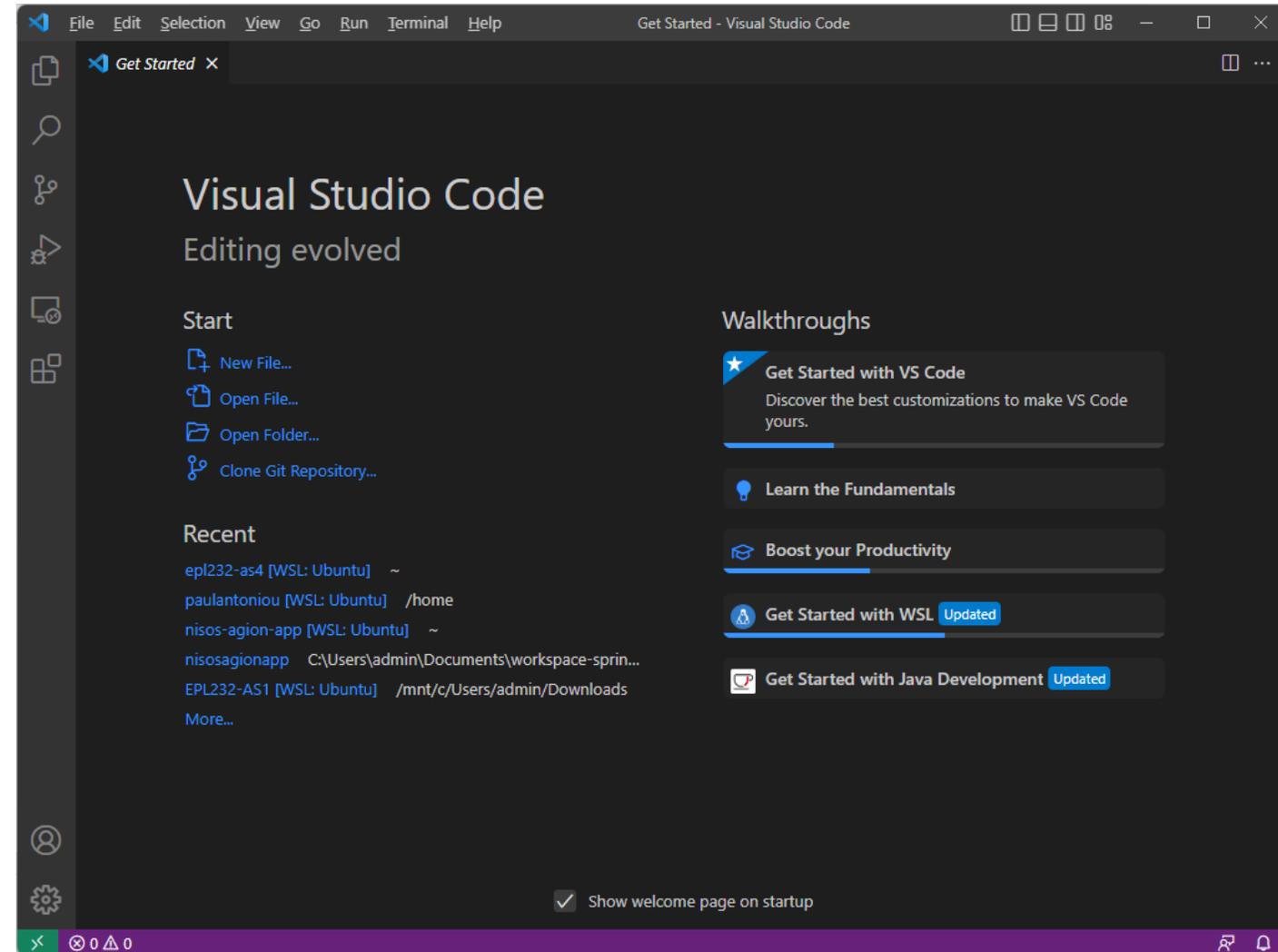
C  D E P E N



Install VS Code (recommended)



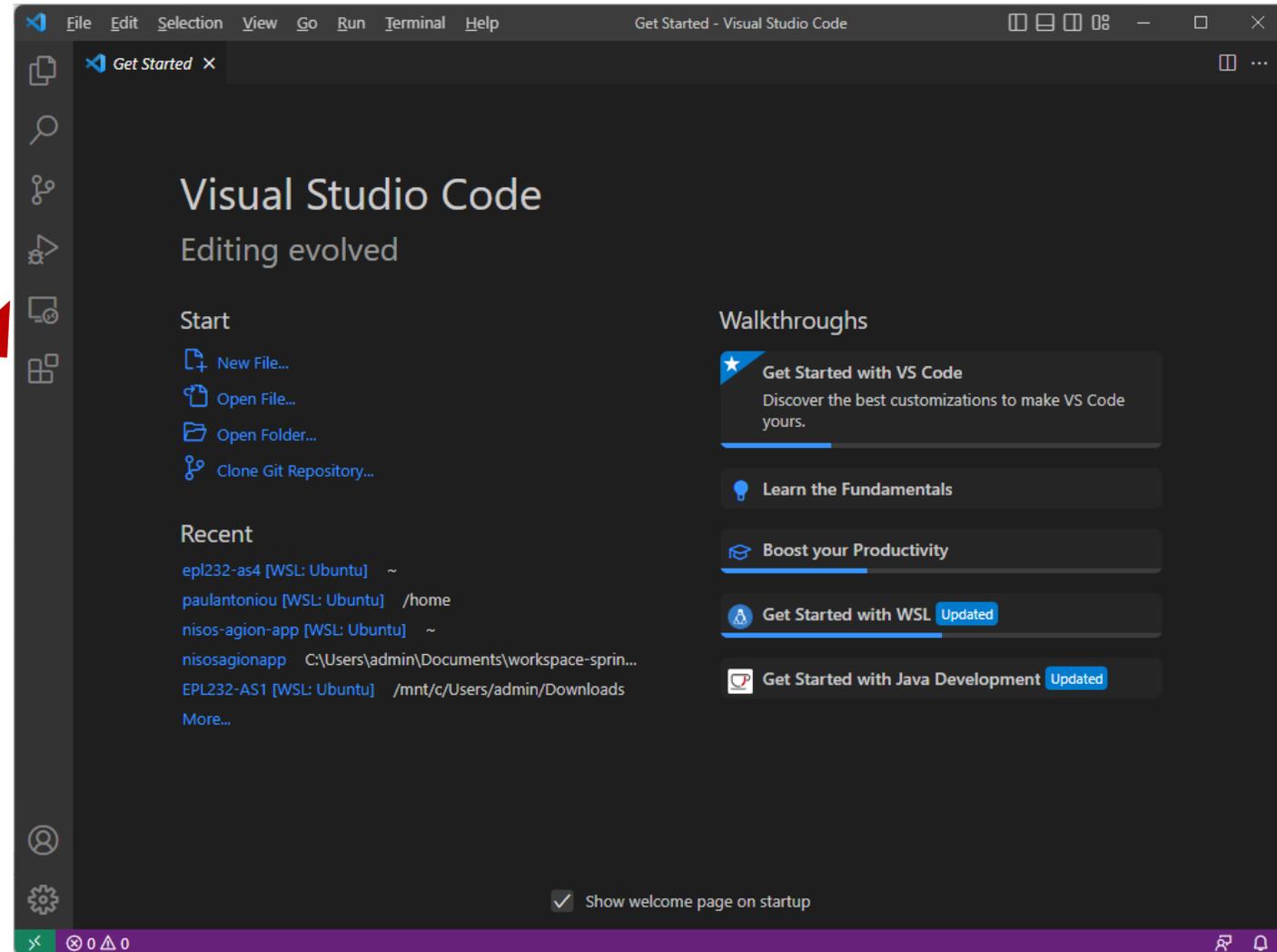
- If you don't yet have VS Code installed on your machine, head to code.visualstudio.com to download it
- Double click (on Windows) executable installer file to install VS Code
- Launch VS Code



Install Web development extensions



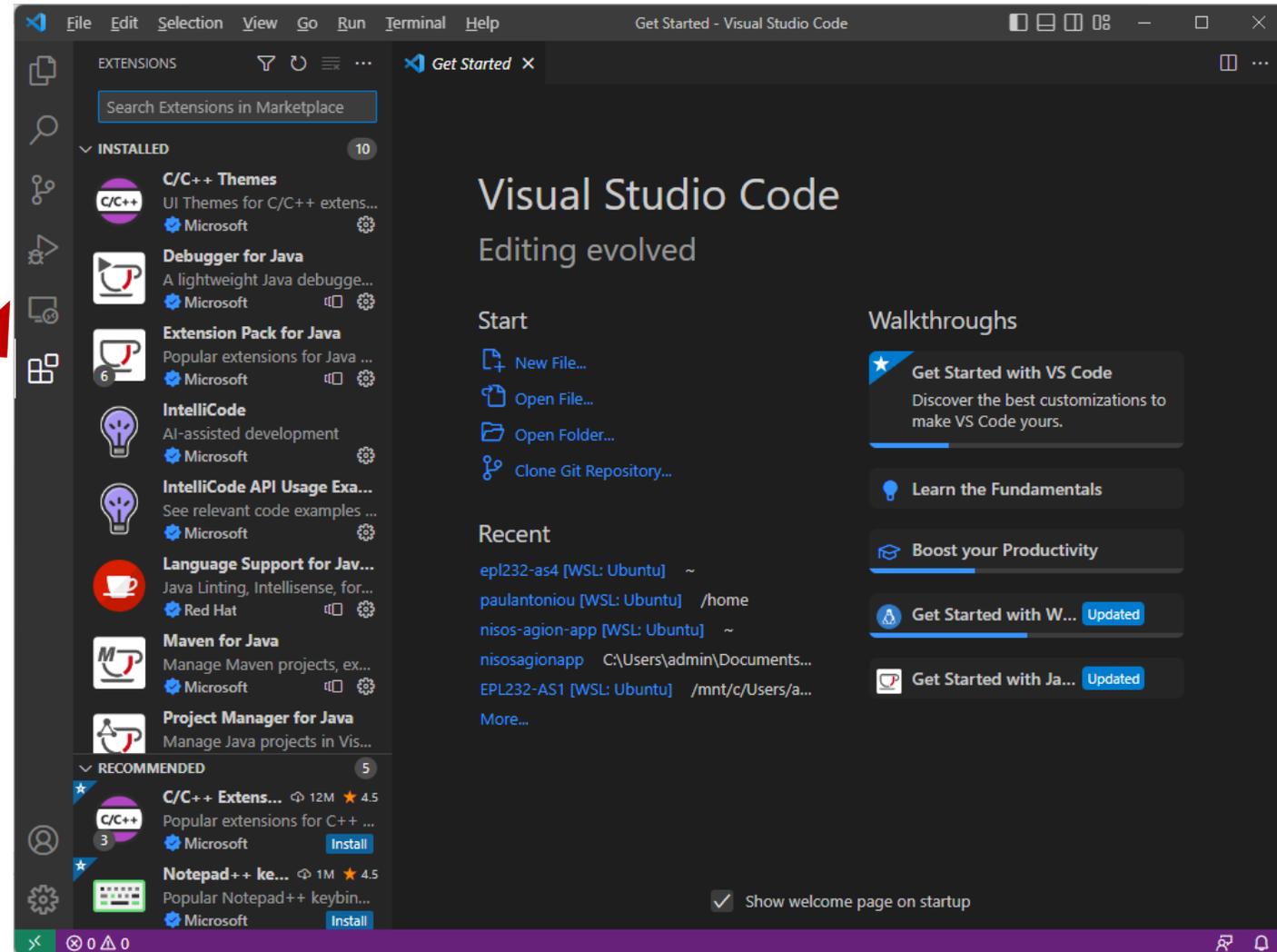
- Open **Extensions** view



Install Web development extensions



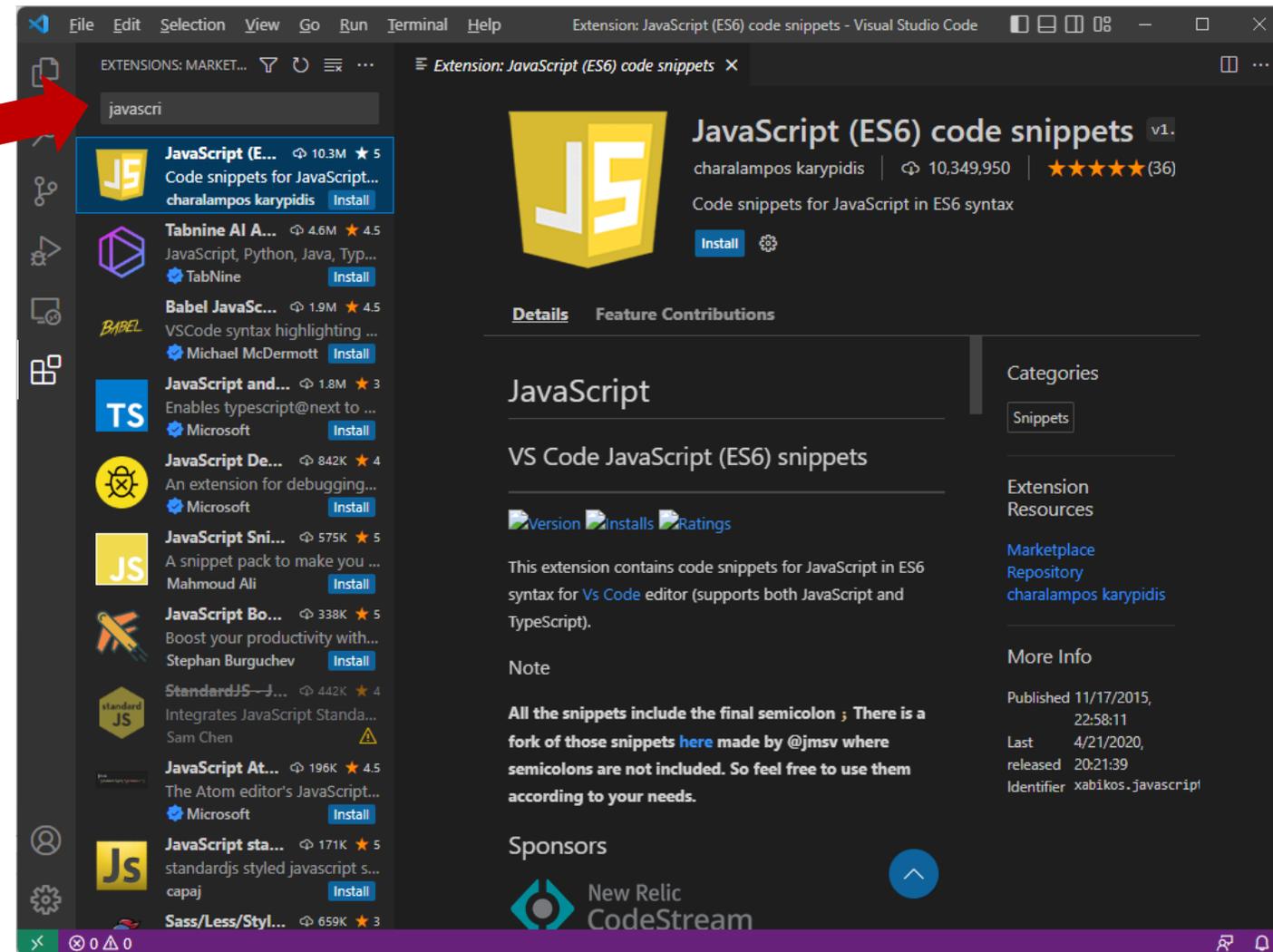
- Open **Extensions** view



Install Web development extensions



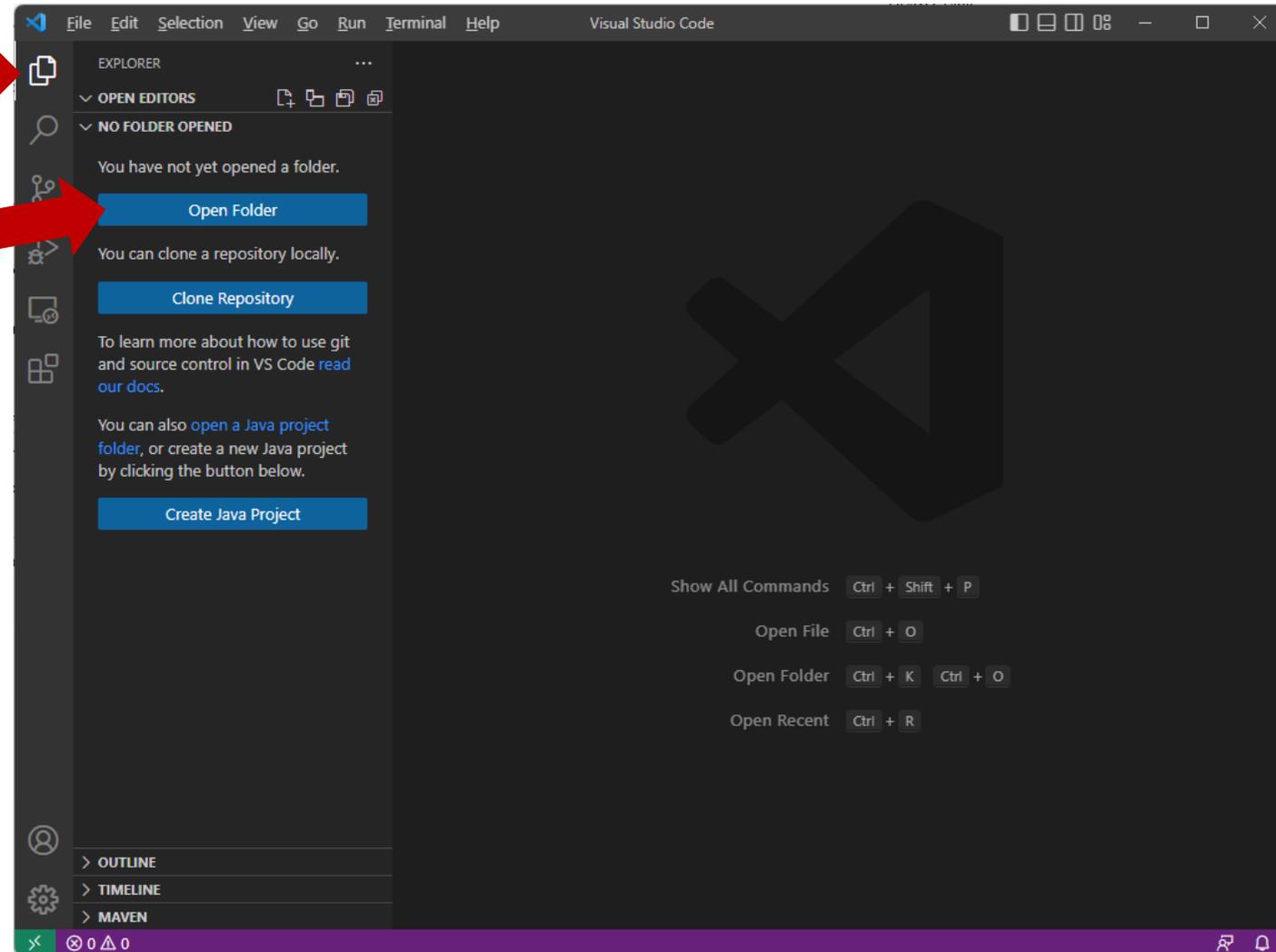
- Type and install:
 - JavaScript (ES6) Code Snippets
 - PHP Intelephense
 - ESLint
 - CSS Peek
 - Auto Close Tag
 - Prettier – Code formatter
 - Path intellisense
 - Remote Development
 - Live Preview



Importing or Creating a New Web Project



- Click on the first (upper) icon on the left menu bar to access the file explorer
- Click **Open Folder** button and select your project's directory, e.g.
C:\xampp\htdocs\dashboard
- In case you are creating a new project, first you need to create a new folder e.g.
C:\xampp\htdocs\mywebsite
and then select (Open) that as your project directory.



Loading a Web Project

- The explorer window will now show the project's directory tree, giving you quick access to files and directories on your project.
- You can view and edit the source code of a file by clicking on it



Live Preview,
see next slide

```
1 <!doctype html>
2 <html lang="en">
3   <head>
4     <meta charset="utf-8">
5     <!-- Always force latest IE rendering engine or request Chrome Frame -->
6     <meta content="IE=edge,chrome=1" http-equiv="X-UA-Compatible">
7     <meta name="viewport" content="width=device-width, initial-scale=1.0" />
8
9     <!-- Use title if it's in the page YAML frontmatter -->
10    <title>Welcome to XAMPP</title>
11
12    <meta name="description" content="XAMPP is an easy to install Apache dist
13    <meta name="keywords" content="xampp, apache, php, perl, mariadb, open so
14
15    <link href="/dashboard/stylesheets/normalize.css" rel="stylesheet" type="
16    <link href="//cdnjs.cloudflare.com/ajax/libs/font-awesome/3.1.0/css/font-
17
18    <script src="/dashboard/javascripts/modernizr.js" type="text/javascript">
19
20
21    <link href="/dashboard/images/favicon.png" rel="icon" type="image/png" />
22
23
24  </head>
25
26  <body class="index">
27    <div id="fb-root"></div>
28    <script>(function(d, s, id) {
29      var js, fjs = d.getElementsByTagName(s)[0];
30      if (d.getElementById(id)) return;
31      js = d.createElement(s); js.id = id;
32      js.src = "//connect.facebook.net/en_US/all.js#xfbml=1&appId=27738539576
33      fjs.parentNode.insertBefore(js, fjs);
```

Figure: VSCode → Open folder → C:\xampp\htdocs\dashboard
Double click on index.html

Preview Web Project using Live Preview



The screenshot displays the Visual Studio Code interface with the 'Live Preview' extension. The Explorer sidebar on the left shows the project structure, including folders like 'fr', 'hu', 'images', 'it', 'jascripts', 'jp', 'pl', 'pt_br', 'ro', 'ru', 'stylesheets', 'tr', 'ur', 'zh_cn', 'zh_tw', and files like '404.html', 'faq.html', 'favicon.ico', 'howto_platform_links.html', 'howto_shared_links.html', and 'howto.html'. The Editor view shows the 'index.html' file with the following code:

```
1 <!doctype html>
2 <html lang="en">
3 <head>
4 <meta charset="utf-8">
5 <!-- Always force latest IE rendering engine or...
6 <meta content="IE=edge,chrome=1" http-equiv="X-U...
7 <meta name="viewport" content="width=device-widt...
8
9 <!-- Use title if it's in the page YAML frontmat...
10 <title>Welcome to XAMPP</title>
11
12 <meta name="description" content="XAMPP is an ea...
13 <meta name="keywords" content="xampp, apache, ph...
14
15 <link href="/dashboard/stylesheets/normalize.css...
16 <link href="//cdnjs.cloudflare.com/ajax/libs/fon...
17
18 <script src="/dashboard/jascripts/modernizr.js...
19
20
21 <link href="/dashboard/images/favicon.png" rel="...
22
23
24 </head>
25
26 <body class="index">
27 <div id="fb-root"></div>
28 <script>(function(d, s, id) {
29   var js, fjs = d.getElementsByTagName(s)[0];
30   if (d.getElementById(id)) return;
31   js = d.createElement(s); js.id = id;
32   js.src = "//connect.facebook.net/en_US/all.js#...
33   fjs.parentNode.insertBefore(js, fjs);
```

The Live Preview window shows the rendered page with the following content:

- [Apache Friends](#)
- [Menu](#)
- [FAQs](#)
- [HOW-TO Guides](#)
- [PHPInfo](#)
- [phpMyAdmin](#)

XAMPP Apache + MariaDB + PHP + Perl

Welcome to XAMPP for Windows 8.2.4

You have successfully installed XAMPP on this system! Now you can start using Apache, MariaDB, PHP and other components. You can find more info in the [FAQs](#) section or check the [HOW-TO Guides](#) for getting started with PHP applications.

XAMPP is meant only for development purposes. It has certain configuration settings that make it easy to develop locally but that are insecure if you want to have your installation accessible to others.

Start the XAMPP Control Panel to check the server status.

Community

XAMPP has been around for more than 10 years – there is a huge community behind it. You can get involved by joining our [Forums](#), liking us on [Facebook](#),

If you have the “Live Preview” extension installed, you can preview your HTML files (VSCode hosts a local server)

Appropriate for front-end development (HTML, CSS, JavaScript)