INTRODUCTION TO WEB TECHNOLOGIES

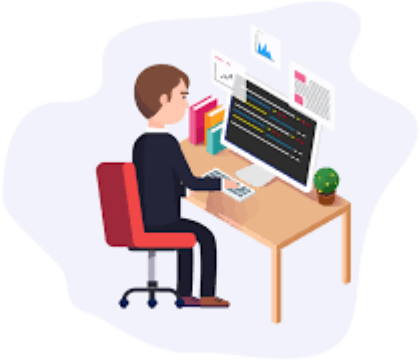
What happens when you use www.aydin.edu.tr in your browser**?**

How do we see the page above?

www (Web): The World Wide Web, abbreviated as WWW and commonly known as the Web, is *a system of interlinked hypertext documents accessed via the Internet*. With a web browser, one can view web pages that may contain text, images, videos, and other multimedia and navigate between them via hyperlinks. Web is a way of accessing information over the medium of the Internet. Web is an information-sharing model that is built on top of the Internet.

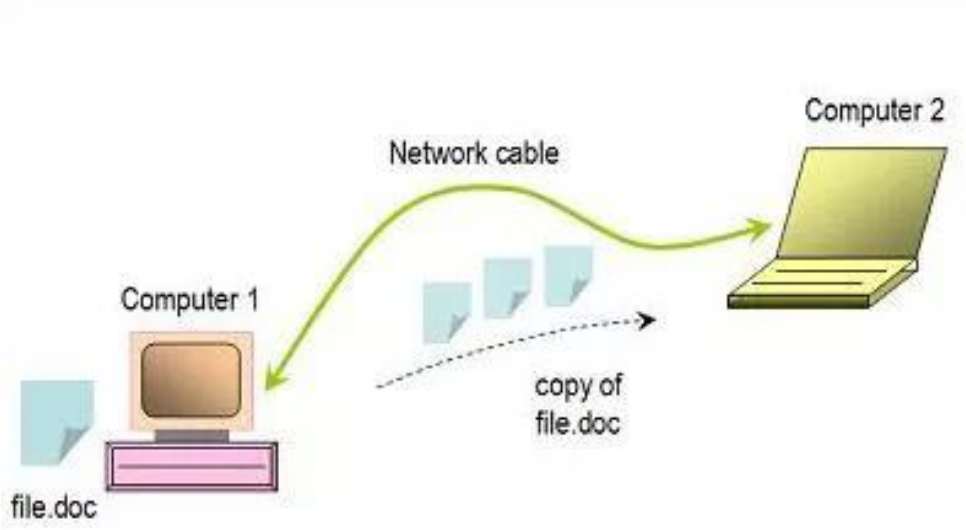
From Standalone Computer to Internet

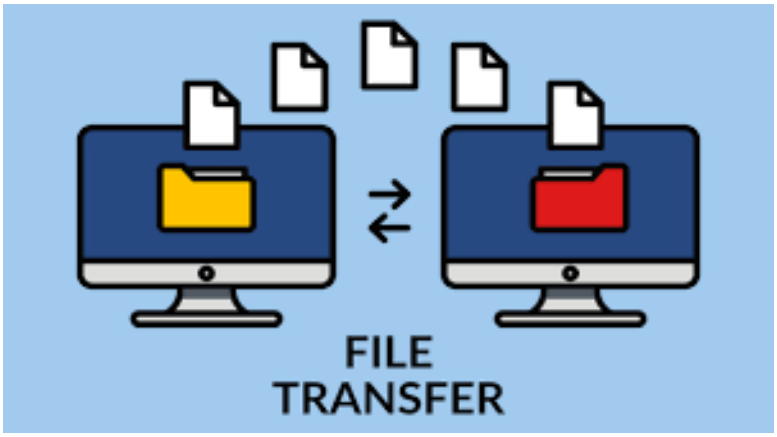
Standalone Computer



Developed an Application. So what? Who is going to use it. Then share it.

A Simple Network with two Computers





Personal Area Network (PAN)

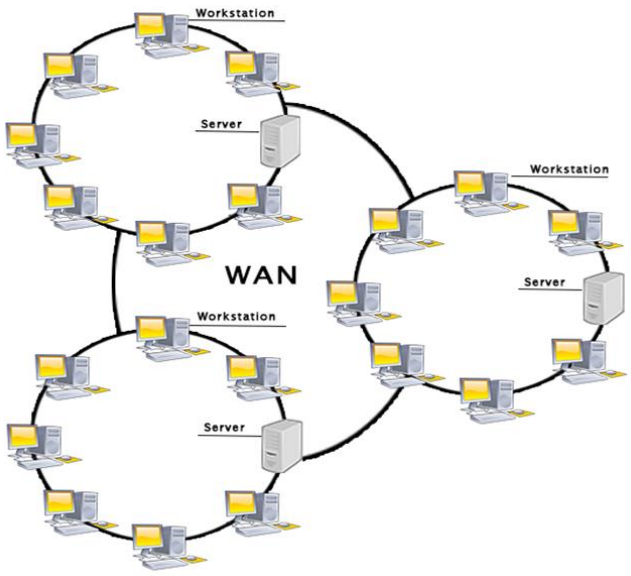
- A network arranged within an individual person, typically within a range of 10 meters.
- Used for connecting the computer devices of personal use.
- **Thomas Zimmerman** was the first research scientist to bring the idea of the Personal Area Network.
- Personal computer devices that are used to develop the personal area network are the laptop, mobile phones, media player and play stations.

Local Area Network (LAN)

- A group of computers connected to each other in a small area such as building, office.
- LAN is used for connecting two or more personal computers through a communication medium such as twisted pair, coaxial cable, etc.
- It is less costly as it is built with inexpensive hardware such as hubs, network adapters, and ethernet cables.
- The data is transferred at an extremely faster rate in Local Area Network.
- Local Area Network provides higher security.

Wide Area Network (WAN)

- A network that extends over a large geographical area such as **states** or **countries**.
- Quite bigger network than the LAN.
- Is not limited to a single location, it spans over a large geographical area through a telephone line, fibre optic cable or satellite links.
- **The internet** is one of the biggest WAN in the world.



Internet

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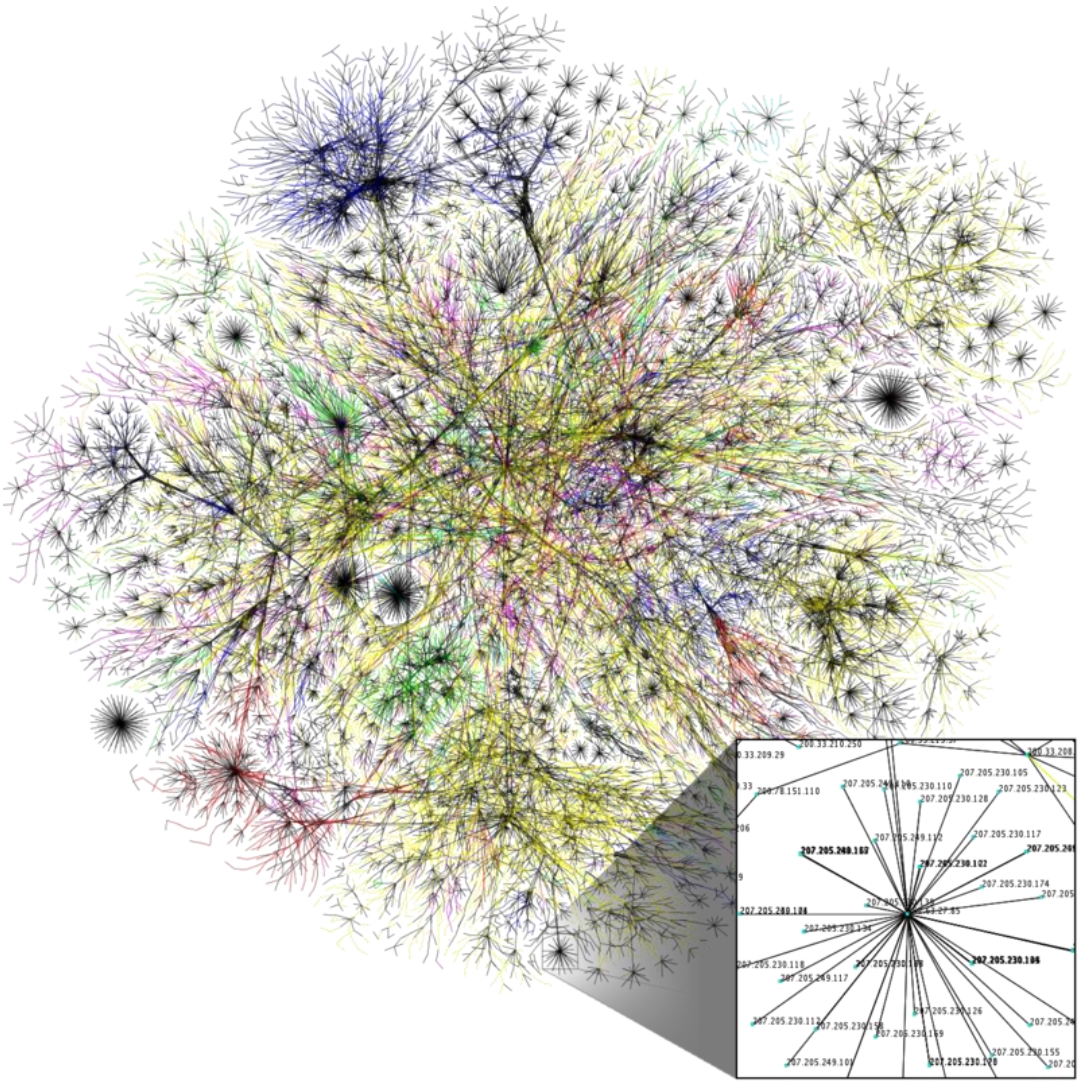
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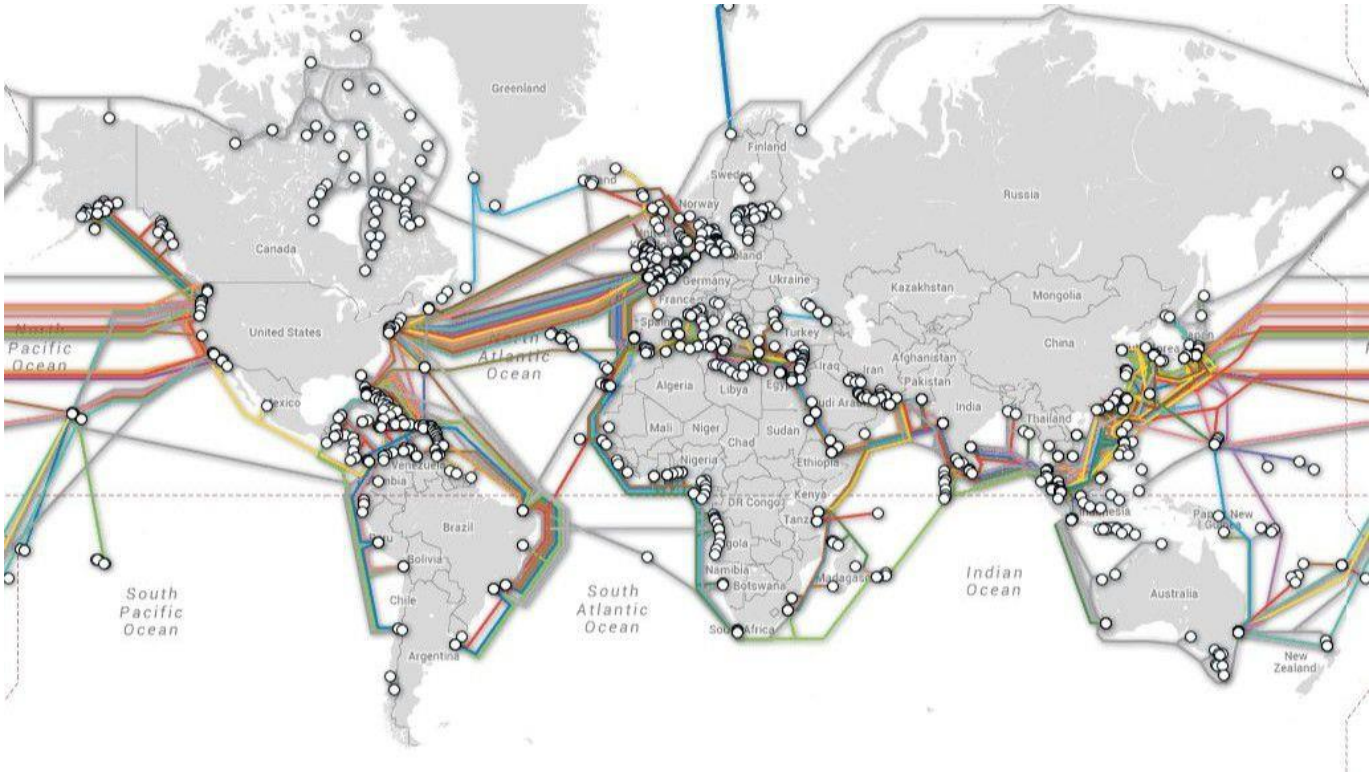
Internet is a short form of the technical term **internetwork**, the result of interconnecting computer networks with special **gateways** or **routers**. The Internet is also often referred to as the **Net**. The Internet is a massive network of networks, a networking infrastructure. It is a **network of networks** that consists of;

- private,
- public,
- academic,
- business,
- government

networks of ***local to global*** scope, linked by a broad array of;

- electronic,
- wireless,
- optical

networking technologies.

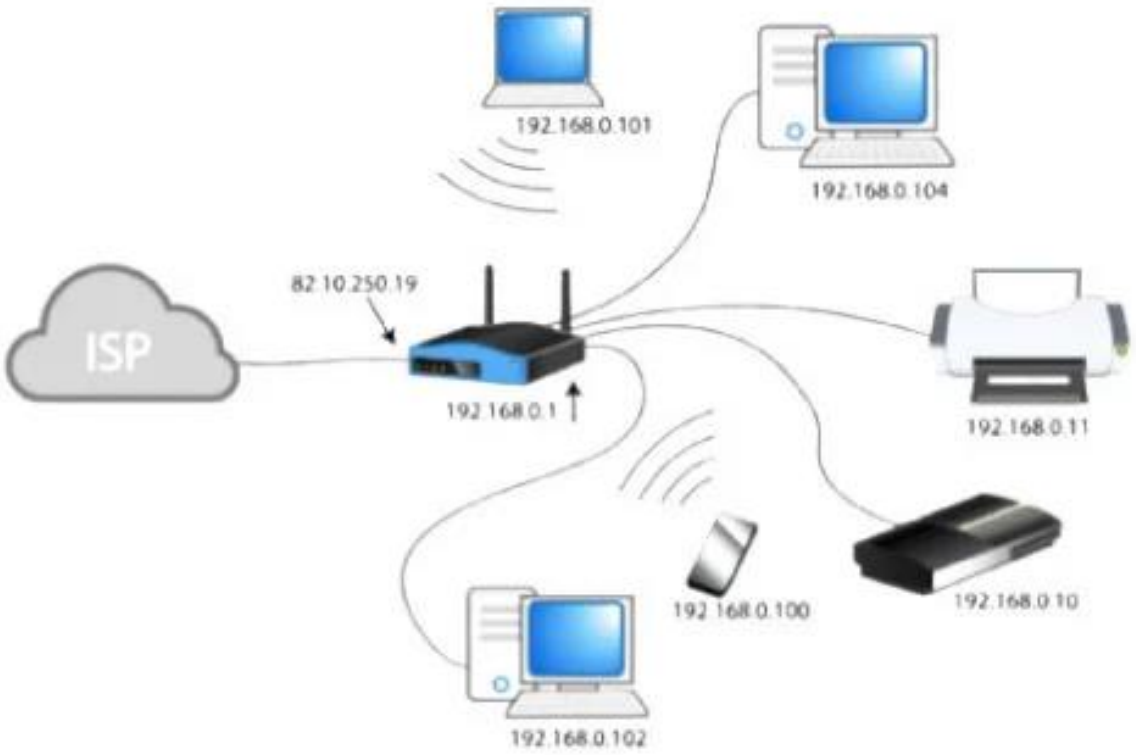


Cables in Ocean

It connects millions of computers together globally, forming a network in which any computer can communicate with any other computer as long as they are both connected to the Internet. Information that travels over the Internet does so via a variety of rules known as **protocols**.

The Internet carries a vast range of information resources and services, such as the;

- interlinked hypertext documents and applications of the World Wide Web (WWW),
- electronic mail,
- telephony,
- file sharing.



The Internet is a globally distributed network comprising many voluntarily interconnected autonomous networks. It operates without a central governing body. However, to maintain interoperability, all technical and policy aspects of the underlying core infrastructure and the principal name spaces are administered by the ***Internet Corporation for Assigned Names and Numbers (ICANN).***

The history of the Internet starts in the 1950s and 1960s with the development of computers. This began with point-to-point communication between mainframe computers and terminals, expanded to point-to-point connections between computers.

Since the mid-1990s the Internet has had a drastic impact on culture and commerce, including the rise of near instant communication by ***electronic mail, instant messaging, Voice over Internet Protocol (VoIP) "phone calls", two-way interactive video calls, and the World Wide Web*** with its *discussion forums, blogs, social networking, and online shopping sites*.

How do the Computers communicate?

(Rules for Communicating between Computers → Protocol)

Protocol, in computer science, a set of rules or procedures for transmitting data between electronic devices, such as computers.

In order for computers to exchange information, there must be a preexisting agreement as to how the information will be structured and how each side will send and receive it. Without a protocol, a transmitting computer, for example, could be sending its data in 8-bit packets while the receiving computer might expect the data in 16-bit packets.

Protocols are established by international or industrywide organizations. Perhaps the most important computer protocol is OSI (Open Systems Interconnection), a set of guidelines for implementing networking communications between computers.

Among the most important sets of Internet protocols are:

- TCP/IP (Transmission Control Protocol/Internet Protocol),
- HTTP (HyperText Transmission Protocol)
- SMTP (Simple Mail Transfer Protocol)
- FTP
- …

World Wide Web (WWW)

WWW is a system of interlinked **hypertext** documents accessed via the Internet. The World Wide Web, or simply Web, is a way of accessing information over the medium of the Internet. It is an information-sharing model that is built on top of the Internet. The Web uses the ***HTTP protocol***, only one of the languages spoken over the Internet, to transmit data. **Web services**, which use HTTP to allow applications to communicate in order to exchange business logic, use the Web to share information. The Web also utilizes browsers, such as Chrome or Firefox, to access Web documents called Web pages that are linked to each other via hyperlinks. Web documents also contain graphics, sounds, text and video.

The Web is one of the services that runs on the Internet. It is a collection of textual documents and other resources, linked by hyperlinks and URLs, transmitted by web browsers and web servers. The Web is just one of the ways that information can be disseminated over the Internet, so the Web is just a portion of the Internet. In short, the Web can be thought of as an application "running" on the Internet.

What is Hypertext?

Hypertext is a text document which has links in it. Hypertext provides the links between different documents and different document types. In a hypertext document, links from one place in the document to another are included with the text. By selecting a link, you are able to jump immediately to another part of the document or even to a different document. In the WWW, links can go not only from one document to another, but from one computer to another

Standarts For HTML

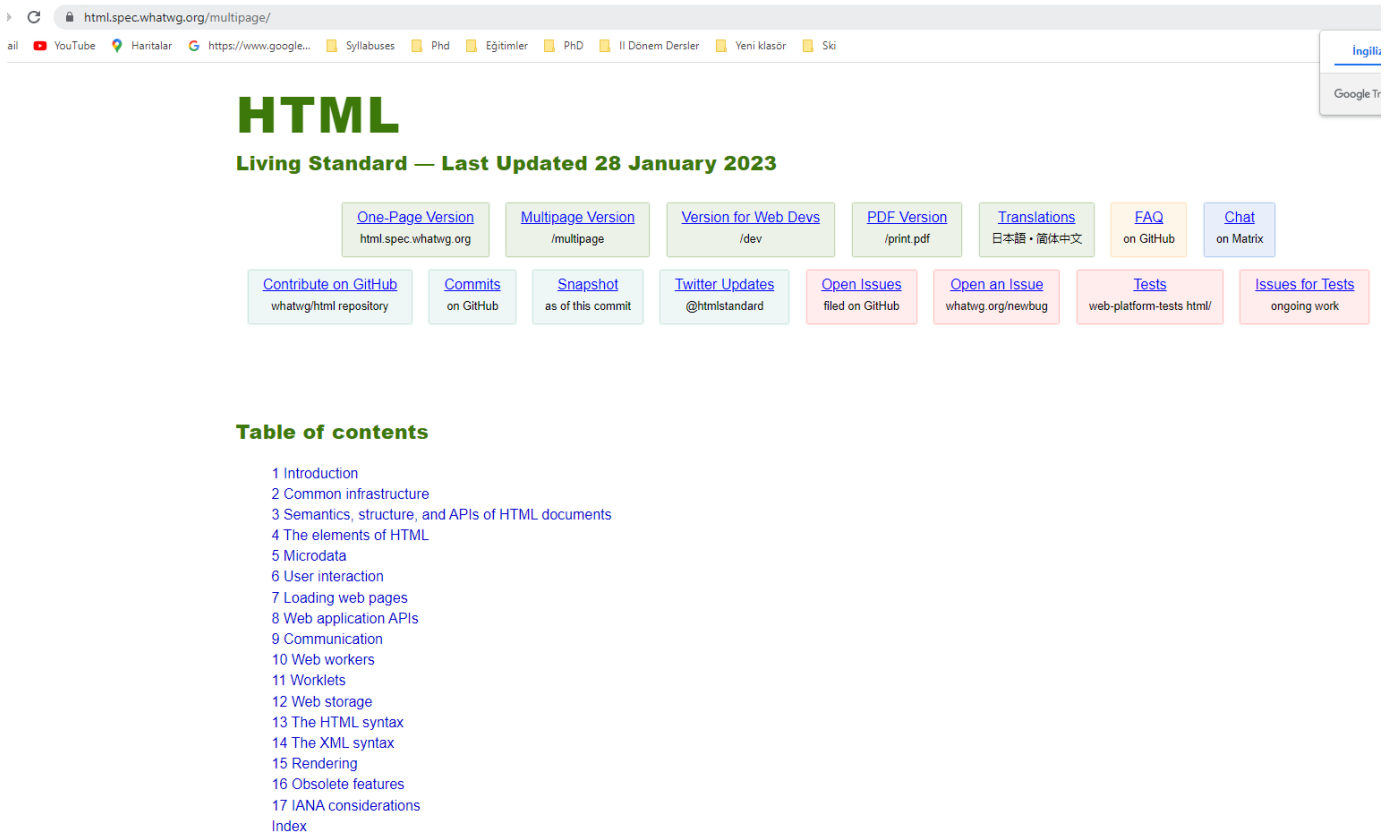
The **World Wide Web Consortium** (W3C) and The **Web Hypertext Application Technology Working Group** (**WHATWG**) are the communities that played important role in developing standards for www.

HTML History

Since the early days of the World Wide Web, there have been many versions of HTML:

Year	Version
1989	Tim Berners-Lee invented www
1991	Tim Berners-Lee invented HTML
1993	Dave Raggett drafted HTML+
1995	HTML Working Group defined HTML 2.0
1997	W3C Recommendation: HTML 3.2
1999	W3C Recommendation: HTML 4.01
2000	W3C Recommendation: XHTML 1.0
2008	WHATWG HTML5 First Public Draft
2012	WHATWG HTML5 Living Standard
2014	W3C Recommendation: HTML5
2016	W3C Candidate Recommendation: HTML 5.1
2017	W3C Recommendation: HTML5.1 2nd Edition
2017	W3C Recommendation: HTML5.2

On 28 May 2019, the W3C announced that WHATWG would be the sole publisher of the HTML and DOM standards. The W3C and WHATWG had been publishing competing standards since 2012. While the W3C standard was identical to the WHATWG in 2007 the standards have since progressively diverged due to different design decisions. The WHATWG "Living Standard" had been the de facto web standard for some time. html.spec.whatwg.org/multipage/



Web Page

A web page is a document or information resource that is suitable for the **World Wide Web** and can be accessed through a web browser and displayed on a monitor or mobile device. This information is usually in HTML format, and may provide navigation to other web pages via hypertext links. Web pages frequently contains other resources such as **style sheets**, **scripts** and **images** into their final presentation. Web pages may be retrieved from a *local computer* or from a *remote web server*. The web server may restrict access only to a private network, e.g. a corporate intranet, or it may publish pages on the World Wide Web. Web pages are requested and served from web servers using Hypertext Transfer Protocol (HTTP). Web pages may consist of files of static text and other content stored within the web server's file system (static web pages), or may be constructed by server-side software when they are requested (dynamic web pages). Client-side scripting can make web pages more responsive to user input once on the client browser.

Web Site

A website or simply site, is a collection of related web pages containing images, videos or other digital assets. A website is hosted on at least one web server, accessible via a network such as the Internet or a private local area network through an Internet address known as a **Uniform Resource Locator**. All publicly accessible websites collectively constitute the World Wide Web. Web sites can be static or dynamic.

Domain Names, DNS, and URLs

- IP addresses are not convenient for users to remember easily. So an IP address can be represented by a natural language convention called a **domain name**.
    - **Domain name system (DNS)** translates domain names into IP addresses. DNS is the "***phone book***" for the Internet, it maps between host names and IP addresses.
- **URL** is an acronym for **Uniform Resource Locator** and is a reference (an address) to a resource on the Internet. A URL has two main components:
    - Protocol identifier: For the URL http://example.com , the protocol identifier is **http**.
    - Resource name: For the URL http://example.com , the resource name is **example.com**.

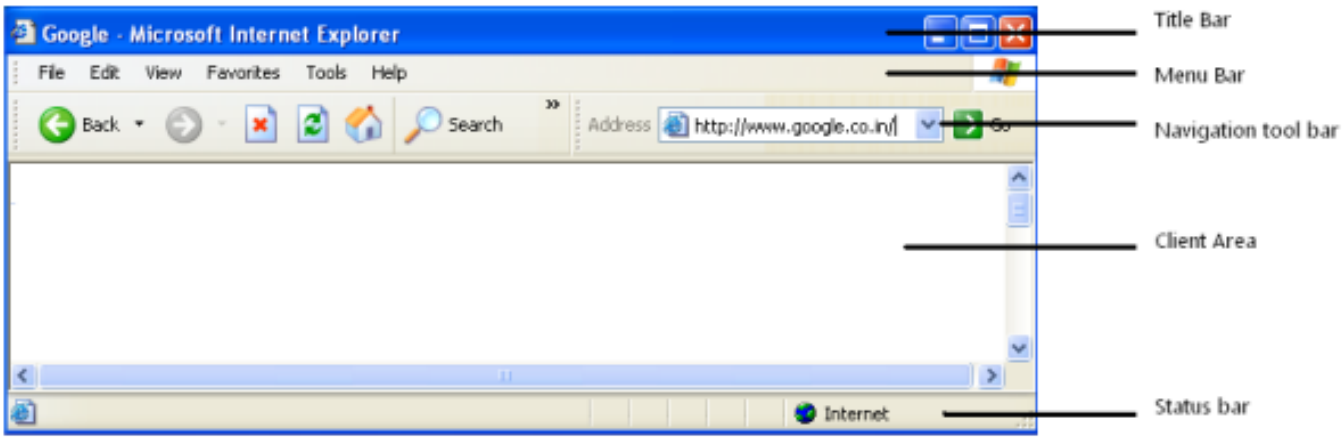
HTTP

- HTTP is based on the request-response communication model:
    - Client sends a request
    - Server sends a response
- HTTP is a stateless protocol: where the protocol does not require the server to remember anything about the client between requests.
- Normally implemented over a TCP connection (80 is standard port number for HTTP)
- The following is the typical browser-server interaction using HTTP:

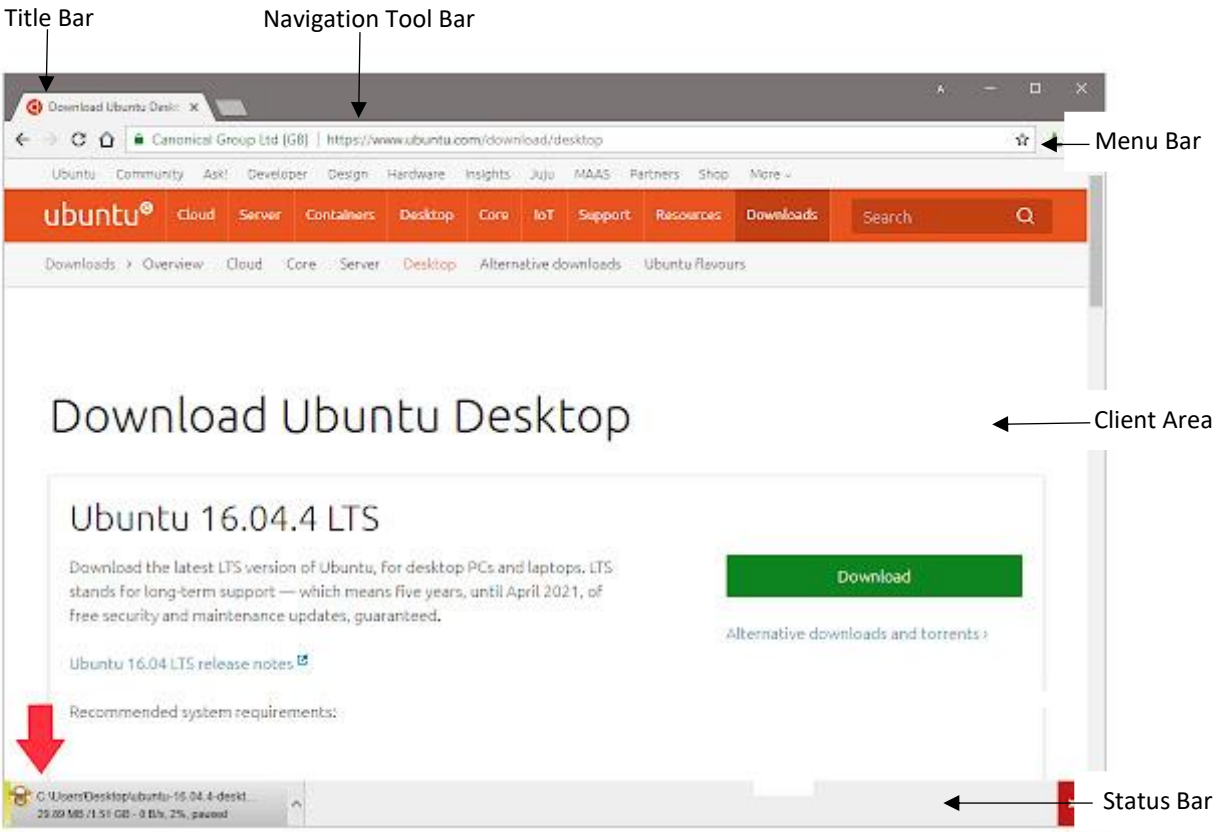
1. User enters Web address in browser
2. Browser uses DNS to locate IP address
3. Browser opens TCP connection to server
4. Browser sends HTTP request over connection
5. Server sends HTTP response to browser over connection
6. Browser displays body of response in the client area of the browser window.

Web Browsers

Internet Explorer



Chrome



Status Bar: You will find the status bar at the very bottom of your browser window. It basically tells you what you are doing at the moment. Mainly, it shows you load speed and the URL address of whatever your mouse is hovering over.

Title Bar: You will find this bar at the absolute top of your browser and in will be the colour blue for the major browsers. The purpose of the Title bar is to display the title of the web page that you are currently viewing.

Menu Bar: The menu bar contains a set of dropdown menus

Navigational Tool: A bar contains standard push button controls that allow the user to return to a previously viewed page, to reverse and refresh the page, to display the home page and to print the page etc.

Toolbar Icons: You will find the Toolbar directly under the Title Bar. The Toolbar is where you will find the back button, home button and the refresh button etc.

Client Area: It is a display window which is the space in which you view the website.

Scroll Bars: The Scroll bars, usually located to the right of the Display Window, allows you to "scroll" (move down or up the web page) so you can view information that is below or above what is currently in the Display Window.

Static Website

A static website is one that has web pages stored on the server in the format that is sent to a client web browser. It is primarily coded in Hypertext Markup Language, HTML.

Simple forms or marketing examples of websites, such as classic website, a five-page website or a brochure website are often static websites, because they present pre-defined, static information to the user. This may include information about a company and its products and services via text, photos, animations, audio/video and interactive menus and navigation.

This type of website usually displays the same information to all visitors. Similar to handing out a printed brochure to customers or clients, a static website will generally provide consistent, standard information for an extended period of time. Although the website owner may make updates periodically, it is a manual process to edit the text, photos and other content and may require basic website design skills and software.

In summary, visitors are not able to control what information they receive via a static website, and must instead settle for whatever content the website owner has decided to offer at that time.

Dynamic Website

A dynamic website is one that changes or customizes itself frequently and automatically, based on certain criteria.

Dynamic websites can have two types of dynamic activity: Code and Content. Dynamic code is invisible or behind the scenes and dynamic content is visible or fully displayed.

- The first type is a web page with dynamic code. The code is constructed dynamically on the fly using active programming language instead of plain, static HTML.
- The second type is a website with dynamic content displayed in plain view. Variable content is displayed dynamically on the fly based on certain criteria, usually by retrieving content stored in a database

Web Servers

A **web server** is a;

- computer software and
- underlying hardware

that ***accepts*** requests via

- **HTTP** (the network protocol created to distribute web content) or
- its secure variant **HTTPS**,

and ***responds*** to this request depending the type of the request.

A user agent, commonly a **web browser** or **web crawler**;

- initiates communication by making a request for a web page or other resource using HTTP,
- then, the server responds with the content of that resource or an error message.

A web server can also accept and **store resources** sent from the user agent if configured to do so.

Web Technology

Web Technology refers to the various **tools and techniques** that are utilized in the process of communication between different types of devices over the internet.

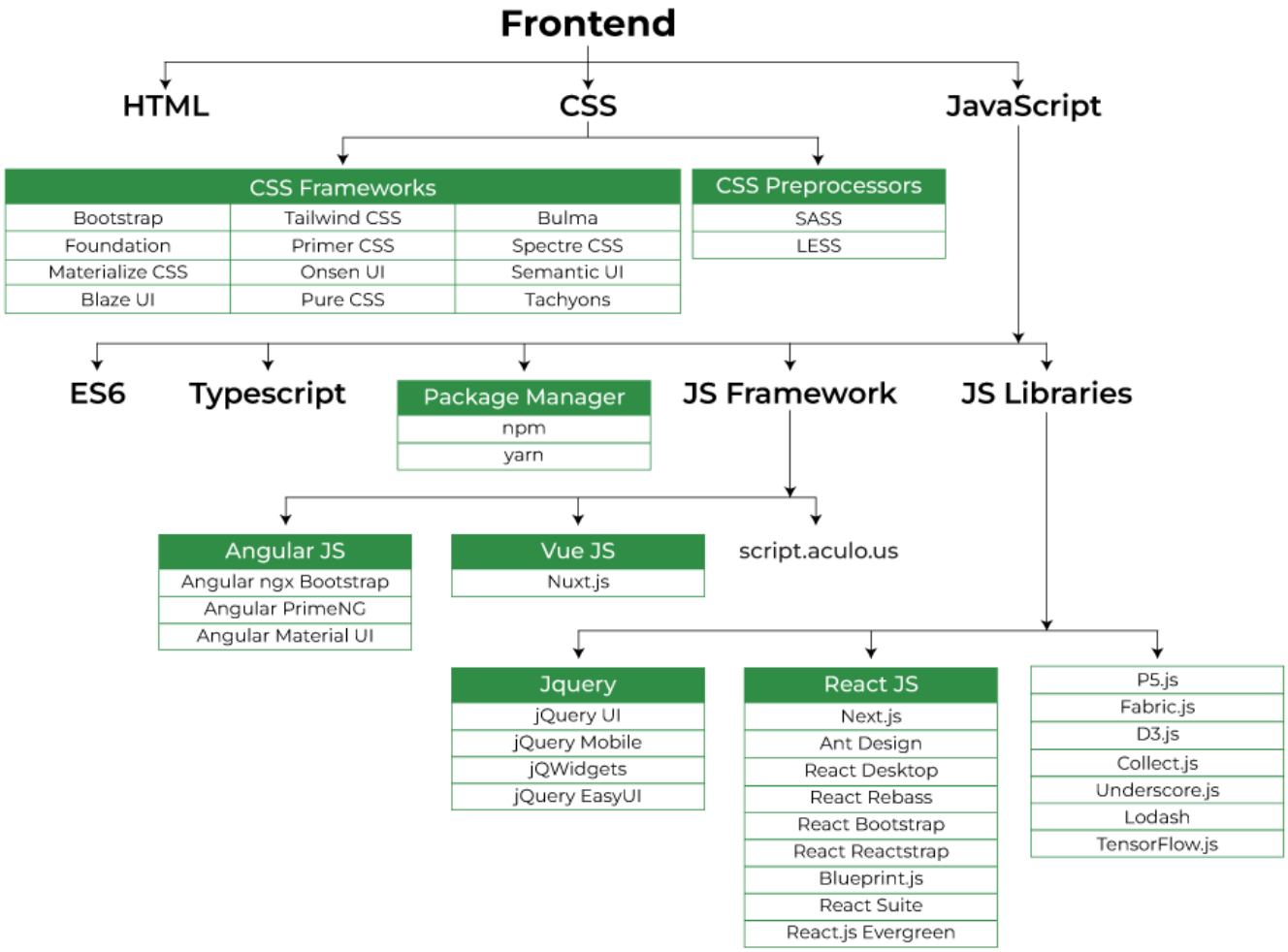
Web Development

Web development refers to the **building, creating**, and **maintaining** of websites. It includes aspects such as *web design*, *web publishing*, *web programming*, and *database management.*

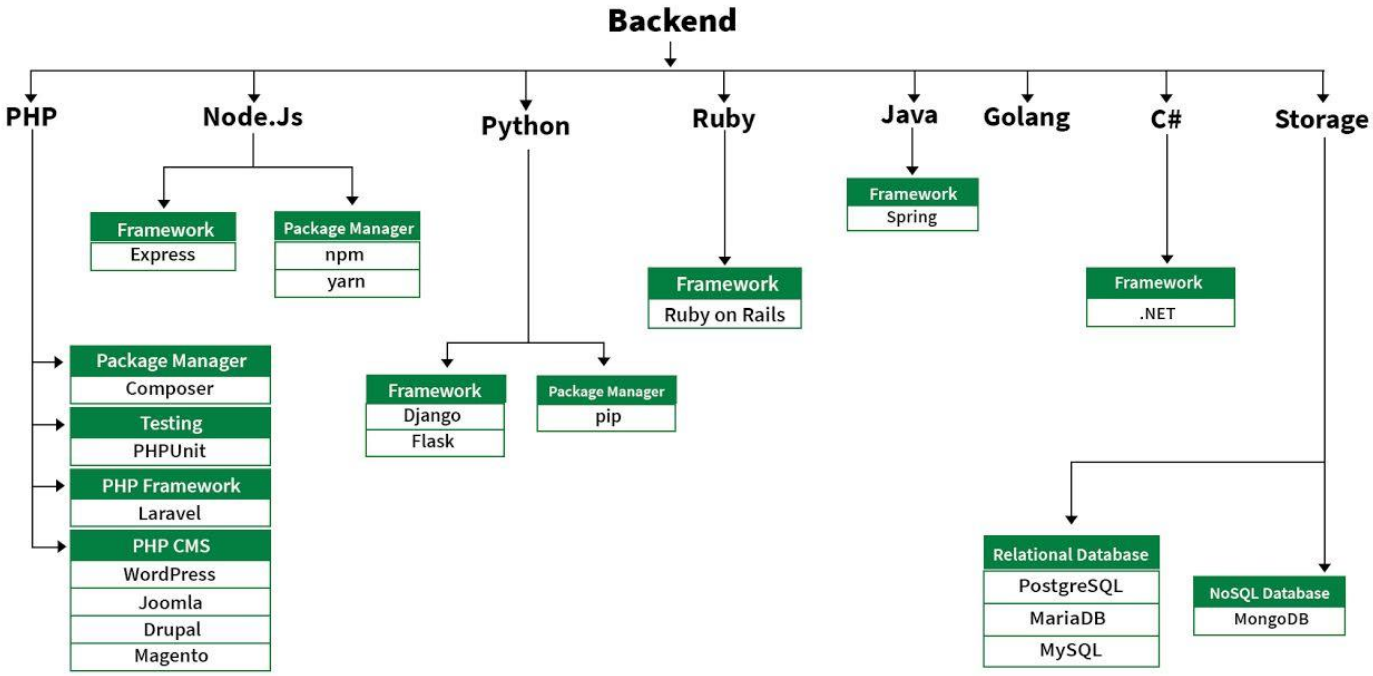
Web Application: It is the creation of an application that works over the internet i.e. websites.

Web Development can be classified into two ways:

- **Frontend Development:** The part of a website that the user interacts directly is termed as front end. It is also referred to as the 'client side' of the application.



- **Backend Development:** Backend is the server side of a website. It is the part of the website that users cannot see and interact. It is the portion of software that does not come in direct contact with the users. It is used to store and arrange data.



Frontend Languages: The front end portion is built by using some languages which are discussed below:

- **HTML:** HTML stands for Hypertext Markup Language. It is used to design the front-end portion of web pages using a markup language. HTML is the combination of Hypertext and Markup language. Hypertext defines the link between the web pages. The markup language is used to define the text documentation within the tag which defines the structure of web pages.
- **CSS:** Cascading Style Sheets fondly referred to as CSS is a simply designed language intended to simplify the process of making web pages presentable. CSS allows you to apply styles to web pages. More importantly, CSS enables you to do this independent of the HTML that makes up each web page.
- **JavaScript:** JavaScript is a famous scripting language used to create magic on the sites to make the site interactive for the user. It is used to enhancing the functionality of a website to running cool games and web-based software.
- **AJAX:** Ajax is an acronym for Asynchronous Javascript and XML. It is used to communicate with the server without refreshing the web page and thus increasing the user experience and better performance.

There are many other languages through which one can do front-end development depending upon the framework for example *Flutter* user *Dart*, *React* uses *JavaScript* and *Django* uses *Python*, and much more.

Backend Languages: The back end portion is built by using some languages which are discussed below:

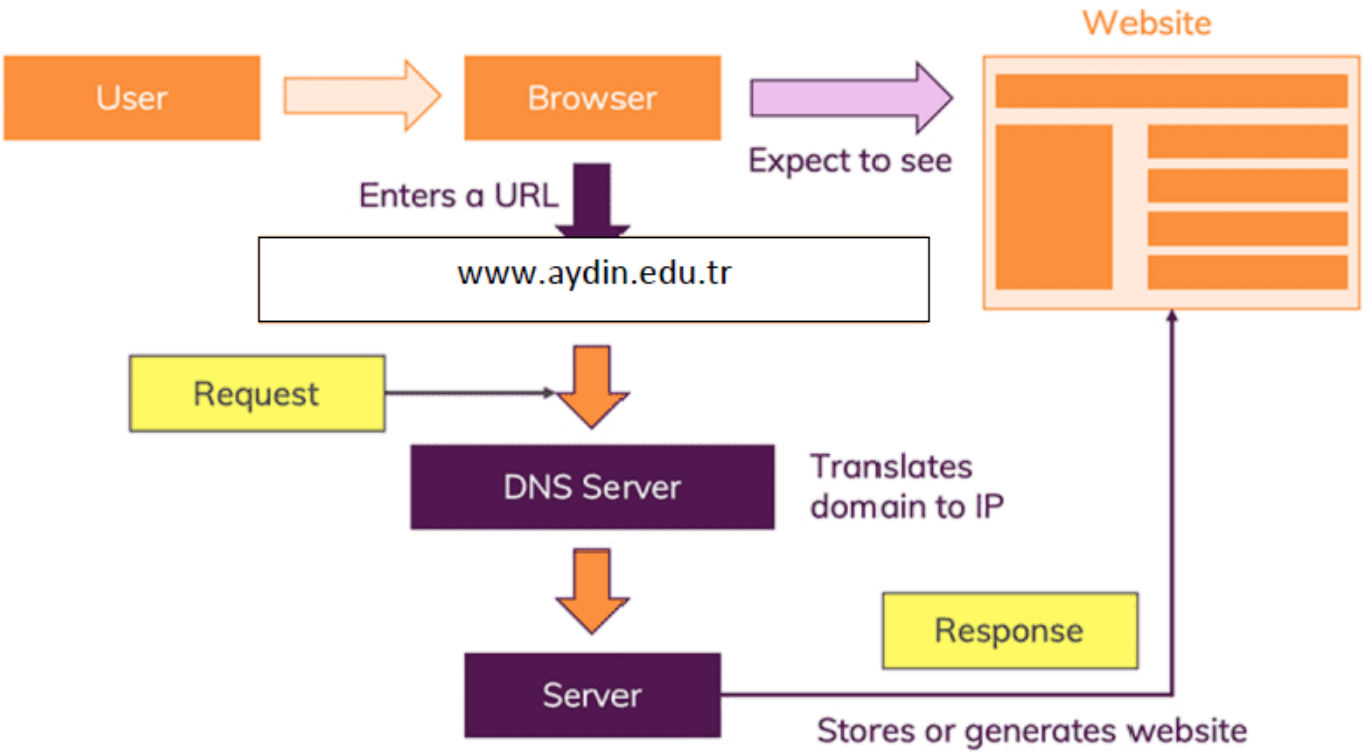
- **PHP:** PHP is a server-side scripting language designed specifically for web development. Since PHP code executed on the server-side, so it is called a server-side scripting language.
- **Node.js:** Node.js is an open-source and cross-platform runtime environment for executing JavaScript code outside a browser. You need to remember that NodeJS is not a framework, and it's not a programming language. Most people are confused and understand it's a framework or a programming language. We often use Node.js for building back-end services like APIs like Web App or Mobile App. It's used in production by large companies such as Paypal, Uber, Netflix, Wallmart, and so on.
- **Python:** Python is a programming language that lets you work quickly and integrate systems more efficiently.
- **Ruby:** Ruby is a dynamic, reflective, object-oriented, general-purpose programming language. Ruby is a pure Object-Oriented language developed by Yukihiro Matsumoto. Everything in Ruby is an object except the blocks but there are replacements too for it i.e procs and lambda. The objective of Ruby's development was to make it act as a sensible buffer between human programmers and the underlying computing machinery.
- **Java:** Java is one of the most popular and widely used programming languages and platforms. It is highly scalable. Java components are easily available.
- **JavaScript:** JavaScript can be used as both (front end and back end) programming.
- **Golang:** Golang is a procedural and statically typed programming language having the syntax similar to C programming language. Sometimes it is termed as Go Programming Language.
- **C#:** C# is a general-purpose, modern and object-oriented programming language pronounced as "C sharp".
- **DBMS:** The software which is used to manage database is called Database Management System (DBMS).

How Websites Work

Let's start with the most obvious way of using the internet: You visit a website like: aydin.edu.tr

The moment you enter this address in your browser and you hit ENTER, a lot of different things happen:

1. The URL gets resolved
2. A Request is sent to the server of the website
3. Server send a response
4. The response of the server is parsed
5. The page is rendered and displayed



Actually, every single step could be split up in multiple other steps, but for a good overview of how it all works, that's something we can ignore here. Let's have a look at all four steps.

Step 1 - URL Gets Resolved

The website code is obviously not stored on your machine and hence needs to be fetched from another computer where it is stored. This "other computer" is called a "server". Because it serves some purpose, in our case, it serves the website.

You enter "aydin.edu.tr" (that is called "a domain") but actually, the server which hosts the source code of a website, is identified via IP (= Internet Protocol) addresses. The browser sends a "request" (see step 2) to the server with the IP address you entered.

An IP address typically looks like this: 172.56.180.5 (though there also is a more "modern" form called IPv6 - but let's ignore that for now). You can learn more about IP addresses in other courses.

How is the domain " aydin.edu.tr" translated to its IP address?

There's a special type of server out there in the internet - not just one but many servers of that type. A so called "name server" or "DNS server" (where DNS = "Domain Name System").

The job of these DNS servers is to translate domains to IP addresses. You can imagine those servers as huge dictionaries that store translation tables: Domain => IP address.

When you enter " aydin.edu.tr", the browser therefore first fetches the IP address from such a DNS server.

Once the IP address is known, we advanced to step 2.

Step 2 - Request Is Sent

With the IP address resolved, the browser goes ahead and makes a request to the server with that IP address.

The browser bundles up a bunch of information (What's the exact URL? Which kind of request should be made? Should metadata be attached) and sends that data package to the IP address.

The data is sent via the "HyperText Transfer Protocol" (known as "HTTP") - a standardized protocol which defines what a request (and response) has to look like, which data may be included (and in which form) and how the request will be submitted.

▼ General

Request URL: https://www.aydin.edu.tr/

Request Method: GET

Status Code: 200

Remote Address: 99.84.92.105:443

Referrer Policy: no-referrer-when-downgrade

▶ Response Headers (11)

▼ Request Headers

:authority: www.aydin.edu.tr

:method: GET

:path: /

:scheme: https

accept: text/html,application/xhtml+xml,applicati
d-exchange;v=b3

accept-encoding: gzip, deflate, br

Step 3 – Server Sends Response

The server then handles the request appropriately and returns a so called "response". Like a request, a response can contain data, metadata etc. When requesting a page like aydin.edu.tr, the response will contain the code that is required to render the page onto the screen.

That's defined by web developers. In the end, a response has to be sent. That response doesn't have to contain "a website". It can contain any data - including files or images.

Some servers are programmed to generate websites dynamically based on the request (e.g. a profile page that contains your personal data), other servers return pre-generated HTML pages (e.g. a news page). Or both is done - for different parts of a webpage. There also is a third alternative: Websites that are pre-generated but that change their appearance and data in the browser.

Step 4 - Response Is Parsed

The browser receives the response sent by the server. This alone, doesn't display anything on the screen though.

Instead, the next step is that the browser parses the response. Just as the server did it with the request. Again, the standardization enforced by HTTP helps of course.

The browser checks the data and metadata that's enclosed in the response. And based on that, it decides what to do.

You might've had cases where a PDF opened in your browser. That happened because the response informed the browser that the data is not a website but a PDF document instead. And the browser tries to pick the best handling mechanism for any data type it detects.

Back to our website scenario.

In that case, the response would contain a specific piece of **metadata**, that tells the browser that the response data is of type text/html.

This allows the browser to then parse the actual data that's attached to the response as HTML code.

HTML is the core "programming language" (technically, it's not a programming language - you can't write any logic with it) of the web. HTML stands for "Hyper Text Markup Language" and it describes the structure of a webpage.

The code looks like this:

```
<h1>Breaking News!</h1>
<p>Websites work because browser understand HTML!</p>
```

<h1> and <p> are so called "HTML tags".

Every HTML tag has some semantic meaning which the browser understands, because HTML is also standardized. Hence there is no guessing about what a <h1> tag means.

The browser knows how to parse HTML and now simply goes through the entire response data (also called "the response body") to render the website.

Step 5 - Page Is Displayed

As mentioned, the browser goes through the HTML data returned by the server and builds a website based on that.

Though it is important to know, that HTML does not include any instructions regarding what the site should look like (i.e. how it should be styled). It really only defines the structure and tells the browser which content is a heading, which content is an image, which content is a paragraph etc. This is especially important for accessibility - screen readers get all the useful information out of the HTML structure.