

CS511 HANDOUTS

LESSON# 1 – INTRODUCTION

LESSON# 2 – ECOSYSTEM OF WEB

A Complicated Ecosystem

As visualized in following figure , web development can also be understood as an ecosystem, one that builds on existing technologies (URL, DNS, and Internet), and contributes new protocols and standards (HTTP, HTML, and JavaScript) that facilitate client-server interactions. As this ecosystem matures, new client and server technologies, frameworks, and platforms continue to be developed in support of the web (PHP, jQuery, Bootstrap, etc.).



The model shows web-development as a three-storey building. Each floor depicts several aspects of web development with an illustration. Ground floor shows Servers, Configuration, Networks, and Protocols which are the basic building blocks. Middle floor shows different languages which are a part of web development, like CSS, HTML, PHP, Javascript, databases, APIs, and

Tools. Top level shows advanced concepts like Design, Search, Integration, Frameworks, and Security.

A Short History of the Internet

- Telephone Network

..Telephone networks provides the basic infrastructure.

- Packet Networks

- ARPANET (Advanced research projects agency networks) (1969)

..This early ARPANET network was funded and controlled by the United States government, and was used exclusively for academic and scientific purposes. The early network started small, with just a handful of connected university campuses and research institutions and companies in 1969.

- X.25 (1974)

..At the same time, alternative networks were created like X.25 in 1974, which allowed (and encouraged) business use.

- USENET (1979)

..USENET, built in 1979, had fewer restrictions still, and as a result grew quickly to 550 connected machines by 1981. It focuses on unrestricted access.

- TCP/IP (1983) ↓↓ INTERNET

..To promote the growth and unification of the disparate networks, a suite of protocols was invented to unify the networks. A protocol is the name given to a formal set of publicly available rules that manage data exchange between two points. Communications protocols allow any two computers to talk to one another, so long as they implement the protocol. By 1981, protocols for the Internet were published and ready for use. New networks built in the United States began to adopt the TCP/IP (Transmission Control Protocol/Internet Protocol) communication model.

Internet vs. (World Wide) Web



“Internet is the hardware part - it is a collection of computer networks connected through either copper wires, fiber-optic cables or wireless connections whereas, the World Wide Web can be termed as the software part – it is a collection of web pages connected through hyperlinks and URLs. In short, the World Wide Web is one of the services provided by the Internet. Other services over the Internet include e-mail, chat and file transfer services. All of these services can be provided to consumers for use by businesses or government or by individuals creating their own networks or platforms.”

...[https://www.diffen.com/difference/Internet_vs_World_Wide_Web]

The Birth of the Web (1990)

The British Tim Berners-Lee (now Sir Tim Berners-Lee), who, along with the Belgian Robert Cailliau, published a proposal in 1990 for a hypertext system while both were working at CERN (European Organization for Nuclear Research) in Switzerland. Shortly thereafter Berners-Lee developed the main features of the web. This early web incorporated the following essential elements that are still the core features of the web today:

A Uniform Resource Locator (URL) to uniquely identify a resource on the WWW. The Hypertext Transfer Protocol (HTTP) to describe how requests and responses operate. A software program (later called web server software) that can respond to HTTP requests. Hypertext Markup Language (HTML) to publish documents. A program (later called a browser) that can make HTTP requests to URLs and that can display the HTML it receives.

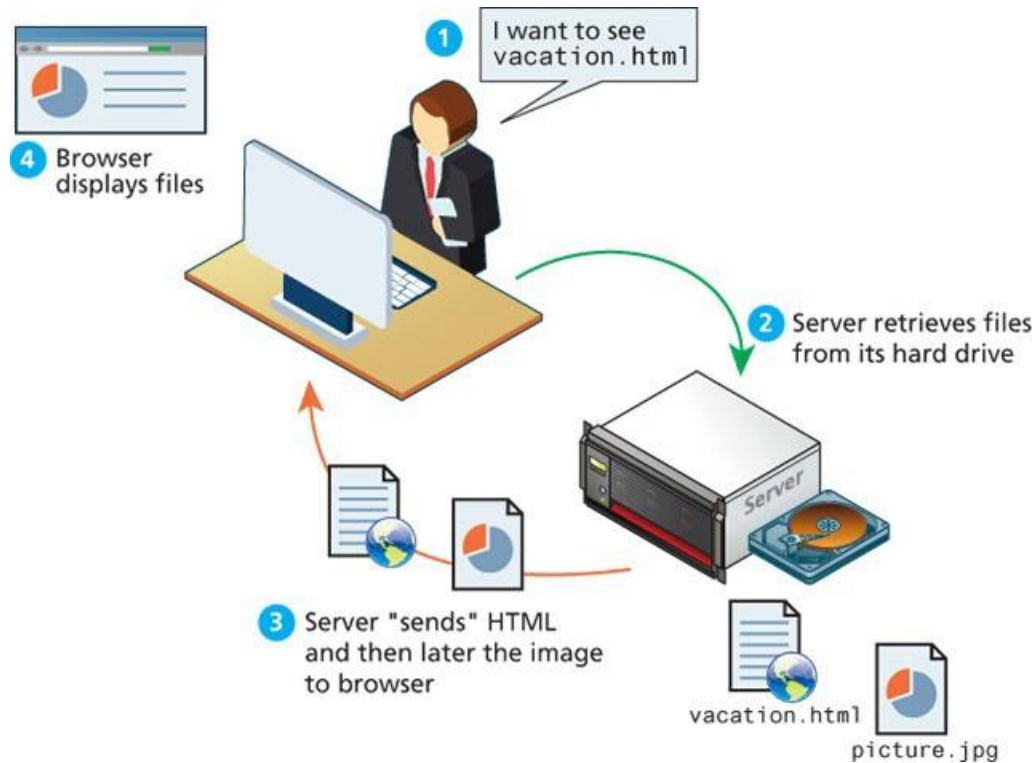
Growth of Internet

Number of Internet Hosts increases tremendously between 2000 to 2015 for a figure of 1 billion hosts.

LESSON# 3 – STATIC VS DYNAMIC WEBSITE

Static website

Static website consists only of HTML pages that look identical for all users at all times. A publisher would publish web pages and periodically update them. Users could read the pages but could not provide feedback. Following figure illustrates a simplified representation of the interaction between a user and a static website.

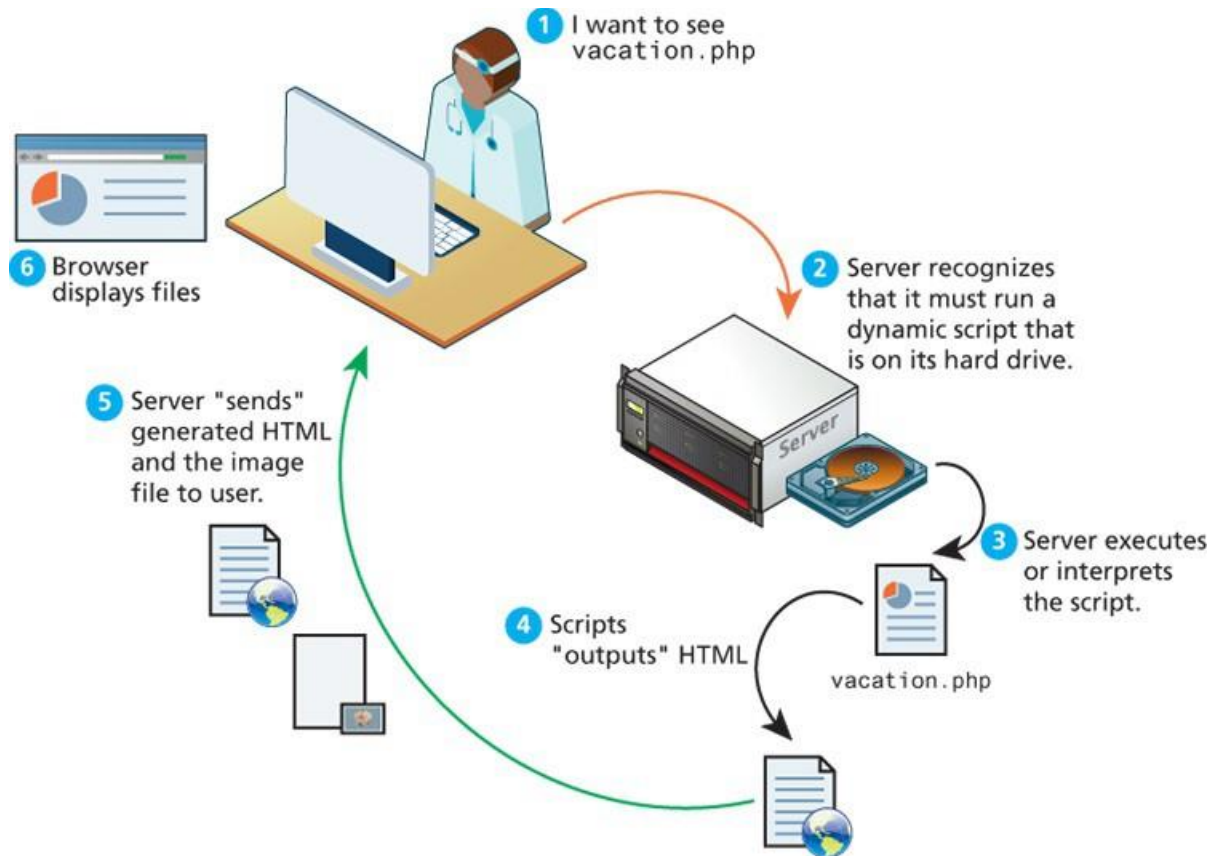


The illustration shows user at a desktop monitor saying, "I want to see vacation.html". An arrow points from the user to a server machine which has its hard drive open. Server has second step defined as, "Server retrieves files from its hard drive". Two files labeled "vacation.html" and "picture.jpg" are shown next to the hard drive. This leads to third step, depicting two files being transferred from server to the user's machine. This step is labeled as, "Server 'sends' HTML and then later the image to browser". This leads to final and fourth step, which shows a webpage consisting a picture and text. Picture and text depicted on webpage is same as depicted on "vacation.html", and "picture.jpg" files. This step is labeled as "Browser displays files".

Traditional or server-side) Dynamic Websites

Within a few years of the invention of the web, sites began to get more complicated as more and more sites began to use programs running on web servers to generate content dynamically. These server-based programs would read content from databases, interface with existing enterprise computer systems, communicate with financial institutions, and then output HTML that would be sent back to the users' browsers. This type of website is called a dynamic server-side website because the page content is being created at run time by a program created by a programmer; this

page content can vary from user to user. Following figure illustrates a very simplified representation of the interaction between a user and a dynamic website.



The illustration shows six steps of the interaction as follows:

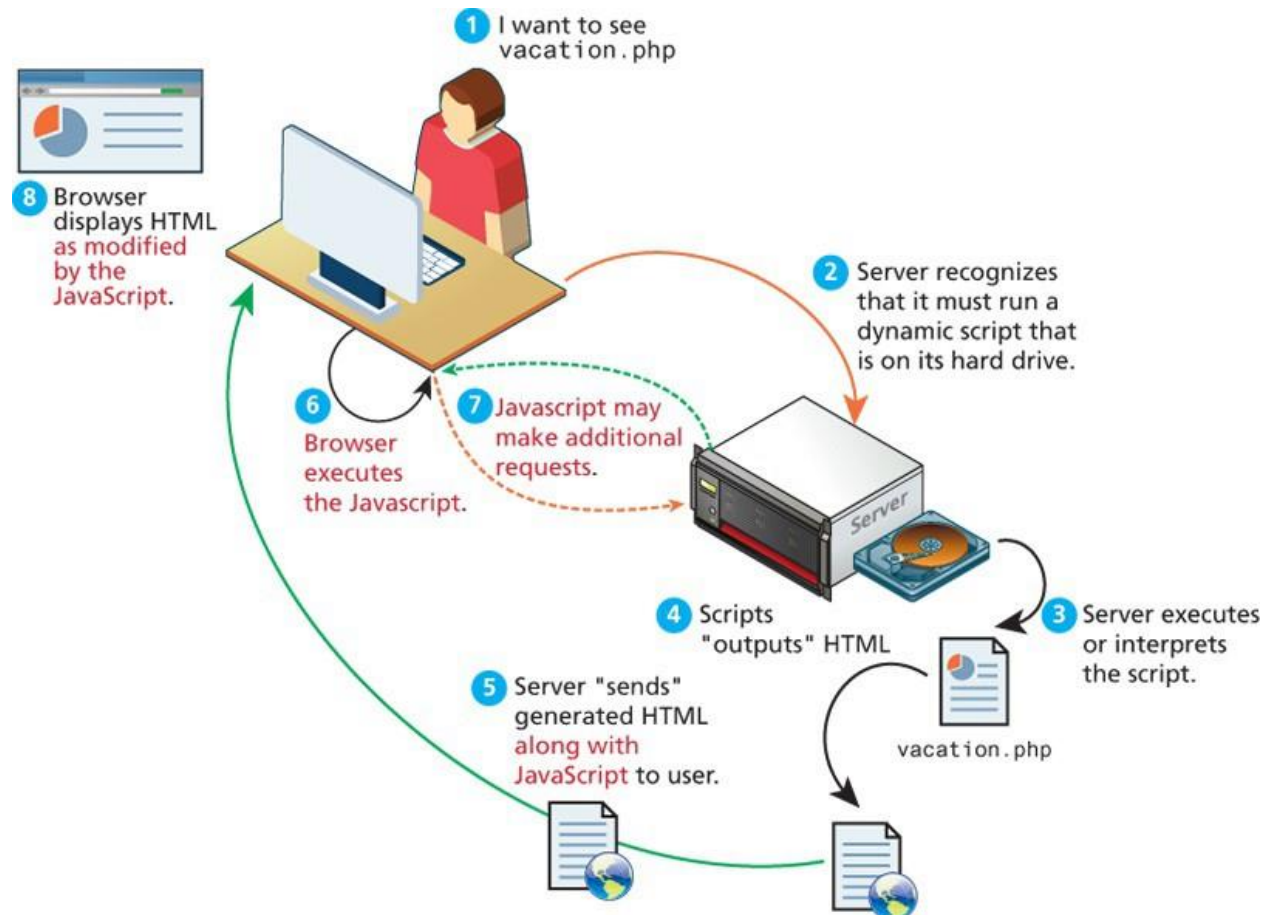
1. User at a terminal says, "I want to see vacation.php"
2. Server recognizes that it must run a dynamic script that is on its hard drive (an arrow points from the user terminal to the Server, with an open hard drive).
3. Server executes or interprets the script. (an arrow points from the server to a page titled "vacation.php")
4. Scripts "outputs" HTML (an arrow points from vacation.php to a html script).
5. Server "sends" generated HTML and the image file to user. (an arrow points from html file to user terminal).
6. Browser displays files (An assembled webpage is displayed on the user's terminal).

Modern) Dynamic Websites

Dynamic Websites of modern era (Web 2.0) refer to an interactive experience where users could contribute and consume web content, thus creating a more user-driven web experience.

For software developers, (Web 2.0) require more programming logic, which previously existed only on the server, began to migrate to the browser (see following figure).

This required learning JavaScript, a rather tricky programming language that runs in the browser, as well as mastering the rather difficult programming techniques involved in asynchronous communication.



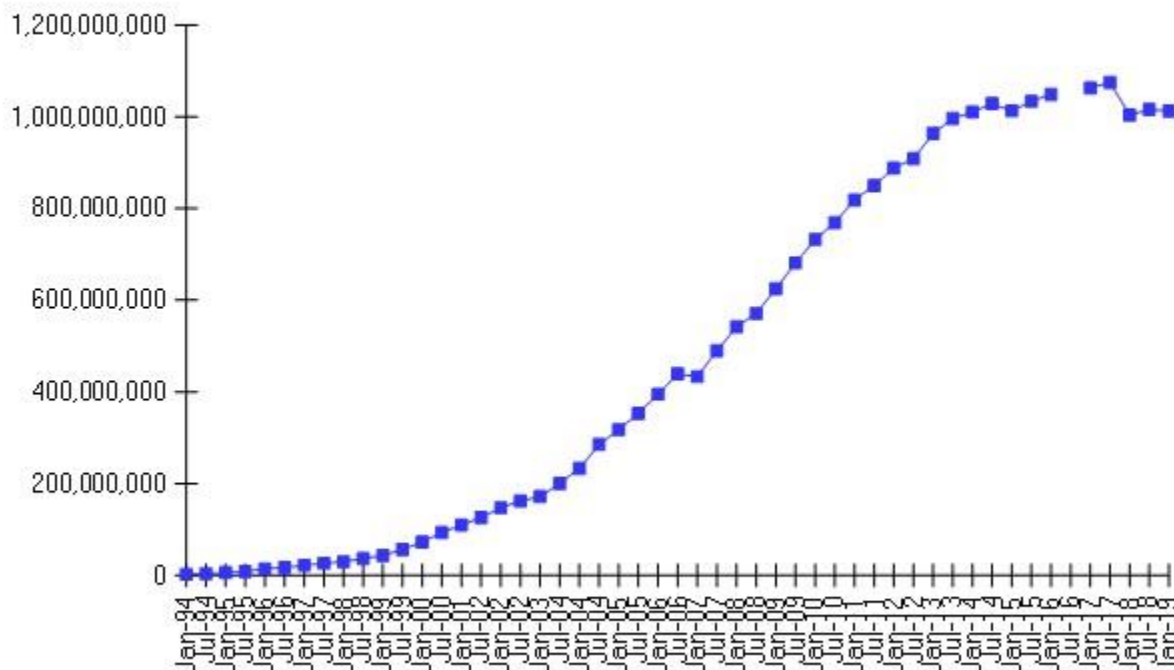
The illustration shows six steps of interaction between an user and a dynamic website depicted as:

1. User at a terminal says, "I want to see vacation.php"
2. Server recognizes that it must run a dynamic script that is on its hard drive (an arrow points from the user terminal to the Server, with an open hard drive).
3. Server executes or interprets the script. (an arrow points from the server to a page titled "vacation.php").

4. Scripts “outputs” HTML (an arrow points from vacation.php to an html script).
5. Server “sends” generated HTML and the image file to user. (an arrow points from html file to user terminal).
6. Browser executes the Javascript. (An arrow points back to the user's terminal).
7. Javascript may make additional requests (back and forth arrows between the user terminal and the server).
8. Browser displays HTML as modified by the Javascript (An assembled webpage is displayed on the user's terminal).

Textbook

Internet Domain Survey Host Count



Source: Internet Systems Consortium (www.isc.org)

Web Apps vs. Desktop Apps

- Advantages
 - Accessible from any Internet-enabled computer

- Cross platform and browser compatibility
- Easier to roll out program updates
- Fewer security concerns about local storage
- Disadvantages
 - Requires internet
 - Security concerns about sensitive private data being transmitted over the Internet
 - Concerns over the storage, licensing, and use of uploaded data
 - Problems with certain websites not having an identical appearance across all browsers
 - Restrictions on access to operating system resources
 - May need plugins for functioning

LESSON# 4 – BRIEF HISTORY OF WEB

Web 1.0

In the earliest days of the web, a webmaster (the term popular in the 1990s for the person who was responsible for creating and supporting a website) would publish web pages and periodically update them.

Users could read the pages but could not provide feedback.

- Contents generated by publishers
- Company generated companies

Web 1.0 include both type:

- Static websites
- Dynamic websites

Web 2.0

Web 2.0 is mainly characterized by:

- User Generated Contents (UGC)
- Dynamic websites

In the mid-2000s, a new buzzword entered the computer lexicon: Web 2.0.

This term had two meanings, one for users and one for developers. For the users, Web 2.0 referred to an interactive experience where users could contribute and consume web content, thus creating a more user-driven web experience. Some of the most popular websites today fall into this category: Facebook, YouTube, and Wikipedia. This shift to allow feedback from the user,

such as comments on a story, threads in a message board, or a profile on a social networking site has revolutionized what it means to use a web application.

For software developers, Web 2.0 also referred to a change in the paradigm of how dynamic websites are created. Programming logic, which previously existed only on the server, began to migrate to the browser. This required learning JavaScript, a rather tricky programming language that runs in the browser, as well as mastering the rather difficult programming techniques involved in asynchronous communication.

Web 3.0

There is no standard consensus over Web 3.0 but some people have, however, argued that Web 3.0 will be something called the semantic web. It is mainly characterized by:

- Machine understandable contents
- Semantic web

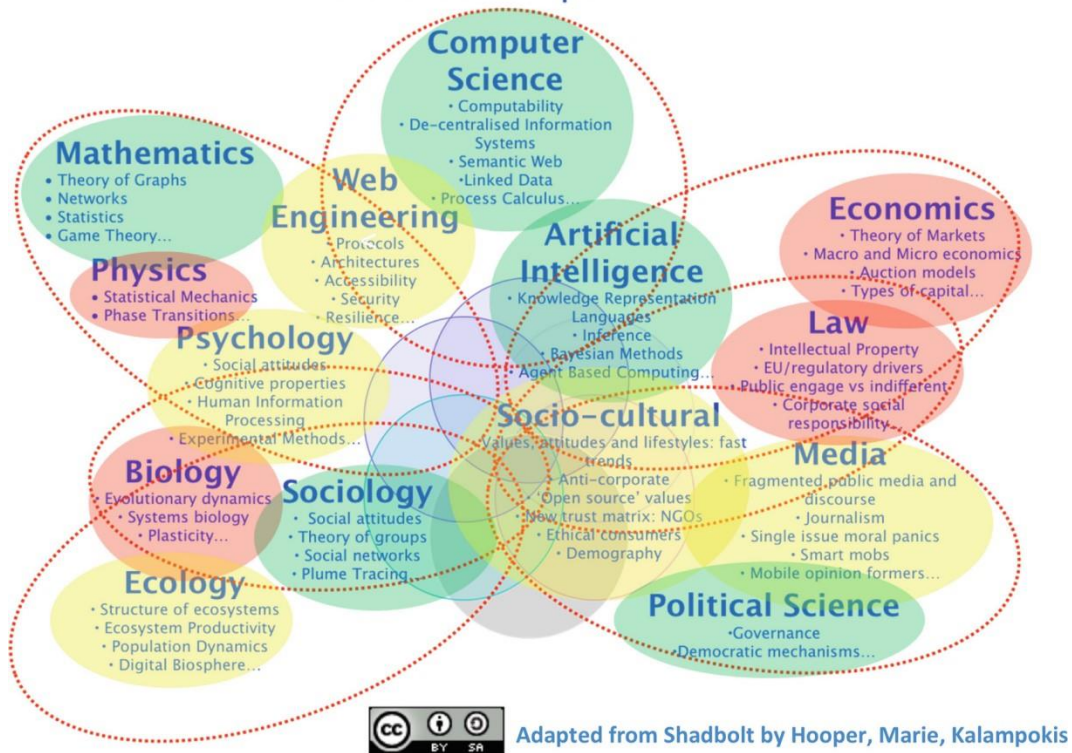
Semantic is a word from linguistics that means, quite literally, “meaning.” The semantic web thus adds context and meaning to web pages in the form of special markup. These semantic elements would allow search engines and other data-mining agents to make sense of the content. The goal of the semantic web is to make it easier to figure out those meanings, thereby dramatically improving the nature of search on the web.

Web Science

- Interdisciplinary study of sociotechnical integration of the world wide web.

Web Science, as it is known, studies the sociotechnical systems that apply the web in areas as diverse as finance, politics, activism, romance, and hate speech. If you look at each interaction on the web as more than just a technical exchange using protocols and file transmission, you can see there is often an underlying social need motivating each exchange. The technical system facilitates a social interaction and social interactions span nearly the entire human experience, so there is now an entire area of study looking at the web as a sociotechnical system. This is just another example of how the web can facilitate entirely new areas of study.

Web Science: Components

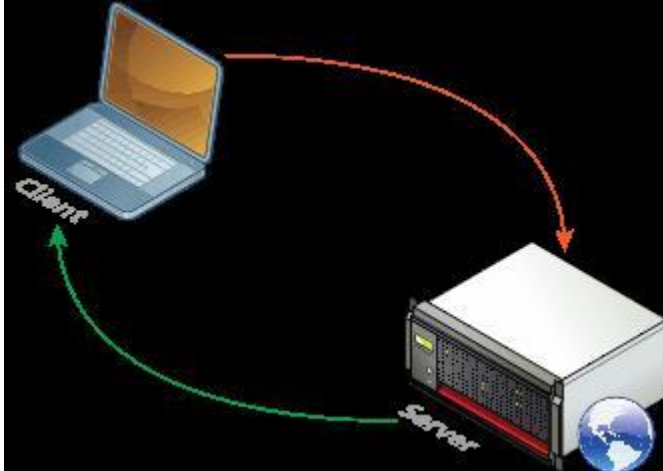


LESSON # 5 – CLIENT SERVER MODEL

Client server model

The web is sometimes referred to as a client server model of communications. In the client-server model, there are two types of actors: clients and servers. The server is a computer agent that is normally active 24/7, listening for requests from clients. A client is a computer agent that makes requests and receives responses from the server.

The request-response Loop



The diagram shows a laptop labelled as “client”. An arrow, labelled as “Request”, is pointing from the laptop to a server machine, depicted with a blue globe next to it. This server machine is labelled as “server”. Another arrow from the server machine to the laptop is labelled as “Response”.

Server Types

Most real-world websites are typically not served from a single server machine, but by many server machines. It is common to split the functionality of a website between several different types of server, as shown in following figure. These include the following:

Web servers

A web server is a computer servicing HTTP requests. This typically refers to a computer running web server software, such as Apache or Microsoft IIS (Internet Information Services).

Application servers

An application server is a computer that hosts and executes web applications, which may be created in PHP, ASP.NET, Ruby on Rails, or some other web development technology.

Database servers

A database server is a computer that is devoted to running a Database Management System (DBMS), such as MySQL, Oracle, or MongoDB, that is being used by web applications.

Mail servers

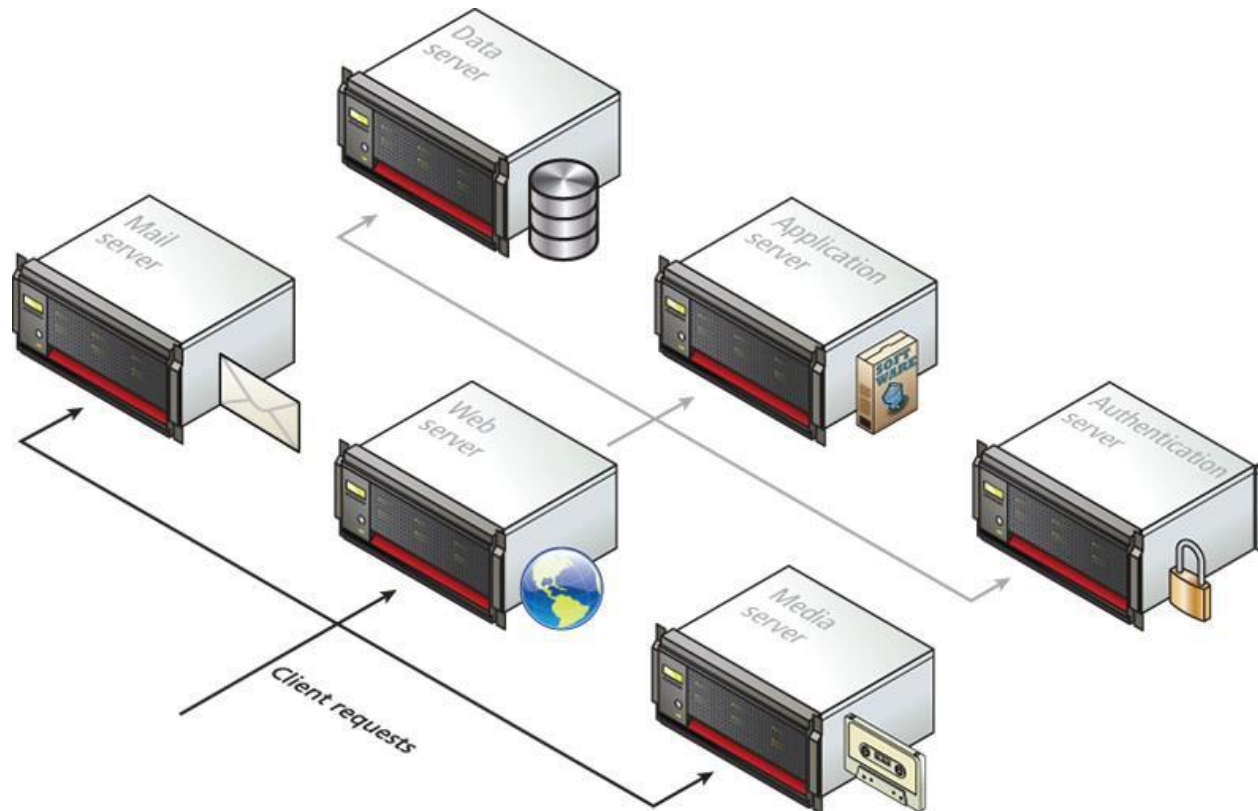
A mail server is a computer creating and satisfying mail requests, typically using the Simple Mail Transfer Protocol (SMTP).

Media servers

A media server (also called a streaming server) is a special type of server dedicated to servicing requests for images and videos. It may run special software that allows video content to be streamed to clients.

Authentication servers

An authentication server handles the most common security needs of web applications. This may involve interacting with local networking resources, such as LDAP (Lightweight Directory Access Protocol) or Active Directory.

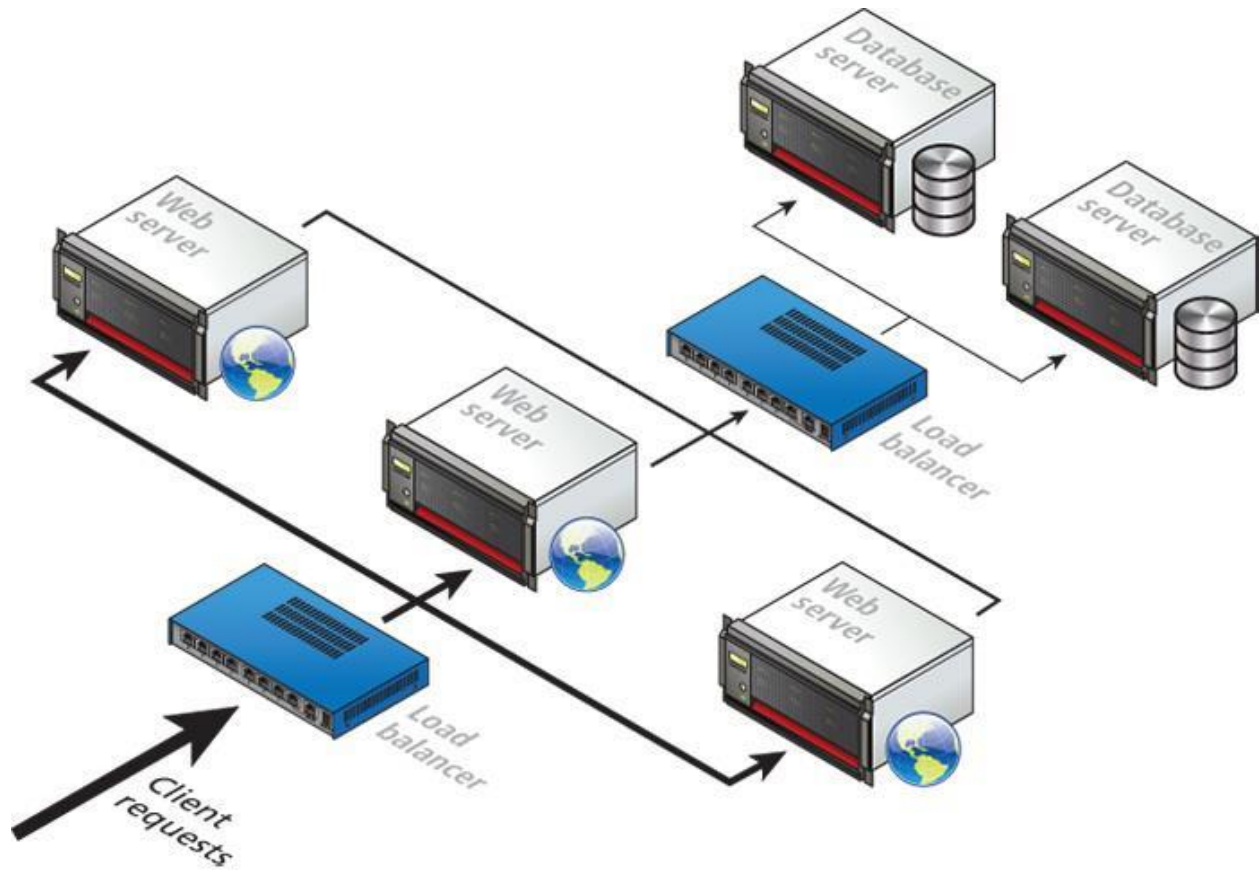


In smaller sites, these specialty servers are often the same machine as the web server.

Server Farms

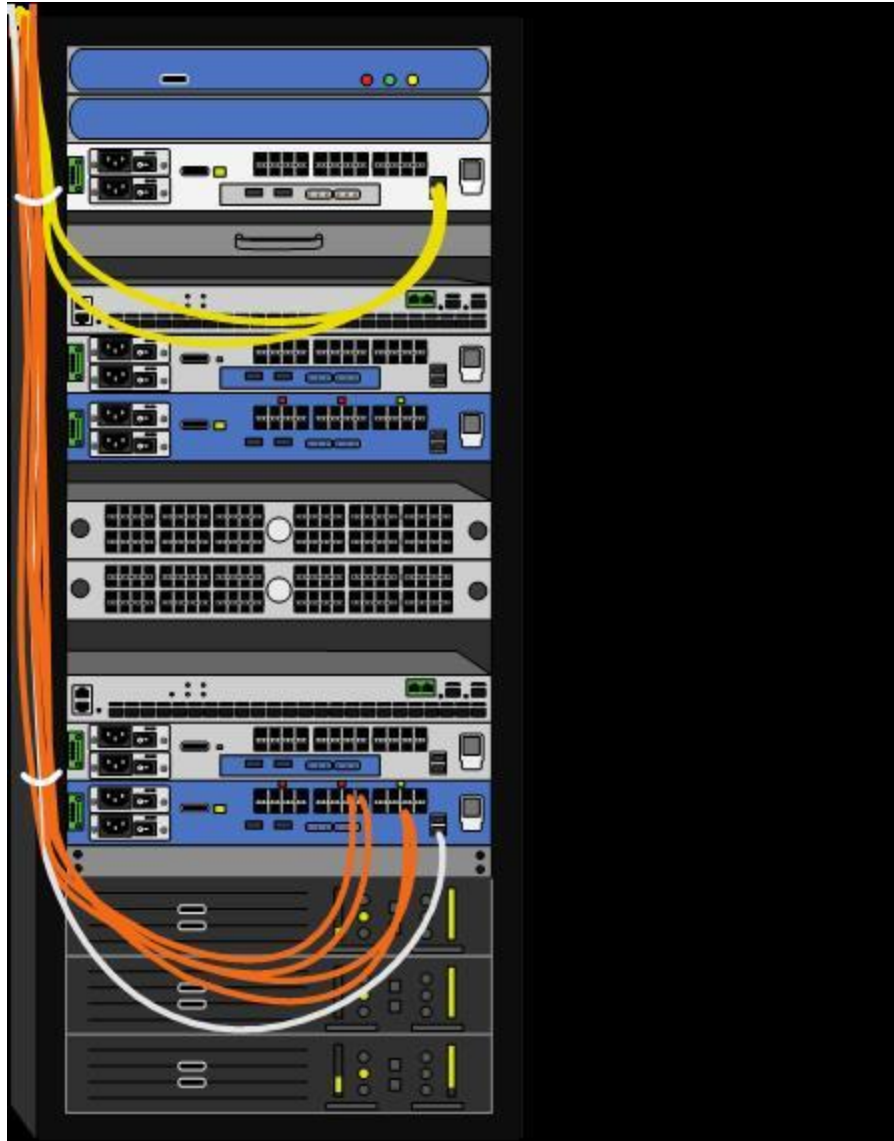
A single web server that is also acting as an application or database server will be hard-pressed to handle more than a few hundred requests a second. A busy site can receive thousands or even tens of thousands of requests a second; globally popular sites such as Facebook receive millions of requests a second.

The usual strategy for busier sites is to use a server farm. The goal behind server farms is to distribute incoming requests between clusters of machines so that any given web or data server is not excessively overloaded, as shown in following figure. Special devices called load balancers distribute incoming requests to available machines.



Server Racks

In a server farm, the computers do not look like the ones in your house. Instead, these computers are more like the plates stacked in your kitchen cabinets. That is, a farm will have its servers and hard drives stacked on top of each other in server racks. A typical server farm will consist of many server racks, each containing many servers, as shown in following figure.



Data Centers

Server farms are typically housed in special facilities called data centers. A data center will contain more than just computers and hard drives; sophisticated air conditioning systems, redundancy power systems using batteries and generators, specialized fire suppression systems, and security personnel are all part of a typical data center, as shown in following figure.

