An Introduction to Web Programming

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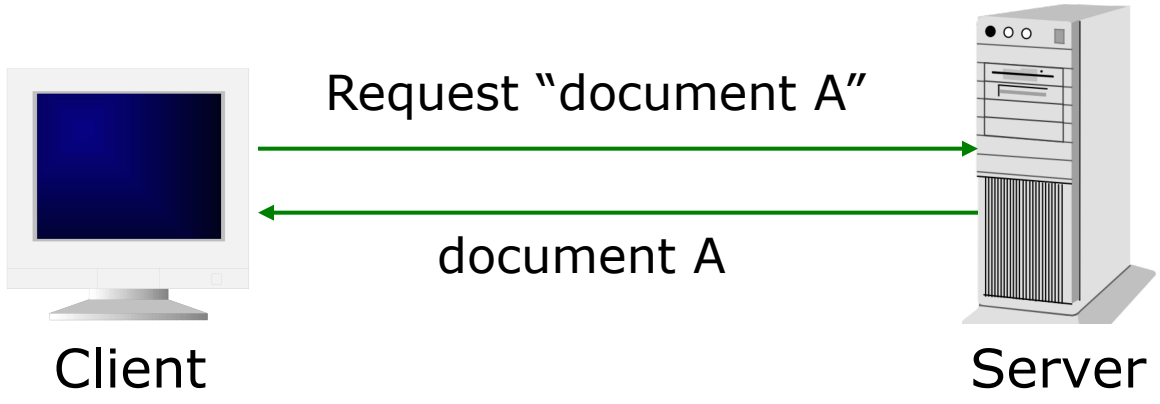
Web Programming

OUTLINE

- Introduction to web technologies

WEB ESSENTIALS

- **Client**: web browsers, used to surf the Web
- **Server** systems: used to supply information to these browsers
- Computer **networks**: used to support the browser-server communication



INTERNET V.S. WEB

- **The Internet**: a inter-connected computer networks, linked by wires, cables, wireless connections, etc.
- **Web**: a collection of interconnected documents and other resources.
- The world wide web (**WWW**) is accessible via the Internet, as are many other services including email, file sharing, etc.

HOW DOES THE INTERNET WORK?

- Through communication protocols
- A **communication protocol** is a specification of how communication between two computers will be carried out
  - **IP** (Internet Protocol): defines the packets that carry blocks of data from one node to another
  - **TCP** (Transmission Control Protocol) and **UDP** (User Datagram Protocol): the protocols by which one host sends data to another.
  - Other application protocols: **DNS** (Domain Name Service), **SMTP** (Simple Mail Transmission Protocol), and **FTP** (File Transmission Protocol)

THE INTERNET PROTOCOL (IP)

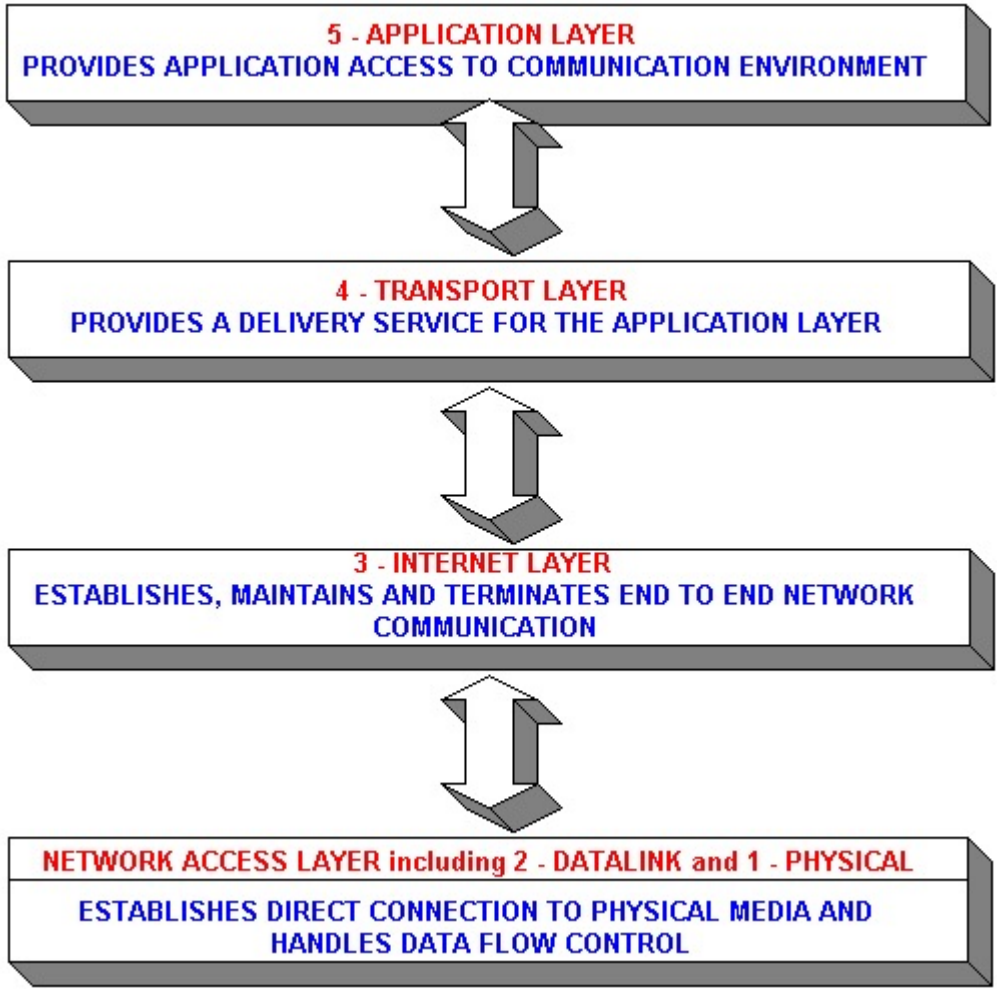
- A key element of IP is IP address, a 32-bit number
- The Internet authorities assign ranges of numbers to different organizations
- IP is responsible for moving packet of data from node to node
- A packet contains information such as the data to be transferred, the source and destination IP addresses, etc.
- Packets are sent through different local network through gateways
- A checksum is created to ensure the correctness of the data; corrupted packets are discarded

THE TRANSMISSION CONTROL PROTOCOL (TCP)

- TCP is a higher-level protocol that extends IP to provide additional functionality: reliable communication

- TCP adds support to detect errors or lost data and to trigger retransmission (إعادة الإرسال) until the data is correctly and completely received

TCP/IP PROTOCOL SUITES



HTTP, FTP, Telnet, DNS, SMTP, etc.

TCP, UDP

IP (IPv4, IPv6)

THE WORLD WIDE WEB (WWW)

- **WWW** is a system of interlinked, hypertext documents that runs over the Internet
- Two types of software:
  - **Client**: a system that wishes to access the information provided by servers must run client software (e.g., web browser)
  - **Server**: an internet-connected computer that wishes to provide information to others must run server software
  - Client and server applications communicate over the Internet by following a protocol built on top of TCP/IP – HyperText Transport Protocol (**HTTP**)

BASICS OF THE WWW

- **Hypertext**: a format of information which allows one to move from one part of a document to another or from one document to another through **hyperlinks**
- Uniform Resource Locator (**URL**): unique identifiers used to locate a particular resource on the network
- **Markup language**: defines the structure and content of hypertext documents

WEB CLIENT: BROWSER

- Makes HTTP requests on behalf of the user
  - Reformat the URL entered as a valid HTTP request
  - Use DNS to convert server's host name to appropriate IP address
  - Establish a TCP connection using the IP address
  - Send HTTP request over the connection and wait for server's response
  - Display the document contained in the response
    - If the document is not a plain-text document but instead is written in HTML, this involves rendering the document (positioning text, graphics, creating table borders, using appropriate fonts, etc.)

WEB SERVERS

- Main functionalities:
  - Server waits for connect requests
  - When a connection request is received, the server creates a new process to handle this connection
  - The new process establishes the TCP connection and waits for HTTP requests
  - The new process invokes software that maps the requested URL to a resource on the server
  - If the resource is a file, creates an HTTP response that contains the file in the body of the response message
  - If the resource is a program, runs the program, and returns the output

STATIC WEB: HTML/XHTML, CSS

- **HTML** stands for **H**yper**T**ext **M**arkup **L**anguage
  - It is a text file containing small markup tags that tell the Web browser how to display the page
- **XHTML** stands for e**X**tensible **H**yper**T**ext **M**arkup **L**anguage
  - It is identical to HTML 4.01
  - It is a stricter and cleaner version of HTML
- **CSS** stands for **C**ascading **S**tyle **S**heets
  - It defines how to display HTML elements

WHY PROGRAMMABILITY?

- What's the drawback to simple document model?
  - Static
  - Assume that documents are created before they are requested

- What are examples of information that might be part of web documents that may not be known before they are requested?

CLIENT-SIDE PROGRAMMABILITY

- Scripting language: a lightweight programming language
- Browser scripting: **JavaScript**
  - Designed to add interactivity to HTML pages
  - Usually embedded into HTML pages
  - What can a JavaScript Do?
    - Put dynamic text into an HTML page
    - React to events
    - Read and write HTML elements
    - Validate data before it is submitted to a server
    - Create cookies
    - …

SERVER-SIDE PROGRAMMABILITY

- The requests cause the response to be generated
- Server scripting:
  - **CGI/Perl**: Common Gate Way Interface (*.pl, *.cgi)
  - PHP: Open source, strong database support (*.php)
  - ASP: Microsoft product, uses .Net framework (*.asp)
  - Java via JavaServer Pages (*.jsp)
  - …

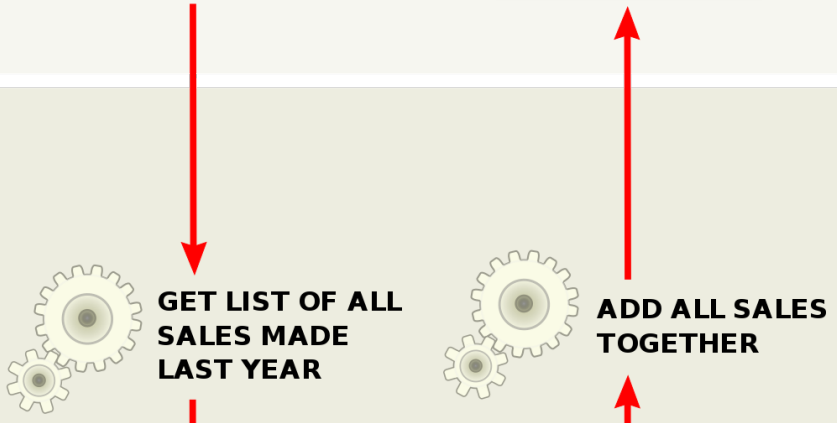
Three Tiers Architecture

Presentation tier

The top-most level of the application is the user interface. The main function of the interface is to translate tasks and results to something the user can understand.

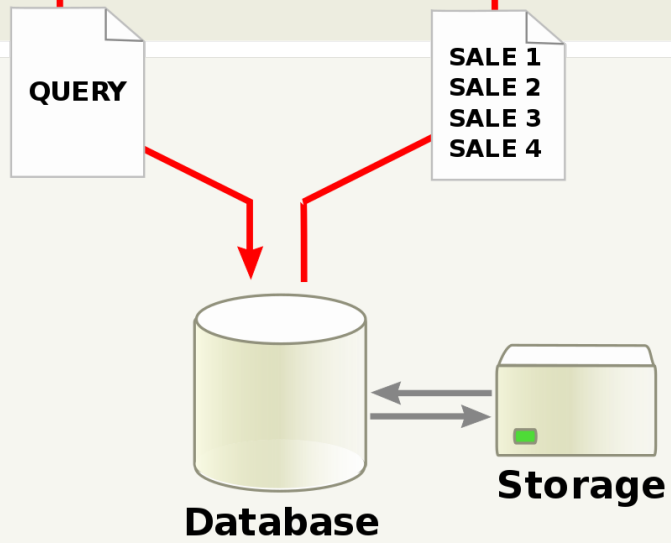
Logic tier

This layer coordinates the application, processes commands, makes logical decisions and evaluations, and performs calculations. It also moves and processes data between the two surrounding layers.



Data tier

Here infomation is stored and retrieved from a database or file system. The infomation is then passed back to the logic tier for processing, and then eventually back to the user



Most Popular Programming Languages of 2018