

Introduction

There are two sections in these notes:

1. Web architecture and components
2. Technologies that can be used to build and operate a website

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1.1a Describe at least five hardware components that enable access to the web and enable website production.

Hardware Components

Web Server Hardware

Web server hardware comprises a dedicated computer that is used to serve web pages to users. The web server stores web server software and a website's component files (e.g. HTML documents, images, CSS stylesheets, and JavaScript files). It is connected to the Internet and supports physical data interchange with other devices connected to the web. The client (user) uses a browser to access the server and request web pages from the web site hosted on that server. The server then responds by sending the client the web pages which are then displayed in the client's browser. This architecture is an example of the client/server model.

Proxy Server

A proxy server is a computer that acts as an intermediary gateway between the user's computer and the Internet. It allows client computers to make indirect network connections to other network services by separating end users from the websites they browse. Proxy servers act as a firewall and web filter, they provide shared network connections and cache data to speed up common requests. A good proxy server provides high levels of security and privacy.

Mail Server

A mail server (email server) is a server that handles and delivers email over a network, usually over the Internet. A mail server can receive emails from client computers and deliver them to other mail servers.

DSL Modem

This converts digital signals into analogue signals that are suitable for sending over a telephone line. It is usually built into the Internet/broadband router and not normally purchased as a separate component.

Routers

A router connects networks together. Routers operate at the networking level of the TC protocol stack. On Home networks the router is responsible for connecting the home network to the Internet and provides several important networking services like DHCP and DNS. Most home routers provide both Wi-Fi and Ethernet connections. Home routers also provide NAT (Network Address translation) services. They are also commonly known as hubs but this doesn't actually describe their networking role.

Network Switch

A switch Connects two or more computers together and is used today in preference to a hub or a bridge. Like a bridge a switch learns about the **MAC addresses** connected to each port and will only send data to the port that has the MAC address specified in the data. A switch is effectively computer and a bridge with more ports. Using switches usually speeds up a network but it depends on the network configuration.

Network Bridge

A bridge connects two network segments together and is a **selective repeater**. It examines the MAC address of the traffic it sees and learns which network segments contain the various **MAC addresses**. It uses this information to decide whether or not to repeat the traffic on a network segment. A Bridge works at level 2 (data link Level) and will transmit broadcasts. Bridges are being replaced by switches.

Network Hub

A hub connects two or more computers together. Hubs are effectively multi-port repeaters and operate at the physical layer (level one). They do not examine the network traffic. They are being replaced today by switches. The smallest hub usually has 4 ports.

Wi-Fi Range Extender/Repeater

When placed within the range of an existing wireless network, it takes the signal from the network and rebroadcasts it, thus increasing the range of the network. Modern range extenders plug directly into a mains socket and require no other connections.

Firewall

A firewall functions like a router except that it blocks traffic from the external network according to user configured rules. A firewall protects your home/small business network computers and devices from intruders on the Internet. It effectively acts like a one-way digital gate blocking access to your network from devices on the Internet, but at the same time allowing devices on your network to connect to devices on the Internet.

Wireless Access Point

A wireless access point connects wireless devices to an Ethernet network, and to each other. It effectively does the same job as a hub/switch but for wireless devices.

Mi-Fi-BroadBand Wi-Fi Hub

A Mi-Fi Hub is a relatively new device, and it can be used for connecting multiple devices to the Internet over the mobile network (3g and 4G). Your devices connect to the hub using Wi-Fi and the Hub connects to the mobile network using 3G/4G. Mi-Fi hubs are low cost and many will work for several hours without being connected to the mains. You will need a SIM card and a mobile data plan.

UTP Cable

Unshielded Twisted Pair (UTP) cable is a 100-ohm copper cable that consists of 2 to 1800 unshielded twisted pairs surrounded by an outer jacket and is used in Ethernet based LANs, data centre networks and telephone wiring. UTP cable has no metallic shield. This makes the cable small in diameter but unprotected against EMI (Electromagnetic Interference), however, the twist in pairs of cable helps to improve the cables immunity to electrical noise. The two main types of UTP cabling in common use have four twisted pairs of wires. And they are CAT5e (supporting 1 Gbps for 100 meters) and CAT6 (supporting 1 Gbps for up to 100 meters and 10 Gbps for up to 50 meters). The most common connector used with UTP cable is RJ-45. Fiber optic cable is an alternative to UPT cable.

Fiber Optic Cable

A fiber optic cable is a network cable that contains strands of glass fibers inside an insulated casing. They're designed for long distance, very high-performance data networking, and telecommunications. Compared to wired cables, fiber optic cables provide higher bandwidth and can transmit data over longer distances. Fiber optic cables support much of the world's internet, cable television, and telephone systems.

NIC

A **Network Interface Controller (NIC**, also known as a Network Interface Card, network adapter, LAN adapter or physical network interface, and by similar terms) is a computer hardware component that connects a computer to a computer network.

Computer/Laptop

An electronic device for storing and processing data usually used to search the internet with the assistance of a browser.

Smart Phone

A smart phone is a mobile phone that offers computer-like features that can include e-mail, an Internet browser, a personal organiser, a touch screen or a keyboard.

Tablet

A tablet is a smaller version of a laptop. It is a handheld personal computer that incorporates a touch screen.

1.1b. Describe at least three software components that enable access to the web and enable website production.

Software Components

Web Server Software

Web server software is comprised of several parts that control how web users access the web sites hosted on the web server computer. At a minimum, web server software contains a HTTP (HyperText Transfer Protocol) server. HTTP is the protocol used by a client browser to view webpages. HTTP uses URLs (Uniform Resource Locator - web addresses) to access the websites stored on the server, and deliver their content to the client's browser. Leading Web servers include Apache, Microsoft Internet Information Server (IIS), NGNIX, Novell NetWare server, Google Web Server and IBM Domino servers. Web server software is run on a hardware computer also referred to as a web server.

Website Development Software

Web development software enables you to develop (design, create, edit, update) a website for the Internet (World Wide Web) or an intranet (a private network). This may include anything from a simple single static page of plain text to complex web-based internet applications (web apps), electronic businesses, and social network services. Common web development software applications include; WordPress, Adobe Dreamweaver and Google Web Designer.

Operating System

An operating system (OS) is system software that manages computer hardware and software resources and provides common services for computer programs. The best-known operating systems are those found on personal computers; Microsoft Windows, MacOS and Linux (a UNIX-like OS). A modern OS contains built-in software designed to simplify the networking of a computer and access to the Internet.

Computer Firewalls

Modern operating systems will have built-in software firewalls. This software firewall is less secure than the one built into a switch/router/hub but it is normal to leave it enabled on a user's computer.

Browser

A browser is a piece of software that allows you access and view information on the Internet. The most popular browsers are currently Chrome, Microsoft's Internet Explorer, Mozilla, Firefox and Edge.

Email Client

Email client is a desktop application that enables configuring one or more email addresses to receive, read, compose and send emails from that email address(s) through the desktop interface.

1.2. Explain the role of the TCP/IP protocol including IPv6

Explain the role of the following protocols:

- TCP/IP including IPv6
- HTTP
- SMTP

TCP/IP including IPv6

Transmission **C**ontrol **P**rotocol/**I**nternet **P**rotocol (TCP/IP) defines a set of rules for message formats and procedures that allow machines and application programs to exchange information. These rules must be followed by each machine involved in the communication in order for the receiving host to be able to understand the message. TCP/IP carefully defines how information moves from sender to receiver.

The sending procedure is:

1. Application programs send messages or streams of data using either the User Datagram Protocol (UDP) or the Transmission Control Protocol (TCP)
2. The data is then divided it into smaller pieces called packets
3. The packets are then enclosed in an Internet Protocol (IP) datagram and header and trailer information is added
4. The datagrams are then transmitted as frames over a specific network hardware, such as Ethernet or Token-Ring networks

Frames received by a host go through the protocol in reverse. The receiving procedure is:

1. The frames of data are received
2. The IP header is removed and footer are removed
3. The data packets are reassembled
4. The application receives the data

TCP/IP includes an Internet addressing scheme that allows users and applications to identify a specific network or host with which to communicate.

An Internet address works like a postal address, allowing data to be routed to the chosen destination. TCP/IP provides standards for assigning addresses to networks, subnetworks, hosts, and sockets, and for using special addresses for broadcasts and local loopback.

Internet addresses are made up of a network address and a host (or local) address. This two-part address allows a sender to specify the network as well as a specific host on the network. A unique, official network address is assigned to each network when it connects to other Internet networks. However, if a local network is not going to connect to other Internet networks, it can be assigned any network address that is convenient for local use.

IPv4 and IPv6

An Internet **P**rotocol (IP) address is an identifier for a computer or device on a TCP/IP network. Networks using the TCP/IP protocol route messages based on the IP address of the destination.

The format of an IPv4 IP address is a 32-bit numeric address written as four numbers separated by periods. Each number can be in the range of zero to 255. For example, 1.160.10.240 could be an IP address.

Within an isolated network (not connected to the Internet), you can assign IP addresses at random as long as each one is unique. However, connecting a private network to the Internet requires using registered IP addresses (called Internet addresses) to avoid duplicates.

An IP address can be static or dynamic. A static IP address will never change and it is a permanent Internet address. A dynamic IP address is a temporary address that is assigned each time a computer or device accesses the Internet.

The number of addresses that IPv4 can manage is running out, so a new system, IPv6 (or IPng) is the next generation of IP and has been designed to be an evolutionary step from IPv4. In IPv6 the IP address size is increased from 32 bits to 128 bits. This extension anticipates considerable future growth of the Internet and provides relief for what was perceived as an impending shortage of network addresses. IPv6 also supports auto-configuration to help correct most of the shortcomings in version 4, and it has integrated security and mobility features.

To view your IP address, you can use the **ipconfig** command from the command prompt.

HTTP

HyperText Transfer Protocol (HTTP) is the underlying protocol used by the World Wide Web and defines how messages are formatted and transmitted, and what actions Web servers and browsers should take in response to various commands. Hypertext documents include hyperlinks to other resources that the user can easily access and HTTP was developed specifically to facilitate hypertext and the World Wide Web.

For example, when you enter a URL in your browser, this actually sends an HTTP command to the Web server directing it to fetch and transmit the requested Web page. The other main standard that controls how the World Wide Web works is HTML, which covers how Web pages are formatted and displayed.

HTTP is called a stateless protocol because each command is executed independently, without any knowledge of the commands that came before it. This is the main reason that it is difficult to implement Web sites that react intelligently to user input. This shortcoming of HTTP is being addressed in a number of new technologies, including ActiveX, Java, JavaScript and cookies.

There is a secure version of HTTP; Hyper Text Transfer Protocol Secure (HTTPS). Communications between the browser and website are encrypted by Transport Layer Security (TLS), or its predecessor, Secure Sockets Layer (SSL).

SMTP

Simple Mail Transfer Protocol (SMTP) is an Internet standard used for sending and receiving email between servers. Email messages can then be retrieved with an email client that uses either POP or IMAP (SMTP is used to send email and POP or IMAP is used for receiving email).

POP

Post Office Protocol (POP) is an application-layer Internet standard protocol used by email clients to retrieve email from a mail server. It works by contacting your email service and downloading all of your new messages from it. Once they are downloaded onto your computer, they are deleted from the email service. This means that after the email is downloaded, it can only be accessed using the same computer. If you try to access your email from a different device, the messages that have been previously downloaded won't be available to you. Sent mail is stored locally on your PC or Mac, not on the email server.

IMAP

The Internet Message Access Protocol (IMAP) is an email protocol used for accessing email on a remote web server from a local client. IMAP allows you to access your email wherever you are, from any device. When you read an email message using IMAP, you aren't actually downloading or storing it on your computer; instead, you're reading it from the email service. As a result, you can check your email from different devices, anywhere in the world. IMAP only downloads a message when you click on it, and attachments aren't automatically downloaded. This way you're able to check your messages a lot more quickly than POP.

1.3. Explain the role of Internet Service Providers, Web Hosting Services and Domain Name Registrars

Explain the role of the following:

- Internet Service Provider
- Web Hosting Service
- Domain Name Registrar

Internet Service Provider

An Internet **S**ervice **P**rovider (ISP) is a company that provides subscribers with access to the Internet, they are the gateway to the Internet and everything else online. ISPs may be organized in various forms, such as commercial (Telecom/Cable/Media companies), community-owned, non-profit, or otherwise privately owned. Typical services provided by ISPs include Internet access, Internet transit, domain name registration, web hosting, Usenet service, and colocation.

Web Hosting Service

Web Hosting Services act as an Internet hosting service allowing their clients to make their website accessible via the World Wide Web. They provide this service by leasing space on their data servers to their clients. Their clients then store their files, images, HTML and everything else that makes up their website on the leased space. The web hosting service then makes their clients websites available to the World Wide Web via a browser and the domain name of the web site.

Web hosts may also provide data centre space and connectivity to the Internet for other servers located in their data centre, this is called colocation.

Simply put a web hosting service rents or leases space on the Internet to their clients.

Domain Name Registrar

A domain name registrar is company that has been accredited by the Internet Corporation for Assigned Names and Numbers (ICANN) or a national country code top-level domain (TLD) (such as .ie or .uk) to register domain names. Domain name registration is a competitive industry, in which domains may be sold in a number of TLDs, including ".com," ".net," and ".org." among others.

As an example, a company may wish to make their goods and services available over the web via a new domain name "topgoods.ie". The company needs to register this new domain with the Domain Name Registrar and, if the name has not already been taken, the company will gain the right to use it by paying the registrar a yearly fee to secure the space.

1.4 Describe Available Types of Web Functionality

Web1.0

Web 1.0 is the term used to refer to the first stage of development on the World Wide Web when websites were characterised by simple static websites. Web 1.0 websites were built with static HTML pages, and a few simple styles embedded in the HTML mark-up. Web 1.0 websites typically had the following characteristics:

- Static pages - no interactive features
- Website content stored in files and not in a separate database
- Layout and content were combined in the web page
- Proprietary HTML tags created incompatibility between websites
- Guest books were used for comments rather than attached directly to content pages
- E-mailing of forms (no server-side scripting)

Web 2.0

Web 2.0 is the name used to describe the second generation of the world wide web, where it moved static HTML pages to a more interactive and dynamic web experience. Web 2.0 is focused on the ability for people to collaborate and share information online via social media, blogging and Web-based communities.

Web 2.0 signalled a change in which the world wide web became an interactive experience between users and Web publishers, rather than the one-way conversation that had previously existed. It also represents a more populist version of the Web, where new tools make it possible for nearly anyone to contribute, regardless of their technical knowledge.

Blogs

A Blog (short for “**web log**”) is a regularly updated website or web page run by an individual or small group, that is written in an informal or conversational style. It is used as a platform where the blogger shares his/her thoughts, experiences, views, diary, journal, personal reflections, comments, hyperlinks, videos, and photographs on a specific subject. A characteristic of blogs is that they are regularly updated; once a day, once a week, once a month. Blogs may be private, but most of them are available on the internet for others to see.

Online Applications

An Online Application or web app is a client–server computer program in which the client (including the user interface and client-side logic) runs in a web browser. These applications are programmes quite similar to the ones found on a typical PC such as Word or Excel except that they operate online on a website and browser. Common web applications from Google include Gmail, YouTube, Docs, and Slides. Microsoft offer a suite of applications in Office 365. One feature of these online applications is that they can be run on any browser, on any device, anywhere. Another plus is that the software will always be up to date.

Cloud Computing

Cloud computing is the on-demand delivery of compute power, database storage, applications, and other IT resources through a cloud services platform via the internet with pay-as-you-go pricing.

Users of cloud computing typically only pay for the services they use, thus minimising upfront hardware and software investment, and operating costs. Users can instantly access as many or as few resources as they need, and only pay for what they use.

Cloud computing service providers, such as Amazon Web Services, Google Cloud Platform and Microsoft Azure, own and maintain the network-connected hardware required for the cloud computing services, while the end users access what they need via web applications.

Social Media

Describing the term Social Media is a challenge because of the variety of stand-alone and built-in social media services that are currently available on the Internet.

However, an examination of Social Media websites reveals some common features. Social Media websites facilitate people to interact with each other in the creation and sharing of information, ideas, career interests and other forms of expression via virtual communities and networks. The content created and shared by users includes; text, comments, digital photos, videos, and data generated through all online interactions. A basic definition of Social Media is: Social Media are web-based communication tools that enable people to interact with each other by both sharing and consuming information. Popular Social Media sites include Facebook, YouTube, Instagram, Twitter, Reddit.

Web Services

Web Services describes a standardised way of integrating Web-based applications using the XML, SOAP, WSDL and UDDI open standards over an Internet protocol backbone. XML is used to tag the data, SOAP is used to transfer the data, WSDL is used for describing the services available and UDDI is used for listing what services are available. Used primarily as a means for businesses to communicate with each other and with clients, Web services allow organizations to communicate data without intimate knowledge of each other's IT systems behind the firewall.

Unlike traditional client/server models, such as a Web server/Web page system, Web services do not provide the user with a GUI. Web services instead share business logic, data and processes through a programmatic interface across a network. The applications interface, not the users. Developers can then add the Web service to a GUI (such as a Web page or an executable program) to offer specific functionality to users.

Web services allow different applications from different sources to communicate with each other without time-consuming custom coding, and because all communication is in XML, Web services are not tied to any one operating system or programming language. For example, Java can talk with Perl, Windows applications can talk with UNIX applications.

2.1 Explain the use of markup languages

In computer text processing, a markup language is a system for annotating or tagging a document in such a way that the markup is syntactically distinguishable from the text. The idea and terminology evolved from the "marking up" of paper manuscripts, i.e., the revision instructions by editors, traditionally written with a blue pencil on authors' manuscripts. In digital media, this "blue pencil instruction text" was replaced by tags, that is, instructions are expressed directly by tags or "instruction text encapsulated by tags."

To properly define this term - a markup language is a language that annotates text so that the computer can manipulate that text. Most markup languages are human readable because the annotations are written in a way to distinguish them from the text itself. For example, with HTML and XML, the markup tags are `<` and `>`. Any text that appears between these characters is considered part of the markup language and not part of the annotated text. Every tag used in a markup language specifies a formatting to be applied to the text.

While several markup languages exist, the two most popular are HTML and XML.

NOTE: Since both HTML and XML files are saved in a plain text format, they can be viewed in a standard text editor. You can also view the HTML source of an open webpage by selecting the "View Source" option. This feature is found in the View menu of most Web browsers.

HTML

Hyper**T**ext **M**arkup **L**anguage (HTML) is the primary language of the Web and it is a markup language used for creating webpages. HTML defines the way that images, multimedia, and text are displayed in web browsers. This language includes elements to connect your documents (hypertext) and make your web documents interactive (such as with forms).

HTML is a defined standard markup language. It is based upon SGML (**S**tandard **G**eneralized **M**arkup **L**anguage). HTML is a language that uses tags to define the structure of your text. Elements and tags are defined by the `<` and `>` characters. Basic page tags, such as `<head>`, `<body>`, and `<div>` define sections of the page, while tags such as `<table>`, `<form>`, `<image>`, and `<a>` define elements within the page. Most elements require a beginning and end tag, with the content placed between the tags.

While HTML is by far the most popular markup language used on the Web today, it is not the only choice for web development. As HTML was developed, it got more and more complicated and the style and content tags combined into one language. Eventually, the W3C decided that there was a need for a separation between the style of a web page and the content. A tag that defines the content alone would remain in HTML while tags that define style were deprecated in favour of **C**ascading **S**tyle **S**heets (CSS).

XML

The eXtensible Markup Language (XML) is a software and hardware independent tool for storing and transporting data that is both human and machine readable. It is a markup language similar to HTML that you can use to create your own tags. XML was designed to store and transport data.

XML was created by the World Wide Web Consortium (W3C) to overcome the limitations of HTML. XML was designed with the Web in mind. Examine the following:

```
<p><b>Mrs. Mary McMurphy</b>
<br>
14 Model Farm Road
<br>
Cork City, T12 ABC9</p>
```

The trouble with HTML is that it was designed with humans in mind. Even without viewing the above HTML document in a browser, it is clear that it is someone's postal address.

Humans have the intelligence to understand the meaning and intent of most documents. A machine, unfortunately doesn't. While the tags in this document tell a browser how to display this information, the tags don't tell the browser what the information is. A human will know it's an address, but a machine won't.

With XML, you can assign some meaning to the tags in the document. More importantly, it's easy for a machine to process the information as well. You can extract the postal code from this document by simply locating the content surrounded by the <postal-code> and </postal-code> tags, technically known as the <postal-code> element.

```
<address>
  <name>
    <title>Mrs.</title>
    <first-name>Mary</first-name>
    <last-name>McMurphy</last-name>
  </name>
  <street>14 Model Farm Road</street>
  <city>Cork City</city>
  <postal-code>T12 ABC9</postal-code>
</address>
```

XML enables developers to create documents with self-describing data, below are a few key areas of how this is being done:

- XML simplifies data interchange between organisations (or even different parts of the same organization)
- XML enables smart code because XML documents can be structured to identify every important piece of information and the relationships between the pieces
- XML enables smart searches, for example, searching for someone with the name Stormy would yield the weather forecast whereas searching XML documents for <first-name> elements that contained the text Stormy would give a much better set of results

2.2 Explain the use and functionality of:

- **Web runtime environments**
- **Web application programming languages**

Web Runtime Environments

A runtime environment is a configuration of hardware and software provided to an application so that it can run. It includes the CPU type, operating system and any runtime engines, system software or application software required by a particular category of applications.

A web runtime environment may be either client-side or server-side. Client-side is a single user and server-side is many, many thousands or even millions of concurrent users. Each of these have different runtime requirements in terms of hardware, software and connecting to the Internet.

On the client-side, the web runtime environment enables the user to connect to the Internet and to web sites. On the server-side the web runtime environment enables a web site to serve its contents to its many clients.

The following web runtime environment specifications are an average of the minimum requirements for hardware and software:

- **Client-side**
 - Hardware
 - Desktop/Laptop with minimum:
 - Pentium 4
 - Intel
 - RAM: 512 MB
 - HD: 200 MB free
 - ADSL broadband router/firewall
 - Software
 - Operating System:
 - Windows 7 or later
 - OS X Yosemite 10.10 or later
 - Linux - 64-bit
 - Ubuntu 14.04+
 - Debian 8+
 - openSUSE 13.3+
 - Fedora Linux 24+
 - Web Browser
 - Internet Explorer
 - Firefox
 - Chrome
 - Safari
 - Internet Service Provider (ISP)

- **Server-side**

- Hardware supporting up to 7500 users
 - Server
 - 1 TB of disk space for cache
 - 16 CPU cores
 - 64 GB RAM
 - Gigabit Ethernet Controllers
 - Uninterruptible Power Supply (UPS)
 - Backup Generator
- Software
 - Operating System
 - Windows Server 2003 or later
 - Linux
 - Red Hat Enterprise Linux
 - Web Hosting Software
 - Apache HTTP Server
 - Internet Information Services
 - NGIX
- Internet Service Provider (ISP)

Web application programming languages

One of the most integral aspects of web development is web application programming which is achieved with the help of programming languages. Web application programming languages are used to develop website content such as games and applications. They are also used to add interactive elements to websites - a web page may change dynamically based on the user's preferences. Web application programming languages are also used to gather data from and deliver data to users from databases housed on servers.

The following is a short list of popular web development languages:

- **JavaScript** is used for front-end development of the majority of websites and it may it may also be used for the creation of back-end content
- **Java** - object-oriented, class-based, concurrent language, cross-platform
- **Python** is aimed at increasing coders productivity due to its simple syntax and big scope of useful features
- **Ruby** is a language intended to be productive with web applications and sites and it is not hard to learn
- **PHP** is one of most frequently used website coding languages. It is a server-side scripting language designed for web development. Its syntax is similar to that of the C programming language

2.3 Explain the role of databases in building websites and web applications

Databases

A Web database is a database application designed to be managed and accessed through the Internet. The primary role of a database on a website and in web applications is to store and display updated information. Registration websites, discussion forums, online banking and retail commercial websites are examples of web applications that depend upon a robust database component.

Database applications are used to search, sort, filter and present information based upon web requests from users. Databases can also contain code to perform mathematical and statistical calculations on the data to support queries submitted from web browsers.

Databases grant and limit access to data based upon criteria such as user name, password, region or account number. Databases also enforce data integrity by ensuring that data is collected and presented using a consistent format.

A dynamic website displays updated information on web pages when the database is updated by the host or when users submit information using web forms. The database automatically updates web pages, eliminating the requirement to manually update the HTML code on individual pages.

The databases used by websites and web applications include:

- IBM DB2
- Microsoft Access
- Microsoft SQL Server
- MySQL
- Oracle RDBMS
- MongoDB

SQL

Structured Query Language (SQL) is a computer language used to communicate with a relational database. According to the American National Standards Institute (ANSI), it is the standard language for **relational database management systems (RDBMS)**.

SQL statements are used to carry out four basic functions on the data stored in the database and these are **create**, **read**, **update**, and **delete (CRUD)**.

Some common relational database management systems that use SQL are: Oracle, Microsoft SQL Server, Access, MySQL, SQLite.

Although most database systems use SQL, there are slight syntactical differences between them. However, the standard SQL commands such as **SELECT**, **INSERT**, **UPDATE**, **DELETE**, **CREATE** and **DROP** can be used to accomplish almost everything that one needs to do with a database.

SQL statements may be divided into several categories, by function, the main ones are:

- **Data Definition Language (DDL)** - allows a database user to create and restructure database objects, such as the creation or the deletion of a table
- **Data Manipulation Language (DML)** - used to manipulate data within objects of a relational database. The three basic DML commands are; **INSERT**, **UPDATE**, and **DELETE**
- **Data Query Language (DQL)** – has only one command which is the most used by relational database users; **SELECT**
- **Data Control Language (DCL)** – allows access control to data within the database
- **Data administration commands** - allow the user to perform audits and perform analyses on operations within the database
- **Transactional control commands** - allow the user to manage database transactions

PHP

The PHP acronym originally derived from Personal Home Page Tools but now stands for PHP: Hypertext Preprocessor. PHP is a server-side script language and interpreter that is open source and free. It is used for the development of web applications

PHP executes on a server, while a comparable alternative, JavaScript, executes on a client. PHP is an alternative to Microsoft's Active Server Page (ASP) technology. As with ASP, the PHP script is embedded within a Web page along with its HTML. Before the page is sent to a user that has requested it, the Web server calls PHP to interpret and perform the operations called for in the PHP script.

An HTML page that includes a PHP script is typically given a file name suffix of ".php", ".php7," or ".phtml". Like ASP, PHP can be thought of as "dynamic HTML pages," since content will vary based on the results of interpreting the script.

PHP scripts can be used on most of the well-known operating systems like Linux, Unix, Solaris, Microsoft Windows, MAC OS and many others. It also supports most web servers including Apache and IIS. Using PHP affords web developers the freedom to choose their operating system and web server.

In PHP, server-side scripting is the main area of operation and involves:

- **PHP Parser** - a program that converts source and human readable code into a format easier for the computer to understand
- **Web Server** - a Web server is a program that uses HTTP (Hypertext Transfer Protocol) to serve the files that form Web pages to client users
- **Web Browser** - a web browser is a software program that allows a user to locate, access, and display web pages

2.4 Identify typical product stack combinations that can be used for web development

Web stacks are composed of multiple languages that are used concurrently. They are a bundle of software that runs everything from the frontend to the backend, from databases to server administration to the rendering of websites.

Many start-up developers invent their own stacks as needed and they are based mostly on the specific knowledge of the developer rather than on any specific compatibility between the elements of the stack bundle. A start-up's needs change as the company expands, and therefore its stack may (and probably should) change based on those needs.

LAMP (Linux, Apache, MySQL, PHP)

There are some common bundles, with LAMP probably being the most famous stack. LAMP became the dominant stack around the year 2000. It is very popular because it's completely open source (and free) and easy to customise (you can take it and change it without having to pay anybody).

Each component of the LAMP stack is the best in its field:

- **Linux** is the best operating system for web development because it was built by developers for developers
- **Apache** HTTP Server is run by most websites to host servers and it is also free and open source (though actual hosting can cost money)
- **Mysql** is a **Relational Database Management System** (RDBMS) based on **Structured Query Language** (SQL). It is used for a wide range of purposes, including data warehousing, e-commerce, and logging applications, however, its most common is for the purpose of a web database
- **PHP** is a very popular, powerful, general-purpose, server-side scripting language that is especially suited in web development for making dynamic and interactive Web pages. It is Fast, flexible and pragmatic and powers everything from a blog to the most popular websites in the world. PHP is a widely-used, free, and efficient alternative to competitors such as Microsoft's ASP

Each aspect of the LAMP web stack is popular, but each has been challenged in the last ten years by other languages such as Ruby. LAMP is difficult to learn because it requires mastery of a few unrelated languages, along with knowing everything about Linux and Apache server. Developers tend to have a love/hate relationship with PHP due to its many holes.

With the pros and cons considered, the majority of the web continues to use LAMP. It is a proven method for hosting websites and it has strong community support.

MEAN (MongoDB, ExpressJS, AngularJS, NodeJS)

MEAN is simple as there's only one language to learn, and everything else consists of libraries and frameworks. MEAN uses JavaScript and/or JSON notation across all members of the stack, allowing developers to easily move through and develop within each piece of the stack. Also, MEANs use of JavaScript allows it to be incredibly fast and easy to scale.

The components in the MEAN stack are:

- **MongoDB** is a cross-platform document-oriented distributed database program. Classified as a NoSQL database program, MongoDB uses JSON-like documents with schemata. MongoDB is free and open-source.
- **Express.js** is an open source, minimal and flexible web application framework developed and maintained by the Node.js foundation for Node.js. It is designed for building web and mobile applications. It has been called the de facto standard server framework for Node.js.
- **Angular.js** is an MVC (Model View Controller) JavaScript-based open-source front-end web application framework mainly maintained by Google and by a community of individual to address many of the challenges encountered in developing single-page applications. Angular.js can be added to a HTML page with a `<script>` tag, extends HTML attributes with Directives, and binds data to HTML with Expressions.
- **Node.js** is an open source, server-side, cross-platform runtime environment built on Chrome's JavaScript runtime for developing fast and scalable network applications. Node.js uses an event-driven, non-blocking I/O model that makes it lightweight and efficient, perfect for data-intensive real-time applications that run across distributed devices. Node.js applications are written in JavaScript. Node.js provides a rich library of various JavaScript modules which simplifies the development of web applications.

MEAN isn't as stable as LAMP because it's so new. It doesn't have a large community and therefore provides less support than other stacks. There's the possibility of having more problems and not having a forum to turn to for troubleshooting.

Ruby on Rails

Ruby on Rails (Rails for short) is an open source server-side web application framework written in Ruby under the MIT License. Rails is a MVC (Model View Controller) framework, providing default structures for a database, a web service, and web pages. It encourages and facilitates the use of web standards such as JSON or XML for data transfer, HTML, CSS and JavaScript for user interfacing. In addition to MVC, Rails emphasizes the use of other well-known software engineering patterns and paradigms, including convention over configuration, don't repeat yourself, and the active record pattern.

Some components in the Ruby on Rails Stack are:

- **Ruby Programming Language** - Ruby is a high-level, interpreted, object oriented programming language like Smalltalk, Eiffel, Ada or Java. It is elegant, easy to use and pragmatic.
- **Database** - Rails is database agnostic, meaning it can be used with a variety of different databases. By default, it assumes that MySQL is being used but this can be exchanged with any other database relatively easily.
- **Server** - There are many servers that can manage running Rails apps. The most popular, and the easiest to use and configure is Apache/NGIX with Phusion Passenger.

Ruby on Rails removes a lot of the details of development and replaces them with “Ruby magic”. This is great for building applications quickly and is best suited for developers already familiar with the backend.

Ruby on Rails is liked and disliked for the same reason: lack of control. However, this comes in exchange for ease of use and developer-friendliness. A novice developer could effectively create full applications with Ruby on Rails and be misled into missing out on crucial programming fundamentals. It's easy to be a Ruby typist issuing commands without really knowing what's going on.

Glossary of Terms

LAN

A **Local Area Network** (LAN) is a computer network that interconnects computers within a limited area such as a residence, school, laboratory, university campus or office building.

MAC Address

A **Media Access Control** address (MAC address) of a device is a unique identifier assigned to a network interface controller (NIC) for communications at the data link layer of a network segment. MAC addresses are used as a network address for most IEEE 802 network technologies, including Ethernet, Wi-Fi and Bluetooth.

MiFi

MiFi stands for **Mobile Wi-Fi** and describes a wireless router that acts as mobile Wi-Fi hotspot. A MiFi device can be connected to a cellular network and provide internet access for up to ten devices.

MVC

Stands for "**Model-View-Controller**." MVC is an application design model comprised of three interconnected parts. They include the model (data), the view (user interface), and the controller (processes that handle input).

The MVC model or "pattern" is commonly used for developing modern user interfaces. It provides the fundamental pieces for designing a program for desktop or mobile, as well as web applications. It works well with object-oriented programming, since the different models, views, and controllers can be treated as objects and reused within an application.

NoSQL

A NoSQL ("non SQL" or "non-relational") database provides a mechanism for storage and retrieval of data that is modelled using means other than the tabular relations used in relational databases.

RJ45

RJ45 (**Registered Jack 45**) is a type of connector commonly used for Ethernet networking. Ethernet cables have an RJ45 connector on each end and are sometimes called RJ45 cables.

SIM Card

A **Subscriber Identity Module** or **Subscriber Identification Module** (SIM), widely known as a SIM card, is an integrated circuit that is intended to securely store the international mobile subscriber identity (IMSI) number and its related key, which are used to identify and authenticate subscribers on mobile telephony devices (such as mobile phones and computers). It is also possible to store contact information on many SIM cards. SIM cards are always used on GSM phones; for CDMA phones, they are only needed for newer LTE-capable handsets. SIM cards can also be used in satellite phones, smart watches, computers, or cameras.

SOAP

SOAP is an acronym for **S**imple **O**bject **A**ccess **P**rotocol. It is an XML-based messaging protocol for exchanging information among computers. SOAP is an application of the XML specification.

UDDI

Universal **D**escription, **D**iscovery, and **I**ntegration (UDDI) is an XML-based registry for businesses worldwide to list themselves on the Internet. Its ultimate goal is to streamline online transactions by enabling companies to find one another on the Web and make their systems interoperable for e-commerce. UDDI is often compared to a telephone book's white, yellow, and green pages. The project allows businesses to list themselves by name, product, location, or the Web services they offer.

WAN

A **W**ide **A**rea **N**etwork (WAN) is a telecommunications network or computer network that extends over a large geographical area/distance/place. Wide area networks are often established with leased telecommunication circuits.

Wi-Fi

Wi-Fi is a technology used for radio wireless local area networking of devices based on the IEEE 802.11 standards allowing computers, smartphones, or other devices to connect to the Internet or communicate with one another wirelessly within a particular area. The term Wi-Fi (**W**ireless **F**idelity) was invented as a pun on the word hi-fi (**H**igh **f**idelity), a term for high-quality audio technology.

WSDL

The **W**eb **S**ervices **D**escription **L**anguage (WSDL) is an XML based language used to describe the services offered by a business and provides a way for other businesses to access those services electronically. Services listed in The Universal Description, Discovery, and Integration (UDDI) registry are described using WSDL. WSDL is frequently used with SOAP and XML schema to provide Web services over the Internet.

XML

XML stands for **eX**tensible **M**arkup **L**anguage. It is a markup language similar to HTML and it was designed to store data, transport data and to be self-descriptive. It is a W3C Recommendation.