Firefox
Fairly well-rounded, but nearly unusable because of all its stupid add-ons.

Internet Explorer
Worthless, but good for the occasional bashing.

Safari
While very efficient, its quality is vastly exaggerated by the people that use it.

Opera
Some people really love it, everyone else just thinks it looks f*cking stupid.

Chrome
Very fast. That's about it.
A web browser is a software application for retrieving, presenting, and traversing information resources on the World Wide Web. An information resource is identified by a Uniform Resource Identifier (URI) and may be a web page, image, video, or other piece of content.
Browsers

Internet Explorer
Microsoft’s Internet Explorer (IE) is one of the most popular browser today. IE was introduced in 1995 and passed Netscape in popularity in 1998.

Firefox
Firefox is a browser from Mozilla. It was released in 2004 and is one of the most popular browser today.

Netscape
Netscape was the first commercial Internet browser. Netscape was introduced in 1994, but gradually lost its popularity to Internet Explorer. The development of Netscape officially ended in February 2008.

Mozilla
The Mozilla Project has grown from the ashes of Netscape. Browsers based on Mozilla code are the largest browser-family on the Internet today.

Opera
Opera is a fast, small, and standards-compliant web browser. Opera is the preferred browser for a number of small devices like mobile phones and hand-held computers.

Google Chrome
Google Chrome is a free, open-source web browser developed by Google. It was released in 2008.

Apple Safari
Safari is the default browser for Mac systems. Safari is known for its sleek design.
What is the trend in browser usage?

### Web Statistics and Trends

Statistics are important information. From the statistics below, you can see that Firefox and Internet Explorer are the two most popular browsers.

#### Browser Statistics Month by Month

<table>
<thead>
<tr>
<th></th>
<th>Internet Explorer</th>
<th>Firefox</th>
<th>Chrome</th>
<th>Safari</th>
<th>Opera</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2010</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>August</td>
<td>30.7%</td>
<td>45.8%</td>
<td>17.0%</td>
<td>3.5%</td>
<td>2.3%</td>
</tr>
<tr>
<td>July</td>
<td>30.4%</td>
<td>46.4%</td>
<td>16.7%</td>
<td>3.4%</td>
<td>2.3%</td>
</tr>
<tr>
<td>June</td>
<td>31.0%</td>
<td>46.6%</td>
<td>15.9%</td>
<td>3.6%</td>
<td>2.1%</td>
</tr>
<tr>
<td>May</td>
<td>32.2%</td>
<td>46.9%</td>
<td>14.5%</td>
<td>3.5%</td>
<td>2.2%</td>
</tr>
<tr>
<td>April</td>
<td>33.4%</td>
<td>46.4%</td>
<td>13.6%</td>
<td>3.7%</td>
<td>2.2%</td>
</tr>
<tr>
<td>March</td>
<td>34.9%</td>
<td>46.2%</td>
<td>12.3%</td>
<td>3.7%</td>
<td>2.2%</td>
</tr>
<tr>
<td>February</td>
<td>35.3%</td>
<td>46.5%</td>
<td>11.6%</td>
<td>3.8%</td>
<td>2.1%</td>
</tr>
<tr>
<td>January</td>
<td>36.2%</td>
<td>46.3%</td>
<td>10.8%</td>
<td>3.7%</td>
<td>2.2%</td>
</tr>
<tr>
<td><strong>2009</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>37.2%</td>
<td>46.4%</td>
<td>9.8%</td>
<td>3.6%</td>
<td>2.3%</td>
</tr>
<tr>
<td>November</td>
<td>37.7%</td>
<td>47.0%</td>
<td>8.5%</td>
<td>3.8%</td>
<td>2.3%</td>
</tr>
<tr>
<td>October</td>
<td>37.5%</td>
<td>47.5%</td>
<td>8.0%</td>
<td>3.8%</td>
<td>2.3%</td>
</tr>
<tr>
<td>September</td>
<td>39.6%</td>
<td>46.6%</td>
<td>7.1%</td>
<td>3.6%</td>
<td>2.2%</td>
</tr>
<tr>
<td>August</td>
<td>39.3%</td>
<td>47.4%</td>
<td>7.0%</td>
<td>3.3%</td>
<td>2.1%</td>
</tr>
<tr>
<td>July</td>
<td>39.4%</td>
<td>47.9%</td>
<td>6.5%</td>
<td>3.3%</td>
<td>2.1%</td>
</tr>
<tr>
<td>June</td>
<td>40.7%</td>
<td>47.3%</td>
<td>6.0%</td>
<td>3.1%</td>
<td>2.1%</td>
</tr>
<tr>
<td>May</td>
<td>41.0%</td>
<td>47.7%</td>
<td>5.5%</td>
<td>3.0%</td>
<td>2.2%</td>
</tr>
<tr>
<td>April</td>
<td>42.1%</td>
<td>47.1%</td>
<td>4.9%</td>
<td>3.0%</td>
<td>2.2%</td>
</tr>
<tr>
<td>March</td>
<td>43.3%</td>
<td>46.5%</td>
<td>4.2%</td>
<td>3.1%</td>
<td>2.3%</td>
</tr>
<tr>
<td>February</td>
<td>43.6%</td>
<td>46.4%</td>
<td>4.0%</td>
<td>3.0%</td>
<td>2.2%</td>
</tr>
<tr>
<td>January</td>
<td>44.8%</td>
<td>45.5%</td>
<td>3.9%</td>
<td>3.0%</td>
<td>2.3%</td>
</tr>
</tbody>
</table>

http://www.w3schools.com
There are many commercial browsers that interpret and display a web document. Almost all of them use the same architecture.

The browser is usually made of three parts: controller, client programs, and interpreters. The controller gets input from the keyboard or the mouse and uses the client program to access the document.
• Architecture

Mouse
Keyboard

Controller

HTTP
HTTPS
FTP

NETWORK

HTML
XML
PDF

DISPLAY

• Example of web browsers: Internet Explorer, Netscape Communicator, Mozilla Firefox, Opera
• Browser renders and displays a document, keeping an internal list of where the elements of the document are displayed on screen.
• Controller obtains the coordinates of the user’s cursor from windowing system and compares them with the coordinates of the objects displayed in the page.
• If a link has been selected, the controller extracts the scheme from the URL, this determines which client (HTTP, HTTPS, FTP, etc) will be used to fetch the document.
• The browser fetches the document and depending on the document type (HTML, XML, etc), calls the appropriate interpreter to render and display the document.
The designer of a particular browser may not be able to sustain the development effort required to support all of the possible document formats that the browser might be used to view. In the case of proprietary document formats (e.g., Adobe PDF, Real Audio and others), the owners of a format may not want to expose its encoding. To accommodate these requirements, browsers typically incorporate features that allow new functionality to be added to them without recompilation. We say that applications that can be extended in this manner are extensible (Helper Applications, Plug-ins/Add-ons and Java Applets).
A helper application is an external viewer program launched to display content retrieved using a web browser. Some common examples include Windows Media Player and QuickTime Player for playing streaming content.

Unlike a plugin (whose full code is included into browser code), a small line is added to the browser code to tell it to open a certain helper application in case it encounters a certain file format.

This provides a simple mechanism that allows the browser functionality to be extended by allowing it to invoke external applications (Adobe Reader) to display documents.
A plugin is a piece of code that can be loaded into same address space as the browser process.

Because plugins run in the same address space as the browser, they have to be carefully constructed. A faulty plugin could corrupt some of the browser’s internal data structures. In general, writing plugins requires a great deal of care.

To use plugins, the browser configured with:

- The pathname of a directory that contains the available plugins
- A table that describes which plugins to use with which MIME types.
An applet is a program written in Java, a general purpose programming language. The applet code is downloaded from a web server and executed within the browser.

To run applet you need to install Java virtual machine.

Applets are used to provide interactive features to web applications that cannot be provided by HTML alone.

Applets are also used to create online game collections that allow players to compete against live opponents in real-time.
Following is an example of loading and running applet from a HTML document.

```html
<html>
<head><title>Hello World Applet</title></head>
<body>
<applet code="HelloWorld.class" width=400 height=80>
</applet>
</body>
</html>
```
import java.awt.*;
import java.applet.*;
public class HelloWorld extends Applet {

    Public void init() {
        c = Color.green;
    }

    Public void paint (Graphics g) {
        g.setColor( c );
        g.drawString(“Hello World”, 10, 20);
    }
}
INTRODUCTION TO WEB SERVER

• Web server
  – Specialized software that responds to client requests by providing resources
  – When users enter URL into Web browsers, they request specific documents from Web server
  – Maps URL to file on server and returns requested document to client
  – Communicates with client using HTTP
    • Protocol for transferring requests and files over the Internet

• Example of Web servers
  – Internet Information Services (IIS), Personal Web Server (PWS), Apache Web Server, Tomcat
Given below is a list of top web server software vendors published in a [Netcraft survey](http://en.wikipedia.org/wiki/Web_server) in January 2010.

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Product</th>
<th>Web Sites Hosted (millions)</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apache</td>
<td>Apache</td>
<td>111</td>
<td>54%</td>
</tr>
<tr>
<td>Microsoft</td>
<td>IIS</td>
<td>50</td>
<td>24%</td>
</tr>
<tr>
<td>Igor Sysoev</td>
<td>nginx</td>
<td>16</td>
<td>8%</td>
</tr>
<tr>
<td>Google</td>
<td>GWS</td>
<td>15</td>
<td>7%</td>
</tr>
<tr>
<td>lighttpd</td>
<td>lighttpd</td>
<td>1</td>
<td>0.46%</td>
</tr>
<tr>
<td></td>
<td>IIS</td>
<td>PWS</td>
<td>Apache</td>
</tr>
<tr>
<td>----------------</td>
<td>----------------------------</td>
<td>----------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>Company</strong></td>
<td>Microsoft Corporation</td>
<td>Microsoft Corporation</td>
<td>Apache Software Foundation</td>
</tr>
<tr>
<td><strong>Version</strong></td>
<td>5.0</td>
<td>4.0</td>
<td>1.3.20</td>
</tr>
<tr>
<td><strong>Released</strong></td>
<td>2/17/00</td>
<td>12/4/97</td>
<td>5/21/01</td>
</tr>
<tr>
<td><strong>Platforms</strong></td>
<td>Windows 2000</td>
<td>Windows 95/98/</td>
<td>UNIX, Windows NT/2000,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Millennium Edition (Me)/NT</td>
<td>experimentally supports</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Windows 95/98</td>
</tr>
<tr>
<td><strong>Brief</strong></td>
<td>The most popular Web</td>
<td>A basic Web server for</td>
<td>Currently the most</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pages.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Microsoft IIS in NT 4.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Option Pack. Also</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>included in Windows 98.</td>
<td></td>
</tr>
</tbody>
</table>
GENERAL SERVER CHARACTERISTICS

• Web servers have two separate directories
  – The document root is the root directory of all servable documents
    (well, not really all)
    • e.g. Suppose the site name is www.bloomers.com and the
document root is named topdocs, and it is stored in the
/admin/web directory
    • So, /admin/web/topdocs is the document directory address
    • If a request URL is:
      http://www.bloomers.com/bulbs/tulips.html
      The server will search for the file with the given path
      /admin/web/topdocs/bulbs/tulips.html
  – The server can have virtual document trees
    • Sometimes a different disk, possibly on a different machine,
is used after the original disk is filled
GENERAL SERVER CHARACTERISTICS

• The server root is the root directory for all of the code that implements the server
  – The server root usually has four files
  – One is the code for the server itself
  – Three others are subdirectories
    • conf - for configuration information
    • logs - to store what has happened
    • cgi-bin - for executable scripts

• Contemporary servers provide many services:
  – Virtual hosts - multiple sites on the same system
  – Proxy servers - to serve documents from the document roots of other sites
  – Besides HTTP, support for FTP, Gopher, News, email
  – Support for database access
HTTP REQUEST TYPES

• Also known as request methods
• Most popular are *get* and *post*
  – Retrieve and send client form data to Web server
  – *get* request
    • Sends form content as part of URL
    • Retrieves appropriate resource from Web server
    • Limits query to 1024 characters
  – *post* request
    • Updates contents of Web server (posting new messages to forum)
    • Has no limit for length of query
    • Not part of URL and cannot be seen by user
HTTP REQUEST TYPES

• Posts data to server-side form handler
• Browsers cache (save on disk) Web pages
  – Allows for quick reloading
  – Cache responses to get request
  – Do not cache responses to post request
ACCESSING WEB SERVERS

• Requesting documents
  – Must know machine name on which Web server resides
  – Through local Web servers or remote Web servers
  – Through domain name or Internet Protocol (IP) address

• Local Web server
  – Resides on users’ machines
  – Requests documents in two ways
    • Machine name
    • localhost (Host name that references local machine)
ACCESSING WEB SERVERS

• Remote Web server
  – Resides on different machines

• Domain name
  – Represents group of hosts on Internet
  – Combines with how name (www) and top-level domain to from fully qualified host name

• Top-level domain (TLD)
  – Describes type of organization that owns domain name
    • .com or .org

• Fully qualified host name
  – Provides user friendly way to identify site on Internet
ACCESSING WEB SERVERS

- **IP address**
  - Unique address for locating computers on Internet
- **Domain name server (DNS)**
  - Maintains database of host names and corresponding IP addresses
  - Translates fully qualified host name to IP address
    - Known as DNS lookup
INTERNET INFORMATION SERVICES

• Internet Information Services (IIS)
  – Enterprise-level Web server
  – Included with Windows 2000
  – Allows computer to serve documents

• Internet Services Manager (FIGURE A)
  – Open Control Panel, double click Administrative Tools icon, then double click Internet Services Manager icon
  – Administration program for IIS
  – Place documents to be requested in default directory or virtual directory
    • Default: C:\Inetpub\Wwwroot
    • Virtual: alias for existing directory on local machine
Start > Settings > Control panel> program and features > turn windows features on and off
INTERNET INFORMATION SERVICES

Figure A: Internet Services Manager dialog.
• Default FTP Site and Default Web Site
  – Permit transferring documents between computer and server
  – HTTP used frequently to request documents
• Default SMTP Virtual Server
  – Allows for creation of mail server
• Create virtual directory in Default Web Site
  – Most Web documents reside in Webpub directory
    • Right click Webpub, select New, then Virtual Directory
    • Initiates Virtual Directory Creation Wizard (Figure B)
      – Guides user through virtual directory creation process
Figure B : Virtual Directory Creation Wizard welcome dialog.
INTERNET INFORMATION SERVICES

- Virtual Directory Alias (Fig. C)
  - Enter name for virtual directory
    - Name should not conflict with an existing virtual directory
- Web Site Content Directory (Fig. D)
  - Enter path of directory containing Web documents
- Access Permissions (Fig. E)
  - Presents security level choices
  - Select access level appropriate for Web document
Figure C: Virtual Directory Alias dialog.
Figure D: Web Site Content Directory dialog.
• Access Permissions (Figure E)
  – Presents security level choices
  – Select access level appropriate for Web document
  – **Read** allows users to read and download files
  – **Run Scripts** allows scripts to run in directory
  – **Execute** allows applications to run in directory
  – **Write** allows Web page to accept user input
  – **Browse** allows users to navigate between documents
  – **Read** and **Run Scripts** selected by default
Figure E : Access Permissions dialog.
PERSONAL WEB SERVER (PWS)

• PWS
  – Scaled-down version of IIS
  – Intended for personal computers (PC)
  – Ideal for educational institutions, small businesses and individuals
  – Does not require PC to be used exclusively as Web server

• Personal Web Manager (Fig. F)
  – Administration program for PWS
  – Place documents to be requested in default directory or virtual directory
    • Default: C:\inetpub\wwwroot
    • Virtual: alias for existing directory on local machine
Figure F: Personal Web Manager dialog.
PERSONAL WEB SERVER (PWS)

- Edit Directory (Fig. G)
  - **Directory** field
    - Enter directory path that contains Web documents
  - **Alias** field
    - Enter name to virtual directory
  - **Access** section
    - Select security level for virtual directory
    - **Read** allows users to read and download files
    - **Execute** allows applications to run in directory
    - **Scripts** allows scripts to run in directory
    - **Read** and **Scripts** selected by default
Figure G: Creating a virtual directory in PWS in Edit Directory.
• Apache Web Server
  – Maintained by Apache Software Foundation
  – Currently most popular Web server
    • Stable
    • Efficient
    • Portable
  – Successively select Start → Programs → Apache httpd Server → Control Apache Server → Start (Figure H)
Figure H : Starting the Apache Web server.
SYSTEM ARCHITECTURE

- Client-Server Architectures
- Client tasks:
  - Provide a way for users to submit queries
  - Run applications that use the results of queries
  - Display results of queries
- Server tasks:
  - Implement a data manipulation language, which can directly access and update the database
- A two-tier system has clients that are connected directly to the server.
SYSTEM ARCHITECTURE

- Problems with a two-tier system:
  - Because the relative power of clients has grown considerably, we could shift processing to the client, but then maintaining data integrity is difficult
- Web server part of multi-tier application
  - Divide functionality into separate tiers
  - Logical groupings of functionality
  - Can reside on same computer or on different computers
- Following diagrams illustrates 3-tier application
SYSTEM ARCHITECTURE

2 Tier

User

Application Server

Database Server
SYSTEM ARCHITECTURE

• Information tier
  – Referred to as data tier or bottom tier
  – Maintains data for application
  – Stores data in relational database management system

• Middle tier
  – Implements business logic and presentation logic
  – Controls interactions between application clients and application data
  – Acts as intermediary between data in information tier and application clients
Middle tier (cont)

- Controller logic
  - Processes client requests from top tier
  - Retrieves data from database
- Presentation logic
  - Processes data from information tier
  - Presents content to client
- Business logic
  - Enforces business rules
    - Dictates how clients can access application data and how applications process data
  - Ensures data validity before updating database
Client tier
- Referred to as top tier
- Application’s user interface
- Users interact with application through user interface
- Interacts with middle tier to make requests and to retrieve data from information tier
- Displays data to user