Web Design Fundamentals

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Abstract

As the Internet and the World Wide Web expand for both business and personal Web sites, so does the demand for competent Web developers.

Web pages can be both simple and static, or they can be much more complex and dynamic with user-interactivity features. Presented is a summary of the basic skills and knowledge that a Web manager or Web developer should have.

Web Design Fundamentals

The use of the Internet and World Wide Web has exploded in exponential growth over the past decade. According to Worsley (2000), available Web pages on the Internet number in the billions, with Web sites having single pages to Web sites having thousands of pages. There are many opportunities for Web Developers, and the knowledge required should be commensurate with the complexity of the projects they design or maintain.

History of the Internet

The development of the Internet dates from 1969. The Advanced Research Projects Administration (ARPA) wanted to develop a distributed, decentralized network, so that communications could be maintained in the aftermath of a nuclear attack. Up until around 1969, networks had been point-to-point networks. The desire to have a distributed, decentralized network was important so that if one node of the system was down, information could still travel through the available nodes. The network that ARPA created was termed *ARPANET*, and eventually became the *Internet*.

The adoption of Transmission Control Protocol/Internet Protocol (TCP/IP) as the Internet standard protocol in 1983 heralded the coming to full maturity of the Internet (Dilligan, 1998). At that time, there were several hundred nodes to the Internet, but all shared an affiliation with the military or ARPA. In 1986, access to the Internet was allowed to all universities, and shortly thereafter, to the public at large. By 1990, the number of sites on the Internet had grown to over three hundred thousand. (Dilligan, 1998).

Difference between the Internet and the World Wide Web

The terms *Internet* and *World Wide Web,* although often used synonymously, are different. The term *Internet* is a nominalized abbreviation of *InterNetworking,* and came into use in 1982. The Internet identifies not a single network, but a vast network of networks. These networks communicate with each other via the existing telecommunications networks. The Internet offers several different services including e-mail and File Transfer Protocol (FTP). The World Wide Web, commonly known as "the Web," is the largest and fastest growing area of the Internet (Worsley, 2000). The Web uses the network of the Internet to access and link Web sites. The Internet essentially provides the infrastructure over which the Web is able to operate (Figure 1). The Web is a way of organizing information so that any workstation or computer around the world can access it through the Internet via any means of connectivity.


```
_____
               Figure 1
  All systems can connect to the Internet
```
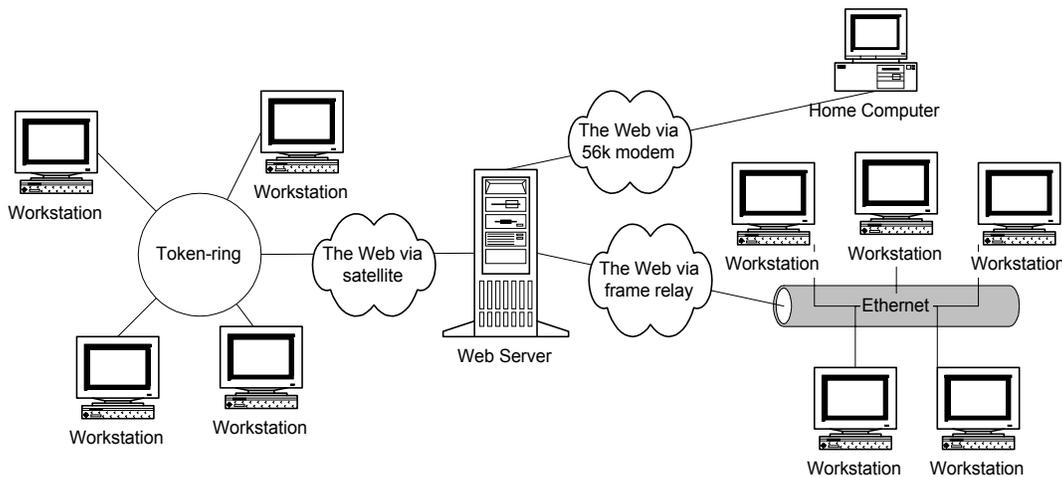
Web features

       The first Web pages contained little more than text and very basic formatting. Today, there are many different things that can be on a Web page, including downloadable files, programs, graphics, hypertext links, text, interactive animations, sound sequences, video clips, and photographs. Five broad descriptive features describe the Web and its capabilities (DiNucci & Giudice & Stiles, 1997): (a) it is based on hypertext, (b) it supports all kinds of media, (c) it can be interactive, (d) it is nonlinear, and (e) its pages can be designed.

       It is based on hypertext   The rules that specify how to access and transfer files over the Web are called Hypertext Transfer Protocol (HTTP). HTTP is an application-level protocol, and allows systems to be built independently of the data being transferred. The term *hypertext* indicates that any text in a Web document can be made to link to any other document that is connected to the Internet. *Hyperlink* is the term used to identify text that links to another location on the Web.

       It supports all types of media The basic format for text that is published on the web is ASCII[1]. The ASCII format is modified with Hypertext Markup Language, to organize and structure data on the user's screen. Browser software communicates with Web servers to interpret data received from them and allows users to open commonly used formats and to move around through the Web. If a particular format cannot be read by the browser, a free, downloadable helper program (or "plug-in") is often available. The helper program is an application that is launched by the browser to display files that it can't read by itself.

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[1] ASCII is an acronym for American Standard Code for Information Interchange. ASCII contains only text, with no formatting information (DiNucci & Giudice & Stiles, 1997).

It can be interactive   Unlike books and television, the Web as a medium allows interactive communication. Publications on the Web can respond to input by the user. The input from the user can be simple, such as typing in a phone number on a form. Or, the input from a user can be more detailed, such as writing a book review online. On certain Web pages, users have the ability to get precise information by citing preferences. For example, a user wanting to book an airlines flight on the Web can submit departure and return dates and can receive available flight information from the databases that house the information.

It is nonlinear Instead of a linear layout that is typical of a textbook (Figure 2), hyperlinks on Web pages allow users are able to choose their own path through the available information. There may be reasons to have a user directed linearly from page to page, such as with an online PowerPoint presentation, or to follow the sequence of several Web pages required to register online with an e-commerce company. But users typically appreciate as much freedom as is possible to move about in whatever fashion they desire. It is therefore important that designers create Web pages that encourage a visitor to stay.

```
    _____
            Figure 2
    Nonlinear vs. Linear Design
```
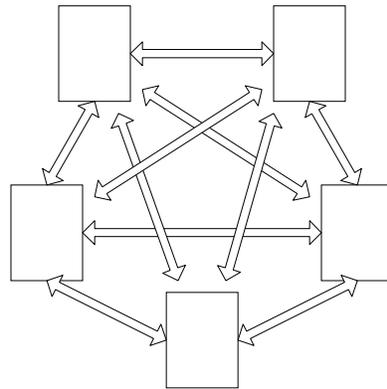

Nonlinear design (e.g., hyperlinked document)

Linear design (e.g., textbook)

Its pages can be designed   Web designers have many options available for creating content on a Web site. It is worthwhile to create a display with content that is attractive to users. Modifications and improvements can be made as often as are necessary.

Process of Web design

DiNucci, Giudice and Stiles (1997) describe three phases of the process of Web development: design, production, and deployment. A fourth phase, maintenance, should also be included.

Design The design phase (Table 1) can also be thought of as the *planning* stage, because meticulous planning is critical to the success of the project, especially if the project is a large one. Tables 1 through 4 list team members typical of a large project and

identify whether or not each plays a *responsible* role, a *consulting* role, or no role, during

that particular phase of building a Web site.

Table 1			
Design phase of Web development process			
(Team member below)	**Goal definition**	**Information architecture**	**Interface design**
Client	Responsible	Consulting	Consulting
Producer	Responsible	Responsible	Responsible
Information Architect	Consulting	Responsible	Consulting
Interface designer			Responsible
Multimedia artist			Responsible
Writer/Editor		Consulting	
Programmer		Consulting	Consulting
Production Engineer			
Webmaster or Site engineer			

The producer of the Web site is the one individual who assumes a *responsible* role

throughout the entire project. The producer is also the liaison between the client and the

production team.

The first step in the design phase is to clearly define the goals of the project.

There will obviously be at least one primary goal for every project, but there may also be

secondary, tertiary, and quaternary goals as well.

The gathering of requirements should also include an understanding of the

demographics of the expected target audience. Understanding the target audience will

dictate the appearance of the site. Younger audiences often prefer flashier sites with

colorful graphics than do older and more mature audiences who prefer a more

information-oriented site (Hubbell, 2000).

The second and third steps of the design phase are *information architecture* and

interface design. It is during these two steps that information is gathered and organized

into meaningful units. Diagrams—either handwritten or using design software—may
make it easier to organize the structure of the Web site.

Production

The first step of the production phase (Table 2) is when the actual content of the
Web site is written and organized on Web pages. According to Hubbell (2000), content is
the most important factor that will keep people coming back to a Web site. Points to
consider when creating the content of a Web site include *readability, accuracy,* and
originality. Being r*eadable* means that it is easy for the user to see what is important. A
home page with a hundred hyperlink choices may be more readable if those choices are
categorized into fewer hyperlinks. Being *readable* also means that the content is relevant
to the goals of the Web site. For instance, an animated graphic that seems unrelated to the
content of the site may confuse the viewer.

Table 2 Production phase of Web development process			
(Team member below)	**Content creation**	**Scripting and programming**	**Testing**
Client	Consulting		
Producer	Responsible	Responsible	Responsible
Information Architect			
Interface designer	Responsible		
Multimedia artist	Responsible		
Writer/Editor	Responsible		
Programmer	Consulting	Responsible	Responsible
Production Engineer		Responsible	Responsible
Webmaster or Site engineer			Responsible

A Web site that is *accurate* has data that is current and updated. *Accuracy* also
means that the data is timely. Advertising an event may be accurate in that all of the facts
are correct, but if the event occurred l0 days ago, then it is not timely information.

Accuracy also means that the content has been proofread for spelling and grammar errors. Small spelling and grammar errors can make a company seem unprofessional.

A Web site that displays *originality* shows uniqueness. It would not help a company to have a Web site that is a copycat of another site, especially if the goals of each company are different. A good designer or design team can ensure that a new Web site is created that is original and is reflective of the goals of the company.

Any scripting or programming that is needed is accomplished during the design phase, and may occur in conjunction with the content creation step. Programmers may be needed to create back-end[2] applications so that forms and online questionnaires can be processed. Scripts are lists of instructions for the computer to follow in response to a user's input, and can be used to perform calculations, or return a file as a result of that user's input (Stein, 1997).

Regarding the layout of Web pages, Greenspun (1999) suggests that the pages be continuous as much as is reasonably possible. Users can be frustrated when they have to try to search for data on multiple pages, and can easily get lost when too many wrong hyperlink choices are made. Users do not mind scrolling down a page when relevant material is included on that page. The exception to having long continuous pages is the home page, where it is preferable to have all introductory data and main hyperlink choices visible on one screen (L. Merkin, personal communication, May 1, 2001).

The testing step of the design phase is very important. It is during this step that all hyperlinks are tested for accuracy. The designer and production engineer also make sure that all HTML files, graphics, animations, and images are in the proper directories and

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[2] Back-end applications are programs that receive data from a Web server and do some form of processing based on that data (Ambegaonkar, 1997).

subdirectories. Web design companies may or may not host the client's project on their

own Web server. If they don't host the client's project, they usually use what is called a

staging server (DiNucci, Giudice, & Stiles, 1997), which is a temporary server used to

fully test the finished Web site.

Deployment   When the project is ready for deployment (Table 3), the client must

first make sure that they have secured a domain name. The domain name is a name by

which an Internet server is known (e.g., Sears.com). The first part of the domain name

provides a unique name for the company. The second part of the domain name identifies

the type of site (e.g., .com for commercial; .edu for educational institutions; .gov for

governmental agencies). Once it has been determined that the site works as expected, it is

then uploaded (i.e., published) to the host Web server.

Table 3 Deployment phase of Web development process		
(Team member below)	**Publishing**	**Publicizing**
Client	Consulting	Responsible
Producer	Responsible	Responsible
Information Architect		
Interface designer		
Multimedia artist		
Writer/Editor		
Programmer		
Production Engineer		
Webmaster or Site engineer	Responsible	Consulting

The *publicizing* step of the deployment phase is the responsibility of both the

client and the producer. The client is responsible in the sense that they pay for any

publicizing costs, and they decide what type (viz., mediums) of publicizing they want.

While not an advertising expert, the producer is responsible for the parts of publicizing

related to Web exposure. The producer and the Webmaster will make sure that the Web

address of the site is publicized on all of the major Web search engines (e.g., Lycos, Yahoo, Webcrawler).

Maintenance   While creating and deploying a Web site may take only a few weeks to accomplish, maintaining a Web site will continue on for as many months or years as the site is active. Table 4 indicates that the Webmaster or site engineer is the only responsible team member at this phase of the Web development process. All other team members will have gone on to other projects. The Webmaster may be technically proficient to handle all future improvements or modifications, or some of the other team members may need to be called back to work on an as-needed basis. During the maintenance phase, the client should continue to assume a consulting role for at least two reasons. The first reason is because customers and employees may make suggestions that need to be passed onto the Webmaster. Secondly, changing business operations may require modifications, improvements, or updates to the structure of the Web site.

Table 4 Maintenance phase of Web development process	
(Team member below)	
Client	Consulting
Producer	
Information Architect	
Interface designer	
Multimedia artist	
Writer/Editor	
Programmer	
Production Engineer	
Webmaster or Site engineer	Responsible

Uniform Resource Locator

A Uniform Resource Locator (URL) is simply an address on the Web, and specifically identifies each document's location. There are numerous interpretations of the URL naming scheme. Five of those interpretations are listed below:

- <Service Type>://<Machine IP Address>/<File Path Name> (Dilligan, 1998)

- protocol://hostname:port/path/to/the/resource (Stein, 1997).

- scheme://host/path (Spainhour & Quercia, 1996).

- protocol://Domain name/Path name (Smith & Bebak, 1996).

- protocol identifier://host name/path name/specific file name (Niederst, 1999).

Regardless of the variations of the URL naming scheme, all point to the format as

exemplified in the example of the Web page published by the American Toy Fox Terrier

Club to list its Code of Ethics: http://www.atftc.com/ethics.html.

HTML Programming

Description of HTML   Hypertext Markup Language (HTML) was

developed in 1989 and makes the *Web* possible. The "markup" aspect of HTML dates

from the 1960's and the subsequent development of Structured General Markup

Language (SGML) as a standard for the communication of documents across different

proprietary systems. HTML allows a user whose computer has a Linux operating system

to "read" the same information that users with PCs and Macintoshes can. However, the

way that a computer "reads" or "presents" the information depends upon which browser

it uses. According to Niederst (1999), the biggest challenge in Web design is dealing with

the variety of browsers, each with its own implementation of HTML. Therefore, most

Web designers base their designs on the functionality of Microsoft's Internet Explorer

and Netscape's Navigator, the two most popular browsers.

Hubbell (2000) describes HTML as a "series of elements and attributes that are

used to suggest effects and where those effects should begin and end." HTML

instructions are know as tags, and are placed precisely to render the desired effect.

Formatting tags, for instance, define the beginning and the ending of a formatting effect.

For instance, to add bold a single word, <B> precedes the word and </B> immediately

follows the word to indicate that the bolding effect ends.

A Web document has the following basic ordering of elements:

```
<HTML>
<HEAD>
<!--   -->
<TITLE>  </TITLE>
</HEAD>
<BODY>

</BODY>
</HTML>
```

The <HTML> element indicates the start of an HTML document. The very end of

the HTML document uses the </HTML> element to signify that there are no more

HTML instructions.

The <HEAD> element is used to start the heading section of an HTML document, which

includes information that is read and processed, but not displayed as a part of the page

body by a Web browser (Hubbell, 2000). The end of the heading section is identified

with </HEAD>.

Comments can be written between <!-- and -->, and are useful to keep track of a

certain version when working on different versions. Also, comments are helpful to other

developers who may add additional elements to the Web page. The comments are not

visible by a browser.

The title of a document is placed between <TITLE> and </TITLE> and contains

text that will appear on the top bar of a browser. It is also the text that is saved when

someone bookmarks a page with a browser.

The <BODY> element indicates the beginning of the content of the Web page that will be visible to the browser. It is in this section that the user sees things including text, graphic images, downloadable files, hyperlinks, and pictures. The body section ends with </BODY>.

Sample HTML document

Consider the following sentence as it would appear on a user's computer screen through use of a browser:

My dog's name is *Sugar Belle*.

The dog's name is in italics. To achieve the italics effect, the HTML instruction for formatting text in italics is written with the text as follows:

My dog's name is <I>Sugar Belle</I>.

The part to be italicized is bordered by <I> and </I>. Thus, to make the entire sentence have the italics effect, the HTML code would be written as:

<I>My dog's name is Sugar Belle</I>.

For a detailed example that includes several more HTML instructions, consider the following example as it would appear on a Web page:
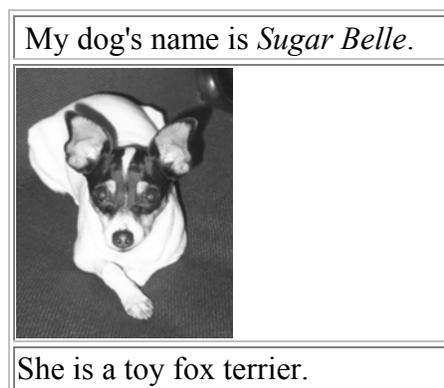
The HTML code for the example above would be written as follows. (Note: the text that would appear on the Web page is in black ink to distinguish it from the rest of the HTML coding. Also, since the title would be visible on the computer screen on the top bar of the browser, it is also written in black ink in this example.)

```
<HTML>
<HEAD>
<!--This is my first version, and is a very simple HTML example.-->
<TITLE>Sugar Belle</TITLE>
</HEAD>
<TABLE BORDER="0" WIDTH="35%">
 <TR>
  <TD WIDTH="100%">
   <P ALIGN="left">My dog's name is <I>Sugar Belle</I>.</P>
  </TD>
 </TR>
 <TR>
  <TD WIDTH="100%">
   <P ALIGN="left"><IMG BORDER="0" SRC="C:/Pictures/SugarBelle.gif" WIDTH="108"
HEIGHT="136"></TD>
 </TR>
 <TR>
  <TD WIDTH="100%">
   <P ALIGN="left">She is a toy fox terrier.</P>
  </TD>
 </TR>
</TABLE>
</HTML>
```

The code starts out with a tag that identifies itself as an HTML document (i.e., <HTML>). The next section of the HTML document is the heading section, which is identified with the <HEAD> tag. In the heading section, information is read and processed, but is not displayed as a part of the Web page. My comment identifying this as my first version is written in the heading section by using the <!-- tag to begin the comment and --> to end the comment. Also within the heading section is the title "Sugar Belle" that will appear on the top bar of the browser. The heading section closes with </HEAD>.

The first item after the heading section was the reference to the table. A table was included to help separate the contents of each cell. The properties of the table are

referenced, as well as the left alignment of the contents of each of the three cells of the

table

The first section of the HTML document itself that that is visible to the user (not

including the title that appears on the browser bar) is the sentence My dog's name is

Sugar Belle. The sentence begins with <P> and ends with </P>, which identify it as a

paragraph.

The next item from the example is a graphic image in GIF format[3]. The image

border value equals "0" since there is no visible border around the image. The *Pictures*

directory where the file resides on my hard drive is also identified. Upon uploading a file

to an actual Web site, it is important to make sure that the image is placed in the proper

subdirectory on the server. The last part referencing the graphic image is the size of the

image. The height and width can be modified as necessary so that the image's size

compliments the overall layout of the page.

Below the graphic image is another line of text which is bordered by paragraph

identifier tags <P> and </P>. The next section of HTML code identifies the end of the

table cell, and the end of the table itself (</TABLE>). Lastly, the HTML document closes

with </HTML>.

Web pages are visual in nature, so it is important to have them be visually

appealing. Four changes have altered the original example to render the modified version.

---

[3] On the Web, Graphics Interchange Format (GIF) and (Joint Photographic Experts Group) JPEG are the
two graphic image types supported by most Web browsers (Ambegaonkar, 1997). Most Web designers use
JPEG for photographs and GIF for everything else (e.g., logos) (Smith & Bebak, 1996).

My dog's name is *Sugar Belle*.

She is a toy fox terrier.

The first change is that the borders of the table were set to a value of "0" to make them invisible. While a table may be useful to separate sections of a Web page, it is not always necessary to have it borders visible. The table is still present to separate the contents, but its borders are hidden from view. The second change is that the contents of each cell were centered within that cell, thereby rendering a more balanced appearance. The third change made was that the words "toy fox terrier" were hyperlinked to a document on the Web that describes that particular breed of dog. An interested viewer of the Web page could find out more about the toy fox terrier breed by clicking on the hyperlink and being sent to the Web site of the American Toy Fox Terrier Club: http://www.atftc.com. The fourth change was that a background color was added to the top and bottom cells of the table. The HTML code of the modified version is shown below. Note also that my comment has changed in order to identify this as my second version.

```
<HTML>
<HEAD>
<!--This is my second version of an HTML example.-->
<TITLE>Sugar Belle</TITLE>
</head>
<TABLE BORDER="0" WIDTH="35%">
 <TR>
  <TD WIDTH="100%" BGCOLOR="#99FFCC">
   <P ALIGN="CENTER">My dog's name is <I>Sugar Belle</I>.</P>
  </TD>
 </TR>
```

```
 <TR>
   <TD WIDTH="100%">
     <P ALIGN="CENTER"><IMG BORDER="0" SRC="C:/Pictures/SugarBelle.gif" WIDTH="108"
HEIGHT="136"></TD>
 </TR>
 <TR>
   <TD WIDTH="100%" BGCOLOR="#99FFCC">
     <P ALIGN="CENTER">She is a <A HREF="http://www.atftc.com">toy
     fox terrier</A>.</P>
   </TD>
 </TR>
</TABLE>
</HTML>
```

Other programming possibilities

Even though HTML is a formatting language that lays out text, graphics, and

hypertext links, it may not be enough to provide every feature on a Web site that is

needed. When static documents are not sufficient for the needs of a company's Web site,

tools such as Java, JavaScript, and Common Gateway Interface (CGI) may be used

(Spainhour & Quercia, 1996).

Java   Web pages can be spruced up by embedding Java programs that activate

them. Java adds active content to Web pages so that an individual can interact with the

page but not be burdened with the long download times required by older active Web

technologies (Perry, 1998). Java is an object-oriented language, combining data with the

functions for processing the data. Java is platform-independent (Laudon & Laudon,

2000), thereby allowing a PC, a Macintosh, and a UNIX system to share the same Java

application.

Java can be used to create small programs called *applets*. Java applets are often

used to provide interactive capabilities for Web pages, and they can also be used to create

animated cartoons or to insert real-time news tickers on a Web page (Laudon & Laudon,

2000).

Scripting languages   In addition to HTML and Java, most browsers can also support special scripting languages like JavaScript and VBScript. These scripting languages allow a programmer to embed controlling code inside HTML that interacts with and reacts to other objects on a Web page. JavaScript is similar to the Java programming language, and VBScript is similar to the Visual Basic programming language. According to Perry (1998), the scripting languages give enhanced analysis power to the code behind Web pages.

XML   XML stand for extensible Markup Language, and is a general-purpose language that is designed to improve delivery of Web documents. Whereas HTML is used to create display formatting for a Web document, XML is used for creating structured documents in which data can be manipulated (Laudon & Laudon, 2000). XML can be used for both Web and non-Web applications.

ActiveX   Microsoft's ActiveX is sometimes used instead of Java for creating interactivity on a Web page. ActiveX is a set of controls that enables programs or other objects such as charts, tables, or animations to be placed within a Web page. Unlike Java, ActiveX is not platform-independent, and was designed for use within a Windows software environment.

Active Server Pages   Unlike client-side scripting, Active Server Pages (ASP) allows for impressive user-interactive Web site creation by combining programming code and standard HTML for use on servers. ASP must be supported on the server to function, and free software for this purpose is available on the Web. Many large Web sites (e.g., Dell.com, HotBot.com, Buy.com) use ASP to display dynamic Web content, The most commonly used scripting language for creating ASP is VBScript.

Besides interactive Web sites, ASP can be used to (a) create personalized content for

users, (b) connect a Web site to databases, (c) collect user input and automatically

process forms, (d) read and write files on a server, and (e) write Structured Query

Language (SQL) statements to add database-driven content to Web sites (Mitchell &

Atkinson, 2000).

Common Gateway Interface   The technology of Common Gateway

Interface (CGI) makes computation of dynamic Web pages possible. CGI allows a Web

server to associate some URLs with computer programs instead of static documents.

When a user's Web browser requests one of the special URLs, the server runs the

computer program associated with it and sends the output from the program back to the

user. A CGI program can access data and perform computations. It can show current

stock prices, display the current temperature, and keep a visual counter of how many

users have visited a certain Web page. A CGI program can store information on a disk,

and can also keep a history (Comer, 1997).

Conclusion

With the Internet becoming an integral component of both business and pleasure,

there is a high demand for Web developers. Sullivan-Trainor (1996) predicted that "as the

Web's content, site count, and expectations of its users increase, so then must the Internet

itself respond to each of these changes." Thus, as the Internet evolves, there are growing

opportunities for Web developers.

Management in the world of commerce should also recognize the way that

business evolves as the Internet is increasingly used to conduct business operations. The

Web can alter the way companies interact within the industry and with respect to

consumers. Failure to recognize the changes that Internet marketplace activities can offer can add up to lost opportunity. As the Internet and the Web mature and are directed towards more e-business implementations, they will change the companies that rely on them.

Besides the growth for business purposes, personal uses of the Internet are also evolving. Greenspun (1999) discusses the importance of the emergence of online communities, where users are allowed to express opinions, offer advice and suggestions, post questions, and discuss ideas with other users. An online community is helpful when people are not able to interact face-to-face.

With the expansive growth of the Internet in our everyday lives, being able to create dynamic, user-responsive Web sites is one of the most in-demand technical skills. Not only is the dynamic Web design market a hot market, but it is also a challenging and interesting field to work in.

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