



CS3120 Web Programming

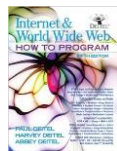
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Designed By: Dabin Ding
UCM

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Books and reference materials

- ▶ Books:
 - *Internet & World Wide Web How to Program* (5th ed.), Deitel, Deitel, and Deitel, Prentice Hall, 2012.



- ▶ Online materials:
 - W3schools.com online web tutorial
 - A lot of videos and tutorials

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Chapter 1

Introduction to Computers and the Internet

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1.1 Introduction

- ▶ **Client-side programming** technologies are used to build web pages and applications that are run on the *client* (i.e., in the browser on the user's device).
- ▶ **Server-side programming**—the applications that respond to requests from client-side web browsers, such as searching the Internet, checking your bank-account balance, bidding on an eBay auction and ordering concert tickets.

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1.1 Introduction (cont.)

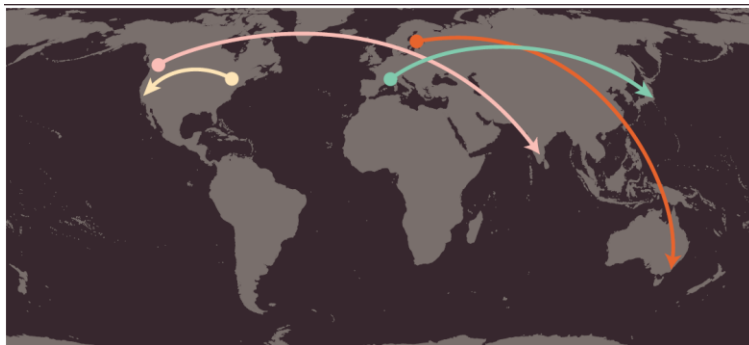
- ▶ Web pages run on smartphones and tablet computers
- ▶ The technologies are evolving rapidly. Browser support varies.
 - *Not every feature discussed in this book will render properly in every browser.*

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1.1 Introduction

How the Web Works



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1.1 Introduction

How the Web Works

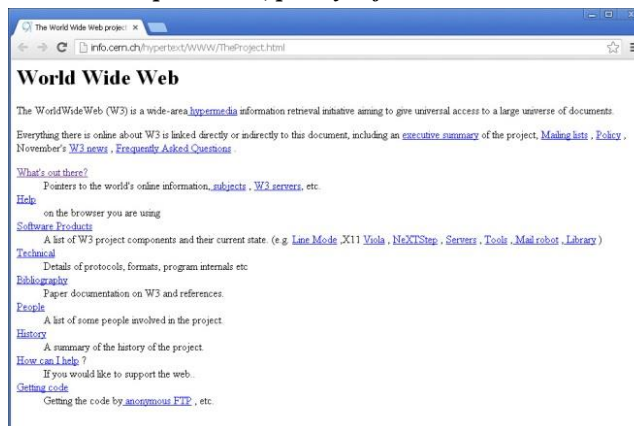


1. When you connect to the web, you do so via an Internet Service Provider (ISP). You type a domain name or web address into your browser to visit a site; for example: **google.com**, **bbc.co.uk**, **microsoft.com**.
2. Your computer contacts a network of servers called Domain Name System (DNS) servers. These act like phone books; they tell your computer the IP address associated with the requested domain name.
An IP address is a number of up to 12 digits separated by periods / full stops. Every device connected to the web has a unique IP address; it is like the phone number for that computer.
3. The unique number that the DNS server returns to your computer allows your browser to contact the web server that hosts the website you requested. A web server is a computer that is constantly connected to the web, and is set up especially to send web pages to users.

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1.2 A Look Back in Website Design

Early 1990s: dial-up modems, purely informational





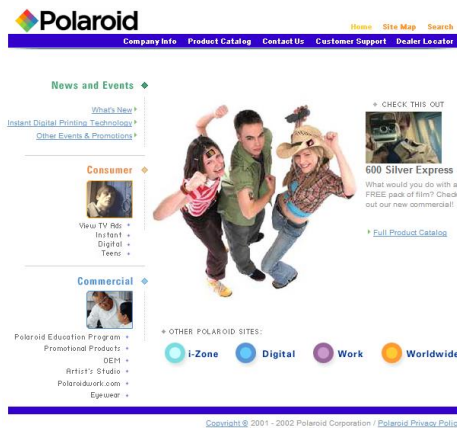
1.2 A Look Back in Website Design

Mid to Late90s: GIFs, Flash



1.2 A Look Back in Website Design

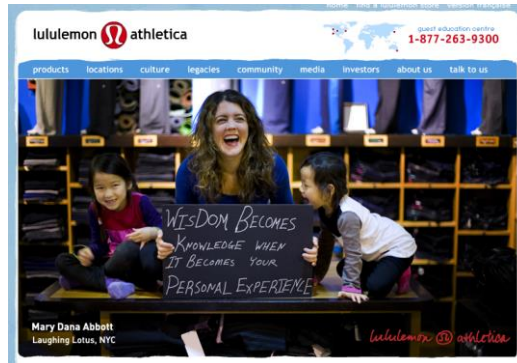
Early 2000s: support for CSS





1.2 A Look Back in Website Design

Late 2000s: Social, moving toward modern web



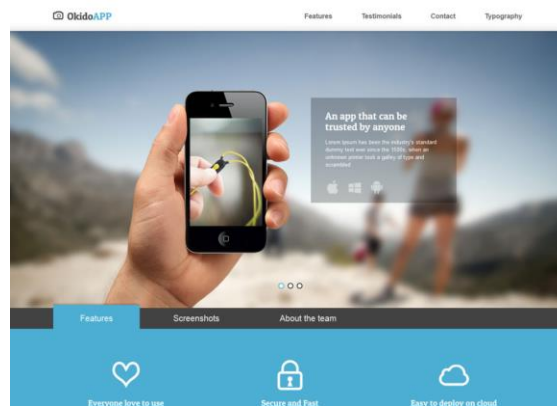
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1.2 A Look Back in Website Design

*Today: minimalism, flat graphics, **mobile** friendly, blended typography, and large background images*

Responsive design





1.2 A Look Back in Website Design

Today: Single page application (SPA)



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Apple.com 1996–2016 TIME LAPSE: 2
Decades in 3 Minutes



Apple.com
TIME LAPSE
1996-2016.
Two decades.
3 minutes.



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1.3 HTML5, CSS3, JavaScript

HTML5

- ▶ **HTML** (HyperText Markup Language) is a special type of computer language called a *markup language* designed to specify the *content* and *structure* of web pages (also called documents) in a portable manner.
- ▶ **HTML5**, now under development, is the emerging version of HTML.
- ▶ HTML will render appropriately across the extraordinary range of devices connected to the Internet

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1.3 HTML5, CSS3, JavaScript (cont.)



▶ **Cascading Style Sheets (CSS)** are used to specify the *presentation*, or styling, of elements on a web page (e.g., fonts, spacing, sizes, colors, positioning).

▶ CSS is *independently* of web page's content and structure.

▶ Why **separate**?

▶ CSS3 is the current version of CSS under development.


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1.3 HTML5, CSS3, JavaScript

JavaScript

- ▶ JavaScript helps you build *dynamic* web pages (i.e., pages that can be modified “on the fly” in response to *events*, such as user input, time changes and more) and computer applications.
- ▶ It enables you to do the client-side programming of web applications.
- ▶ JavaScript is a portable scripting language. Programs written in JavaScript can run in web browsers across a wide range of devices.




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1.3 HTML5, CSS3, JavaScript (cont.)

Web Browsers and Web-Browser Portability

- ▶ Ensuring a consistent look and feel on client-side browsers is one of the great challenges of developing web-based applications.
- ▶ Currently, a standard does not exist to which software vendors must adhere when creating web browsers.
- ▶ Although browsers share a common set of features, each browser might render pages differently.

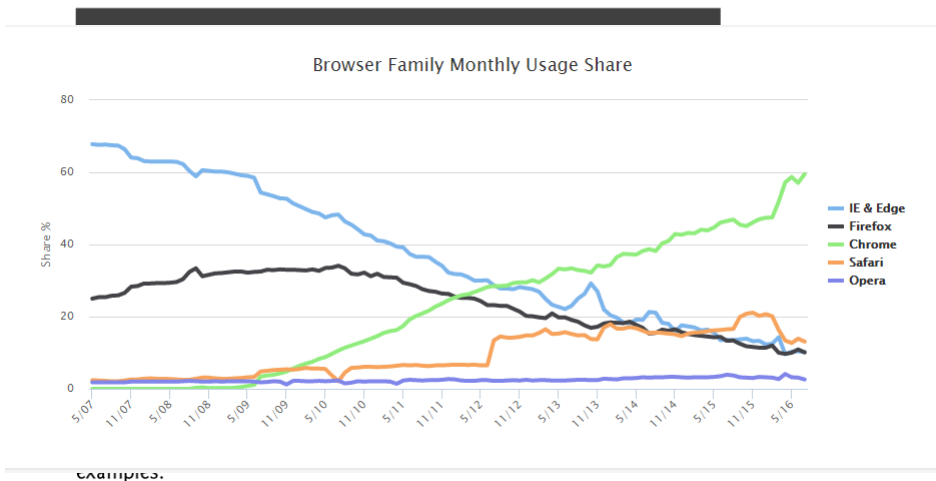


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1.3 HTML5, CSS3, JavaScript (cont.)

- ▶ Browsers are available in many versions and on many different platforms (Microsoft Windows, Mac, Linux, UNIX, etc.).
- ▶ Vendors add features to each new version that sometimes result in cross-platform incompatibility issues.
- ▶ It's difficult to develop web pages that render correctly on all versions of each browser.





Portability Tip 1.1

The web is populated with many different browsers, including many older, less-capable versions, which makes it difficult for authors and web-application developers to create universal solutions. The W3C is working toward the goal of a universal client-side platform (<http://www.w3.org/2006/webapi/admin/charter>).

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1.3 HTML5, CSS3, JavaScript, (cont.)

- ▶ Support for HTML5, CSS3 and JavaScript features varies by browser.
- ▶ The *HTML5 Test* website (<http://html5test.com/>) scores each browser based on its support for the latest features of these evolving standards.

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1.2 The Internet in Industry and Research (cont.)



- ▶ The follow figures provide a sample of some of the exciting ways in which computers and the Internet are being used for social good.
- ▶ And gives some examples of how computers and the Internet provide the infrastructure to communicate, navigate, collaborate and more.



Name	Description
AMBER™ Alert	The AMBER (America's Missing: Broadcast Emergency Response) Alert System is used to find abducted children. Law enforcement notifies TV and radio broadcasters and state transportation officials, who then broadcast alerts on TV, radio, computerized highway signs, the Internet and wireless devices. AMBER Alert recently partnered with Facebook, whose users can "Like" AMBER Alert pages by location to receive alerts in their news feeds.
World Community Grid	People worldwide can donate their unused computer processing power by installing a free secure software program that allows the World Community Grid (www.worldcommunitygrid.org) to harness unused capacity. This computing power, accessed over the Internet, is used in place of expensive supercomputers to conduct scientific research projects that are making a difference, providing clean water to third-world countries, fighting cancer, growing more nutritious rice for regions fighting hunger and more.

Fig. 1.2 | Projects that use computers and the Internet for social good.





Name	Description
Cloud computing	Cloud computing allows you to use software, hardware and information stored in the “cloud”—i.e., accessed on remote computers via the Internet and available on demand—rather than having it stored on your personal computer. Amazon is one of the leading providers of public cloud computing services. You can rent extra storage capacity using the Amazon Simple Storage Service (Amazon S3), or augment processing capabilities with Amazon’s EC2 (Amazon Elastic Compute Cloud). These services, allowing you to increase or decrease resources to meet your needs at any given time, are generally more cost effective than purchasing expensive hardware to ensure that you have enough storage and processing power to meet your needs at their peak levels. Business applications (such as CRM software) are often expensive, require significant hardware to run them and knowledgeable support staff to ensure that they’re running properly and securely. Using cloud computing services shifts the burden of managing these applications from the business to the service provider, saving businesses money.

Fig. 1.3 | Examples of computers and the Internet in infrastructure. (Part 1 of 3.)



Name	Description
GPS	Global Positioning System (GPS) devices use a network of satellites to retrieve location-based information. Multiple satellites send time-stamped signals to the GPS device, which calculates the distance to each satellite based on the time the signal left the satellite and the time the signal arrived. This information is used to determine the exact location of the device. GPS devices can provide step-by-step directions and help you easily find nearby businesses (restaurants, gas stations, etc.) and points of interest. GPS is used in numerous location-based Internet services such as check-in apps to help you find your friends (e.g., Foursquare and Facebook), exercise apps such as RunKeeper that track the time, distance and average speed of your outdoor jog, dating apps that help you find a match nearby and apps that dynamically update changing traffic conditions.
Robots	Robots can be used for day-to-day tasks (e.g., iRobot’s Roomba vacuum), entertainment (e.g., robotic pets), military combat, deep sea and space exploration (e.g., NASA’s Mars rover) and more. RoboEarth (www.robearth.org) is “a World Wide Web for robots.” It allows robots to learn from each other by sharing information and thus improving their abilities to perform tasks, navigate, recognize objects and more.

Fig. 1.3 | Examples of computers and the Internet in infrastructure. (Part 2 of 3.)





Name	Description
E-mail, Instant Messaging, Video Chat and FTP	Internet-based servers support all of your online messaging. E-mail messages go through a mail server that also stores the messages. Instant messaging (IM) and Video Chat apps, such as AIM, Skype, Yahoo! Messenger and others allow you to communicate with others in real time by sending your messages and live video through servers. FTP (file transfer protocol) allows you to exchange files between multiple computers (e.g., a client computer such as your desktop and a file server) over the Internet using the TCP/IP protocols for transferring data.

Fig. 1.3 | Examples of computers and the Internet in infrastructure. (Part 3 of 3.)



Name	Description
iTunes and the App Store	iTunes is Apple's media store where you can buy and download digital music, movies, television shows, e-books, ringtones and apps (for iPhone, iPod and iPad) over the Internet. Apple's iCloud service allows you to store your media purchases "in the cloud" and access them from any iOS (Apple's mobile operating system) device. In June 2011, Apple announced at their World Wide Developer Conference (WWDC) that 15 billion songs had been downloaded through iTunes, making Apple the leading music retailer. As of July 2011, 15 billion apps had been downloaded from the App Store (www.apple.com/pr/library/2011/07/07Apples-App-Store-Downloads-Top-15-Billion.html).
Internet TV	Internet TV set-top boxes (such as Apple TV and Google TV) allow you to access an enormous amount of content on demand, such as games, news, movies, television shows and more.

Fig. 1.4 | Examples of computers and the Internet in entertainment. (Part 1 of 2.)





Name	Description
Game programming	Global video game revenues are expected to reach \$65 billion in 2011 (uk.reuters.com/article/2011/06/06/us-videogames-factbox-idUKTRE75552I20110606). The most sophisticated games can cost as much as \$100 million to develop. Activision's <i>Call of Duty 2: Modern Warfare</i> , released in 2009, earned \$310 million in just one day in North America and the U.K. (news.cnet.com/8301-13772_3-10396593-52.html?tag=mnco1;txt)! Online <i>social gaming</i> , which enables users worldwide to compete with one another over the Internet, is growing rapidly. Zynga—creator of popular online games such as <i>Farmville</i> and <i>Mafia Wars</i> —was founded in 2007 and already has over 265 million monthly users. To accommodate the growth in traffic, Zynga is adding nearly 1,000 servers each week (techcrunch.com/2010/09/22/zynga-moves-1-petabyte-of-data-daily-adds-1000-servers-a-week/)!

Fig. 1.4 | Examples of computers and the Internet in entertainment. (Part 2 of 2.)



1.5 Web Basics

- ▶ In its simplest form, a *web page* is nothing more than an HTML (HyperText Markup Language) document (with the extension .html or .htm) that describes to a web browser the document's content and structure.
 - Hyperlinks*
- ▶ HTML documents normally contain **hyperlinks**, which, when clicked, load a specified web document.
- ▶ Both images and text may be hyperlinked.
- ▶ When the user clicks a hyperlink, a **web server** locates the requested web page and sends it to the user's web browser.
- ▶ Similarly, the user can type the *address of a web page* into the browser's *address field* and press *Enter* to view the specified page.





1.5 Web Basics (cont.)

- ▶ Hyperlinks can reference other web pages, e-mail addresses, files and more.
- ▶ If a hyperlink's URL is in the form mail to :*emailAddress*, clicking the link loads your default e-mail program and opens a **message window** addressed to the specified e-mail address.
- ▶ If a hyperlink references a file that the browser is incapable of displaying, the browser prepares to **download** the file, and generally prompts the user for information about how the file should be stored.



Making a Request and Receiving a Response

Figure 1.8 shows a web browser sending a request to a web server.

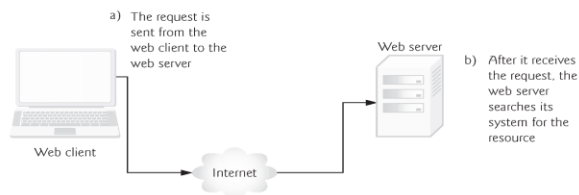


Fig. 1.8 | Client requesting a resource from a web server.





Figure 1.9 shows the web server responding to a request.

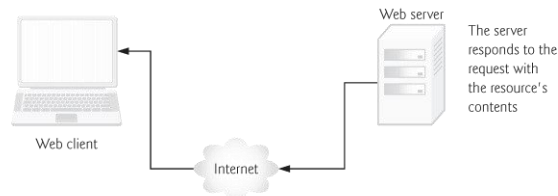


Fig. 1.9 | Client receiving a response from the web server.

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1.5 Web Basics (cont.)

- ▶ The server first sends a line of text that indicates the HTTP version, followed by a numeric code and a phrase describing the status of the transaction. For example,
 - HTTP/1.1 200 OK
- ▶ indicates success, whereas
 - HTTP/1.1 404 Not found
- ▶ informs the client that the web server could not locate the requested resource.

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Software Engineering Observation 1.1

The data sent in a `post` request is not part of the URL, and the user can't see the data by default. However, tools are available that expose this data, so you should not assume that the data is secure just because a `post` request is used.

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1.5 Web Basics (cont.)

Client-Side Caching

- ▶ Browsers often **cache** (save on disk) recently viewed web pages for quick reloading.
- ▶ If there are no changes between the version stored in the cache and the current version on the web, this speeds up your browsing experience.
- ▶ An HTTP response can indicate the length of time for which the content remains “fresh.”

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1.5 Web Basics (cont.)

Client-Side Caching

- ▶ If this amount of time has not been reached, the browser can avoid another request to the server. If not, the browser loads the document from the cache.
- ▶ Similarly, there's also the "not modified" HTTP response, indicating that the file content has not changed since it was last requested (which is information that's sent in the request).
- ▶ Browsers typically do not cache the server's response to a post request, because the next post might not return the same result.



Figure 1.10 presents the basic structure of a **three-tier web-based application**.

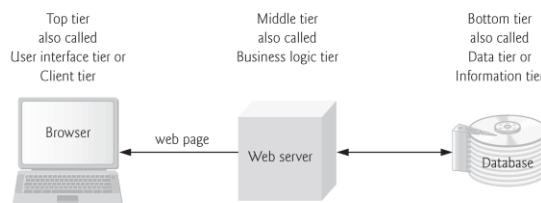


Fig. 1.10 | Three-tier architecture.



1.6 Client-Side Scripting versus Server-Side Scripting



- ▶ Another issue is that client-side scripts can be viewed by the client by using the browser's source-viewing capability.
- ▶ Sensitive information, such as passwords or other personally identifiable data, should not be on the client.
- ▶ All client-side data validation should be mirrored on the server. Also, placing certain operations in JavaScript on the client can open web applications to security issues.

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1.6 Client-Side Scripting versus Server-Side Scripting



- ▶ Client-side scripting with JavaScript can be used to validate user input, to interact with the browser, to enhance web pages, and to add client/server communication between a browser and a web server.
- ▶ Client-side scripting does have limitations, such as browser dependency; the browser or [scripting host](#) must support the scripting language and capabilities.
- ▶ Scripts are restricted from arbitrarily accessing the local hardware and file system for security reasons.

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Web services source	How it's used
Google Maps	Mapping services
Facebook	Social networking
Foursquare	Mobile check-in
LinkedIn	Social networking for business
YouTube	Video search
Twitter	Microblogging
Groupon	Social commerce
Netflix	Movie rentals
eBay	Internet auctions
Wikipedia	Collaborative encyclopedia
PayPal	Payments
Last.fm	Internet radio

Fig. 1.11 | Some popular web services that you can use to build web applications (www.programmableweb.com/apis/directory/1?sort=mashups). (Part 1 of 2.)

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Web services source	How it's used
Amazon eCommerce	Shopping for books and more
Salesforce.com	Customer Relationship Management (CRM)
Skype	Internet telephony
Microsoft Bing	Search
Flickr	Photo sharing
Zillow	Real estate pricing
Yahoo Search	Search
WeatherBug	Weather

Fig. 1.11 | Some popular web services that you can use to build web applications (www.programmableweb.com/apis/directory/1?sort=mashups). (Part 2 of 2.)

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Company	Description
Facebook	Facebook was launched in 2004 and is already worth an estimated \$100 billion. By January 2011, Facebook was the most active site on the Internet with more than 750 million users who were spending 700 billion minutes on Facebook per month (www.facebook.com/press/info.php?statistics). At its current growth rate (about 5% per month), Facebook will reach one billion users in 2012, out of two billion Internet users! The activity on the site makes it extremely attractive for application developers. Each day, over 20 million applications are installed by Facebook users (www.facebook.com/press/info.php?statistics).
Twitter	Twitter (founded in 2006) has revolutionized <i>microblogging</i> . Users post tweets—messages up to 140 characters long. Approximately 140 million tweets are posted per day. You can follow the tweets of friends, celebrities, businesses, government representatives (including Barack Obama, who has 10 million followers), and so on, or you can follow tweets by subject to track news, trends and more. At the time of this writing, Lady Gaga had the most followers (over 13 million). Twitter has become the point of origin for many breaking news stories worldwide.

Fig. 1.13 | Social applications. (Part I of 4.)

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Company	Description
Groupon	Groupon, a <i>social commerce</i> site, was launched in 2008. By August 2011 the company was valued as high as \$25 billion, making it the fastest growing company ever! Groupon offers daily deals in each market for restaurants, retailers, services, attractions and more. Deals are activated only after a minimum number of people sign up to buy the product or service. If you sign up for a deal and it has yet to meet the minimum, you might be inclined to tell others about the deal via e-mail, Facebook, Twitter, etc. One of the most successful national Groupon deals to date was a certificate for \$50 worth of merchandise from a major retailer for \$25. More than 620,000 vouchers were sold in one day (www.huffingtonpost.com/2011/06/30/the-most-successful-group_n_887711.html)!

Fig. 1.13 | Social applications. (Part 2 of 4.)

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Company	Description
Foursquare	Foursquare, launched in 2009, is a mobile <i>check-in</i> application that allows you to notify your friends of your whereabouts. You can download the app to your smartphone and link it to your Facebook and Twitter accounts so your friends can follow you from multiple platforms. If you do not have a smartphone, you can check in by text message. Foursquare uses GPS to determine your location. Businesses use Foursquare to send offers to users in the area. Launched in March 2009, Foursquare already has over 10 million users worldwide (foursquare.com/about).
Skype	Skype (founded in 2003) allows you to make mostly free voice and video calls over the Internet using a technology called <i>VoIP</i> (<i>Voice over IP</i> ; IP stands for “Internet Protocol”). The company was recently sold to Microsoft for \$8.5 billion.

Fig. 1.13 | Social applications. (Part 3 of 4.)



Company	Description
YouTube	YouTube is a video-sharing site that was founded in 2005. Within one year, the company was purchased by Google for \$1.65 billion. YouTube now accounts for 8.2% of all Internet traffic (www.engadget.com/2011/05/17/study-finds-netflix-is-the-largest-source-of-internet-traffic-in/). Within one week of the release of Apple's iPhone 3GS—the first iPhone model to offer video—mobile uploads to YouTube grew 400% (www.hypebot.com/hypebot/2009/06/youtube-reports-1700-jump-in-mobile-video.html).

Fig. 1.13 | Social applications. (Part 4 of 4.)

