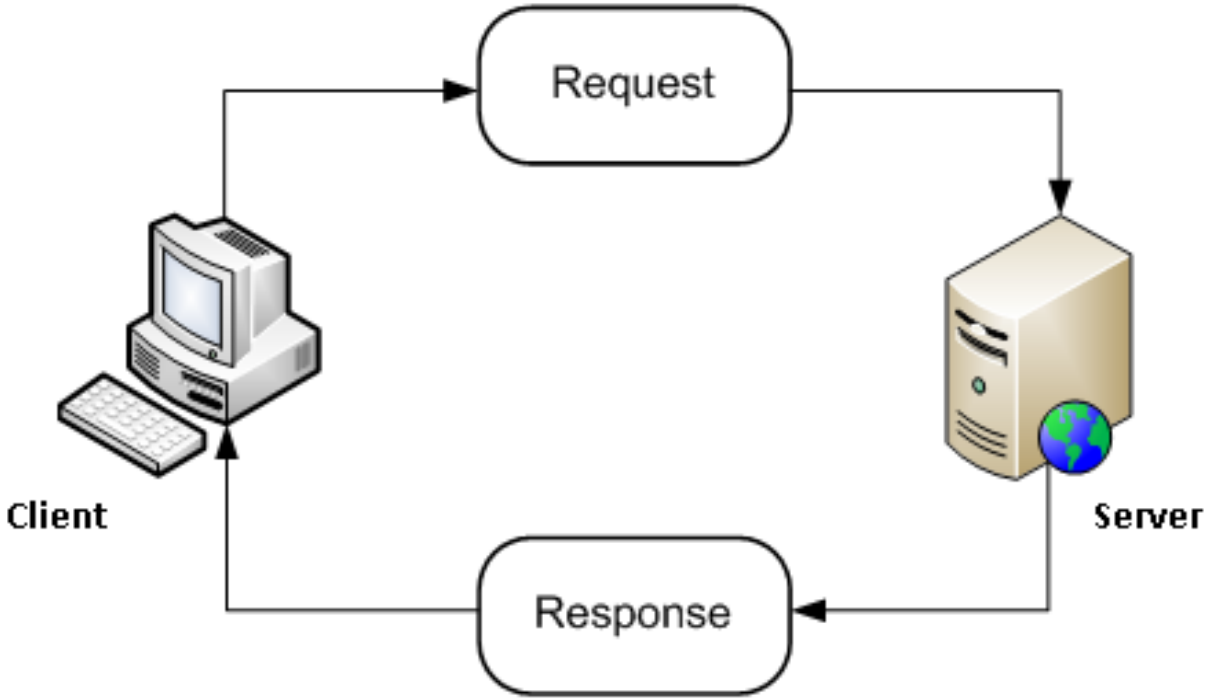
# Web Sites and Web Applications

- A web site is a collection of static files, HTML pages, graphics, and various other files.
- A web application is an element of a web site that provides dynamic functionality on the web server.
- A web application runs programs on the web server.
  - For example:
    - A browser makes a request to the web server for an HTML form.
    - The web server responds by sending the HTML form back to the browser in an HTTP request stream.
    - The browser sends another request with data from the HTML form to the web server.
    - The web server passes the request and data to a program that responds by sending data back to the browser.

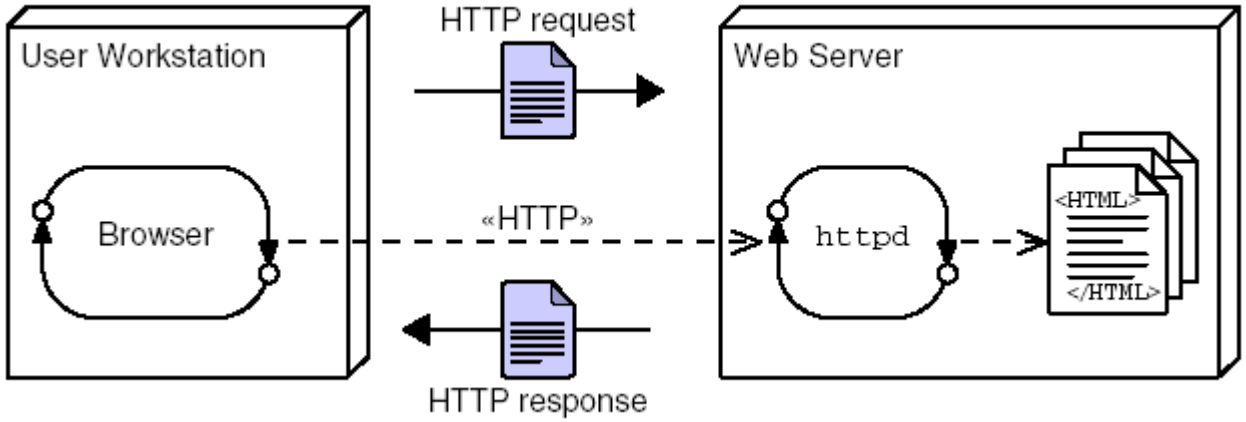

Request
Client
Server
Response

# Web Application Technologies

- Hypertext Transfer Protocol (HTTP) is used to transfer instructions and data between machines.
- Hypertext Markup Language (HTML):
  - Is a document display language that lets users create visually pleasing documents and link from one document to another.
  - Permits images and other media objects to be embedded in an HTML document.
- The combination of the HTTP protocol and the HTML page description language is the foundation technology of the World Wide Web (WWW).

# HTTP Client-Server Architecture

- For every exchange over the web using HTTP, there is a request and a response, as shown in the following figure.



# HTTP Client-Server Architecture (Contd.)

- The web browser sends a single request to the web server.
- The web server determines which file is being requested and sends back the data in that file as the response.
- The web browser interprets the response and represents the content on the screen.
- The request information includes:
  - Location of the requested file.
  - Resource and information about the browser and its environment.
- The response includes the requested resource and other information.

# Execution of CGI Programs

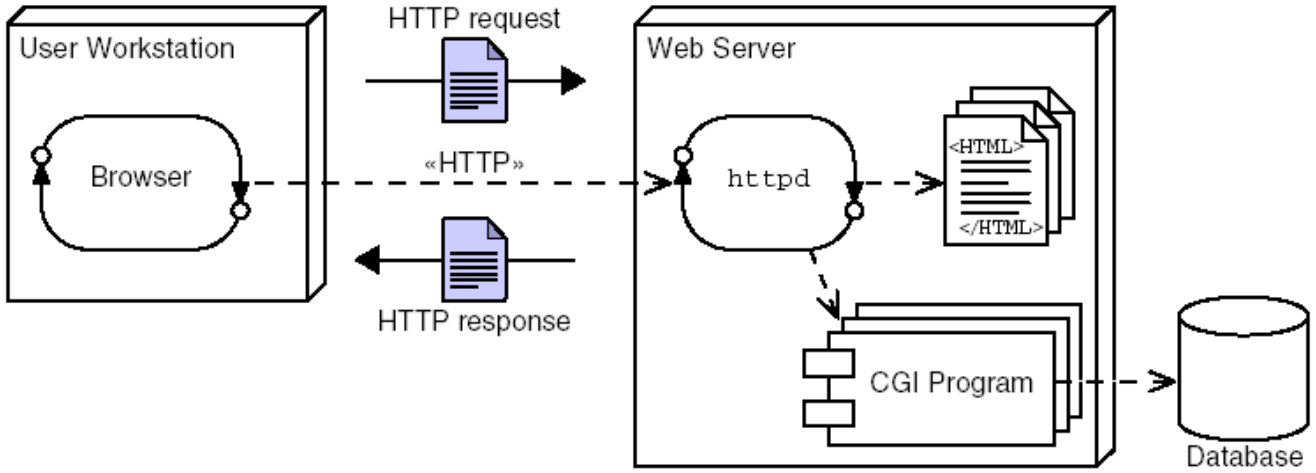
- Common Gateway Interface (CGI) is a mechanism to permit a user to invoke a program on the web server.
- When a web site includes CGI processing, it is called a web application.
- The CGI specification defines how the data is packaged and sent in the HTTP request to the web server.

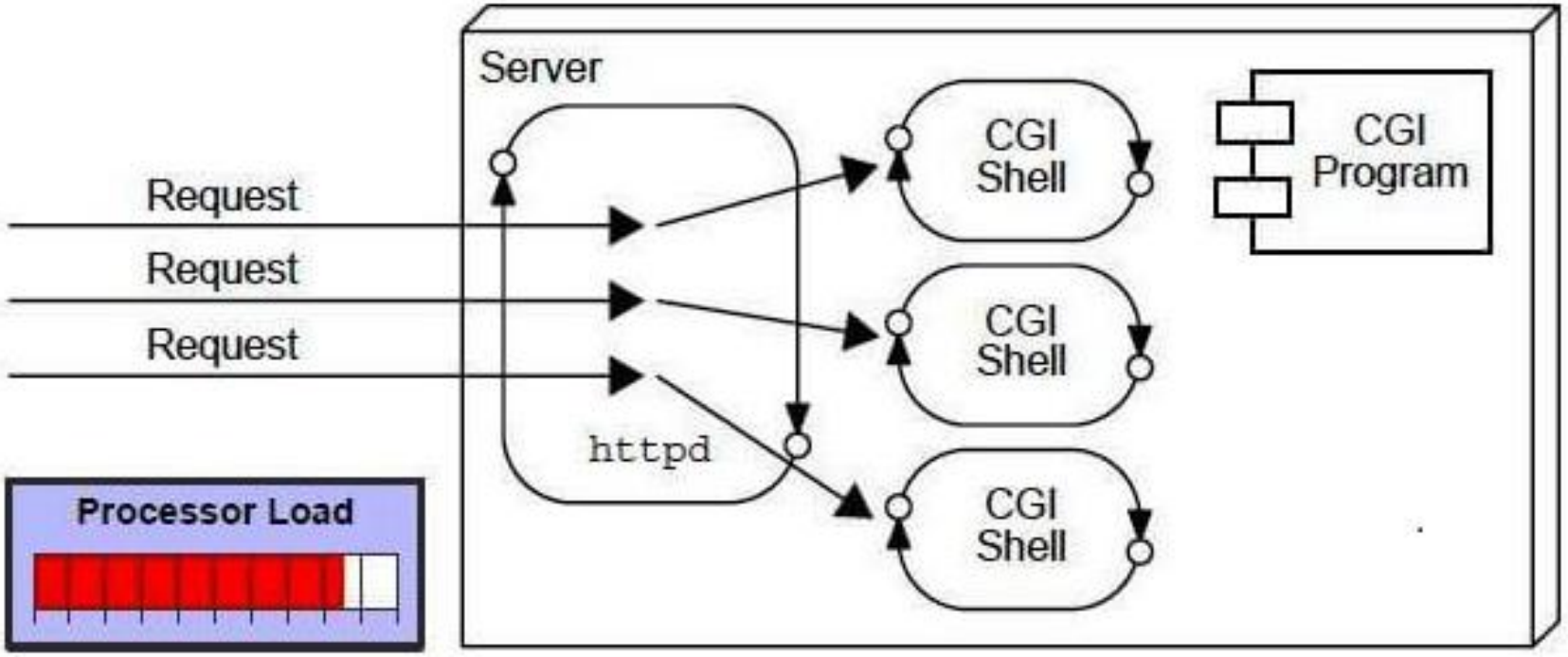
# Execution of CGI Programs (Contd.)

- The execution of CGI Programs consists of the following steps:
  1. The URL determines which CGI program to execute. This can be a script or an executable file.
  2. The CGI program:
     a. Parses the CGI data in the request.
     b. Processes the data.
     c. Generates a response.
  3. The CGI response is sent back to the web server, which wraps the response in an HTTP response.
  4. The HTTP response is sent back to the web browser.

# Execution of CGI Programs (Contd.)

- The following figure shows an example of a web application architecture that uses CGI programs.




Server
Request
Request
Request
httpd
CGI Shell
CGI Shell
CGI Shell
CGI Program
Processor Load

# Advantages and Disadvantages of CGI Programs

- The advantages of CGI programs are:
  - Programs can be written in a variety of languages.
  - A CGI program with bugs does not crash the web server.
  - Concurrency issues are isolated at the database because CGI programs execute in separate processes.
  - CGI support is very common.

# Advantages and Disadvantages of CGI Programs (Contd.)

- The disadvantages of CGI programs are:
  - The response time of CGI programs is high because the creation of a new process is a heavyweight activity for the Operating System (OS).
  - CGI does not scale well.
  - The languages for CGI are not always secure or object-oriented.
  - The CGI code is mingled with HTML, which is not a good separation of presentation and business logic.
  - Scripting languages are often platform-dependent.

- **Using Java in the Web**

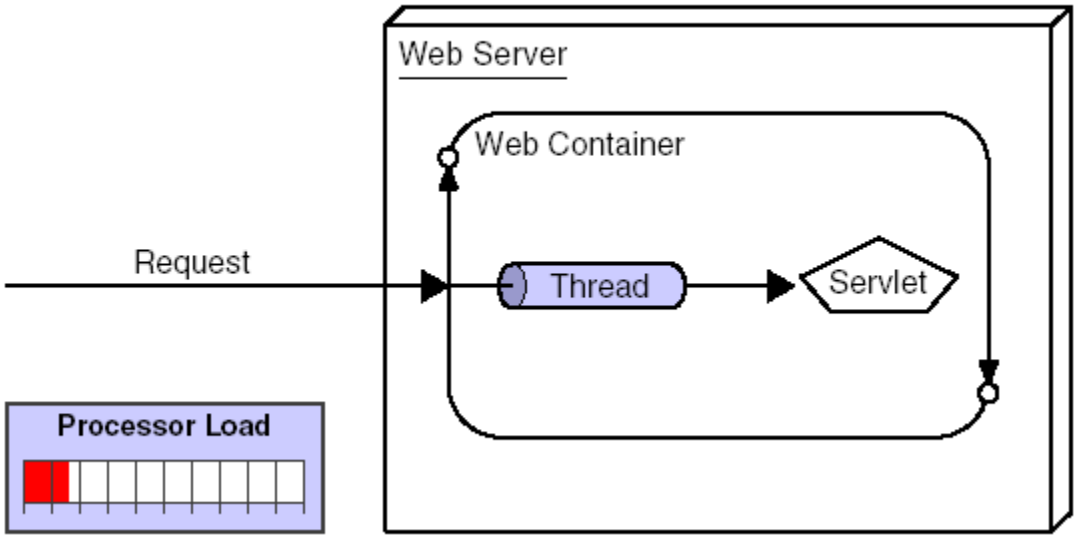
  - Java has the ability to service HTTP requests and is used to develop dynamic web sites.
  - Servlet was the earliest technology developed to create dynamic web sites using Java.
  - Servlets provide a simple framework that allows Java program code to process an HTTP request and create an HTML page in response.

# Execution of Java Servlets

- A Java servlet is similar to a CGI program, which responds to HTTP requests and runs on the web server.
- The servlet runs as a thread in the web container instead of a separate OS process.
- The web container itself is an OS process, but it runs as a service and is available continuously in contrast to the CGI script, which creates new process for each request.

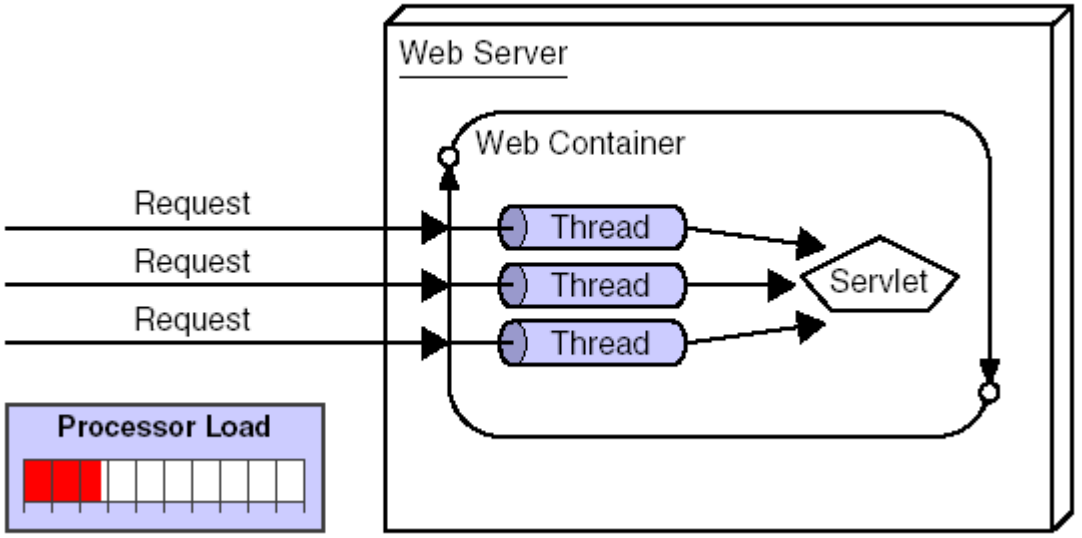
# Execution of Java Servlets (Contd.)

- The following figure shows that a servlet executes as a thread within the web container's process.



# Execution of Java Servlets (Contd.)

- When the number of requests for a servlet rises, no additional instances of the servlet or OS processes are created.
- Each request is processed concurrently using one Java thread per request, as shown in the following figure.



# Introducing a Web Container

- A web container is a runtime environment that manages the components, such as servlets, JavaServer Pages (JSP) pages, filters, web event listeners, of a web application.
- The following features are provided by the web container to all web applications:
  - Communication support
  - Lifecycle management
  - Multithreading support
  - Declarative security
  - JSP support

# Advantages and Disadvantages of Java Servlets

- The advantages of servlets are:
  - Servlet request processing is faster than CGI processing because each request is run in a separate thread within a single process.
  - Servlets are more scalable than CGI because more requests can be executed because the web container uses a thread rather than an OS process.
  - Servlets benefit from the simple, robust, platform-independent, and object-oriented nature of the Java programming language.
  - Servlets have access to standardized and easy-to-use logging capabilities.
  - The web container provides additional services to the servlets, such as error handling and security.

# Advantages and Disadvantages of Java Servlets (Contd.)

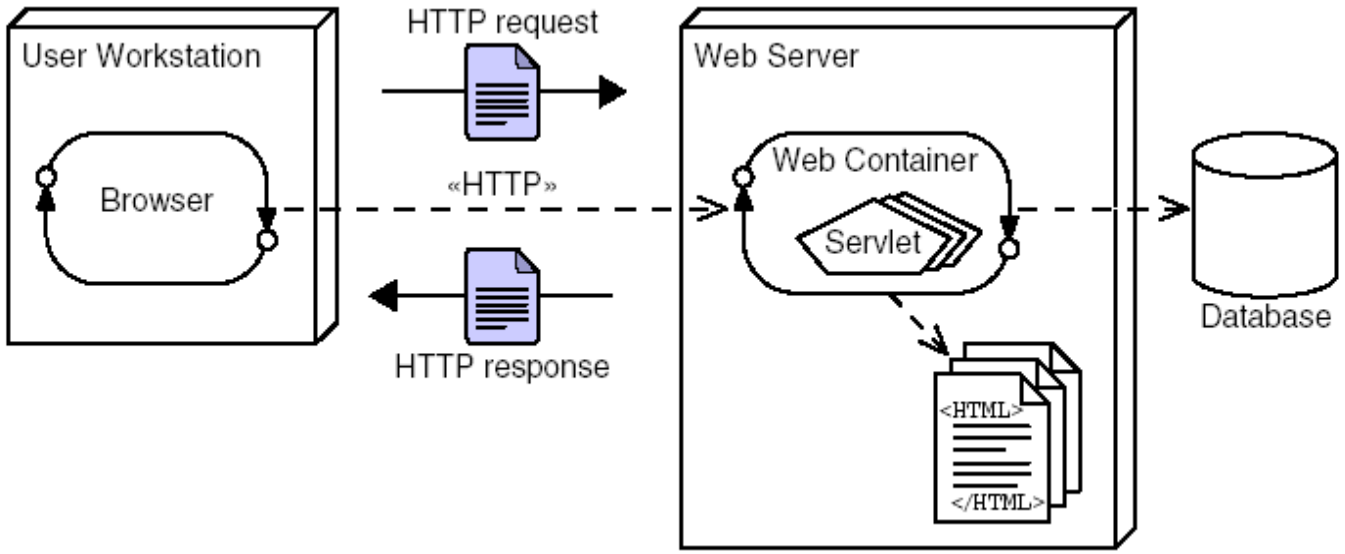
- The disadvantages of servlets are:
  - Servlets can only be written in the Java programming language, so developers are required to be competent with this language.
  - Servlets might introduce new concurrency issues not found in CGI.

# Java Servlets

- Servlets run within the Java Platform Enterprise Edition (Java EE) component container architecture, also known as the web container.
- The web container is a Java technology program that implements the servlet Application Programming Interface (API).
- Servlets are components that respond to HTTP requests.
- The web container:
  - Performs initial processing, and selects the intended servlet to handle the request.
  - Controls the life-cycle of the servlet.

# Java Servlets (Contd.)

- The following figure shows a sample web server architecture with Java servlets.



# Web Server

- Web Server is a computer that accepts the client request and sends the response back to the client.
- For example, Apache Server is one of the most used web servers that runs on physical computers and listens to client requests on specific ports.

# Application Server

- Number of the application servers have Web Server as an essential part of them, that means App Server can do whatever Web Server is capable of.
- The App Server have components and features to support Application-level services.

# A First Java Servlet

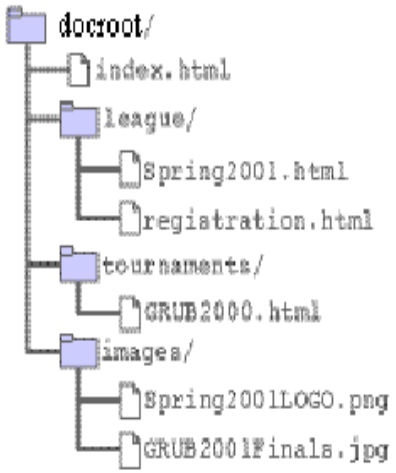
- A servlet is invoked by the web container when an appropriate request is received by that container.
- In Java EE 6, an annotation specifies the URL that the servlet is used to respond to.
- The method in the servlet that is invoked depends on the type of HTTP request.
- For example, an HTTP GET request will invoke the `doGet` method in the servlet.

# Web Site Structure

- A web site:
  - Is a collection of HTML pages and other media files that contains all the content that is visible to the user on a given web server.
  - Is internally composed of a directory hierarchy, which is visible to the end user in the Uniform Resource Locators (URLs) that identify each page.

# Web Site Structure (Contd.)

- The following figure shows the directory structure of a web site.




- The `index.html` file is a special file used when the user requests a URL that ends in a slash character (`/`).

# Web Site Structure (Contd.)

- A URL locates a specific resource on the Internet.
- It consists of the following structure:
  - `protocol://host:port/path/file`
    - The `path` element includes the complete directory structure path to find the file.
    - The `port` number is used to identify the port that is used by the protocol on the server.
- For example:
  - `http://www.soccer.org:80/league/Spring2001.htm`

# A First Java Servlet (Contd.)

- The `doGet` method takes two parameters:
  - The first parameter carries information related to the original request.
  - The second parameter provides information for the control of the response.
- The servlet's job is two-fold. First, it must perform the required computation; second, it must present the results in a well-formed HTML page.

# A First Java Servlet (Contd.)

- The features of the preceding code are:
  - The class extends `javax.servlet.http.HttpServlet`.
  - The class overrides the method `doGet`, which provides the home for the code that will service the HTTP request.
  - The `doGet` method creates an entire HTML page and sends it to the browser.
  - The servlet is associated with a URL within the web server by means of the `@WebServer` annotation.