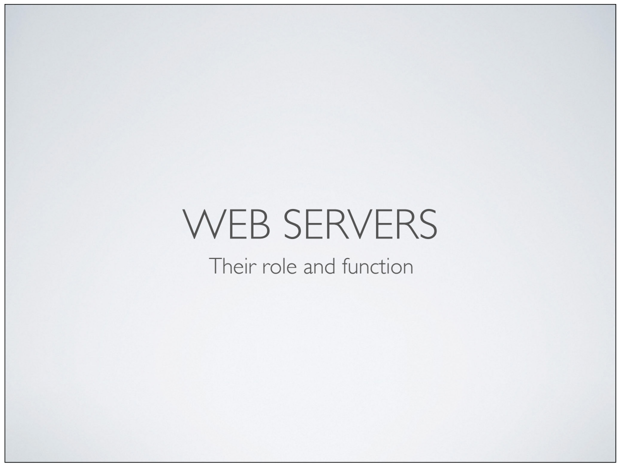
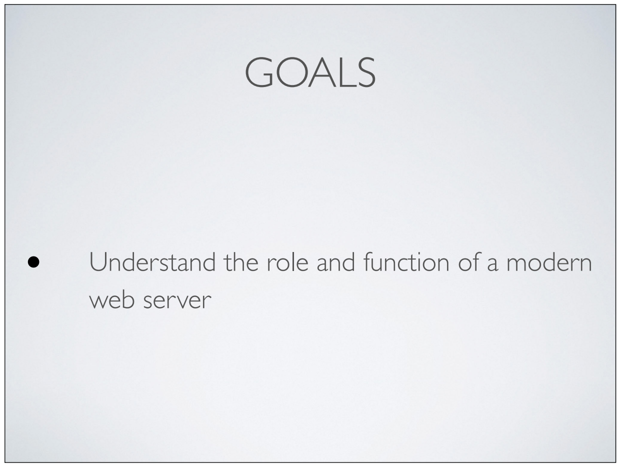


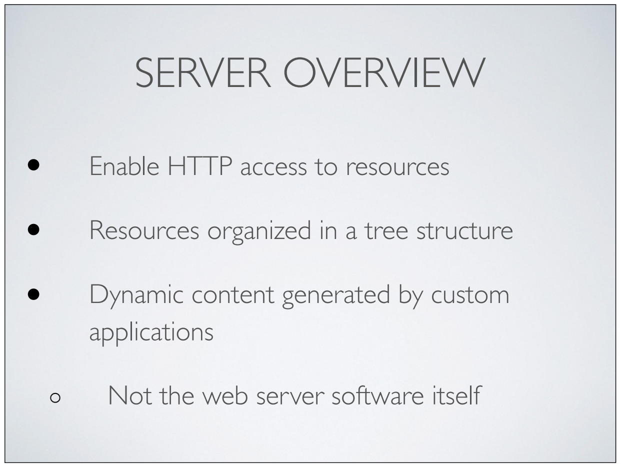
WEB SERVERS

Their role and function



GOALS

- Understand the role and function of a modern web server



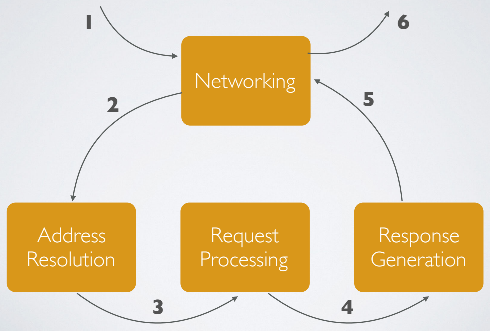
SERVER OVERVIEW

- Enable HTTP access to resources
- Resources organized in a tree structure
- Dynamic content generated by custom applications
  - Not the web server software itself

SERVER BASICS

- Server receives HTTP request
- Find the requested resource
- Generate response
- Send response back to the client

WEB SERVER REFERENCE ARCHITECTURE



NETWORKING MODULE

- Receives HTTP requests...

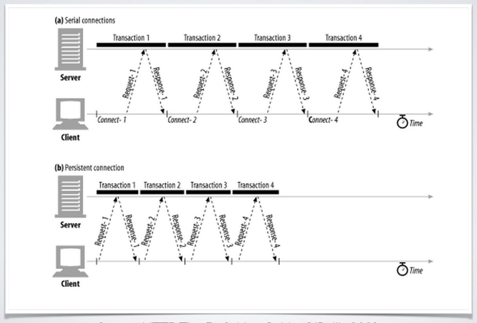
```
GET http://www.cis.gvsu.edu/index.html HTTP/1.1

Host: www.cis.gvsu.edu

User-Agent: Mozilla/4.75 [en]
```

- May support persistent connections
  - FIFO requests/responses

HTTP 1.1 PERSISTENT CONNECTIONS



Source: HTTP: The Definitive Guide. O'Reilly 2002

HTTP1.1 PERSISTENT CONNECTIONS

- Advantages:
  - By opening and closing fewer TCP connections, CPU time is saved in routers and hosts and memory used for TCP protocol control blocks can be saved in hosts.
  - Pipelining is possible

HTTP1.1 PERSISTENT CONNECTIONS

- Advantages:
  - Network congestion is reduced by reducing the number of packets caused by TCP opens.
  - Latency on subsequent requests is reduced since there is no time spent in TCP's connection opening handshake.

HTTP1.1 PERSISTENT CONNECTIONS

- Advantages:
  - HTTP can evolve more gracefully, since errors can be reported without the penalty of closing the TCP connection. Clients using future versions of HTTP might optimistically try a new feature but if communicating with an older server, retry with old semantics after an error is reported.

RESTRICTIONS / RULES

- After sending a Connection: close request header, the client can't send more requests on that connection.
- If a client does not want to send another request on the connection, it should send a Connection: close request header in the final request.

RESTRICTIONS / RULES

- The connection can be kept persistent only if all messages on the connection have a correct, self-defined message length—i.e., the entity bodies must have correct Content-Lengths or be encoded with the chunked transfer encoding.
- HTTP/1.1 proxies must manage persistent connections separately with clients and servers—each persistent connection applies to a single transport hop.

RESTRICTIONS / RULES

- Clients must be prepared to retry requests if the connection closes before they receive the entire response, unless the request could have side effects if repeated.
- A single user client should maintain at most two persistent connections to any server or proxy, to prevent the server from being overloaded. Because proxies may need more connections to a server to support concurrent users, a proxy should maintain at most 2N connections to any server or parent proxy, if there are N users trying to access the servers.

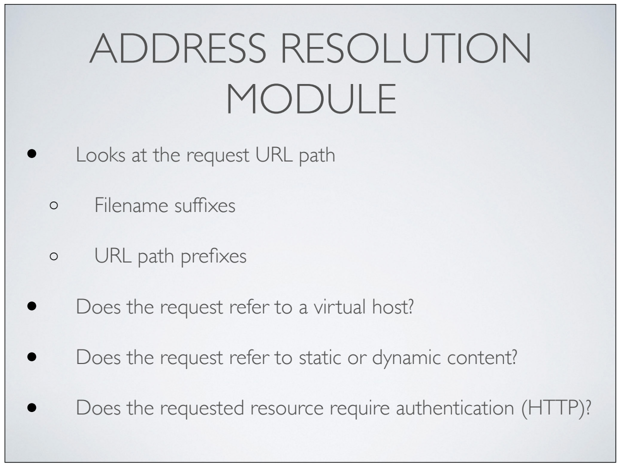
RESTRICTIONS / RULES

- Regardless of the values of Connection headers, HTTP/1.1 devices may close the connection at any time, though servers should try not to close in the middle of transmitting a message and should always respond to at least one request before closing.

SERVER MODULES

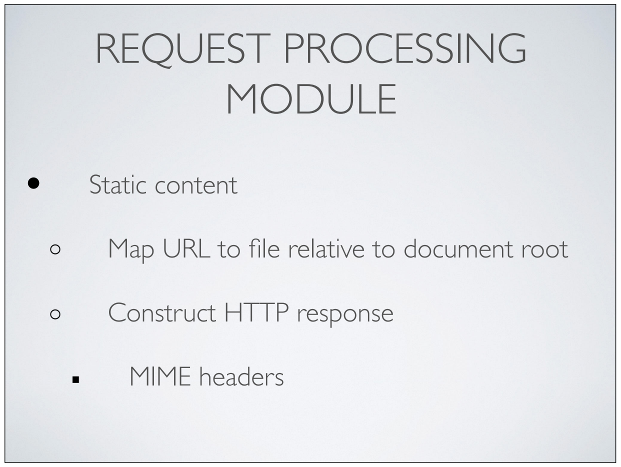
Address Resolution

- Virtual hosting addresses
- Static or dynamic content
- URL path parsing
- Authentication



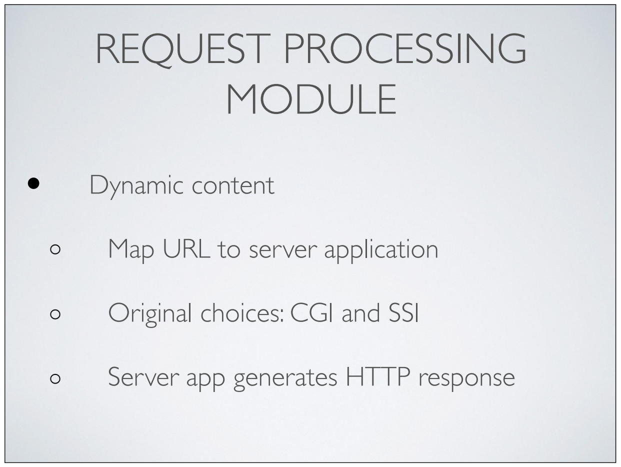
ADDRESS RESOLUTION MODULE

- Looks at the request URL path
  - Filename suffixes
  - URL path prefixes
- Does the request refer to a virtual host?
- Does the request refer to static or dynamic content?
- Does the requested resource require authentication (HTTP)?



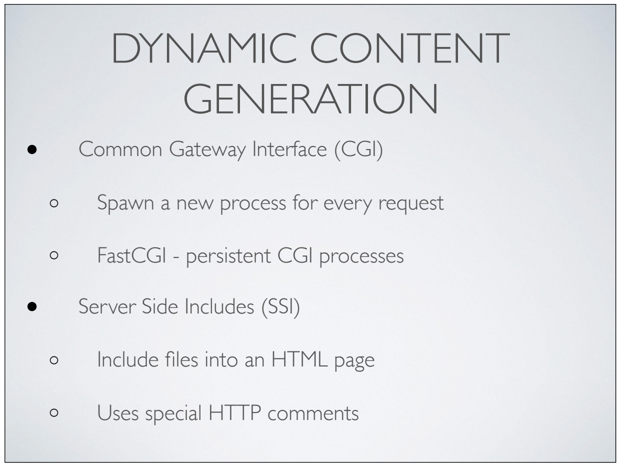
REQUEST PROCESSING MODULE

- Static content
  - Map URL to file relative to document root
  - Construct HTTP response
    - MIME headers



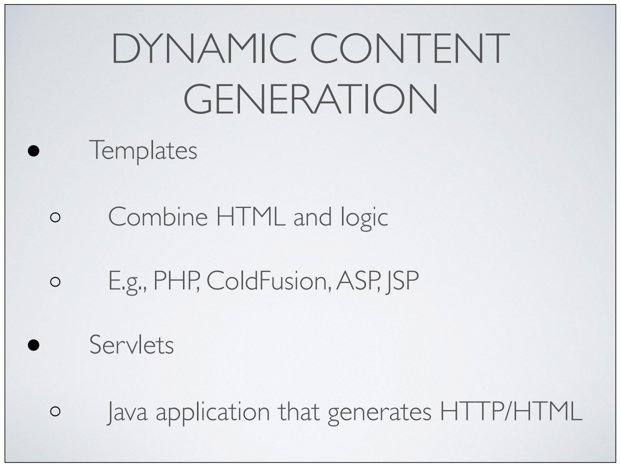
REQUEST PROCESSING MODULE

- Dynamic content
  - Map URL to server application
  - Original choices: CGI and SSI
  - Server app generates HTTP response



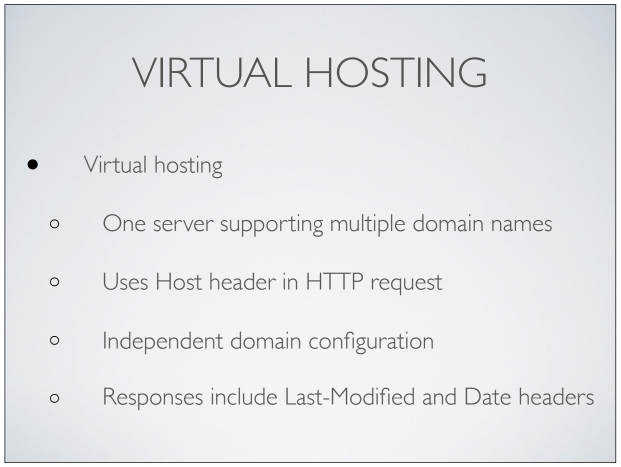
DYNAMIC CONTENT GENERATION

- Common Gateway Interface (CGI)
    - Spawn a new process for every request
    - FastCGI - persistent CGI processes
- Server Side Includes (SSI)
    - Include files into an HTML page
    - Uses special HTTP comments



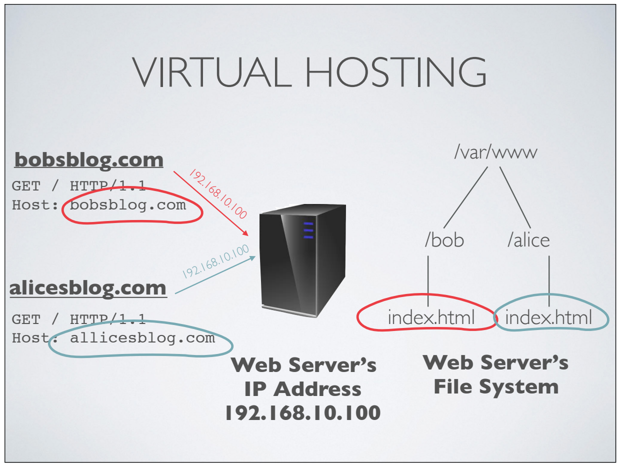
DYNAMIC CONTENT GENERATION

- Templates
    - Combine HTML and logic
    - E.g., PHP, ColdFusion, ASP, JSP
- Servlets
    - Java application that generates HTTP/HTML



VIRTUAL HOSTING

- Virtual hosting
    - One server supporting multiple domain names
    - Uses Host header in HTTP request
    - Independent domain configuration
    - Responses include Last-Modified and Date headers



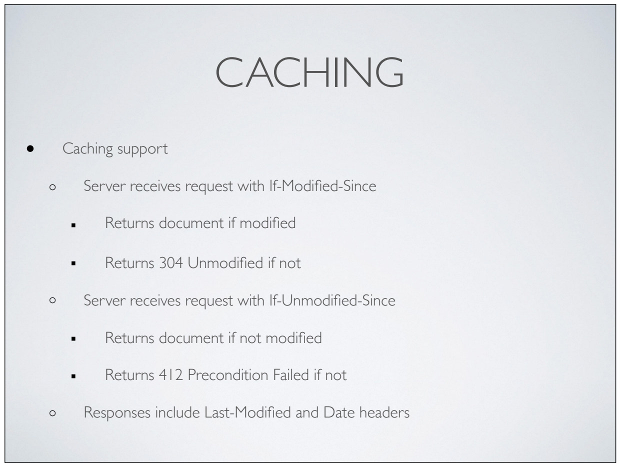
VIRTUAL HOSTING

bobsblog.com

```
GET / HTTP/1.1
Host: bobsblog.com
```

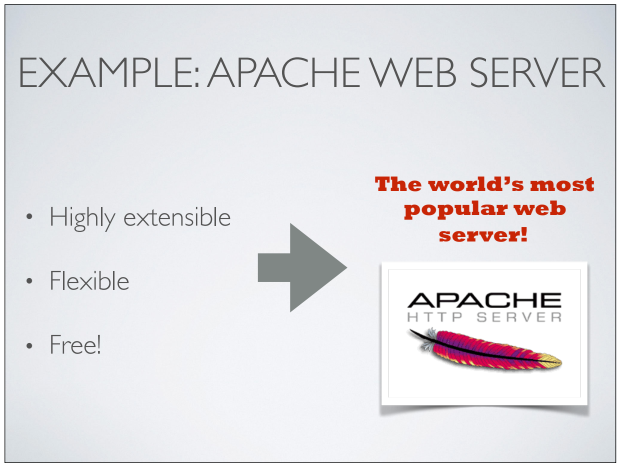
alicesblog.com

```
GET / HTTP/1.1
Host: allicesblog.com
```



CACHING

- Caching support
  - Server receives request with If-Modified-Since
    - Returns document if modified
    - Returns 304 Unmodified if not
  - Server receives request with If-Unmodified-Since
    - Returns document if not modified
    - Returns 412 Precondition Failed if not
  - Responses include Last-Modified and Date headers

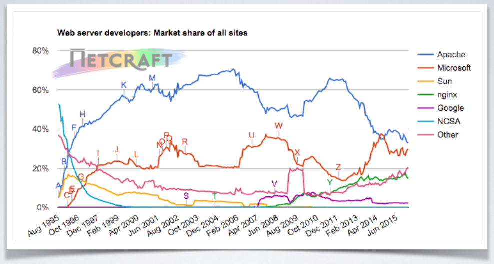


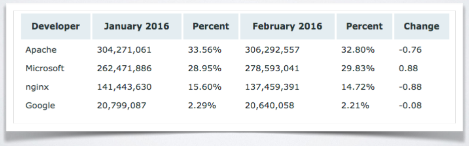
EXAMPLE: APACHE WEB SERVER

- Highly extensible
- Flexible
- Free!

The world's most popular web server!

APACHE HTTP SERVER

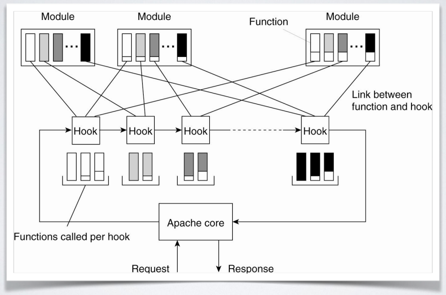




Developer	January 2016	Percent	February 2016	Percent	Change
Apache	304,271,061	33.56%	306,292,557	32.80%	-0.76
Microsoft	262,471,886	28.95%	278,593,041	29.83%	0.88
nginx	141,443,630	15.60%	137,459,391	14.72%	-0.88
Google	20,799,087	2.29%	20,640,058	2.21%	-0.08

Source: http://news.netcraft.com/

APACHE ARCHITECTURE



READING ASSIGNMENT

- Chapter 6 in Shklar & Rosen textbook.
- Chapter 3, 6, 7 in Rails book (or equivalent)