Web server and Apache

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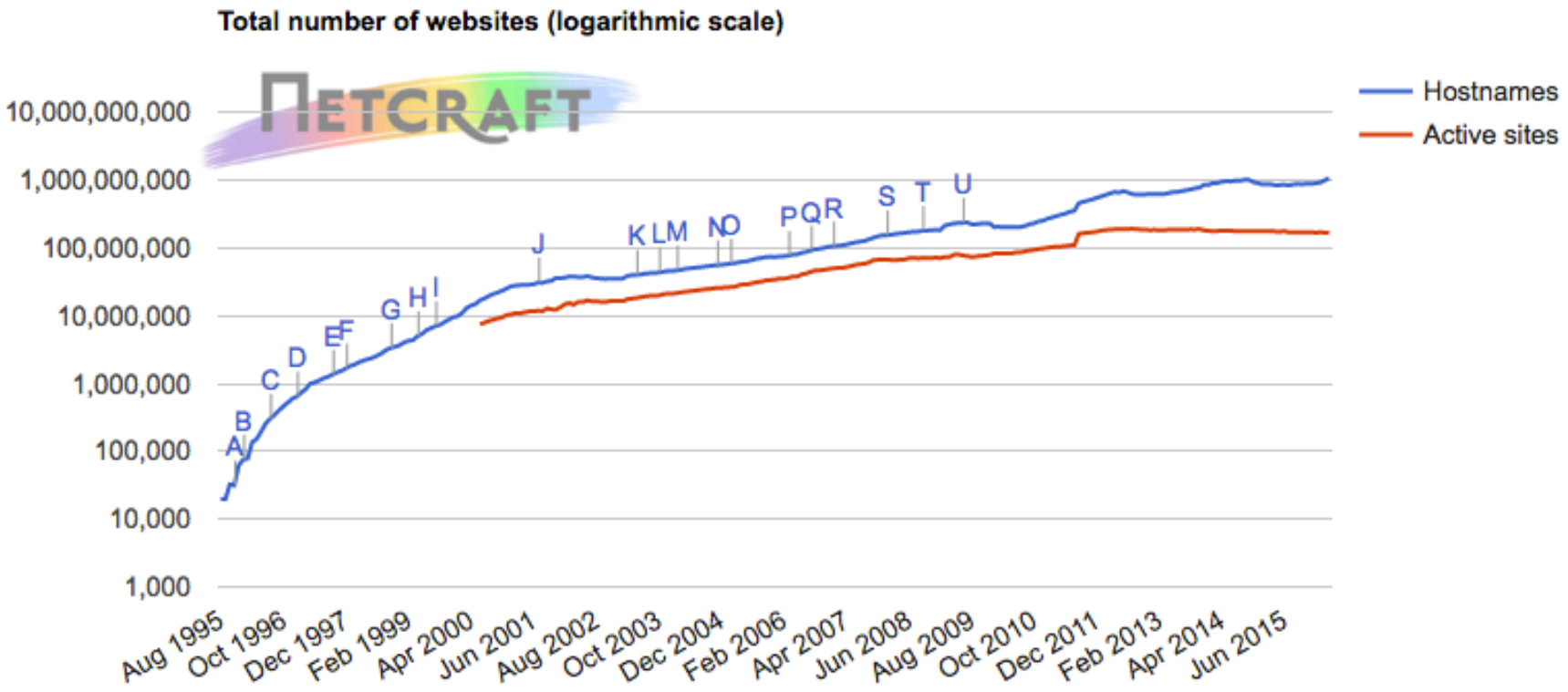
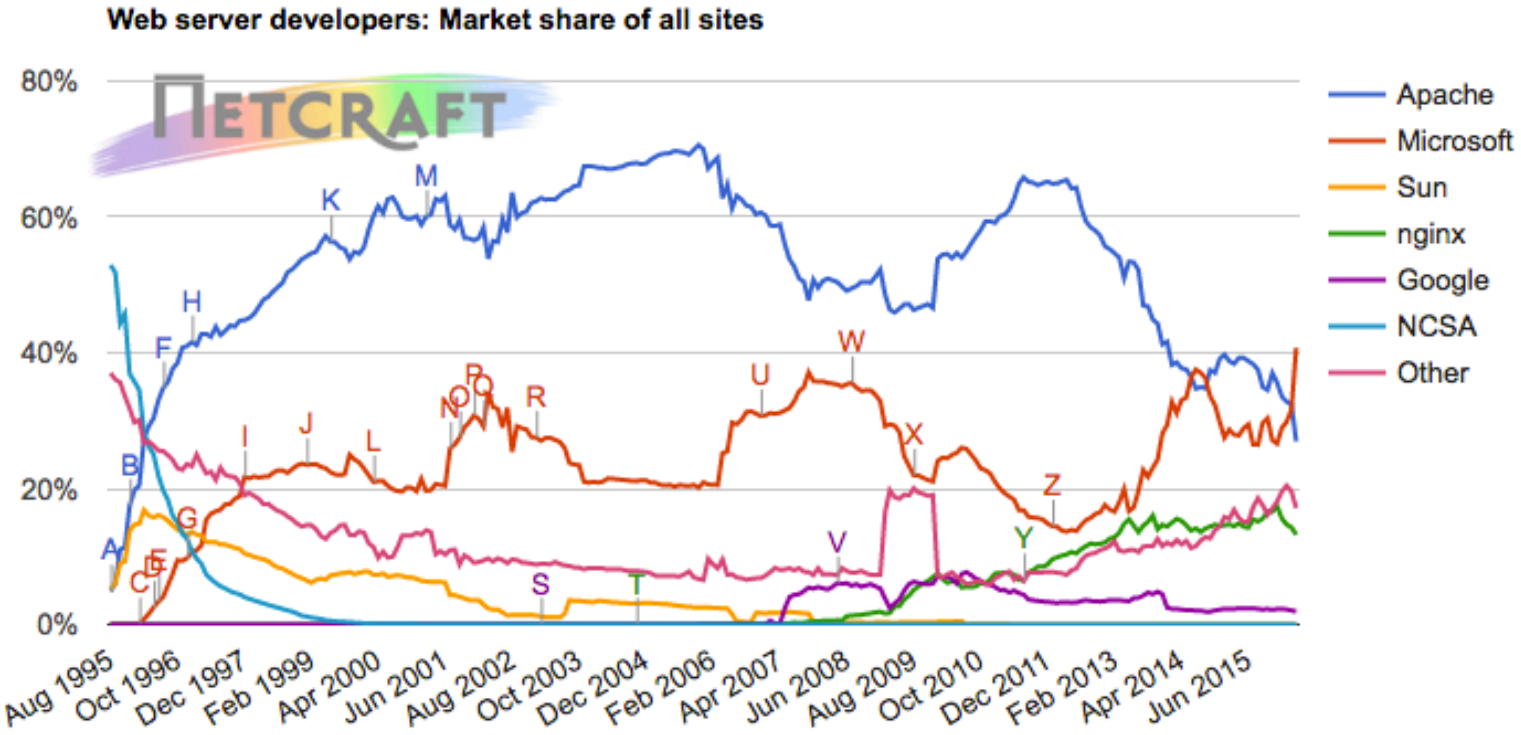
Number of Websites



src: http://news.netcraft.com/archives/category/web-server-survey/

Apache diffusion



Developer	March 2016	Percent	April 2016	Percent	Change
Microsoft	317,761,318	31.65%	441,470,894	40.75%	9.10
Apache	325,285,185	32.40%	292,043,548	26.96%	-5.44
nginx	143,464,293	14.29%	143,349,439	13.23%	-1.06
Google	20,790,767	2.07%	20,597,605	1.90%	-0.17

(user-generated content)

Where to study

- Apache Server 2 - Mohammed J. Kabir
  - Hungry Minds

- Apache Server 2 Official Documentation
  - http://httpd.apache.org/docs/2.0/

Apache

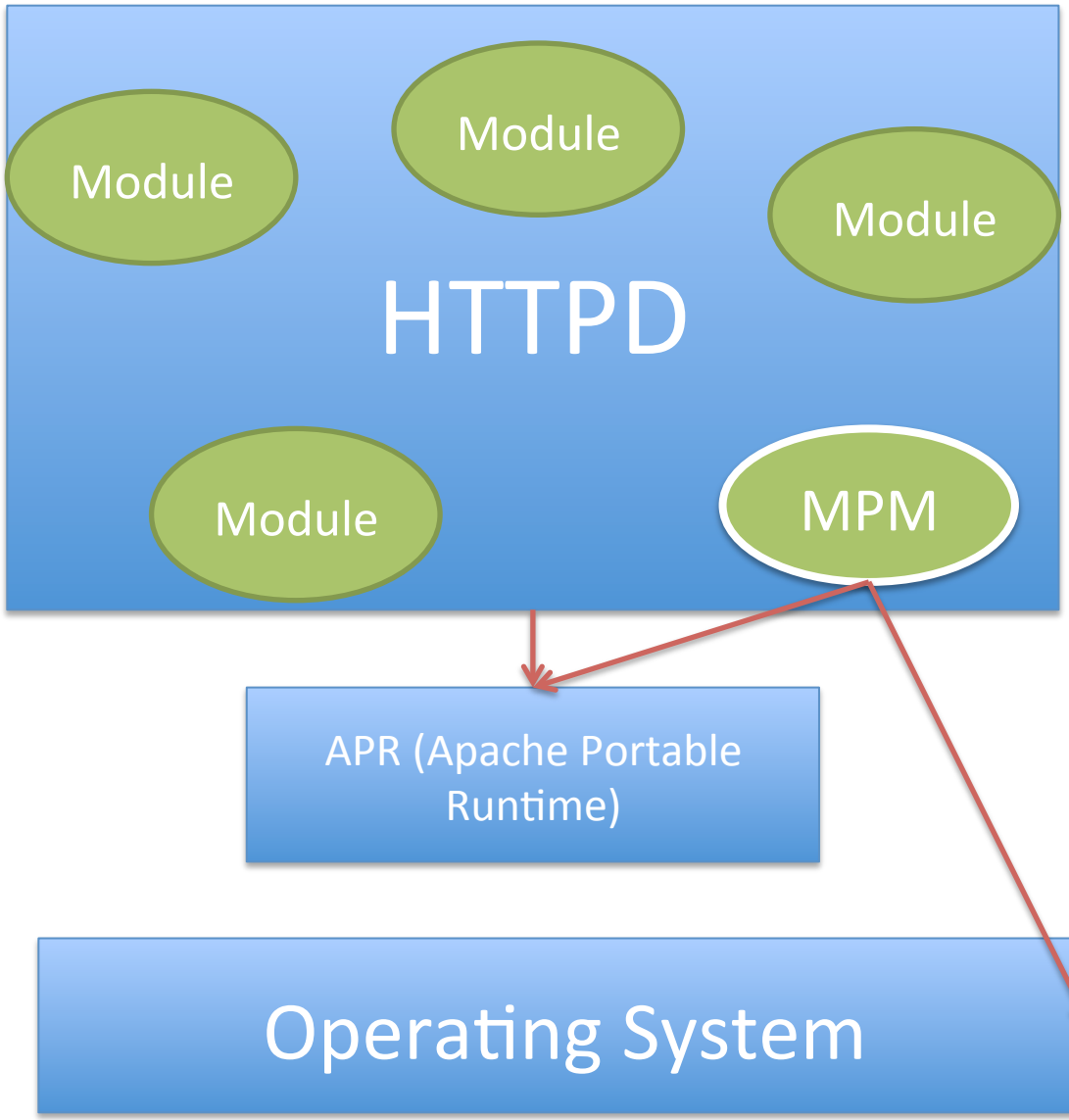
- developed by the *Apache Software Foundation* (released April 1995)
- bundled in the popular “LAMP” (**L**inux **A**pache **M**ysql **P**hp)

- apt-get install apache2

- Start / stop:
  - /etc/init.d/apache2 start
  - /etc/init.d/apache2 stop

try!

Apache Architecture



small core

several modules

- compiled statically or loaded dynamically

Cross platform utilities (APR)

How apache works: MPM

- MultiProcessing Modules (MPMs) since Apache2:
  - In apache 1.3 uses a preforking architecture
    - the parent creates/destroys children if required
    - does not work well on some platform (such Windows)
  - MPM offers several alternatives (implemented in MPM modules) :
    - prefork MPM (like Apache 1.3)
    - worker MPM (multiple child, each one with several threads)
    - winnt MPM: single process, multithread (specific for windows)
    - event MPM: like worker, improved (dedicated thread to deal with the kept-alive connections)

```
<IfModule mpm_prefork_module>
    StartServers          5
    MinSpareServers       5
    MaxSpareServers      10
    MaxClients          150
    MaxRequestsPerChild   0
</IfModule>
```

We can tune parameters in /etc/apache2/apache2.conf

```
<IfModule mpm_worker_module>
    StartServers          2
    MaxClients          150
    MinSpareThreads      25
    MaxSpareThreads      75
    ThreadsPerChild      25
    MaxRequestsPerChild   0
</IfModule>
```

- Check which apache mpm we currently use
  - apachectl -V | grep -i mpm
- List Available MPM Modules
  - ls /etc/apache2/mods-available/mpm*
- List enabled MPM modules
  - ls -l /etc/apache2/mods-enabled/mpm*

Processes vs Threads

- Both threads and processes are methods of parallelizing an application
- **Processes** are independent execution units that contain their own state information, use their own address spaces, and only interact with each other via inter-process communication (IPC) mechanisms
- **Threads** share the same state and same memory space, and can communicate with each other directly, because they share the same variables

Are your cgi library thread safe?

Apache Web server files

```
# Include generic snippets of statements
Include /etc/apache2/conf.d/

# Include the virtual host configurations:
Include /etc/apache2/sites-enabled/
```

/usr/sbin/apache2	Apache 2 server binary
/usr/sbin/apache2ctl	Apache2 control interface (configtest could help!)
/etc/apache2/apache2.conf	default configuration file (could be overwritten during apache upgrade)
/etc/apache2/httpd.conf	user configuration files (and files inside /etc/apache2/conf.d)
/etc/apache2/conf.d	other configuration files (included as well in apache2.conf)
/etc/apache2/sites-available	configuration files for virtual hosting
/etc/apache2/sites-enable	symbolic links to sites-available files (created with a2ensite, a2dissite)
/etc/apache2/mods-available	configuration files for modules
/etc/apache2/mods-enabled	symbolic links to mods-available files (created with a2enmod, a2dismod)
/var/log/apache2	log files

Configuring Apache

- ~ 360 directives (!!!). Few selected:
  - ServerRoot: path to configuration, error and log files
  - PidFile
  - ServerName: name and port of the server
  - DocumentRoot: where find files to serve
  - ErrorDocument: override standard error messages

- **Environment-related:** These directives allow you to set and reset environment variables.
- **Authentication and access control:** These directives allow you to authenticate and authorize user access to restricted parts of your Web site.
- **Dynamic contents generation:** These directives allow you to run external programs such as CGI scripts or Server Side Includes to create dynamic contents.
- **Content-type configuration:** These directives allow you to control MIME types of files.
- **Directory listing:** These directives allow you to control how directory listings are formatted.
- **Response header:** These directives allow you to control HTTP response headers.
- **Server information and logging:** These directives allow you to control server logs and status information.
- **URL mapping:** These directives allow you to map, rewrite, and create aliases for a URL.
- **Miscellaneous modules:** These directives allow you to control miscellaneous aspects of Apache such as proxy service, WEBDEV module, etc.

Apache Modules

- Apache has modular architecture:
  - To enable/disable modules : a2enmod / a2dismod MODNAME
  - configurable via directives
  - apache2ctl –M #list of modules
  - mod_so load module at runtime (Dynamic Shared Object (DSO) mechanism) LoadModule

Logging

```
ErrorLog /var/log/apache2/cgrlweb.log

# Possible values include: debug, info, notice, warn, error, crit,
# alert, emerg.
LogLevel warn
```

- location and content: CustomLog directive
- Format: LogFormat
  - specified with common logfile format*

```
LogFormat "%v:%p %h %l %u %t \"%r\" %>s %O \"%{Referer}i\" \"%{User-Agent}i\"" vhost_combined
```

(*) http://www.w3.org/Daemon/User/Config/Logging.html#common-logfile-format

Logrotate

not only for apache!

Log Size: Typically 1 MB for 10000 requests so…

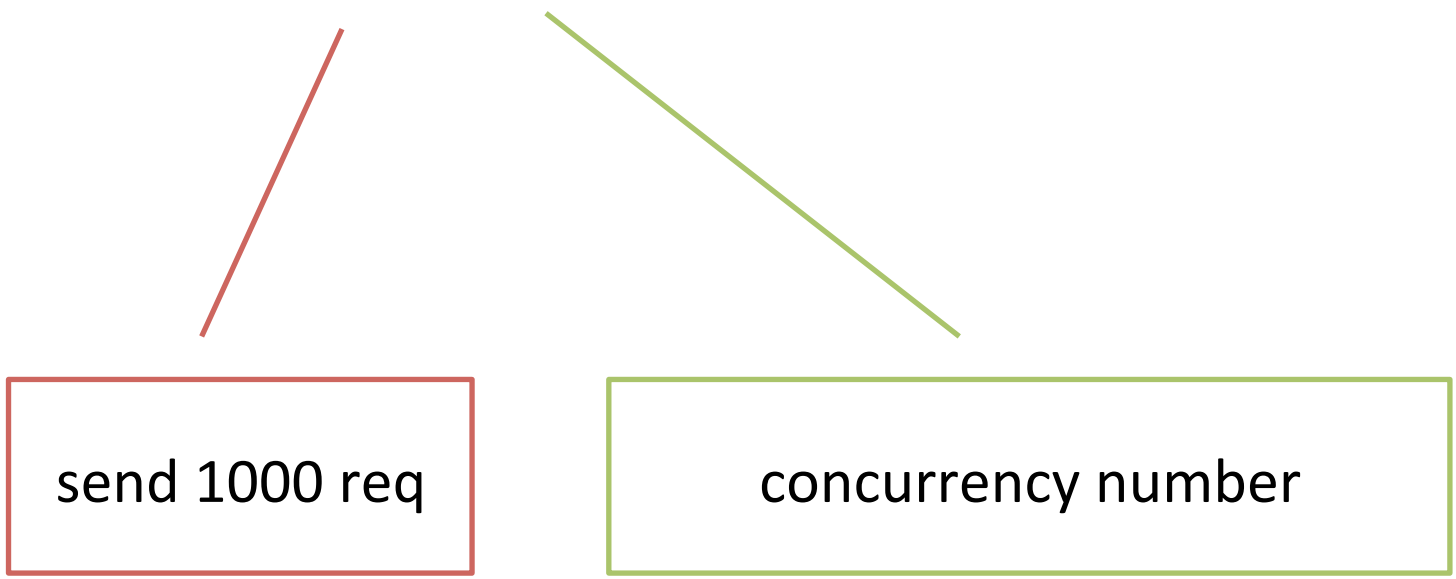
/etc/logrotate.d/apache2

```
/var/log/apache2/*.log {
        weekly
        missingok
        rotate 52
        compress
        delaycompress
        notifempty
        create 640 root adm
        sharedscripts
        postrotate
                if [ -f "`. /etc/apache2/envvars ; echo ${APACHE_PID_FILE:-/var/run/apache2.pid}`" ]; then
                        /etc/init.d/apache2 reload > /dev/null
                fi
        endscript
}
```

- rotate at most 52 times, weekly
- compress (you can see that using zcat, zless or pipelining gzip and cat/tail)

Apache benchmarking

- ab (Apache HTTP server benchmarking tool)
- ab -n 1000 -c 5 http://URL_TO_TEST/index.html



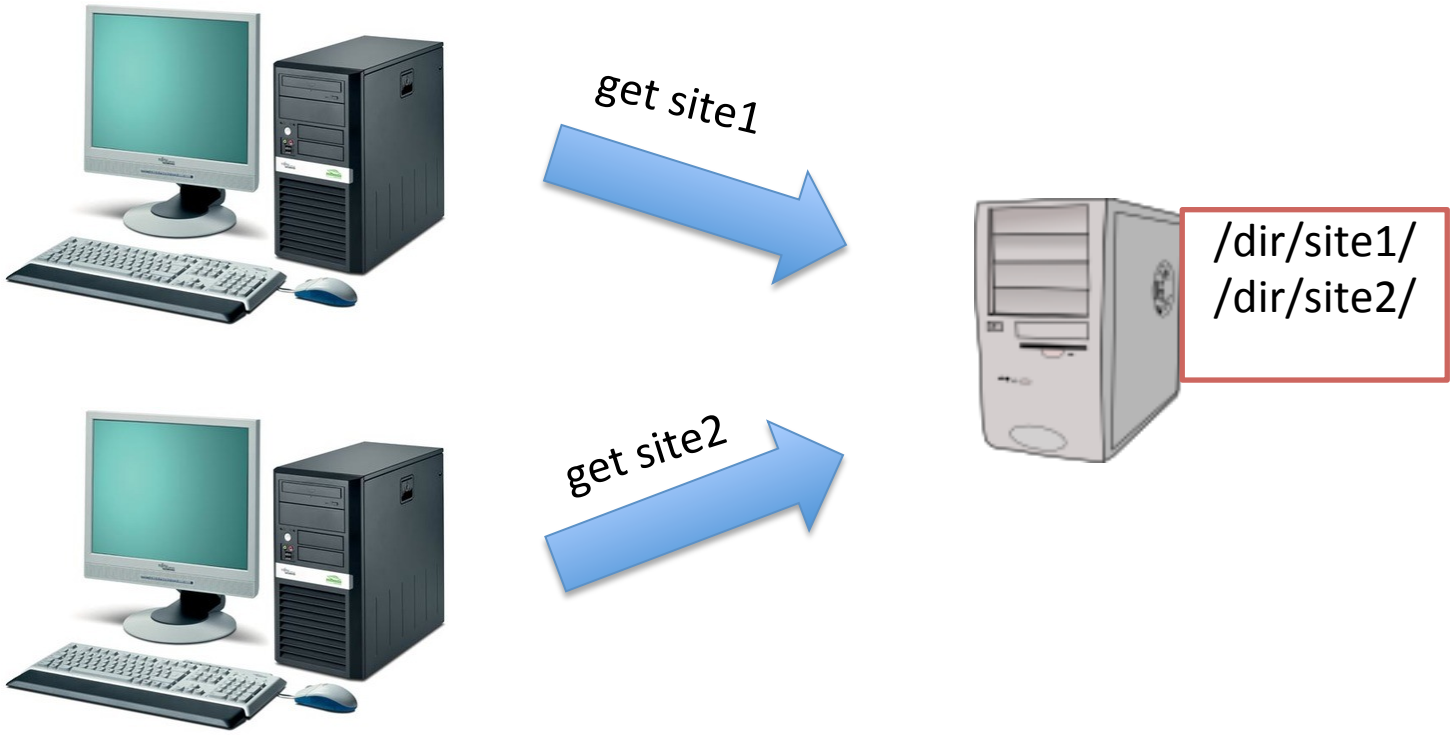
Reference documentation:
http://httpd.apache.org/docs/2.2/programs/ab.html

Exercise

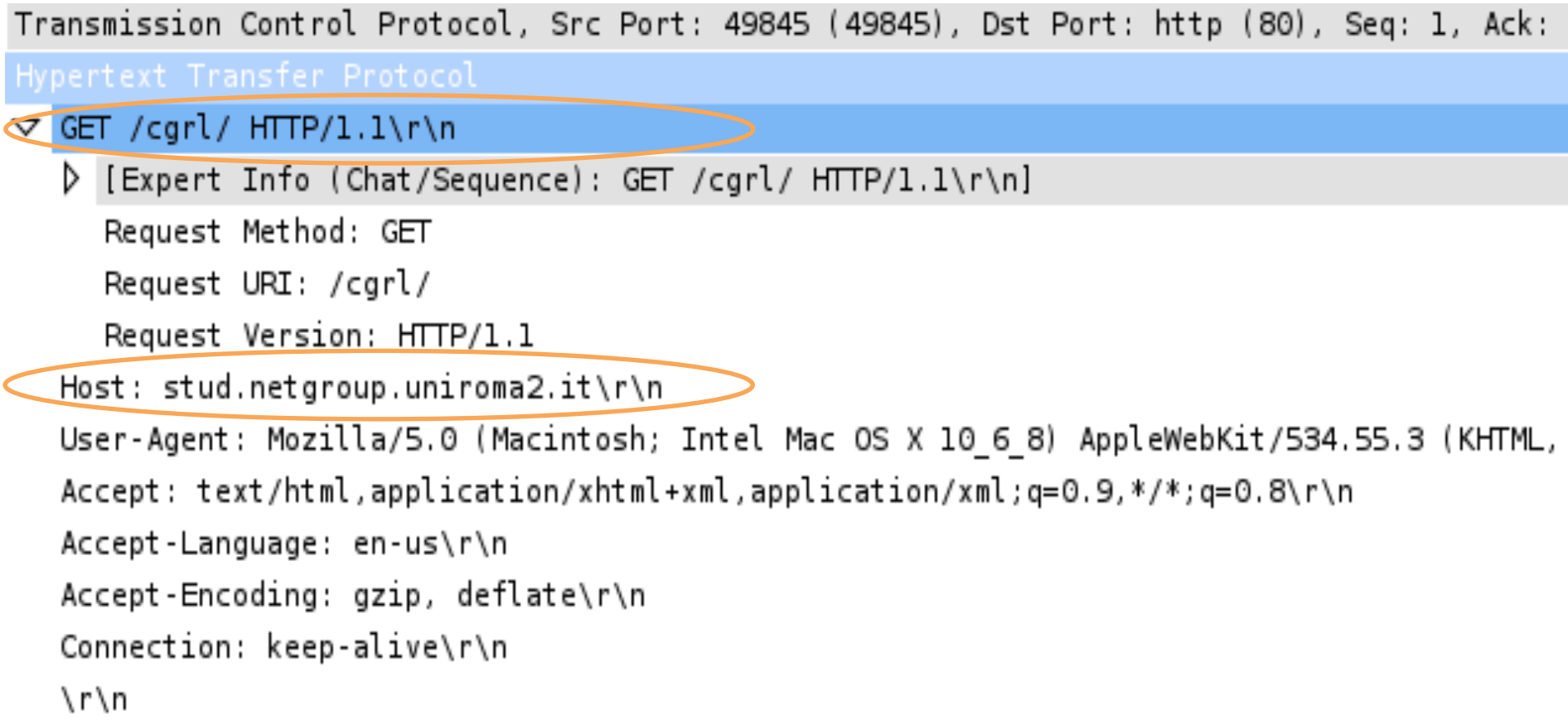
- Benchmark apache changing MPM

Virtual Hosting

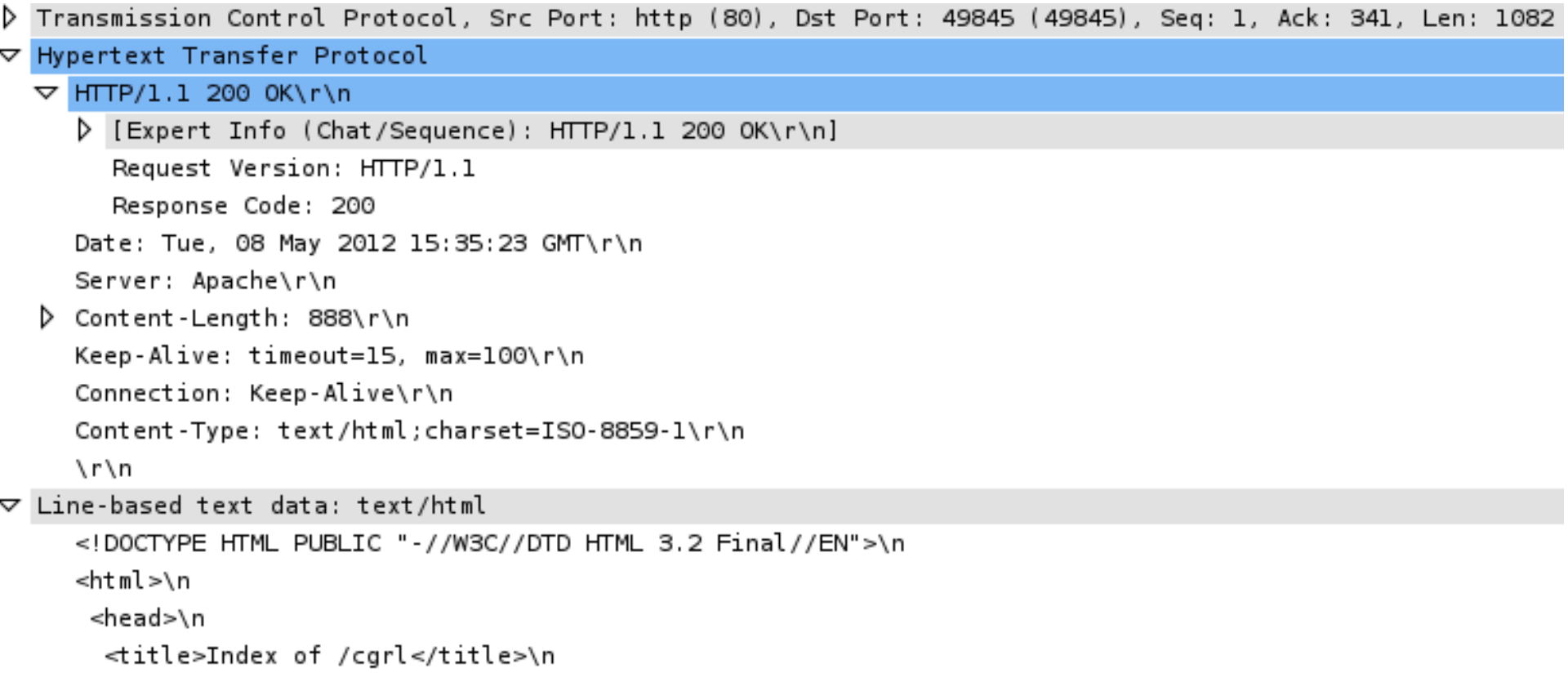
- Problem: *Several* websites, *one* webserver
  - Typically: *name-based* virtual host (but IP based is possible as well)



HTTP Request



HTTP Response



Virtual Hosting: example

put virtual hosts confs in sites-available dir!

```
NameVirtualHost *:80

<VirtualHost *:80>
   ServerName www.domain.tld
   ServerAlias domain.tld *.domain.tld
   DocumentRoot /www/domain
</VirtualHost>

<VirtualHost *:80>
   ServerName www.otherdomain.tld
   DocumentRoot /www/otherdomain
</VirtualHost>
```

IP/Port for listening requests

Name of the virtual host (match **host** http field)

Where the html files are (simple case)

use /etc/hosts to test virtual host without DNS modifications

DocumentRoot

- Where apache finds your documents (html files etc)
  - Typically search for: index.html index.cgi index.pl index.php index.xhtml index.htm
  - Defined from DirectoryIndex (order matters)

```
<html>
    <body>
        <h1>
            HELLO CGRL
        </h1>
    </body>
</html>
```

index.html sample file

Exercise 1: virtual hosting

1. Create two dirs “cgrl-web” and “yourname-web”. Put in the directory two index.html files
2. Configure 2 virtual web hosts
   - www.cgrl.edu
   - www.yourname.com
3. Start apache
4. modify /etc/hosts
5. View your websites with a browser

Standard Container Directives

- Many Container contexts:
  - <VirtualHost ...>: already seen…
  - <Directory>: applies one or more directives to a directory
  - <Files>: applies one or more directives to a file
  - <Location>: applies one or more directives to a URL
- AllowOverride: enable/disable directories directives overriding.
- .htaccess: default filename for the per-directory configuration

Options directive

None	No options.
All	All options except for `MultiViews`.
ExecCGI	Execution of CGI scripts is permitted.
FollowSymLinks	The server follows symbolic links in the directory. However, the server does not change the pathname used to match against `<Directory>` sections.
Includes	SSI commands are permitted.
IncludesNOEXEC	A restricted set of SSI commands can be embedded in the SSI pages. The SSI commands that are not allowed are #exec and #include.
Indexes	If a URL that maps to a directory is requested and there is no `DirectoryIndex` (for example, `index.html`) in that directory, then the server returns a formatted listing of the directory.
SymLinksIfOwnerMatch	The server only follows symbolic links for which the target file or directory is owned by the same user as the link.
MultiViews	Enables content negotiation based on a document's language.

Options +Setting1 – Setting2

```
<Directory /var/www/>
        Options Indexes FollowSymLinks MultiViews
        AllowOverride None
        Order allow,deny
        allow from all
</Directory>
```

Allow-Deny

```
Order allow,deny
Allow from all
```

- First, all Allow directives are evaluated; at least one must match, or the request is rejected. Next, all Deny directives are evaluated. If any matches, the request is rejected. Last, any requests which do not match an Allow or a Deny directive are denied by default.

A domain name, IP, network/netmask (CIDR)

```
#        Deny from all
#        Allow from 127.0.0.0/255.0.0.0 ::1/128
```

Exercise 2: directory listening

1. Take the previous example
2. Create a directory in your DocumentRoot “myfiles” and put some stuff (try a symbolic link) inside that

   <Directory /your/dir/myfiles>
   Options +Indexes
   </Directory>

3. Create a directory inside “myfiles”: “mysecretfiles”:

   <Directory /your/dir/myfiles/mysecrefiles>
   Options -Indexes
   </Directory>

.htaccess

- Same syntax as the main configuration files
  - so use <Directory> block instead (it's faster!)
  - Common misconception: not specifically for passwords or rewrite!
- "AllowOverride" : Types of directives that are allowed in .htaccess files (None, All, one or more directive inside these groups: {**AuthConfig, FileInfo, Indexes, Limit, Options}**)

Exercise 3: .htaccess password protection

- Let we create a new file with passwords:
  - htpasswd –c /root/apache_pass cgrl
  - Then put these directives in .htaccess (or <Directory>)

```
AuthType Basic
AuthName "Restricted Files"
# (Following line optional)
AuthBasicProvider file
AuthUserFile /usr/local/apache/passwd/passwords
Require user rbowen
```

password file

users

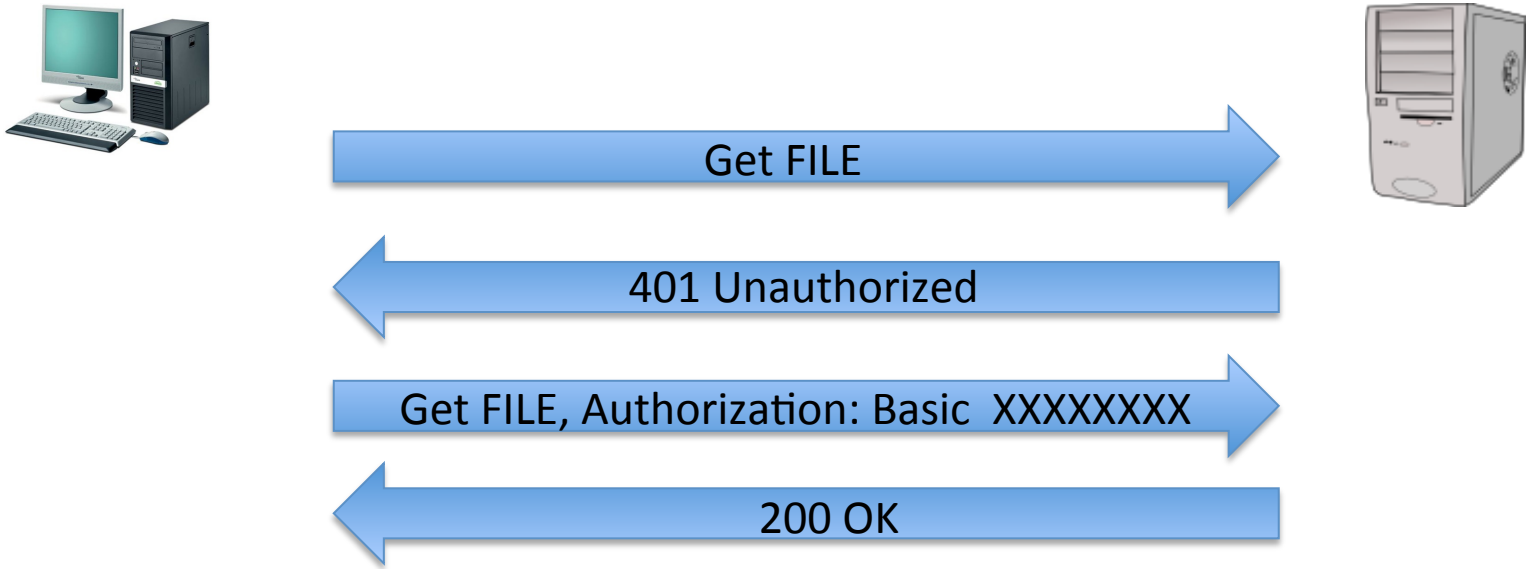
- Now protect our secret file...

What we did?

- Authentication
  - process by which you verify that someone is who they claim he is
- Authorization
  - someone is allowed to be where they want to go, or to have information that he wants to have

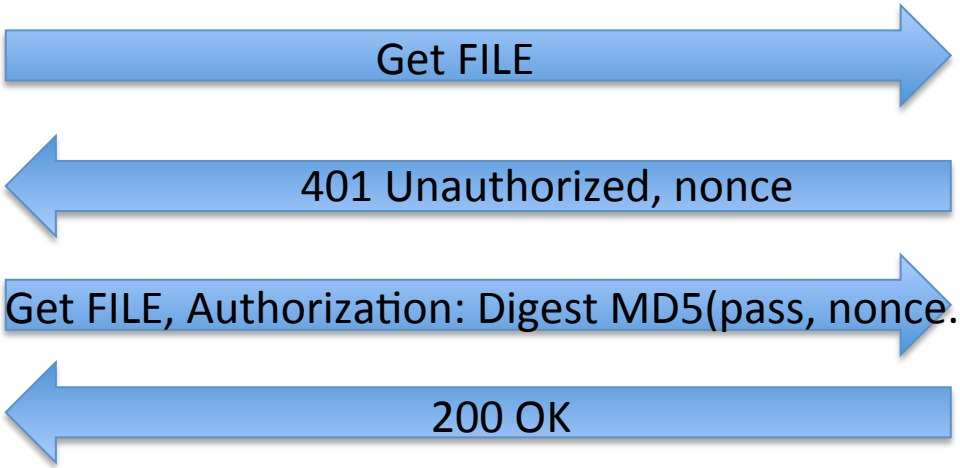
- Authentication type (see the AuthType directive)
  - mod_auth_basic
  - mod_auth_digest
- Authentication provider (see the AuthBasicProv
  - mod_authn_anon
  - mod_authn_dbd
  - mod_authn_dbm
  - mod_authn_file
  - mod_authnz_ldap
  - mod_authn_socache
- Authorization (see the Require directive)
  - mod_authnz_ldap
  - mod_authz_dbd
  - mod_authz_dbm
  - mod_authz_groupfile
  - mod_authz_host
  - mod_authz_owner
  - mod_authz_user

HTTP Basic Authentication




```
▶ GET /myfiles/mysecretfiles/xxx.txt HTTP/1.1\r\n
  Host: www.mysite.com\r\n
  User-Agent: Links (2.3pre1; Linux 3.0.0-16-generic i686; 126x36)\r\n
  Accept: */*\r\n
  Accept-Encoding: gzip,deflate\r\n
  [truncated] Accept-Charset: us-ascii, ISO-8859-1, ISO-8859-2, ISO-885
  Accept-Language: en,*;q=0.1\r\n
  Connection: keep-alive\r\n
▼ Authorization: Basic Y2dybDpjZ3JscGFzcw==\r\n
    Credentials: cgrl:cgrlpass
```

HTTP Digest Authentication




```
GET /dir/index.html HTTP/1.0
Host: localhost
Authorization: Digest username="Mufasa",
                      realm="testrealm@host.com",
                      nonce="dcd98b7102dd2f0e8b11d0f600bfb0c093",
                      uri="/dir/index.html",
                      qop=auth,
                      nc=00000001,
                      cnonce="0a4f113b",
                      response="6629fae49393a05397450978507c4ef1",
                      opaque="5ccc069c403ebaf9f0171e9517f40e41"
```

Static web pages

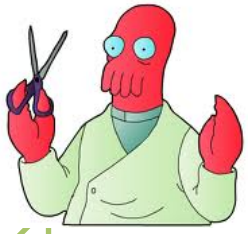
REQUEST

returns the content of a file

RESPONSE

Dynamic web pages

REQUEST



passes the request to a program and return its output

RESPONSE

client-side scripting

server-side scripting

Client-side scripting languages

- javascript
- actionscript

CAN NOT DO WHATEVER YOU WANT

Server-side scripting languagues

- C/C++
- bash (!)
- Perl
- ASP
- PHP
- Java
- Python
- Lua
- Ruby
- ColdFusion
- …

DO WHATEVER YOU WANT

rfc 3875 (2004)
used since 1991

mod_cgi

Common Gateway Interface

- Standard way to delegate the generation of web pages to executable files
- processes isolated from the core Web server

Apache Tutorial: Dynamic Content with CGI

- **Check the lab**
  for an example!
  - www.cgrl.edu/cgi-bin/env.cgi
  - www.cgrl.edu/cgi-bin/interact.cgi

Introduction

Related Modules	Related Directives
mod_alias	AddHandler
mod_cgi	Options
	ScriptAlias

http://httpd.apache.org/docs/2.0/howto/cgi.html

```
ScriptAlias /cgi-bin/ /root/cgrl-web/cgi-bin/
<Directory "/root/cgrl-web/cgi-bin">
    AllowOverride None
    Options +ExecCGI -MultiViews +SymLinksIfOwnerMatch
    AddHandler cgi-script .cgi
    Order allow,deny
    Allow from all
</Directory>
```

FastCGI

- *CGI: every time you access to a page, you call a program whose output generate the HTTP response*
  - *Launching/Quitting one program per request could cost a lot!*
- *mod_fcgid starts a sufficient number instances of the program to handle concurrent requests, and these programs remain running to handle further incoming requests.*
  - *Significantly faster!*

mod_include

Server Side Include

- are “directives that are placed in HTML pages, and evaluated on the server while the pages are being served.”

Options +Includes

and

AddType text/html .shtml
AddOutputFilter INCLUDES .shtml

common directives	examples
include	<!--#include virtual="header.html" -->
exec	<!--#exec cgi="/cgi-bin/foo.cgi" --> <!--#exec cmd="ls -l" -->
echo	<!--#echo var="REMOTE_ADDR" -->
if, elif, else, endif	(control directives)

Installed on more than 20 million Web sites and 1 million web server!

used by:
wordpress, joomla
facebook, flickr
and many more!

PHP

Warning

We do not recommend using a threaded MPM in production with Apache 2. Use the prefork MPM, which is the default MPM with Apache 2.0 and 2.2. For information on why, read the related FAQ entry on using Apache2 with a threaded MPM

LoadModule php5_module modules/libphp5.so

```
<FilesMatch \.php$>
    SetHandler application/x-httpd-php
</FilesMatch>
```

A "handler" is an internal Apache representation of the action to be performed when a file is called

```php
class Person {
    public $firstName;
    public $lastName;

    public function __construct($firstName, $lastName = '') { //Optional parameter
        $this->firstName = $firstName;
        $this->lastName = $lastName;
    }

    public function greet() {
        return "Hello, my name is " . $this->firstName . " " . $this->lastName . ".";
    }

    public static function staticGreet($firstName, $lastName) {
        return "Hello, my name is " . $firstName . " " . $lastName . ".";
    }
}

$he = new Person('John', 'Smith');
$she = new Person('Sally', 'Davis');
$other = new Person('Joe');

echo $he->greet(); // prints "Hello, my name is John Smith."
echo '<br />';
echo $she->greet(); // prints "Hello, my name is Sally Davis."
echo '<br />';
echo $other->greet(); // prints "Hello, my name is Joe ."
echo '<br />';
echo Person::staticGreet('Jane', 'Doe'); // prints "Hello, my name is Jane Doe."
```

source: http://en.wikipedia.org/wiki/PHP#cite_note-54

Model View Controller (MVC) frameworks

mod_passenger (aka mod_rails)

LoadModule passenger_module ...
PassengerRoot ...
PassengerRuby ...

mod_wsgi

WSGI: python standard to communicate with web server

WSGIScriptAlias / /path/to/mysite.com/mysite/wsgi.py

not necessarily in .htaccess

Mod Rewrite

- Go
- Wh
- Ho
  - –
  - –
  - –

```
DocumentRoot /var/www/example.com
Alias /myapp /opt/myapp-1.2.3
<Directory /opt/myapp-1.2.3>
    RewriteEngine On
    RewriteBase /myapp/
    RewriteRule ^index\.html$  welcome.html
</Directory>
```

http://netgroup.uniroma2.it/index.php?post=258&cat=43422342

http://netgroup.uniroma2.it/people/postdoc/marco-bonola/

Mod Rewrite

RewriteRule PATTERN SUBSTITUTION [FLAGS]	Define a rule: if find a pattern in the URL, then substitute. Flags: send headers to browsers (e.g. 401)
RewriteCond %{HTTP_USER_AGENT} ^Mozilla.*	Apply the next rule only in this condition is true. Rules are applied only if ALL the previous conditions are true

Examples of rules:

```
RewriteRule ^/shortcut$ /complicated/and/way/too/long/url/here
RewriteRule /products/([0-9]+) /siteengine/products.php?id=$1
RewriteRule  ^/products/([0-9]+),([ad]*),([0-9]{0,3}),([0-9]*),([0-9]*$)
      /test/index.php?id=$1&sort=$2&order=$3&start=$4
```


KEEP
CALM
AND
CARRY
ON

http://httpd.apache.org/docs/current/mod/mod_rewrite.html

Mod Rewrite Example: wordpress

```
# BEGIN WordPress
<IfModule mod_rewrite.c>
RewriteEngine On
RewriteBase /
RewriteRule ^index\.php$ - [L]
RewriteCond %{REQUEST_FILENAME} !-f
RewriteCond %{REQUEST_FILENAME} !-d
RewriteRule . /index.php [L]
</IfModule>
# END WordPress
```

(last rule)

(is not regular **f**ile)

(is not directory)

Apache apply rules iteratively in cycles until no more rules can be applied (e.g. C1: A->B, B->C - C2-> C->D - C3: Nothing) :

- Or if “iteration limit” is reached

[L] : do not process any rules below in this iteration

mod_rewrite

REGULAR EXPRESSION SYNTAX

^	Start of string
$	End of string
.	Any single character
(a|b)	a or b
(...)	Group section
[abc]	Item in range (a or b or c)
[^abc]	Not in range (not a or b or c)
a?	Zero or one of a
a*	Zero or more of a
a+	One or more of a
a{3}	Exactly 3 of a
a{3,}	3 or more of a
a{3,6}	Between 3 and 6 of a
!(pattern)	"Not" prefix. Apply rule when URL does not match pattern.

Redirection Header Codes

301	Moved permanently
302	Moved temporarily
403	Forbidden
404	Not Found
410	Gone

RewriteRule FLAGS

R[=code]	Redirect to new URL, with optional code (see below).
F	Forbidden (sends 403 header)
G	Gone (no longer exists)
P	Proxy
L	Last Rule
N	Next (i.e. restart rules)
C	Chain
T=mime-type	Set Mime Type
NS	Skip if internal sub-request
NC	Case insensitive
QSA	Append query string
NE	Do not escape output
PT	Pass through
S=x	Skip next x rules
E=var:value	Set environmental variable "var" to "value".

RewriteCond FLAGS

NC	Case insensitive
OR	Allows a rule to apply if one of a series of conditions are true.

Example Rules

```
# Site has permanently moved to new domain
# domain.com to domain2.com
RewriteCond %{HTTP_HOST} ^www.domain.com$ [NC]
RewriteRule ^(.*)$ http://www.domain2.com/$1 [R=301,L]

# Page has moved temporarily
# domain.com/page.htm to domain.com/new_page.htm
RewriteRule ^page.htm$ new_page.htm [R,NC,L]

# Nice looking URLs (no querystring)
# domain.com/category-name-1/ to domain.com/categories.php?name=category-name-1
RewriteRule ^([A-Za-z0-9-]+)/?$ categories.php?name=$1 [L]

# Nice looking URLs (no querystring) with pagination
# domain.com/articles/title/5/ to domain.com/article.php?name=title&page=5
RewriteRule ^articles/([A-Za-z0-9-]+)/([0-9]+)/?$ article.php?name=$1&page=$2 [L]

# Block referrer spam
RewriteCond %{HTTP_REFERER} (weight) [NC,OR]
RewriteCond %{HTTP_REFERER} (drugs) [NC]
RewriteRule .* - [F]
```

Server Variables

Format
%{NAME_OF_VAR}

HTTP Headers
HTTP_USER_AGENT
HTTP_REFERER
HTTP_COOKIE
HTTP_FORWARDED
HTTP_HOST
HTTP_PROXY_CONNECTION
HTTP_ACCEPT

Request
REMOTE_ADDR
REMOTE_HOST
REMOTE_USER
REMOTE_IDENT
REQUEST_METHOD
SCRIPT_FILENAME
PATH_INFO
QUERY_STRING
AUTH_TYPE

Server
DOCUMENT_ROOT
SERVER_ADMIN
SERVER_NAME
SERVER_ADDR
SERVER_PORT
SERVER_PROTOCOL
SERVER_SOFTWARE

Time
TIME_YEAR
TIME_MON
TIME_DAY
TIME_HOUR
TIME_MIN
TIME_SEC
TIME_WDAY
TIME

Special
API_VERSION
THE_REQUEST
REQUEST_URI
REQUEST_FILENAME
IS_SUBREQ

Directives
RewriteEngine
RewriteOptions
RewriteLog
RewriteLogLevel
RewriteLock
RewriteMap
RewriteBase
RewriteCond
RewriteRule

Available free from AddedBytes.com

http://www.addedbytes.com/download/mod_rewrite-cheat-sheet-v1/png/