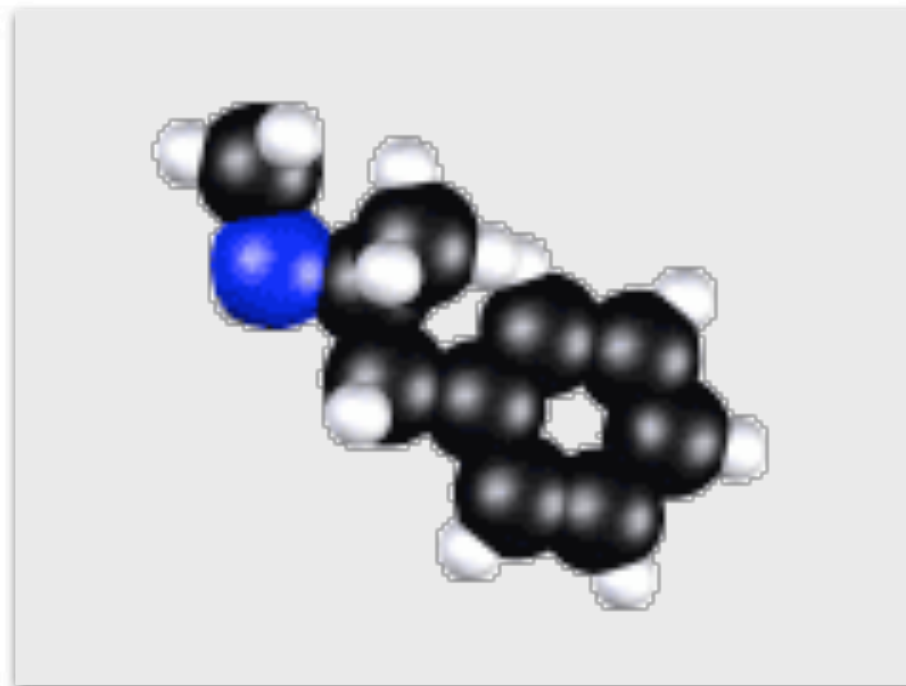


mod_perl For Speed Freaks!

Philippe M. Chiasson
gozer@ectoplasm.org





This is NOT what we will be talking about



This is what we will be
talking about

This is what we will be talking about

```
Requests per second:      1159.49 [# /sec] (mean)
Time per request:         17.249 [ms] (mean)
Time per request:         0.862 [ms] (mean, across all concurrent
requests)
Transfer rate:            5681.49 [Kbytes/sec] received
```

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	1	2 1.6	3	5
Processing:	7	12 2.5	13	18
Waiting:	3	7 2.6	7	12
Total:	11	15 2.7	15	22

First, assumptions

- You have `Apache/mod_perl` running
- Your code is now much faster
- You think you could need a speedup

Information gathering

- Apples vs. Apples
- Reliable information
- metrics

mod_status

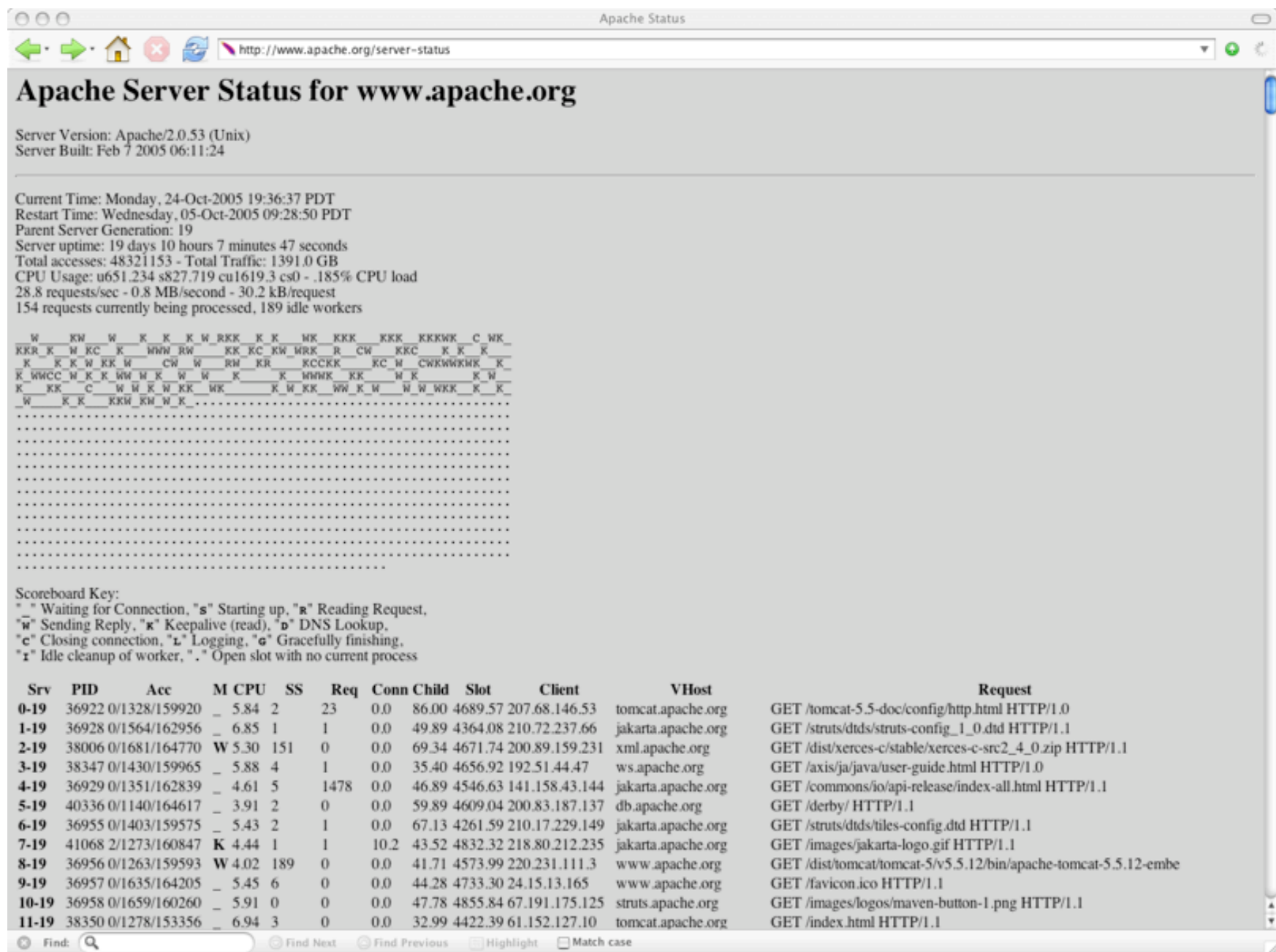
- Server status reporting
- Useful to get an overview of your server's health
- Comes with Apache, so you already have it

Enabling mod_status

```
LoadModule status_module modules/mod_status.so  
ExtendedStatus On
```

```
<Location /server-status>  
    SetHandler server-status  
</Location>
```

mod_status



The screenshot shows the Apache Status page for www.apache.org. The page title is "Apache Server Status for www.apache.org". The server version is Apache/2.0.53 (Unix), built on Feb 7 2005 06:11:24. The current time is Monday, 24-Oct-2005 19:36:37 PDT. The restart time is Wednesday, 05-Oct-2005 09:28:50 PDT. The parent server generation is 19. The server uptime is 19 days 10 hours 7 minutes 47 seconds. The total accesses are 48321153, and the total traffic is 1391.0 GB. The CPU usage is u651.234 s827.719 cu1619.3 cs0 - .185% CPU load. The server is processing 154 requests currently and has 189 idle workers.

The scoreboard key is as follows:

- " " Waiting for Connection, "s" Starting up, "R" Reading Request,
- "W" Sending Reply, "K" Keepalive (read), "D" DNS Lookup,
- "C" Closing connection, "L" Logging, "G" Gracefully finishing,
- "T" Idle cleanup of worker, "." Open slot with no current process

Srv	PID	Acc	M	CPU	SS	Req	Conn	Child	Slot	Client	VHost	Request
0-19	36922	0/1328/159920	_	5.84	2	23	0.0	86.00	4689.57	207.68.146.53	tomcat.apache.org	GET /tomcat-5.5-doc/config/http.html HTTP/1.0
1-19	36928	0/1564/162956	_	6.85	1	1	0.0	49.89	4364.08	210.72.237.66	jakarta.apache.org	GET /struts/dtds/struts-config_1_0.dtd HTTP/1.1
2-19	38006	0/1681/164770	W	5.30	151	0	0.0	69.34	4671.74	200.89.159.231	xml.apache.org	GET /dist/xerces-c/stable/xerces-c-src2_4_0.zip HTTP/1.1
3-19	38347	0/1430/159965	_	5.88	4	1	0.0	35.40	4656.92	192.51.44.47	ws.apache.org	GET /axis/ja/java/user-guide.html HTTP/1.0
4-19	36929	0/1351/162839	_	4.61	5	1478	0.0	46.89	4546.63	141.158.43.144	jakarta.apache.org	GET /commons/io/api-release/index-all.html HTTP/1.1
5-19	40336	0/1140/164617	_	3.91	2	0	0.0	59.89	4609.04	200.83.187.137	db.apache.org	GET /derby/ HTTP/1.1
6-19	36955	0/1403/159575	_	5.43	2	1	0.0	67.13	4261.59	210.17.229.149	jakarta.apache.org	GET /struts/dtds/tiles-config.dtd HTTP/1.1
7-19	41068	2/1273/160847	K	4.44	1	1	10.2	43.52	4832.32	218.80.212.235	jakarta.apache.org	GET /images/jakarta-logo.gif HTTP/1.1
8-19	36956	0/1263/159593	W	4.02	189	0	0.0	41.71	4573.99	220.231.111.3	www.apache.org	GET /dist/tomcat/tomcat-5/v5.5.12/bin/apache-tomcat-5.5.12-embe
9-19	36957	0/1635/164205	_	5.45	6	0	0.0	44.28	4733.30	24.15.13.165	www.apache.org	GET /favicon.ico HTTP/1.1
10-19	36958	0/1659/160260	_	5.91	0	0	0.0	47.78	4855.84	67.191.175.125	struts.apache.org	GET /images/logos/maven-button-1.png HTTP/1.1
11-19	38350	0/1278/153356	_	6.94	3	0	0.0	32.99	4422.39	61.152.127.10	tomcat.apache.org	GET /index.html HTTP/1.1

Find: Find Next Find Previous Highlight Match case

mod_status explained

```
Current Time: Monday, 24-Oct-2005 19:36:37 PDT
Restart Time: Wednesday, 05-Oct-2005 09:28:50 PDT
Parent Server Generation: 19
Server uptime: 19 days 10 hours 7 minutes 47 seconds
Total accesses: 48321153 - Total Traffic: 1391.0 GB
CPU Usage: u651.234 s827.719 cu1619.3 cs0 - .185% CPU load
28.8 requests/sec - 0.8 MB/second - 30.2 kB/request
154 requests currently being processed, 189 idle workers
```

mod_status explained

```
_W_   KW_   W_   K_   K_   K_   W_ RKK_ K_ K_   WK_   KKK_   KKK_   KKKWK_ C_ WK_
KKR_ K_   W_ KC_   K_   WWW_ RW_   KK_ KC_ KW_ WRK_ R_   CW_   KKC_   K_ K_   K_
_ K_   K_ K_ W_ KK_ W_   CW_   W_   RW_   KR_   KCCKK_   KC_ W_   CWKWWKWK_ K_
K_ WWCC_ W_ K_ K_ WW_ W_ K_   W_   W_   K_   K_   WWWK_   KK_   W_ K_   K_ W_
K_   KK_   C_   W_ W_ K_ W_ KK_   WK_   K_ W_ KK_   WW_ K_ W_   W_ W_ WKK_   K_ K_
_W_   K_ K_   KKW_ KW_ W_ K_ .....
```

Scoreboard Key:

"_" Waiting for Connection, "S" Starting up, "R" Reading Request,
"W" Sending Reply, "K" Keepalive (read), "D" DNS Lookup,
"C" Closing connection, "L" Logging, "G" Gracefully finishing,
"I" Idle cleanup of worker, "." Open slot with no current process

mod_status explained

```
$> wget -O- http://www.apache.org/server-status?auto
```

```
Total Accesses: 48340863  
Total kBytes: 1459565806  
CPULoad: .18793  
Uptime: 1678505  
ReqPerSec: 28.8  
BytesPerSec: 890432  
BytesPerReq: 30917.8  
BusyWorkers: 140  
IdleWorkers: 203
```

Apache2::Status

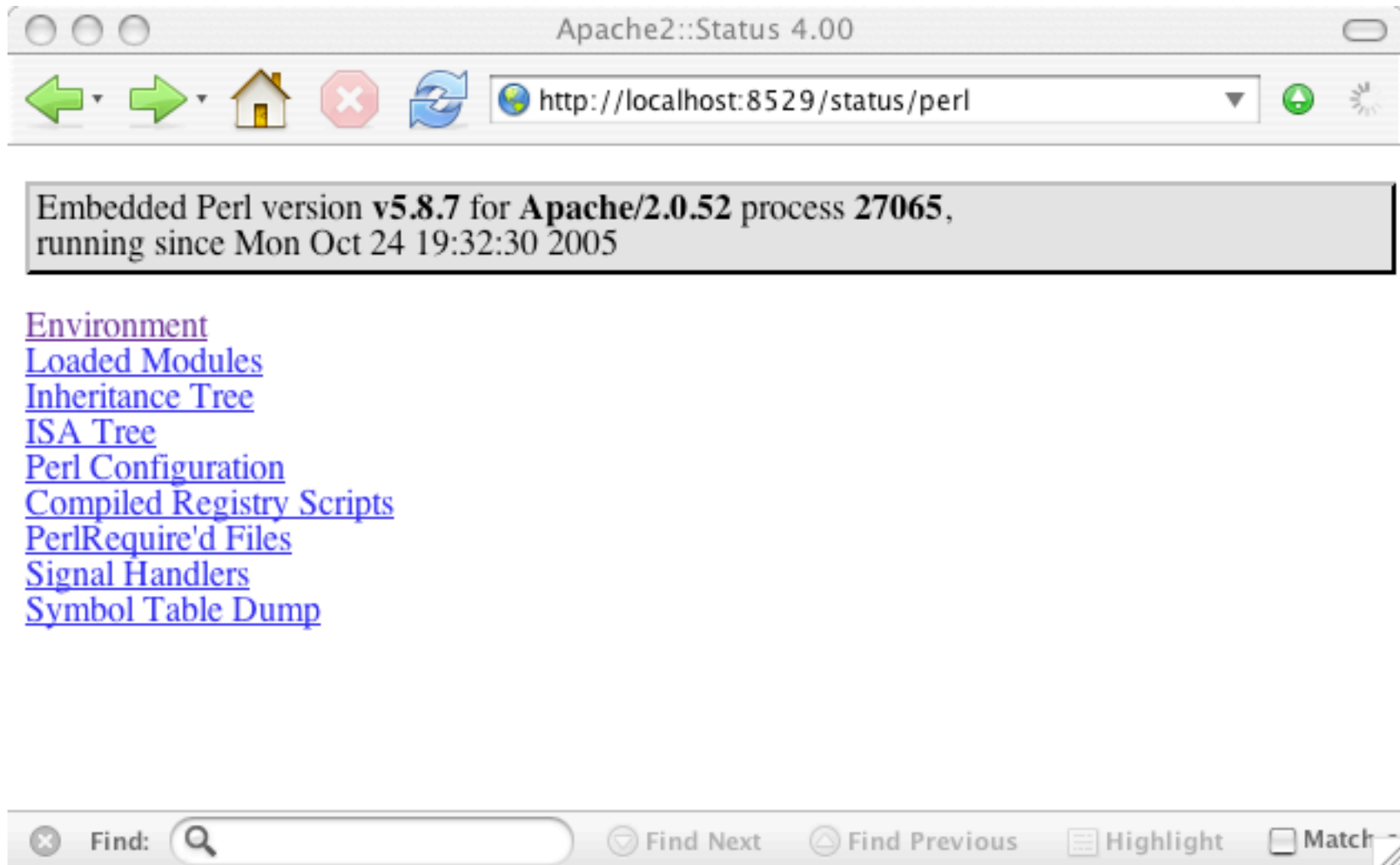
- Perl status reporting
- Great to poke at a running mod_perl server
- Comes with mod_perl, so you already have it

Enabling Apache2::Status

```
<Location /perl-status>
  SetHandler perl-script
  PerlHandler Apache2::Status
  PerlSetVar StatusOptionsAll On
</Location>
```

```
$> cpan \  
Data::Dumper \  
Devel::Peek \  
Apache::Peek \  
B::LexInfo \  
B::Deparse \  
B::Terse \  
B::TerseSize \  
Devel::Symdump \  
B::Fathom \  
B::Graph
```

Apache2::Status



Apache2::Status 4.00

http://localhost:8529/status/perl

Embedded Perl version **v5.8.7** for **Apache/2.0.52** process **27065**,
running since Mon Oct 24 19:32:30 2005

[Environment](#)
[Loaded Modules](#)
[Inheritance Tree](#)
[ISA Tree](#)
[Perl Configuration](#)
[Compiled Registry Scripts](#)
[PerlRequire'd Files](#)
[Signal Handlers](#)
[Symbol Table Dump](#)

Find: Find Next Find Previous Highlight Match

Apache2::Status

		2005	
CGI	3.11	Wed Aug 3 14:14:55 2005	/System/Library/Perl/5.8.6/CGI.pm
CGI::Util	1.5	Mon Mar 7 11:52:11 2005	/System/Library/Perl/5.8.6/CGI/Util.pm
Carp	1.03	Sun Mar 20 16:41:55 2005	/System/Library/Perl/5.8.6/Carp.pm
Config	0.00	Sun Mar 20 16:42:38 2005	/System/Library/Perl/5.8.6/darwin-thread-multi-2leve

Find: Find Next Find Previous Highlight Match case

Apache2::Status

Apache2::Status 4.00

http://localhost:8529/status/perl?CGI

[CGI::print](#), [CGI::put](#), [CGI::r](#), [CGI::rearrange](#), [CGI::save request](#), [CGI::self or CGI](#), [CGI::self or default](#), [CGI::to filehandle](#), [CGI::unescape](#), [CGI::upload hook](#)

hashes [CGI::EXPORT](#), [CGI::EXPORT OK](#), [CGI::EXPORT TAGS](#), [CGI::QUERY FIELDNAMES](#), [CGI::QUERY PARAM](#)

ios

packages [CGI::Util](#)

scalars [CGI::AUTOLOADED ROUTINES](#), [CGI::AUTOLOAD DEBUG](#), [CGI::AutoloadClass](#), [CGI::BEEN THERE](#), [CGI::CGI](#), [CGI::CLOSE UPLOAD FILES](#), [CGI::CRLF](#), [CGI::DEBUG](#), [CGI::DEFAULT DTD](#), [CGI::DISABLE UPLOADS](#), [CGI::DTD PUBLIC IDENTIFIER](#), [CGI::DefaultClass](#), [CGI::EBCDIC](#), [CGI::HEADERS ONCE](#), [CGI::MOD PERL](#), [CGI::NOSTICKY](#), [CGI::NO UNDEF PARAMS](#), [CGI::NPH](#), [CGI::OS](#), [CGI::POST MAX](#), [CGI::PRIVATE TEMPFILES](#), [CGI::SL](#), [CGI::TAINTED](#), [CGI::USE PARAM SEMICOLONS](#), [CGI::VERSION](#), [CGI::XHTML](#), [CGI::needs binmode](#), [CGI::revision](#)

unknowns

[Memory Usage](#)

Find: CGI Find Next Find Previous Highlight Match case

Apache2::Status

The image displays three overlapping browser windows, each showing a different status page from the Apache2::Status tool. The top window shows the status for the CGI package, the middle for DBI, and the bottom for POSIX. Each window includes a search bar at the bottom with the text 'CGI' entered.

Window 1: CGI
200 OK
http://localhost:8529/status/perl/CGI?noh_b_package_siz
Memory Usage for package CGI
Totals: 255794 bytes, 249.80 Kb, 0.25 Mb | 3328 OPs

Window 2: DBI
Mozilla Firefox
http://localhost:8529/status/perl/DBI?noh_b_package_size
Memory Usage for package DBI
Totals: 260655 bytes, 254.55 Kb, 0.25 Mb | 4499 OPs

Window 3: POSIX
Mozilla Firefox
http://localhost:8529/status/perl/POSIX?noh_b_package_siz
Memory Usage for package POSIX
Totals: 113667 bytes, 111.00 Kb, 0.11 Mb | 455 OPs

<u>AUTOLOAD</u>	6611 bytes	131 OPs
<u>import</u>	3646 bytes	59 OPs

Find: CGI Find Next Find Previous Highlight Match case

But exactly how fast are you?

- Comparison points
- Benchmark early
- Benchmark often

ab

- Apache Bench
- A good HTTP benchmark tool
- Comes with Apache, so you already have it
- There are others

ab usage

```
$> ab -h
```

```
Usage: ab [options] [http://]hostname[:port]/path
```

```
Options are:
```

```
-n requests      Number of requests to perform
-c concurrency   Number of multiple requests to make
-t timelimit     Seconds to max. wait for responses
-V              Print version number and exit
-k              Use HTTP KeepAlive feature
-e filename      Output CSV file with percentages served
-h              Display usage information (this message)
```

ab output

```
$> ab -c10 -n50 http://www.google.com/
```

```
This is ApacheBench, Version 2.0.41-dev <$Revision: 1.121.2.12 $> a  
Copyright (c) 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeus  
Copyright (c) 1998-2002 The Apache Software Foundation, http://www.
```

```
Benchmarking www.google.com (be patient).....done
```

```
Server Software:      GWS/2.1  
Server Hostname:     www.google.com  
Server Port:        80  
  
Document Path:      /  
Document Length:    151 bytes
```

ab output

```
$> ab -c10 -n50 http://www.google.com/
```

```
Concurrency Level:          10
Time taken for tests:       0.313241 seconds
Complete requests:         50
Failed requests:           0
Write errors:               0
Non-2xx responses:         50
Total transferred:         24100 bytes
HTML transferred:          7550 bytes
Requests per second:       159.62 [# /sec] (mean)
Time per request:          62.648 [ms] (mean)
Time per request:          6.265 [ms] (mean, across all concurrent requests)
Transfer rate:              73.43 [Kbytes/sec] received
```


ab output

```
$> ab -c10 -n50 http://www.google.com/
```

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	23	24 1.9	24	28
Processing:	27	32 9.1	29	67
Waiting:	27	32 9.0	29	66
Total:	51	57 9.0	56	91

Percentage of the requests served within a certain time (ms)

50%	56
66%	57
75%	57
80%	58
90%	74
95%	79
98%	91
99%	91
100%	91 (longest request)

Memory usage

- Total physical RAM is the limit
- SWAP doesn't count
- Wired counts
- Shared, Resident, Total

top

```
Processes: 81 total, 2 running, 79 sleeping... 237 threads          22:06:18
Load Avg: 1.48, 1.31, 1.23      CPU usage: 90.9% user, 9.1% sys, 0.0% idle
SharedLibs: num = 30, resident = 7.40M code, 904K data, 2.71M LinkEdit
MemRegions: num = 14341, resident = 192M + 12.3M private, 109M shared
PhysMem: 77.3M wired, 284M active, 142M inactive, 504M used, 7.84M free
VM: 6.45G + 21.0M 1417790(0) pageins, 375968(0) pageouts
```

PID	COMMAND	%CPU	TIME	#TH	#PRTS	#MREGS	RPRVT	RSHRD	RSIZE	VSIZE
27068	Grab	0.0%	0:06.77	3	160	195	2.09M	6.77M	3.01M	153M
26955	TextWrangl	0.0%	1:14.01	4	110	260	4.77M	18.4M	15.6M	174M
26905	bash	0.0%	0:00.66	1	14	18	220K	668K	768K	27.1M
26904	login	0.0%	0:00.04	1	16	37	0K	320K	188K	26.9M
26890	firefox-bi	0.0%	9:31.50	12	213	514	38.3M	19.9M	48.3M	398M
26887	Keynote	0.0%	24:04.87	5	124	598	52.7M	24.4M	58.6M	284M
26882	thunderbir	0.0%	2:08.07	10	124	582	36.3M	24.4M	43.0M	230M
26792	bash	0.0%	0:00.24	1	14	17	196K	668K	548K	27.1M
26791	login	0.0%	0:00.05	1	16	37	0K	320K	16K	26.9M
26789	iTerm	0.0%	10:00.31	6	380	204	5.31M	10.3M	9.25M	159M

GTop

```
use GTop;
my $gtop = GTop->new;

my $proc_mem = $gtop->proc_mem($$);
for (qw(size vsize share rss)) {
    printf "    %s => %d\n", $_, $proc_mem->$_();
}
```

```
size    => 1900544
vsize   => 3108864
share   => 1392640
rss     => 1900544
```

BSD::Resource

```
use BSD::Resource;
($usertime,
 $systemtime,
 $maxrss,
 $ixrss,
 $idrss,
 $isrss,
 $minflt,
 $majflt,
 $nswap,
 $inblock,
 $oublock,
 $msgsnd,
 $msgrcv,
 $nsignals,
 $nivcsw,
 $nivcsw) = getrusage();
```

Shared memory

- Identical memory shared by more than one process
- You want to get as much as possible
- Copy on write

Module Preloading

```
PerlModule CGI  
PerlModule DBI  
PerlModule DBD::mysql  
PerlModule Apache2::RequestRec  
PerlModule Apache2::ServerRec
```

Module initialization

- `DBI->install_driver('mysql');`
- `CGI->compile(':all');`
- Check the doc of the modules you use

Registry Preloading

```
#startup.pl
use ModPerl::RegistryLoader ();

my $rl = ModPerl::RegistryLoader->new(
    package => 'ModPerl::Registry',
    debug   => 1,
);

$rl->handler($url, $filename);
```

use Foo vs. use Foo ();

- use Foo: Importing default EXPORTS
- use Foo (): Importing nothing by default

```
use POSIX;
```

```
use POSIX added 696k
```

```
use POSIX ();
```

```
use POSIX () added 316k
```

Apache2::Const

```
use Apache2::Const qw(OK DECLINED);  
return OK;
```

```
use Apache2::Const -compile => qw(OK DECLINED);  
return Apache2::Const::OK;
```

Apache configuration

perl-script vs. modperl

- SetHandler perl-script
 - STDIN/STDOUT tied
 - %ENV, @INC saved/restored
 - %ENV changes propagated
- SetHandler modperl
 - nada

PerlOptions

- PerlOptions Autoload
- PerlOptions GlobalRequest
- PerlOption ParseHeader
- PerlOption SetupEnv

KeepAlive Off

- KeepAlives are an HTTP feature
- Generally a good idea
- mod_perl not so much so

Memory leaks

- OS memory usually not reclaimed
- Perl designed for run fast, then terminate
- mod_perl is a long running process
- Some Perl optimizations don't apply
- all sort of thing can (and will) leak

Slurping

```
sub handler {  
  my $r = shift;  
  open (my $fh, "/tmp/motd.txt");  
  my $motd = join '', <$fh>;  
  print $motd;  
  return OK;  
}
```

```
sub handler {  
  my $r = shift;  
  open (my $fh, "/tmp/motd.txt");  
  while (my $line = <$motd>) {  
    print $line;  
  }  
  return OK;  
}
```

Reffing

```
sub handler {
  my $r = shift;
  open (my $fh, "/tmp/motd.txt");
  my $motd = join '', <$fh>;
  print_motd($motd);
  return OK;
}
```

```
sub print_motd {
  my $motd = shift;
  print $motd;
}
```

```
sub handler {
  my $r = shift;
  open (my $fh, "/tmp/motd.txt");
  my $motd = join '', <$fh>;
  print_motd(\$motd);
  return OK;
}
```

```
sub print_motd {
  my $motd = shift;
  print $$motd;
}
```

Apache2::SizeLimit

```
#startup.pl
use Apache2::SizeLimit;
$Apache2::SizeLimit::MAX_PROCESS_SIZE    = 12000;
$Apache2::SizeLimit::MIN_SHARE_SIZE     = 6000;
$Apache2::SizeLimit::MAX_UNSHARED_SIZE  = 5000;
$Apache2::SizeLimit::CHECK_EVERY_N_REQUESTS = 4;
```

```
#httpd.conf
PerlCleanupHandler Apache2::SizeLimit
```

Profiling

- Finding bottlenecks in Perl code
- Don't guess
- Profilers are out there
- use them

Apache::DProf

PerlModule Apache::DProf

```
$> apachectl restart
```

```
$> cd /var/httpd/logs/prof/12345
```

```
$> dprofpp
```

```
Total Elapsed Time = 6.238159 Seconds
```

```
  User+System Time = 1.188159 Seconds
```

```
Exclusive Times
```

%Time	ExclSec	Cumuls	#Calls	sec/call	Csec/c	Name
10.8	0.129	0.463	19	0.0068	0.0244	Mail::SpamAssassin::BEGIN
9.17	0.109	0.207	71	0.0015	0.0029	Mail::SpamAssassin::PerMsgStatus:: BEGIN
6.73	0.080	0.138	4	0.0200	0.0345	Mail::Transport::IMAP4::BEGIN
6.65	0.079	1.121	24	0.0033	0.0467	main::BEGIN
3.96	0.047	0.079	3	0.0158	0.0265	Mail::IMAPClient::_read_line
3.37	0.040	0.049	8	0.0050	0.0062	Mail::SpamAssassin::Conf::BEGIN
3.37	0.040	0.059	17	0.0023	0.0035	Net::DNS::Resolver::Base::BEGIN
3.37	0.040	0.186	16	0.0025	0.0117	Mail::Box::IMAP4::BEGIN
3.28	0.039	0.293	32	0.0012	0.0092	base::import
2.86	0.034	0.034	1425	0.0000	0.0000	MIME::Type::simplified
2.52	0.030	0.089	3	0.0100	0.0297	Net::DNS::Resolver::UNIX::BEGIN

Devel::Profiler::Apache

- Drop in replacement for Apache::DProf
- dprofpp compatible log files
- Pure Perl implementation

Odd Speedups

Compressed output

- Most modern browsers support gzip'ed
- Adds CPU cycles on the server
- Adds CPU cycles on the client
- Can reduce latency
- Saves bandwidth

mod_deflate

- A good compression module
- Comes with Apache, so you already have it

mod_deflate

```
LoadModule deflate_module modules/mod_defalte.so
```

```
<Location />
```

```
    SetOutputFilter DEFLATE
```

```
    DeflateFilterNote Input instream
```

```
    DeflateFilterNote Output outstream
```

```
    DeflateFilterNote Ratio ratio
```

```
</Location>
```

```
LogFormat '"%r" %{outstream}n/%{instream}n (%{ratio}n%%)' deflate
```

```
CustomLog logs/deflate_log deflate
```

```
"GET /PPMPackages/zips/ HTTP/1.1" 1080/4825 (22%)
```

```
"GET /ppm.css HTTP/1.1" 278/399 (69%)
```

```
"GET /BuildStatus/5.6plus/solaris/Test-ClassAPI-1.02.txt HTTP/1.0" 503/1157 (43%)
```

```
"GET /robots.txt HTTP/1.0" 105/328 (32%)
```

```
"GET /BuildStatus/5.8-hpux/hpux-ia64-5.8/Acme-Your-0.01.txt HTTP/1.0" 972/10103 (9%)
```

```
"GET /BuildStatus/5.8-windows/windows-5.8/DBD-PgPP-0.05.txt HTTP/1.1" 371/1507 (24%)
```

```
"GET /BuildStatus/5.6plus/linux/Data-Page-Pageset-1.02.txt HTTP/1.0" 640/1606 (39%)
```

Databases

- Such a common back-end
- Slow & expensive
- Bottleneck

Apache::DBI

- Wrapper to DBI
- Plug & Play, no code change
- Persistent DB connections

Apache::DBI

```
PerlModule Apache::DBI  
PerlModule DBI
```

```
use DBI;  
my $dbh = DBI->connect("dsn", $user, $pass);
```

connect_on_init

- Pre-connects to hot DBs
- Once for each httpd child

```
Apache::DBI->connect_on_init($DSN, $user, $pass);
```

prepare_cached

- DB handles are cached
- `prepare_cached()` caches prepared statements into DB handles

```
my $sth = $dbh->prepare_cached("SELECT id from User where name = ?");
```

stat()

- System call
- File information (size, owner, lastmod)
- Relatively expensive

AllowOverride

- Depends on default config
- .htaccess files are searched for:
 - /.htaccess
 - /var/.htaccess
 - /var/www/.htaccess
 - /var/www/htdocs/.htaccess

AllowOverride

- We are using mod_perl
- We are speed freaks
- When we need to override, we do it with Perl

AllowOverride None

```
<Directory>  
    AllowOverride None  
</Directory>
```

PerlTransHandler

```
DocumentRoot /var/www/html/root
```

```
<Location /news/story/print/pdf>  
    SetHandler modperl  
    PerlHandler Story::Print::Pdf  
</Location>
```

```
$> GET http://localhost:8529/news/story/print/pdf/12345
```

```
stat("/var/www/html/root/news/story/print/pdf/12345");  
stat("/var/www/html/root/news/story/print/pdf");  
stat("/var/www/html/root/news/story/print");  
stat("/var/www/html/root/news/story");  
stat("/var/www/html/root/news");  
stat("/var/www/html/root");
```

PerlTransHandler

```
DocumentRoot /var/www/html/root
```

```
<Location /news/story/print/pdf>
```

```
    SetHandler modperl
```

```
    PerlHandler Story::Print::Pdf
```

```
    PerlTransHandler Apache2::Const::OK
```

```
</Location>
```

```
$> GET http://localhost:8529/news/story/print/pdf/12345
```

\$r->finfo

- When httpd is serving a file, it had to stat() it
- It's cached
- We can use it

\$r->finfo

```
sub handler {  
  my $r = shift;  
  my $file = $r->filename;  
  if (-M $file) { # extra stat() / extra time()  

```

```
use APR::Finfo ();  
sub handler {  
  my $r = shift;  
  my $finfo = $r->finfo;  
  if ($finfo->mtime > $r->request_time) {  

```

print()

- STDOUT connected to the client
- Might not be buffered
- Generally expensive

print ... print ... print

```
print "<HTML>\n";  
print "<BODY>\n";  
print "<H1>Hello</H1>\n";  
print "</BODY>\n";  
print "</HTML>\n";
```

```
print <<'EOF';  
<HTML><BODY>  
<H1>Hello</H1>  
</BODY></HTML>  
EOF
```

\$|

- `$|++;`
- Buffering causes slower page loads

\$r->rflush();

```
$|++;  
print $header;  
print $info;  
print $news;  
my $results = some_slow_search();  
print $results;  
print $footer;  
  
print  
    $header,  
    $info,  
    $news,  
    ;  
$r->rflush();  
my $results = some_slow_search();  
print  
    $result,  
    $footer,  
    ;
```

Thank you!

More info

- *mod_perl User's mailing-list*
 - <http://perl.apache.org/maillist/modperl.html>
 - [<modperl@perl.apache.org>](mailto:modperl@perl.apache.org)
- *mod_perl Developer's Cookbook*
 - <http://www.modperlcookbook.org/>
- **Practical mod_perl**
 - <http://www.modperlbook.org/>
- **mod_perl at the ASF**
 - <http://perl.apache.org/>

Thank You!

Slides and bonus material:

<http://gozer.ectoplasm.org/talk/>