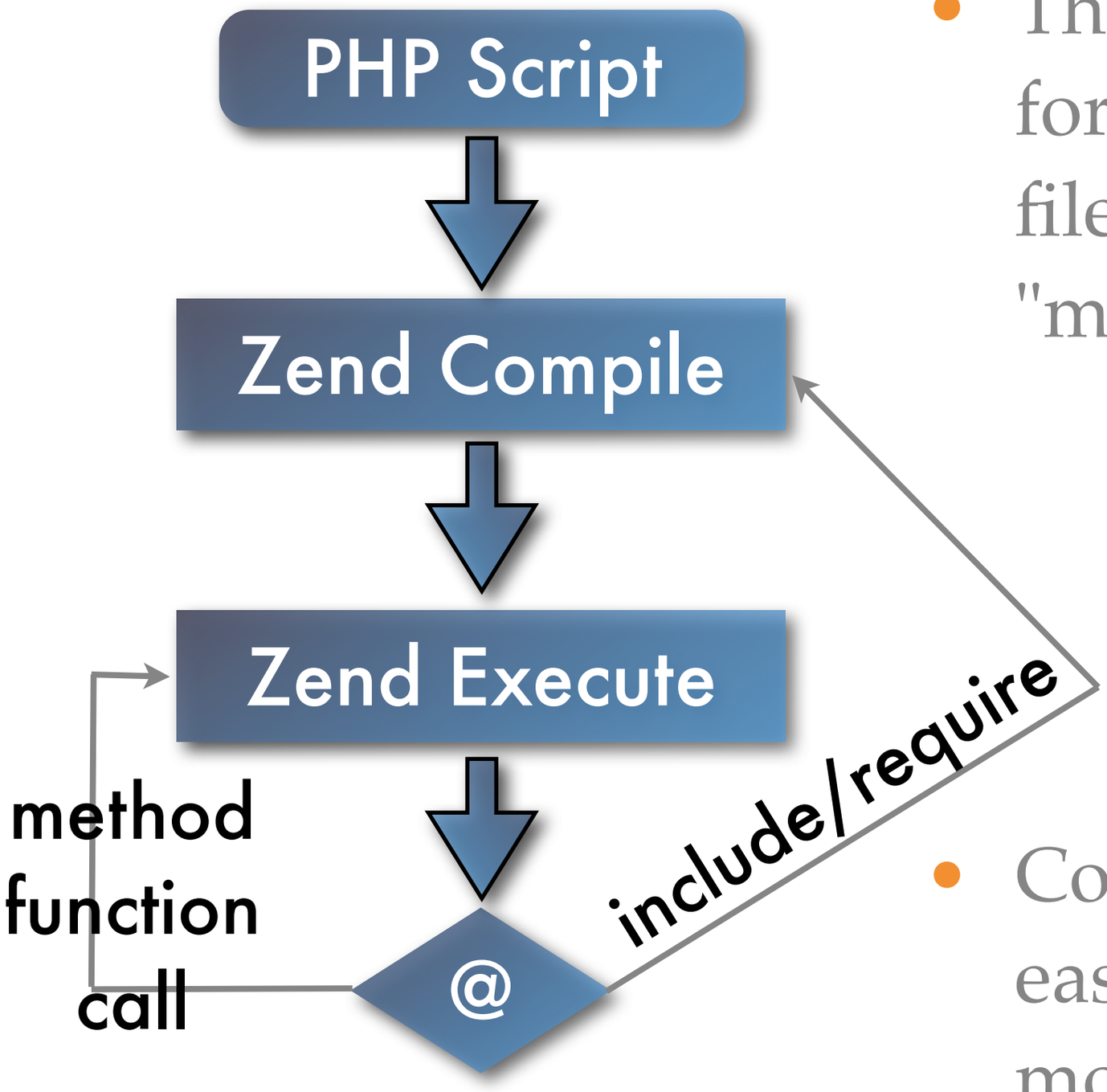
PHP & Performance

By: Ilia Alshanetsky



- This cycle happens for every include file, not just for the "main" script.

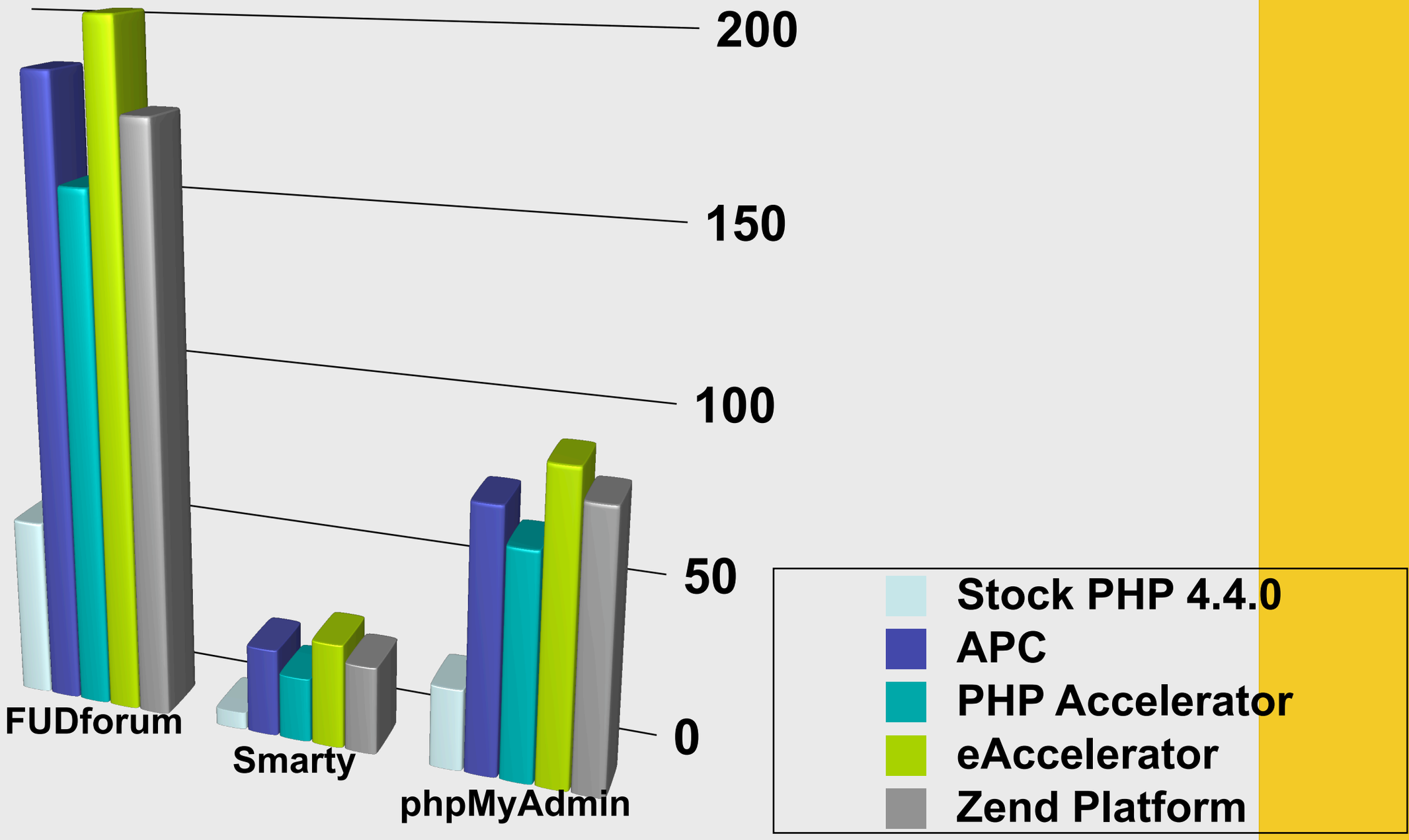
- Compilation can easily consume more time than execution.

2

Compiler/Opcode Caches

- Each PHP script is compiled only once for each revision.
- Reduced File IO, opcodes are being read from memory instead of being parsed from disk.
- Opcodes can optimized for faster execution.

Quick Comparison



Compiler Optimizations

- For absolute maximum performance, ensure that all of the software is compiled to take advantage of the available hardware.

```
export CFLAGS="-O3 -msse -mmmx -march=pentium3 \
    -mcpu=pentium3 -funroll-loops -mfpmath=sse \
    -fomit-frame-pointer"
```

- Enable all compiler optimizations with `-O3`
- Tune the code to your CPU via `-march -mcpu`
- CPU specific features `-msse -mmmx -mfpmath=sse`
- Drop debug data `-fomit-frame-pointer`

5

Web Server: File IO

- ✓ Keep `DirectoryIndex` file list as short as possible.
- ✓ Whenever possible disable `.htaccess` via `AllowOverride none`.
- ✓ Use `Options FollowSymLinks` to simplify file access process in Apache.
- ✓ If logs are unnecessary disable them.
- ✓ If logging is a must, log everything to 1 file and break it up during the analysis stage.

Web Server: Syscalls

- Syscall is function executed by the Kernel. The goal is to minimize the number of these calls needed to perform a request.
  - Do not enable **`ExtendedStatus`**.
  - For Deny / Allow rules use IPs rather then domains.
  - Do not enable **`HostnameLookups`**.
  - Keep **`ServerSignature`** off

7

Web Server: KeepAlive

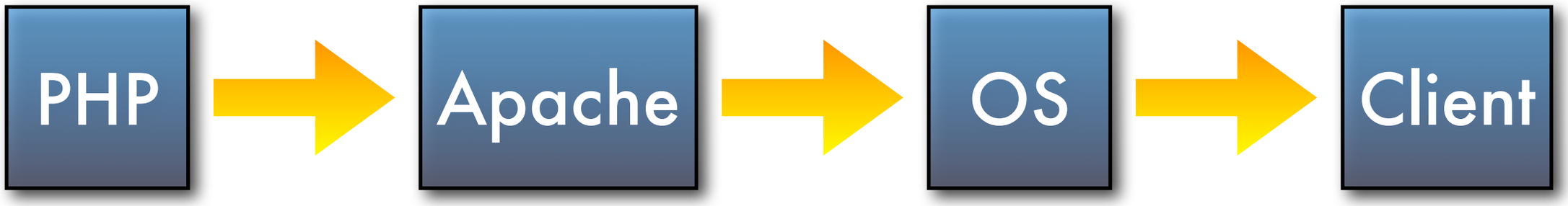
- In theory **`KeepAlive`** is supposed to make things faster, however if not used carefully it can cripple the server.

- In Apache set **`KeepAlive`** timeout, **`KeepAliveTimeout`** as low as possible. **Suggested value: 10 seconds.**

- If the server is only serving dynamic requests, disable **`KeepAlive`** all together.

8

Matching Your IO Sizes

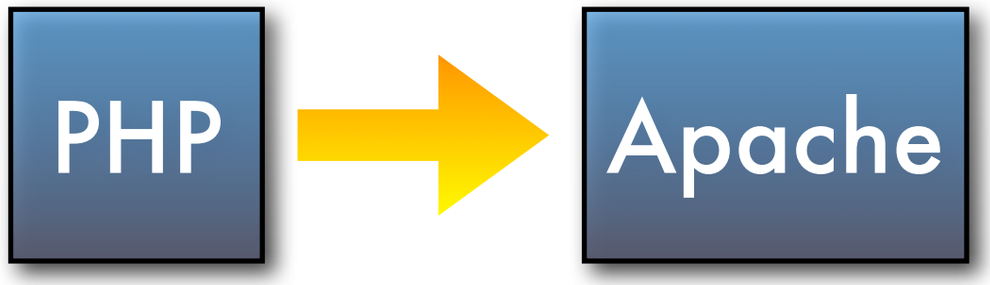


- The goal is to pass off as much work to the kernel as efficiently as possible.
- Optimizes PHP to OS Communication
- Reduces Number Of System Calls

9

PHP: Output Control

- Efficient
- Flexible

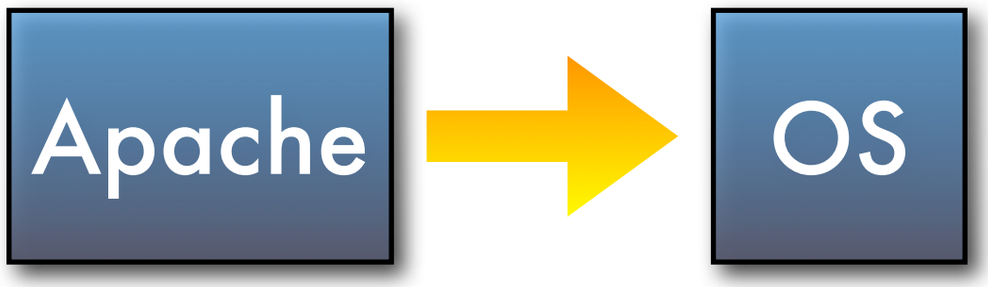


- In your script, with `ob_start()`
- Everywhere, with `output_buffering` = On
- Improves browser's rendering speed

10

Apache: Output Control

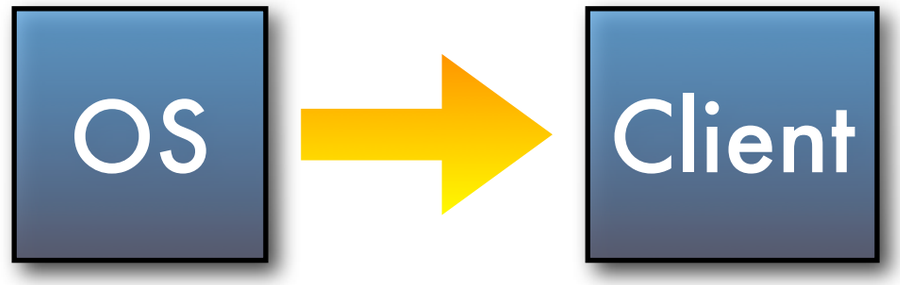
- The idea is to hand off entire page to the kernel without blocking.



- Set **SendBufferSize** = **PageSize**

OS: Output Control

OS (Linux)




```
/proc/sys/net/ipv4/tcp_wmem
4096    16384   maxcontentsize
min       default       max

/proc/sys/net/ipv4/tcp_mem
(maxcontentsize * maxclients) / pagesize
```

- **Be careful on low memory systems!**

Static Content Serving

- While Apache is great for dynamic requests, static requests can be served WAY FASTER by other web servers.
  - **lighttpd**
  - **Boa**
  - **Tux**
  - **thttpd**

- For static requests these servers are easily 300-400% faster then Apache 1 or 2.

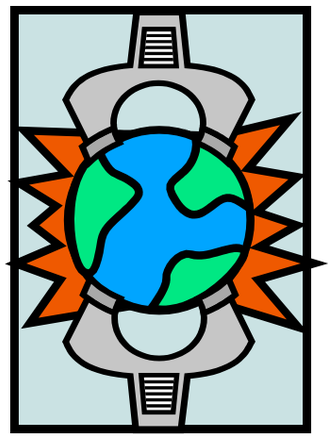
13

Less Output == Faster

- Saves server bandwidth (saves $$ too).
- Reduces server resource usage (CPU / Memory / Disk)
- Pages load faster for clients.
- Reduces network IO high traffic sites, where it is the primary bottleneck in most cases.

Content Compression

- Most browsers support content compression.
- Compressed pages are on average are 6-8 times smaller.
  - Apache 1 (`mod_gzip / mod_deflate`)
  - Apache 2 (`mod_deflate`)
  - PHP
    - From PHP configuration `zlib.output_compression=1`
    - From inside the script `ob_start("ob_gzhandler")`



* Compression will utilize 3%-5% of CPU.

15

Content Reduction

```
<?php
$o = array("clean" => true,
   "drop-proprietary-attributes" => true,
   "drop-font-tags" => true,
   "drop-empty-paras" => true,
   "hide-comments" => true,
   "join-classes" => true,
   "join-styles" => true
);

$tidy = tidy_parse_file("php.html", $o);
tidy_clean_repair($tidy);
echo $tidy;
?>
```

- Use a post-processor like Tidy to remove formatting, comments and CCSify the code.

Tuning PHP Configuration

- register_globals = Off **
- magic_quotes_gpc = Off
- expose_php = Off
- register_argc_argv = Off
- always_populate_raw_post_data = Off **
- session.use_trans_sid = Off **
- session.auto_start = Off **
- session.gc_divisor = 1000 or 10000

17

Profiling & Benchmarking

- Identify Bottlenecks
- Track Resource Usage
- Generate Call Trees
- Create Progress Tracking Data

18

Testing Web Servers

- Apache Bench
  - **ab** utility bundled with Apache
- Siege
  - http://www.joedog.org/JoeDog/Siege
- http_load (Excellent for latency tests)
  - http://www.acme.com/software/http_load/

19

Web Server Testing

```
Concurrency Level:      10
Time taken for tests:   0.265 seconds
Complete requests:      100
Failed requests:        0
Broken pipe errors:     0
Total transferred:      5077082 bytes
HTML transferred:       5061168 bytes
Requests per second:    377.36 [#/sec] (mean)
Time per request:       26.50 [ms] (mean)
Time per request:       2.65 [ms] (mean)
Transfer rate:          19158.80 [Kbytes/sec]
```

Latency Test

```
1000 fetches, 5 max parallel,
  2.9648e+07 bytes,
  in 0.813035 seconds
29648 mean bytes/connection
1229.96 fetches/sec,
3.64658e+07 bytes/sec
msecs/connect:
   0.463202 mean, 12.082 max, 0.045 min
msecs/first-response:
   3.12969 mean,  50.783 max, 0.811 min
HTTP response codes:
   code 200 -- 1000
```

1 msec = 0.0001 seconds

Profiling PHP Code

- APD (Pure profiler)
  - http://pecl.php.net/apd
- XDebug (Profiler & Debugger)
  - http://xdebug.org/
- DBG (Profiler & Debugger)
  - http://dd.cron.ru/dbg/

22

Profiling with APD

- Installation Steps
  - pecl install apd
  - Modify php.ini

```
zend_extension=apd.so
```

Process repeated for every function/method call

Generating A Trace

- Profiling of a script starts from the point when the `apd_set_pprof_trace()` function is called.
  - All code executed prior, will not be profiled.

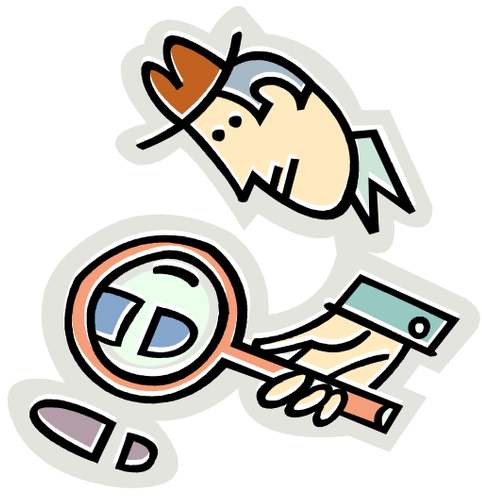
```
$parts = preg_split("!\s!", "a b c");
function test(&$var) {
        $var = base64_encode(trim($var));
}
apd_set_pprof_trace();
array_walk($parts, 'test');
```

- Use the `auto_prepend_file` php.ini setting to activate profiling for an entire application.

24

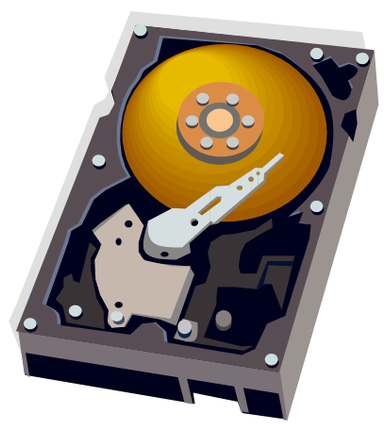
Interpreting the Results

```
 Real     User          System          secs          cumm.
%Time    (excl/cumm)   (excl/cumm)   (excl/cumm)    Calls  call    s/call  Name
-----------------------------------------------------------------------------

82.4    0.00 0.00  0.00 0.00      0.00 0.00          1  0.0007   0.0007  apd_set_pprof_trace

10.2    0.00 0.00  0.00 0.00      0.00 0.00          3  0.0000   0.0000  trim

4.3     0.00 0.00  0.00 0.00      0.00 0.00          3  0.0000   0.0000  base64_encode

1.9     0.00 0.00  0.00 0.00      0.00 0.00          3  0.0000   0.0000  test

0.6     0.00 0.00  0.00 0.00      0.00 0.00          1  0.0000   0.0001  array_walk

0.6     0.00 0.00  0.00 0.00      0.00 0.00          1  0.0000   0.0008  main
```



Drive Tuning

- Hard-drive is in most cases the slowest part of the system, yet all the data eventually comes from it.
- By adjust the drive configuration parameters you can help your OS get the most out of it.



26

Drive Tuning Parameters

- Use the **`hdparm`** utility to adjust settings.
  - **`-c1`** - set IDE 32-bit I/O setting
  - **`-d1`** - enable DMA
  - **`-u1`** - enable IRQ unmasking
  - **`-m16`** - turn on multicount
  - **`-X 34|66|100|133`** - transfer mode

27

Validating Changes

Benchmark the affect of the changes using:

```
hdparm -tT /dev/[drive]
```

RAM Disk

- One way to accelerate File IO operations is by moving the files and directories to a RAM disk.
- On Linux this is extremely simple to do using via **tmpfs**.

```
# Speed Up /tmp Directory
mount --bind -ttmpfs /tmp /tmp

# Accelerate Scripts Directory
mount --bind -ttmpfs /home/webroot /home/webroot
```


29

Session Storage

- PHP's session extension by default stores each session inside a separate file.
  - Many files in one directory reduce access speed.
    - Assign each user their own session directory
    - Split sessions into multiple directories
      session.save_path = "N;/path"

30

Session Storage Alternatives

- File system is slow, lets use memory
- **mm** - native shared memory storage
- **apc** - use APC's store/fetch/delete
- **memcache** - memory storage daemon

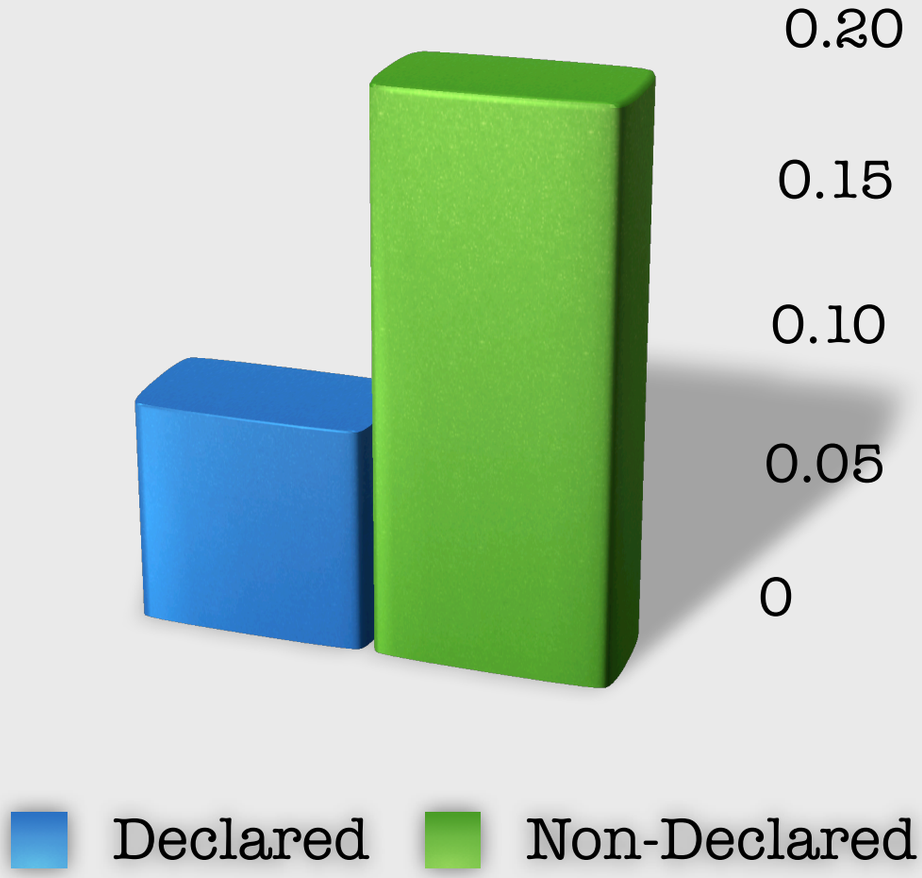
Now let's tune PHP code

OOP Tips

- Always declare your static methods!
  - Cleaner & Faster code

```php
<?php
class bench {
    public function a() { return 1; }
    public static function b() { return 1; }
}

$s = microtime(1);
for ($i = 0; $i < 100000; $i++) bench::a();
$e = microtime(1);
echo "Dynamic Static Method: ".($e - $s)."\n";

$s = microtime(1);
for ($i = 0; $i < 100000; $i++) bench::b();
$e = microtime(1);
echo "Declared Static Method: ".($e - $s)."\n";
```

Speed Comparison



Use Class Constants

- Parsed at compile time, no execution overhead.
- Faster lookups due to a smaller hash.
- “Namespacing” & shorter hash names.
- Cleaner code speeds up debugging ;-)

Avoid Magic

- Magic methods such as **__get()** / **__set()**
- Magic loading functions such as **__autoload()**
- Dynamic methods via **__call()**

require_once() is once too many

```php
<?php
require_once "./a.php";
require_once "./a.php";
```

```
lstat64("/tmp", {st_mode=S_IFDIR|S_ISVTX|0777, st_size=7368, ...}) = 0
lstat64("/tmp/a.php", {st_mode=S_IFREG|0644, st_size=6, ...}) = 0
open("/tmp/a.php", O_RDONLY)                = 3
fstat64(3, {st_mode=S_IFREG|0644, st_size=6, ...}) = 0
fstat64(3, {st_mode=S_IFREG|0644, st_size=6, ...}) = 0

lstat64("/tmp", {st_mode=S_IFDIR|S_ISVTX|0777, st_size=7368, ...}) = 0
lstat64("/tmp/a.php", {st_mode=S_IFREG|0644, st_size=6, ...}) = 0
open("/tmp/a.php", O_RDONLY)                = 3
fstat64(3, {st_mode=S_IFREG|0644, st_size=6, ...}) = 0
fstat64(3, {st_mode=S_IFREG|0644, st_size=6, ...}) = 0
```

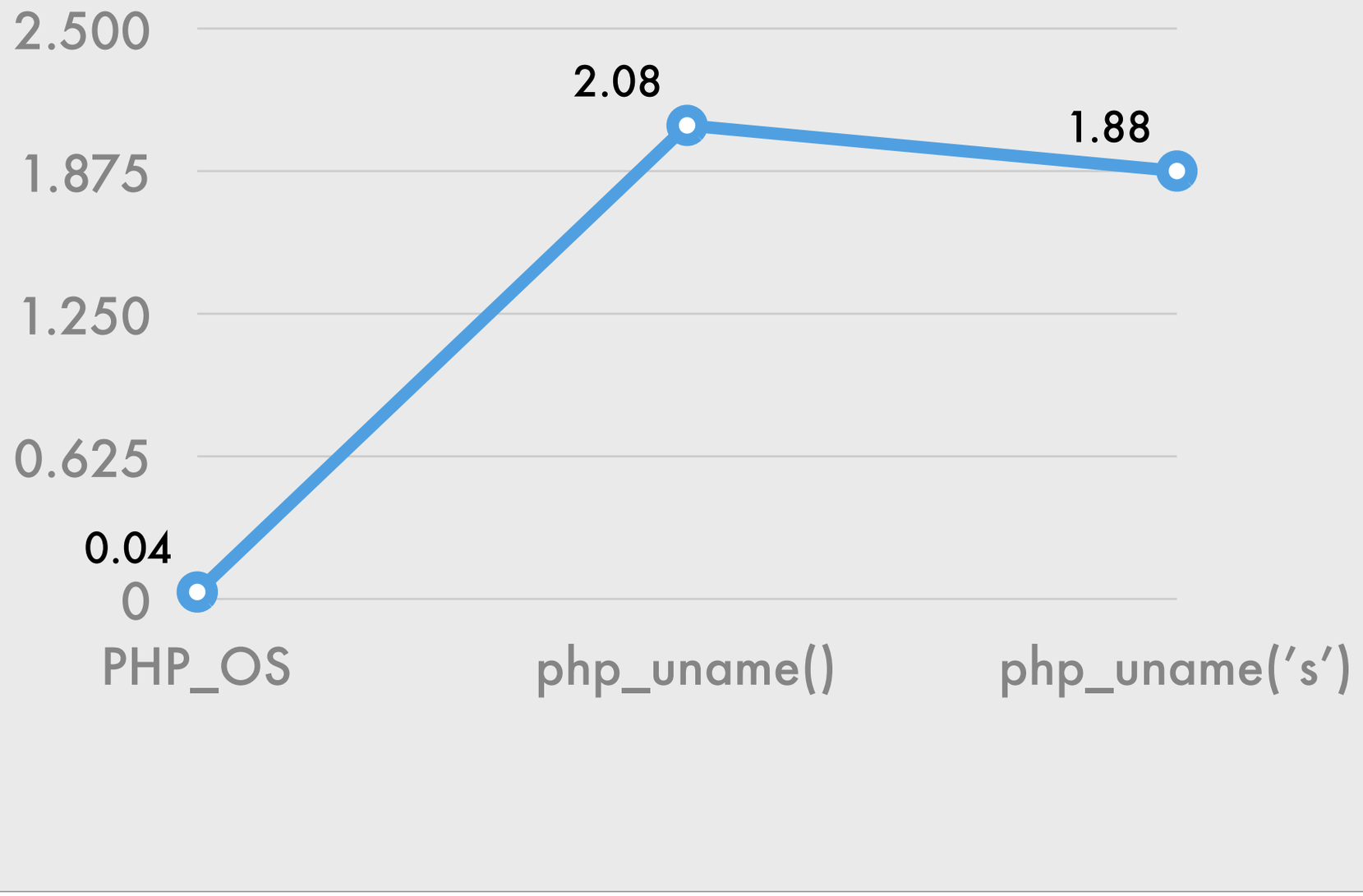
- If you absolutely cannot avoid require_once and include_once use full paths.

- In PHP 5.2>= this will allow PHP to avoid opening the file twice.

Avoid Pointless Function Calls

- php_version()
  - ✓ PHP_VERSION constant
- php_uname('s')
  - ✓ PHP_OS constant
- php_sapi_name()
  - ✓ PHP_SAPI constant

Quick Comparison



Fastest Win32 Detection in the West

```
$isWindows =
    DIRECTORY_SEPARATOR == '\\';
```

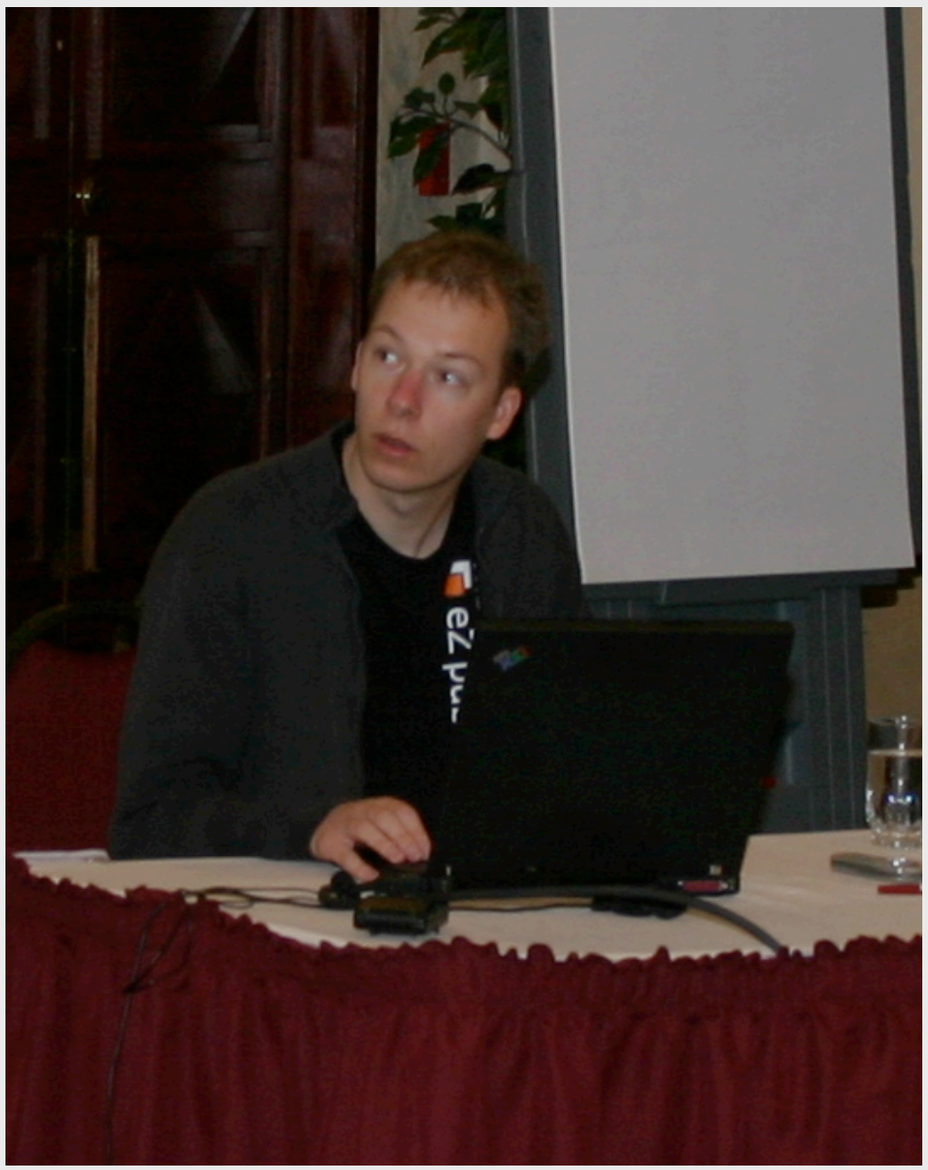
- Does not use functions
- Does not care about WinXP, WinNT, Windows, Windows98, NT 5.0, etc...
- Always available

What time is it?

Rather then calling **time()**, time() and time() again, use

$_SERVER['REQUEST_TIME']

Provides a timestamp, with a second precision, without any function calls.



PCRE Slowdowns

```
$text = preg_replace( '/=\?([^?]+)\?/',
'=?iso-8859-1?', $origtext );
```

```
$text = preg_replace(
'"/(\n|\t|\r\n|\s)+/"', ' ', $origtext );
```

Use non-capturing patterns

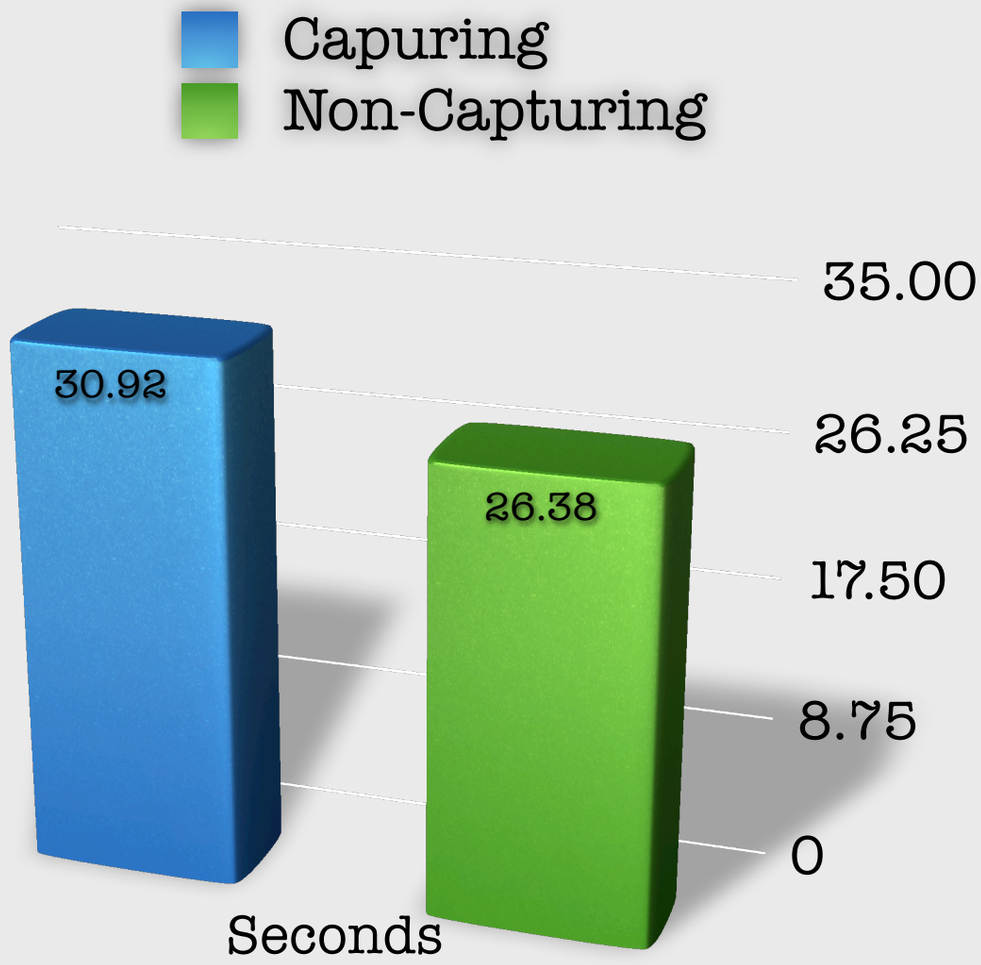
- Placing ?: at the start of a sub-pattern makes it non-capturing.

```
$text = preg_replace( '/=\?(?:[^?]+)\?/',
'=?iso-8859-1?', $origtext );
```

- This means PHP/PCRE does not need to allocate memory to store the matched content block.

```
$text = preg_replace(
'"/(?:\n|\t|\r\n|\s)+/"', ' ', $origtext );
```

End Result



A 15% performance improvement, with a 2 character change.

If Possible Avoid Regex

```php
<?php
// Slow
if (preg_match("!^foo_!i", "FoO_")) { }
// Much faster
if (!strncasecmp("foo_", "FoO_", 4)) { }
```

```php
// Slow
if (preg_match("![a8f9]!", "sometext")) { }
// Faster
if (strpbrk("a8f9", "sometext")) { }

// Slow
if (preg_match("!string!i", "text")) {}
// Faster
if (stripos("text", "string") !== false) {}
```

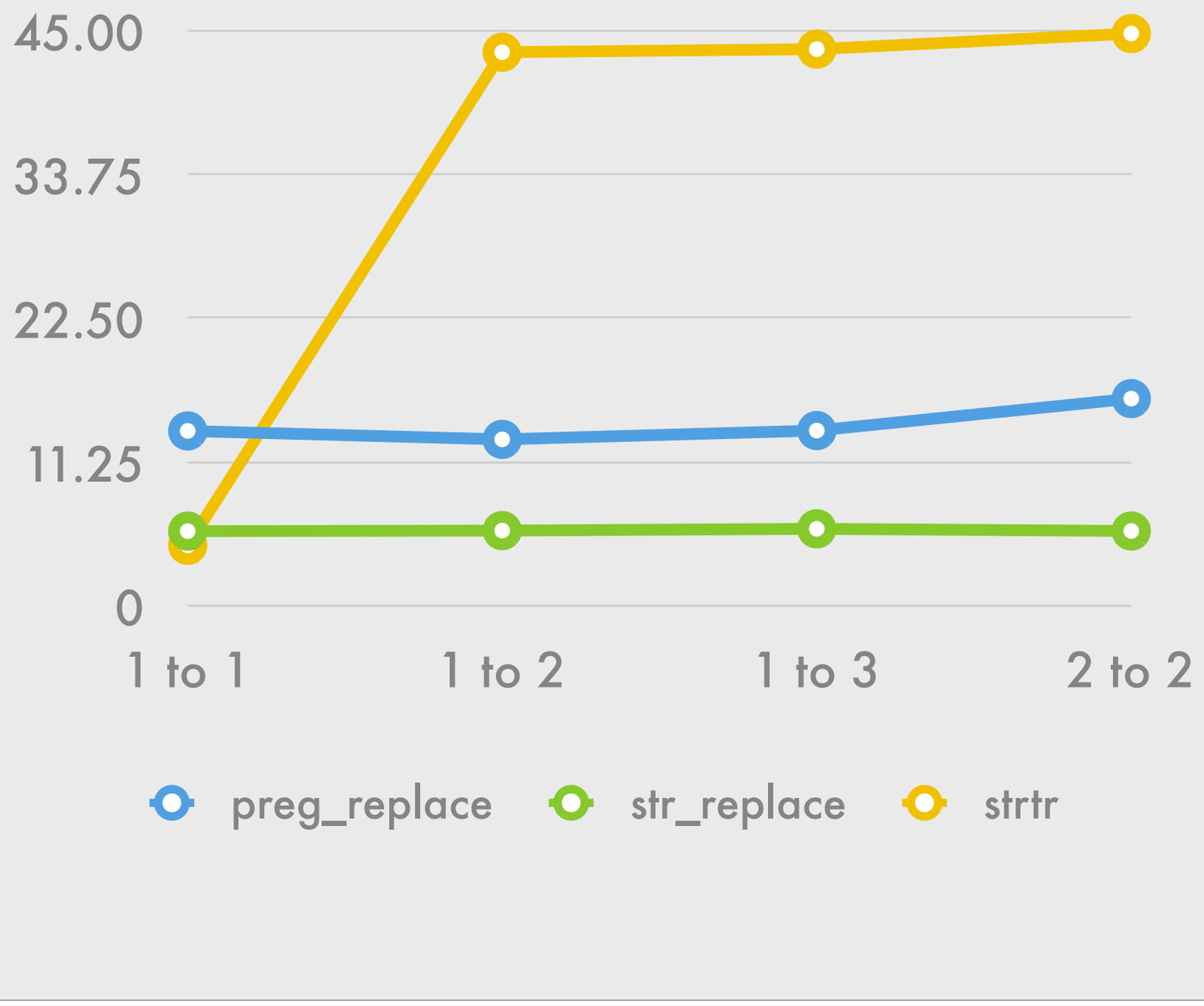
More Regex Avoidance

```
$text = preg_replace( "/\n/", "\\n", $text);
```

In this case it would be simpler and to mention faster to use a regular str_replace()

```
$text = str_replace( "/\n/", "\\n", $text);
```

Speed Comparison



Use strtr() Properly!

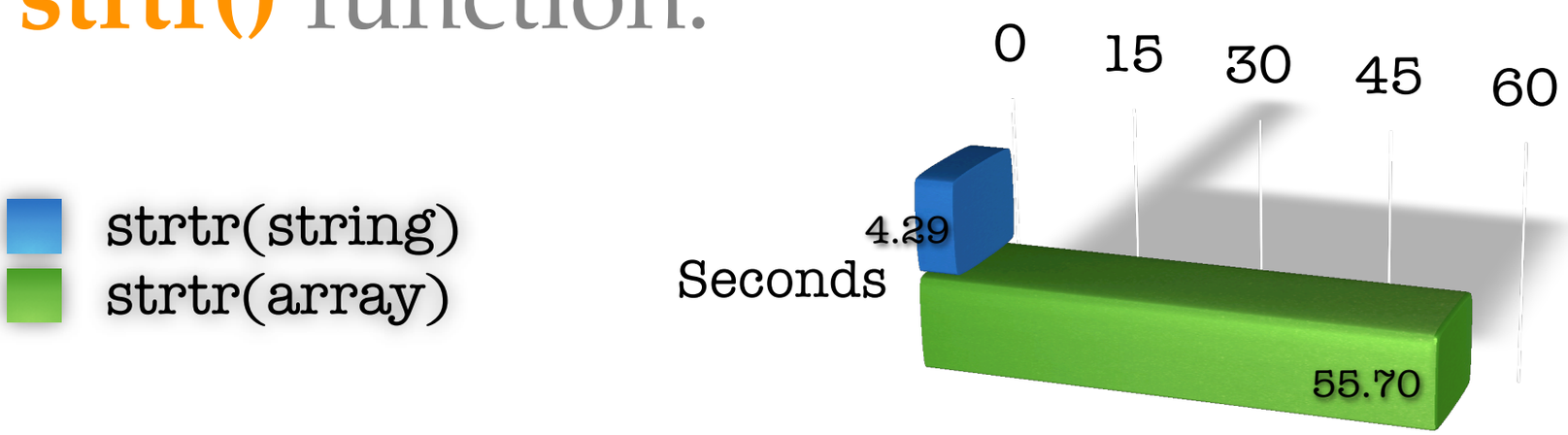
```
$rep = array( '_' => '*', '.' => '*' );

if ( sizeof( $globArr ) > 1 ) {
  $glob = "_" . strtr( $globArr[1], $rep );
} else {
  $glob = strtr( $globArr[0], $rep );
}
```

Any ideas on how we can make this code 10 times faster?

Use Strings!

```
if ( sizeof( $globArr ) > 1 ) {
  $glob = "-" . strtr( $globArr[1], '-.', '**' );
} else {
  $glob = strtr( $globArr[0], '-.', '**' );
}
```

Elimination of array operations speeds up the code and simplifies the internal work in **strtr()** function.



Don’t Replace When you

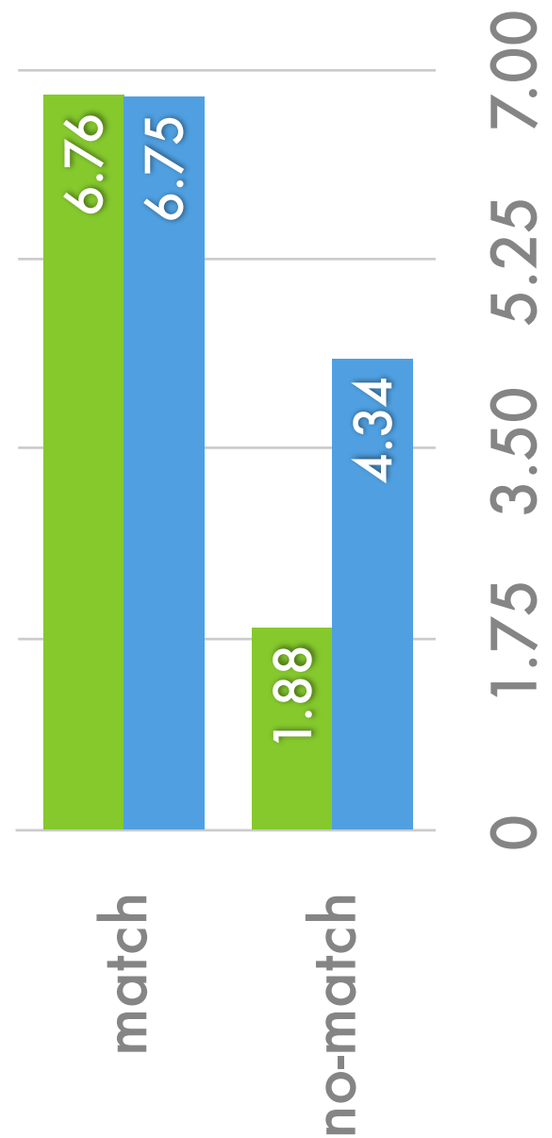
- Any replacement operation requires memory, if only to store the “modified” result.

- A quick **strpos()** to determine if any replacement is actually needed can save memory and improve performance!

Test Scenario

$str is a PHP 5.2 news files, roughly 95kb in size.

```
$s = microtime(1);
for ($i = 0; $i < 10000; $i++)
    str_replace('Ilia', 'Derick', $str);
$e = microtime(1);
echo "non-check (match): ".($e - $s)."\n";

$s = microtime(1);
for ($i = 0; $i < 10000; $i++)
    if (strpos($str, 'Ilia') !== false)
        str_replace('Ilia', 'Derick', $str);
$e = microtime(1);
echo "check (match): ".($e - $s)."\n";
```



@ operator is evil!

- The error blocking operator, is the most expensive character in PHP's alphabet.

```
@action();
```

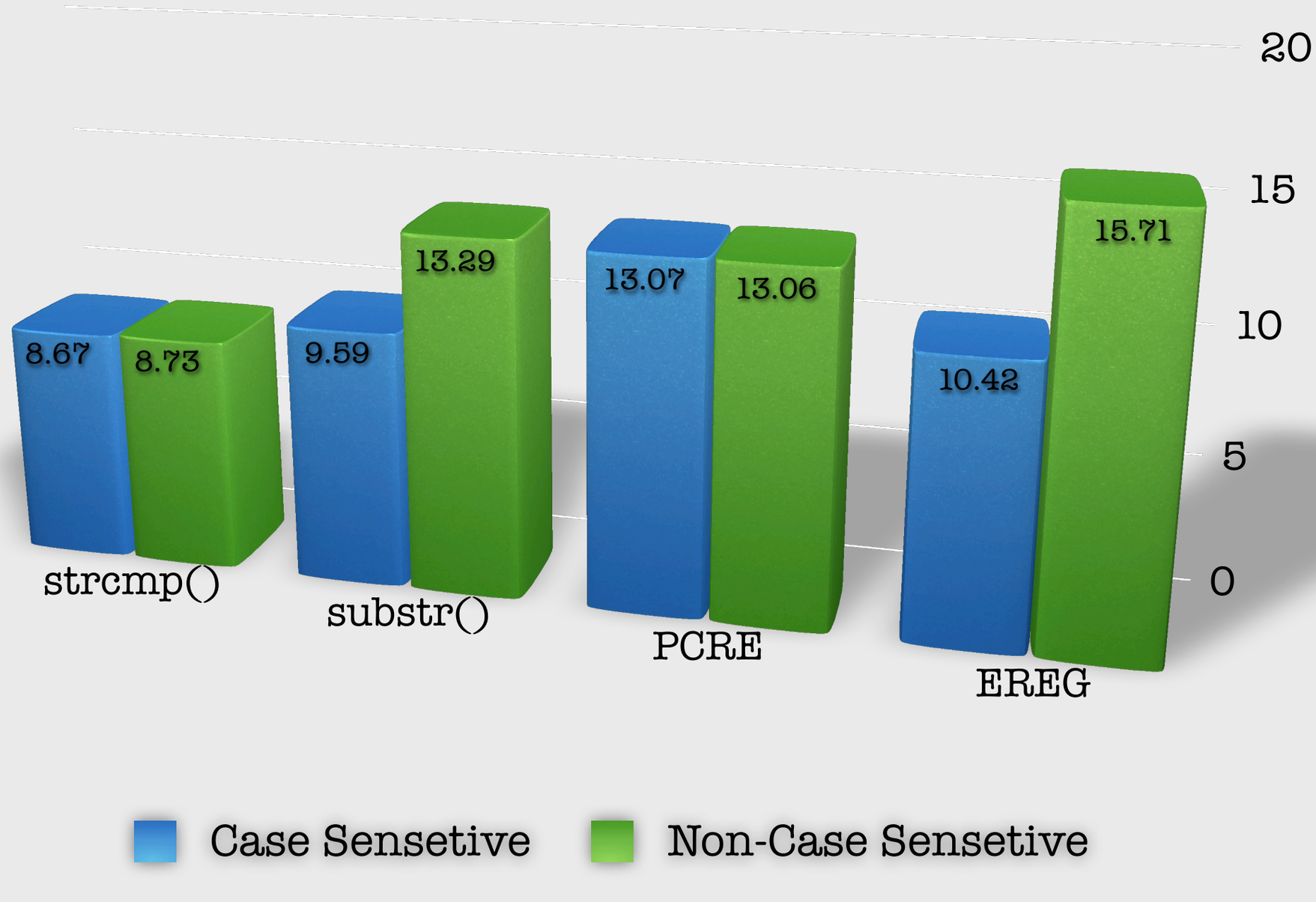
- This seemingly innocuous operator actually performs fairly intensive operations in the background.

```
$old = ini_set("error_reporting", 0);
action();
ini_set("error_reporting", $old);
```

Better String Comparison

```php
<?php
// The Good
if (!strncmp(PHP_OS, 'WIN', 3)) {
if (!strncasecmp(PHP_OS, 'WIN', 3)) {

// The Bad
if (substr(PHP_OS, 0, 3) == 'WIN') {
if (strtolower(substr(PHP_OS, 0, 3))) == 'win') {

// And The Ugly
if (preg_match('!^WIN!', PHP_OS)) {
if (preg_match('!^WIN!i', PHP_OS)) {
```

Quick Benchmark



Comparing From An Offset

- As of PHP 5, you don't need to **substr()** string segments from non-start position to compare them thanks to **substr_compare()**.

```
if (substr($class, -15) != 'text')

/* == */

if (substr_compare($class, 'text', -15))
```

Don't Mis-use Constants

One of my biggest pet-peeves in PHP is this kind of nonsense:

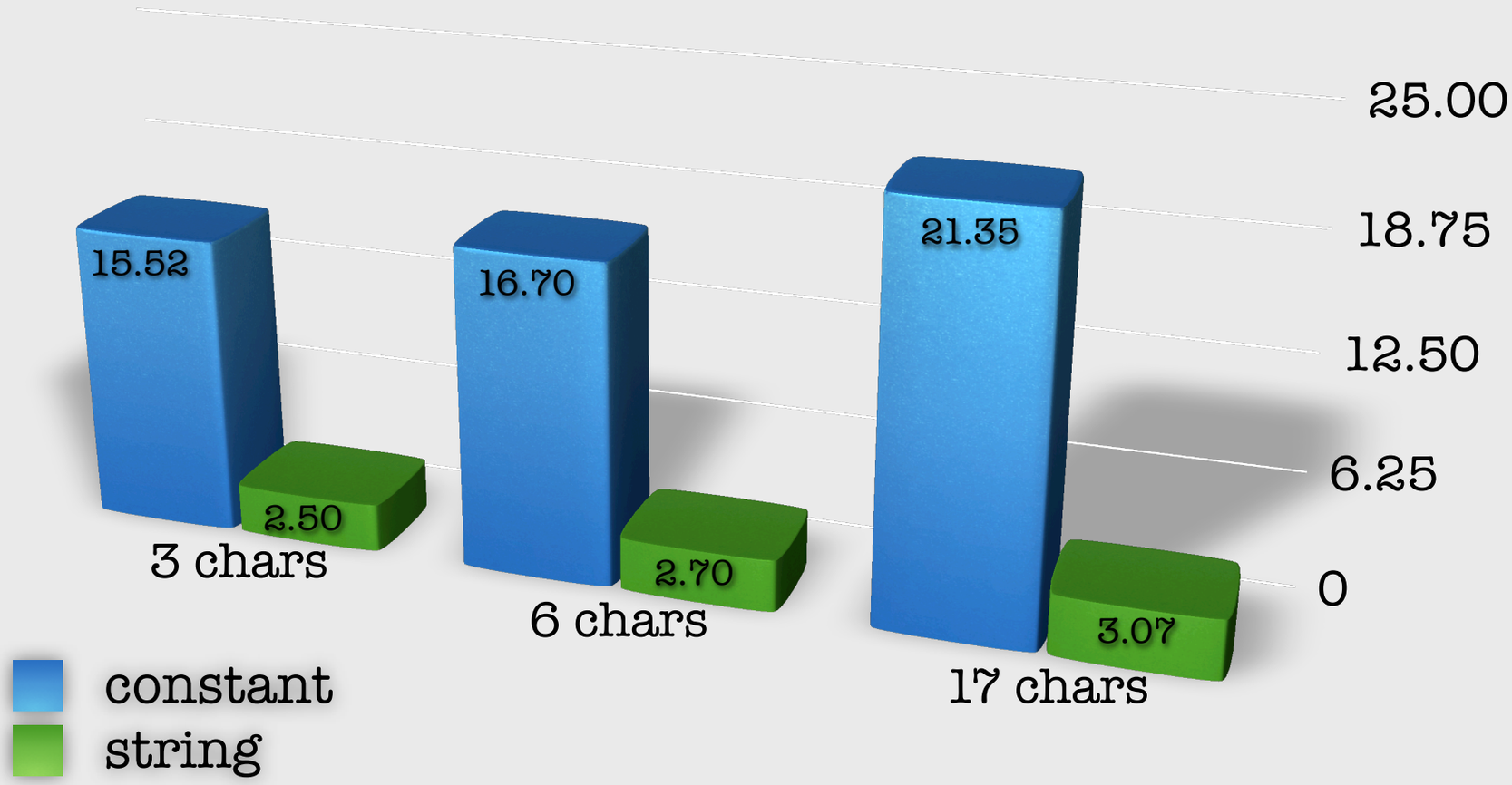
```
$foo = array("bar"=>0);
$foo[bar] = 1;
```

Why is this bad?

- 1 strtolower
- 2 hash lookups
- E_NOTICE error message generated
- temporary string being created on the fly.

Performance Check

```
$foo[bar] = 1; /* vs */ $foo['bar'] = 1;
```



700% difference on average!!!

Fix "harmless" error messages

- Each error results in:
  - Generation of a complex error string
  - Output to stdout/stderr
  - Potential write to a file or syslog
  - In pre-5.2 releases may leak memory in some rare instances.

Simplify for() loop

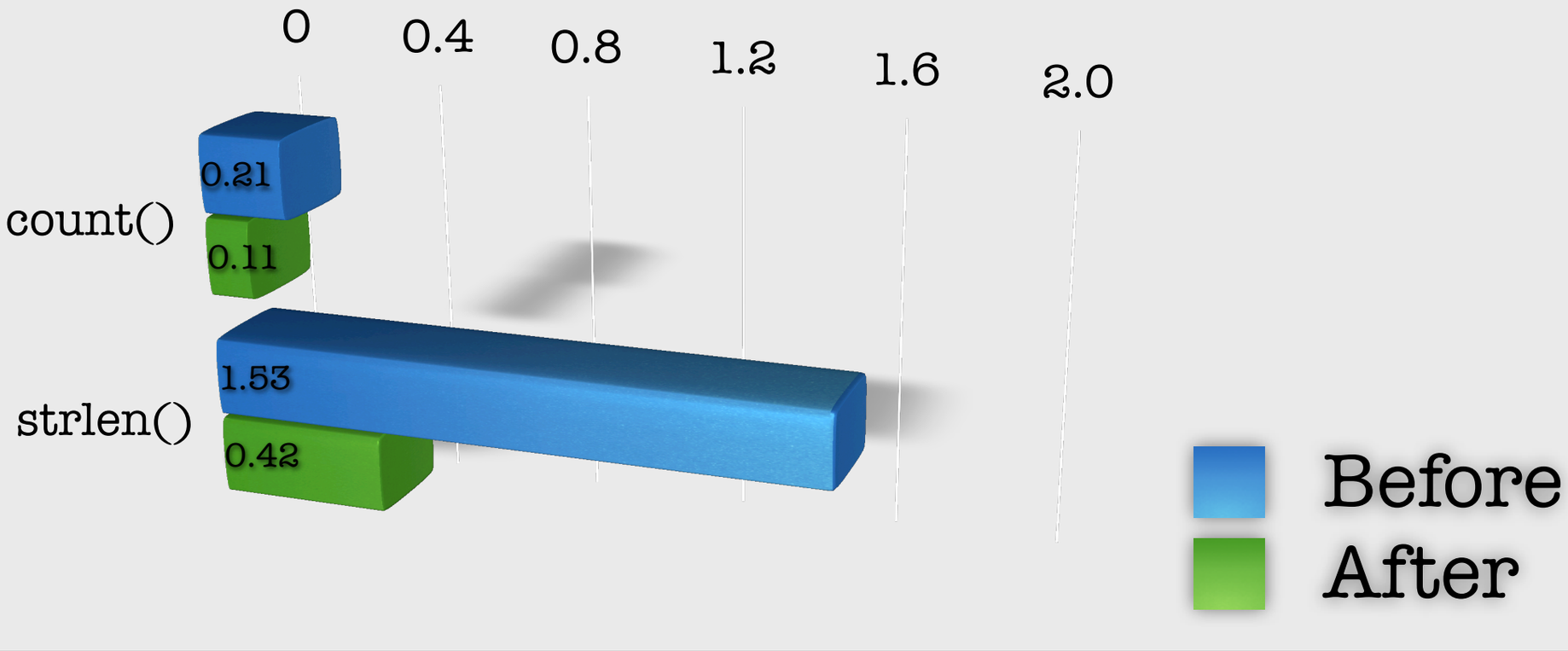
Avoid function calls within **for()** loop control blocks.

```
<?php
for ( $i = 1; $i < sizeof($array); $i++ ) {}

for ( $i = 0; $i < count($array); $i++ ) {}

for ( $i = 0; $i < strlen($string); $i++ ) {}
```

Otherwise function is called for every loop iteration.

Speed Check

```
for ($j = 0; $j < strlen('foo'); $j++) {}
/* vs */
$c = strlen('foo'); for ($j = 0; $j < $c; $j++) {}

for ($j = 0; $j < count($_SERVER); $j++) {}
/* vs */
$c = count($_SERVER); for ($j = 0; $j < $c; $j++){}
```



Don't Re-invent the Wheel

- It is surprising how frequently people try to re-invent the wheel.
- Now a days PHP has
  - ✓ 2,700 functions
  - ✓ 80 core extensions
  - ✓ 154 PECL extensions

- Chances are what you need already exists!

Use Full File Paths

- While it is convenient(??) to do **require "foo.php"** and have it work, internally it leads to significant overhead.

- Whenever possible you should use full paths, that require no resolution in PHP.

The internals of file ops.

```
stat64("./b.php", {st_mode=S_IFREG|0644, st_size=6, ...}) = 0
getcwd("/tmp", 4096)                                    = 5
lstat64("/tmp", {st_mode=S_IFDIR|S_ISVTX|0777, st_size=18008, ...}) = 0
lstat64("/tmp/b.php", {st_mode=S_IFREG|0644, st_size=6, ...}) = 0
open("/tmp/b.php", O_RDONLY)
```

The issue can be further exasperated by the use of include_path.

Reference Tricks

References can be used to simply & accelerate access to multi-dimensional arrays.

```
$a['b']['c'] = array();
// slow 2 extra hash lookups per access
for($i = 0; $i < 5; $i++)
        $a['b']['c'][$i] = $i;

// much faster reference based approach
$ref =& $a['b']['c'];
for($i = 0; $i < 5; $i++)
        $ref[$i] = $i;
```

66

Optimization Myths

- Removing comments makes code faster
- Using " is faster then '
- Passing things by-reference makes code faster
- Objects make code faster
- Ternary **? :** is faster then **if () { } else {}**

Caching is the recognition and exploitation of the fact that most "dynamic" data does not change every time you request it.

68

Most applications will end up using databases for information storage. Improper use of this resource can lead to significant and continually increasing performance loss.

69

Check Your Queries

```
EXPLAIN select * from users where login LIKE '%ilia%';
+----------+------+---------------+------+---------+------+-------+------------+
| table    | type | possible_keys | key  | key_len | ref  | rows  | Extra      |
+----------+------+---------------+------+---------+------+-------+------------+
| mm_users | ALL  | NULL          | NULL |    NULL | NULL | 27506 | where used |
+----------+------+---------------+------+---------+------+-------+------------+
```

Most databases offers tools for analyzing query execution.

```
EXPLAIN select * from users where login LIKE 'ilia%';
+----------+-------+---------------+-------+---------+------+------+------------+
| table    | type  | possible_keys | key   | key_len | ref  | rows | Extra      |
+----------+-------+---------------+-------+---------+------+------+------------+
| mm_users | range | login         | login |      50 | NULL |    2 | where used |
+----------+-------+---------------+-------+---------+------+------+------------+
```


70

Bitwise Option Packing

Rather then creating a column for every Boolean option, you can pack 32 of them into a single integer field.

```
CREATE TABLE users (
        is_active INT,
        is_banned INT,
        is_admin INT,
        ...
);
```

```
CREATE TABLE users (
        user_opt INT,
        ...
);

user_opt & 1 // active
user_opt & 2 // banned
user_opt & 4 // admin
```


71

KISS = Performance

- The simpler the code, the faster it runs, it really is that simple.
  - Syntactic sugar.
  - Unnecessary wrappers.
  - Wrapping one liners in functions.
  - OO for the sake of OO.

72

Thank You For Listening!

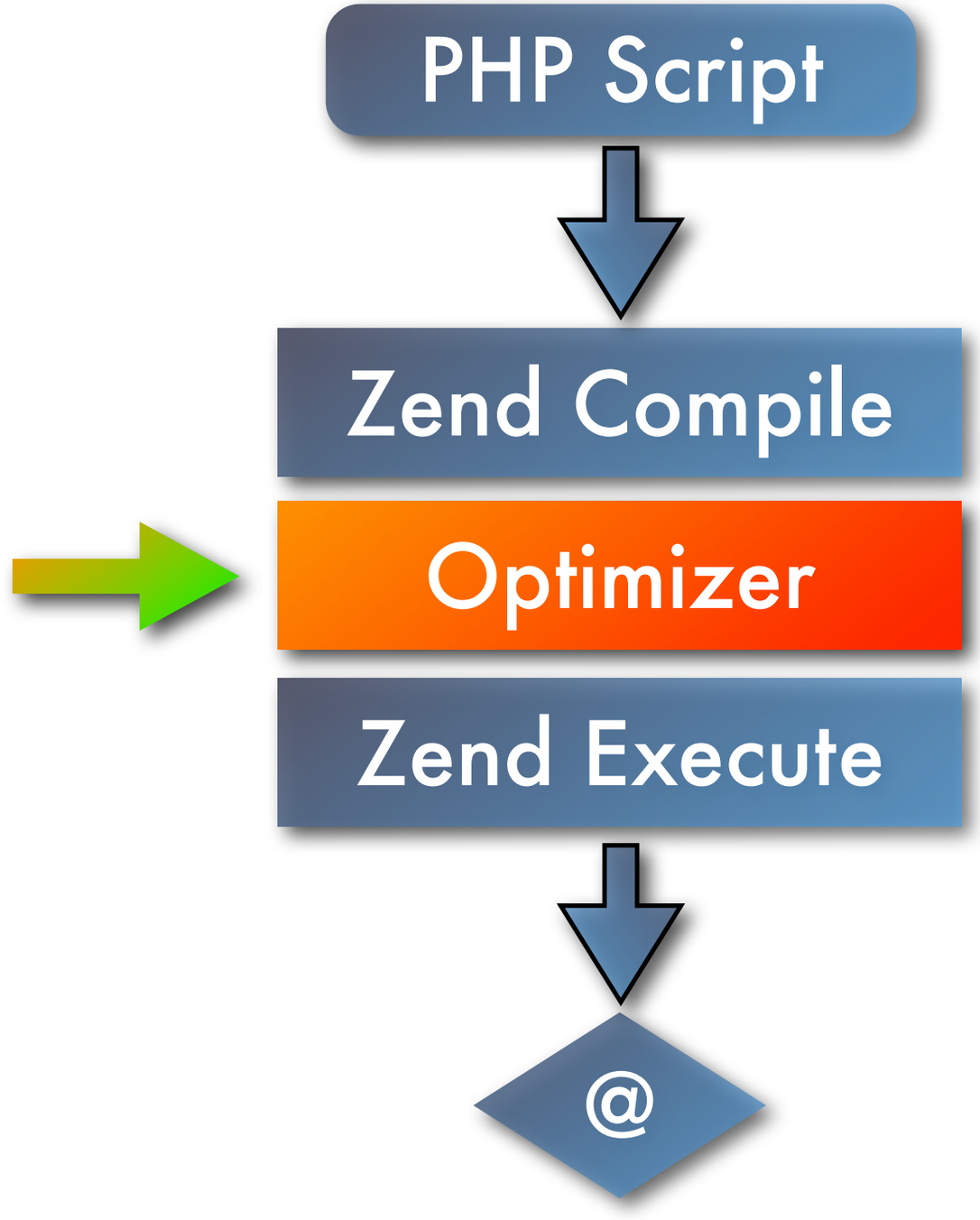
- These slides
  - http://www.ilia.ws/
- APC
  - http://pecl.php.net/apc
- XDebug
  - http://www.xdebug.org/

Optimizer (Why?)

- The opcodes generated by Zend Engine are often inefficient.
- Some operations can be avoided
- A lot of temporary vars are not necessary.
- Every compiler needs an optimizer ;-)

Optimizer (How?)

Kinda Slow



What Can It Do?

- opt. heredoc
- print to echo
- GLOBALS[foo] to foo
- inline known constants
- eliminate NOP
- resolve partial file paths.
- optionally inline define() calls
- 60+ function calls with static values resolved.
- Much more...

Any other ideas?