WEB PROGRAMMING 2

Web brief history

- The Internet has made people to collaborate even without Web
  - It was not for everyone and can access some of those resources just as easy as the Web, given those resources before they were not as all over
- Tim Berners-Lee was with CERN, European Lab for Particle Physics when he needed to invent something for data in a logical method and for more, maybe, acceptable pattern of displaying data for scientific endeavors.
  - Sir Tim developed HTTP (hyperlink framework) and HTML and it revolutionize how we deal over the Internet through WWW, just one but a significant media to discover free information, learn and explore possible opportunities that makes the world better.

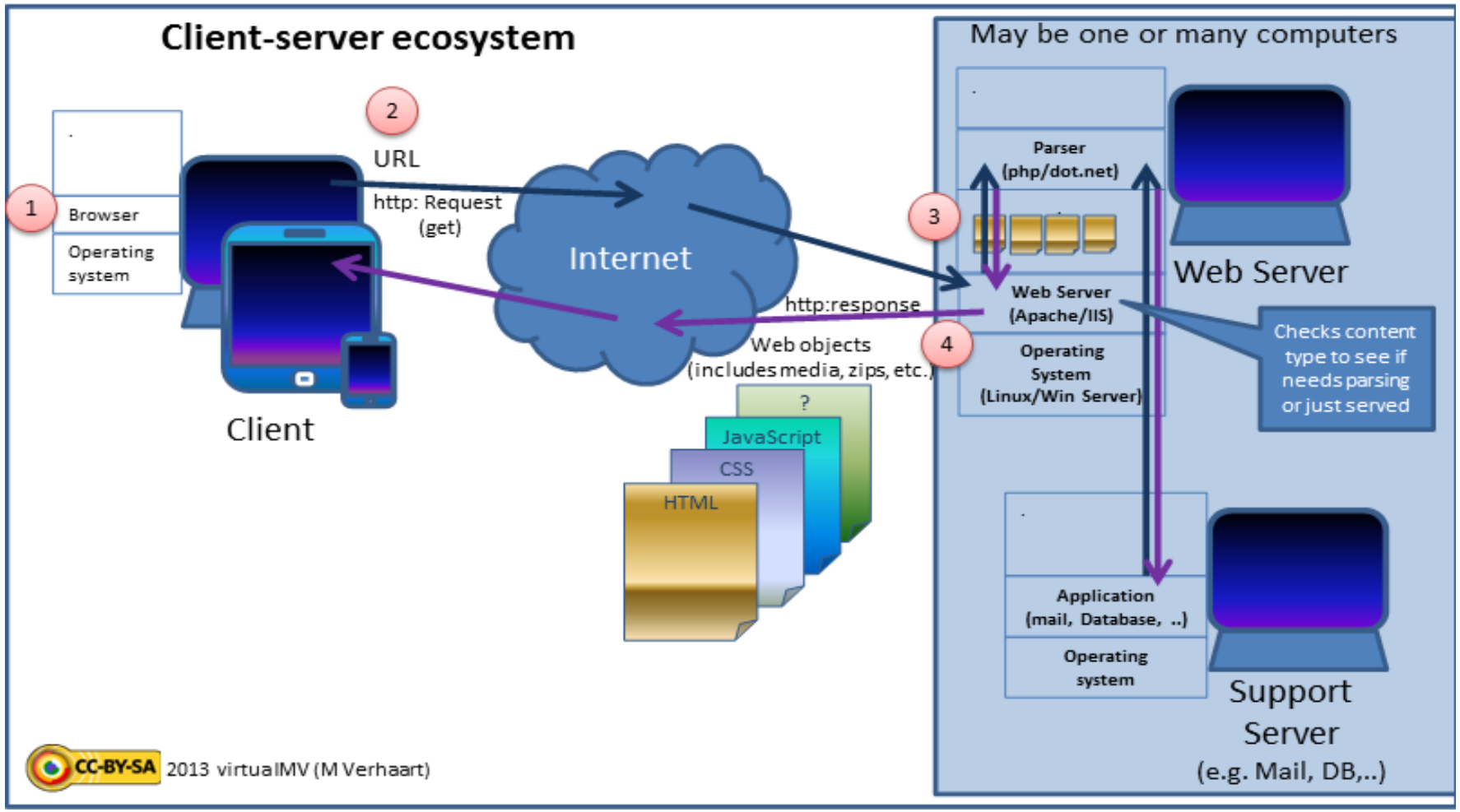
How the Web works, basic content, take note of the entities involved

- User enters: URI (using Web browser)
- Web browser with URI lookup for IP address (through the Internet)
- The Internet forwarded the request to server (using Web browser)
- The request for default page usually index.html was found and ready to be served (through Web server)
- The default page was brought in (through Web server's harddisk)
- The default page was made available (through Web server)
- The default page was displayed (through Web browser)

How the Web works, dynamic content, take note of the entities involved

- User enters: URI (using Web browser)
- Web browser with URI lookup for IP address (through the Internet)
- The Internet forwarded the request to server (using Web browser)
- The request for default page index.html was found and ready to be served (through Web server)
- The default page was brought in (through Web server's harddisk)
- The request for default page index.html with application interface(s) embedded with it was found and ready to be served (through Web server)
- The application is going to be processed (through Server-side P.L. processor i.e. PHP, ASP, et al)
- The application interfaces execute with the SQL server (through MSSQL, MySQL, et al servers)
- The application brought in data from SQL (through Server-side P.L. processor)
- The page containing amalgamated data was made available (through Web server)
- The page and data was displayed (through Web browser)

Web-based client-server ecosystem



Server-side scripting

- A program running on a webserver.
- Is used to generate the web content on various web pages, manage user sessions, and control workflow.
- Server responses may be determined by such conditions as data in a posted HTML form, parameters in the URL, the type of browser being used, the passage of time, or a database or server state.

Server-side scripting P.L.

- Popular are the following:
  - ASP,
  - ColdFusion,
  - JavaScript,
  - Perl,
  - PHP,
  - Ruby,
  - WebDNA
- These P.L.s often used the common gateway interface (CGI, see succeeding slide) to produce dynamic web pages.

Server-side scripting P.L. continuation

- Two notable exceptions which reuces CGI concepts in their APIs but actually dispatch all web requests into a share virtual machine:
  - ASP.NET
  - JSP
- Dynamic web pages are often cached when there are few or no changes expected and the page is anticipated to receive considerable amount of web traffic that would create slow load times for the server if it had to generate the pages on the ply for each request.

Common Gateway Interface

- A standard method used to generate dynamic content on Web pages and Web applications.
  - A result from few group of people's work based on RFC 3875.
- When implemented on a Web server, provides an interface between the Web server and programs that generate the Web content.
  - Known as *CGI scripts* or simply *CGIs*; they are usually written in a scripting language, but can be written in any programming language.
  - The script that sends to standard output is passed to the Web client instead of being shown on-screen in a terminal window.

Environment variables passed to CGI programs, server-specific

- SERVER_SOFTWARE: name/version of HTTP server.
- SERVER_NAME: host name of the server, may be dot-decimal IP address.
- GATEWAY_INTERFACE: CGI/version.

Environment variables passed to CGI programs, request-specific

- SERVER_PROTOCOL: HTTP/version.
- SERVER_PORT: TCP port (decimal).
- REQUEST_METHOD: name of HTTP method (see above).
- PATH_INFO: path suffix, if appended to URL after program name and a slash.
- PATH_TRANSLATED: corresponding full path as supposed by server, if PATH_INFO is present.
- SCRIPT_NAME: relative path to the program, like /cgi-bin/script.cgi.
- QUERY_STRING: the part of URL after ? character. The query string may be composed of *name=value pairs separated with ampersands (such as var1=val1&var2=val2...) when used to submit form data transferred via GET method as defined by HTML application/x-www-form-urlencoded.
- REMOTE_HOST: host name of the client, unset if server did not perform such lookup.
- REMOTE_ADDR: IP address of the client (dot-decimal).
- AUTH_TYPE: identification type, if applicable.
- REMOTE_USER used for certain AUTH_TYPEs.
- REMOTE_IDENT: see ident, only if server performed such lookup.
- CONTENT_TYPE: Internet media type of input data if PUT or POST method are used, as provided via HTTP header.
- CONTENT_LENGTH: similarly, size of input data (decimal, in octets) if provided via HTTP header.
- Variables passed by user agent (HTTP_ACCEPT, HTTP_ACCEPT_LANGUAGE, HTTP_USER_AGENT, HTTP_COOKIE and possibly others) contain values of corresponding HTTP headers and therefore have the same sense.

CGI program example uses, Wiki

- The user agent requests the name of an entry; the Web server executes the CGI; the CGI program retrieves the source of that entry's page (if one exists), transforms it into HTML, and prints the result. The web server receives the input from the CGI and transmits it to the user agent. If the "Edit this page" link is clicked, the CGI populates an HTML `textarea` or other editing control with the page's contents, and saves it back to the server when the user submits the form.

Client-side scripting

- Changes interface behaviors within a specific web page in response to mouse or keyboard actions, or at specified timing events.
- The dynamic behavior occurs within the presentation.
- The Client-side content is generated on the user's local computer system.
- Web pages created using it uses presentation technology called rich interfaced pages.

Client-side scripting, rich Internet applications

- A Web application that has many of the characteristics of desktop application software, typically delivered by way of a site-specific browser, a browser plug-in, an independent sandbox, extensive use of JavaScript, or a virtual machine.
- Current the 3 most common platforms include:
  - Adobe Flash,
  - JavaFX, and
  - Microsoft Silverlight
- Desktop browser penetration of these platforms rates around 96%, 76%, and 66%, respectively (as of August 2011).

Client-side scripting P.L.s

- JavaScript or ActionScript,
- Dynamic HTML (DHTML) and
- Flash
- Are frequently used to orchestrate media types such as
  - Sound
  - Animations
  - Changing texts

Client- and server-side combinations

- Components that collectively build a dynamic web page are called a web application, which manages
  - User interactions,
  - State (of the system and application),
  - Security, and
  - Performance.
- Ajax programming use a combination of both client-side scripting and server-side requests.

Ajax

- A web application development technique for dynamically interchanging content, and it sends requests to the server for data in order to do so.
- The server returns the requested data which is then processed by a client side script.
- This technique can reduce server load time because the client does not request the entire webpage to be regenerated by the server's language parser; only the content that will change is transmitted.
- Google Maps is an example of a web application that uses Ajax techniques.

Web frameworks

- Designed to support the development of
  - Dynamic websites,
  - Web applications,
  - Web services,
  - Web resources.
- Aims to alleviate the overhead associated with common activities performed in web development.
- Example that many frameworks provide includes:
  - Libraries for database access,
  - Session management,
  - Designs and templates,
  - Code reuse.

Framework architectures

- Model-View-Controller
- Push- and Pull-based
- Three tier Organization

P.L. web frameworks

- Ada
- ASP.NET
- C
- C++
- Cold Fusion
- Haskell
- Java
- JavaScript
- Scala
- Perl
- PHP
- Python
- Ruby

Current P.L. web frameworks

FRAMEWORKS	P.L.
Ada Web Server	Ada
ASP.NET MVC	ASP.NET
Saetta Web Server	C
Wt	C++
CFWheels	Cold Fusion Markup Language
Haskell	Snap
Apache Struts 2, Oracle ADF, Ze Framework	Java
AngularJS	JavaScript
CakePHP, Symphony, Zend	PHP
Django, Pyramid	Python
Ruby on Rails	Ruby

Framework architecture, MVC

- A software architectural pattern for implementing user interfaces.
- It divides a given software application into three interconnected parts, so as to separate internal representation of information from the ways that information is presented to or accepted from the user.
- Expresses “the core of the solution” to a problem while allowing it to be adapted for each system.

MVC components, Model

- The central component of the MVC, captures the behavior of the application in terms of its problem domain, independent of the user domain.
- Directly manages the data, logic and rules of application.

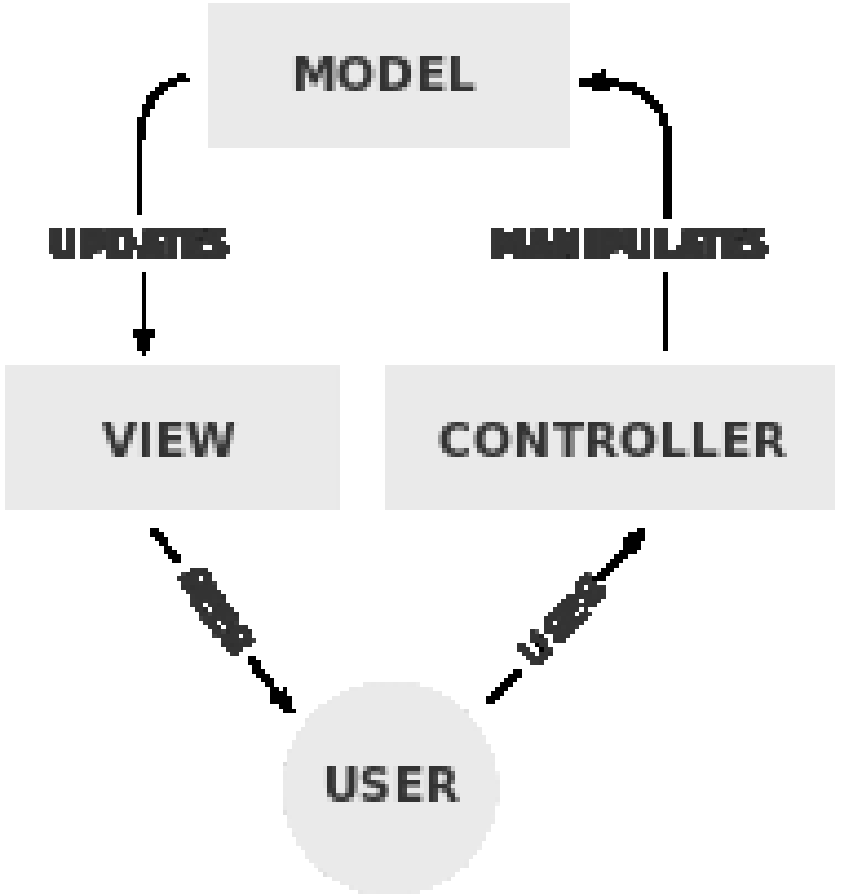
MVC components, View

- Can be any output representation of information, such as a chart or a diagram.
- Multiple views of the same information are possible, such as a bar chart for management and a tabular view for accountants.

MVC components, Controller

- Accepts input and converts it to commands for the model or view.

MVC components collaboration



MVC interaction definition

- **Controller** can send commands to the model to update the model's state (e.g., editing a document). It can also send commands to its associated view to change the view's presentation of the model (e.g., by scrolling through a document).
- **Model** notifies its associated views and controllers when there has been a change in its state. This notification allows the views to produce updated output, and the controllers to change the available set of commands. In some cases an MVC implementation might instead be "passive," so that other components must poll the model for updates rather than being notified.
- **View** requests information from the model that it uses to generate an output representation to the user.

MVC applications

- Originally developed for desktop computing.
- Several commercial and non-commercial web application framework enforce such pattern.

MVC interpretations

- Varies mainly in the way MVC responsibilities are divided in between client and server.
- Early ones took a thin client approach that placed almost the entire model, view and controller logic on the server.
  - The client sends either hyperlink requests or form input to the controller and then receives a complete and updated web page (or other document) from the view; the model exists entirely on the server

PHP

PHP

- Fundamentals and basic codes check your Webprog 1.
- Known
  - PHP Hypertext Preprocessor
    - Originally called Personal Home Page by Rasmus Lerdorf, 1994
  - To serve content that is considered dynamic,
  - As one of the most popular P.L. for web, server-side or backend scripting language,
  - As general purpose P.L.

PHP code

- Can be simply mixed with
  - HTML code
  - Various templating engines
  - Web frameworks
- Processed by an interpreter, which is usually implemented as a web server's native module or a Common Gateway Interface (CGI) executable.
- Has also evolved to include a command-line interface (CLI) capability and can be used in standalone graphical applications.

PHP acts primarily as filter

- Taking input from a file or stream containing text and/or PHP instructions and outputting another stream of data.
- Most commonly the output will be HTML, although it could be JavaScript Object Notation (JSON, see succeeding slide), Extensible Markup Language (XML) or binary data such as image or audio formats.

JSON, PHP output

- An open standard format that uses human-readable text to transmit data objects consisting of attribute–value pairs. It is used primarily to transmit data between a server and web application, as an alternative to XML.
- Originally derived from the JavaScript scripting language, JSON is a language-independent data format.
- Code for parsing and generating JSON data is readily available in a large variety of programming languages.

PHP canonical interpreter, Zend Engine

- No written specification or standard exists for PHP.
  - However effort here has began in 2014.
- It serves as the de facto standard.
- Only executes PHP code within its delimiter.
- The only complete and most widely used PHP implementation.

PHP Zend implementations

- Zend compiles PHP source code on the fly into an internal format that it can execute, thus it works as an interpreter.
- It is also “reference implementation" of PHP
- As PHP has no formal specification, and so the semantics of Zend PHP define the semantics of PHP itself.
- Due to the complex and nuanced semantics of PHP, defined by how Zend works, it is difficult for competing implementations to offer complete compatibility.
- PHP's single-request-per-script-execution model, and the fact the Zend Engine is an interpreter, lead to inefficiency.

Zend Platform

- Formerly Zend Cache and then Zend Accelerator
- A commercial Web Application Server product.
- Has a complete set of performance capabilities that includes more than a simple PHP accelerator.
- Features include
  - Code caching/acceleration, data caching, content (html output) caching, download optimization and off-line (asynchronous) processing capabilities
  - Such features can result in significant performance improvements for most PHP applications.
- It also includes detailed PHP monitoring and root cause analysis support to help in tuning and debugging, session fail-over support for HA (High Availability) needs and other integration capabilities including Java integration.

PHP Accelerators

Name	Availability	Opcode cache	File cache	Resolve file path cache	Object/session cache	Optimization	Cache in memory	Source encoding
APC	Maintained	Yes	Yes	N/A	Yes	Yes	Yes	No
eAccelerator	Discontinued	Yes	N/A	N/A	N/A	N/A	Yes	N/A
PHP Accelerator (PHPA)	Discontinued	Yes	Yes	N/A	No	Yes	Yes	No
Turck MMCache	Discontinued	N/A	N/A	N/A	N/A	N/A	N/A	N/A
XCache	Maintained	Yes	N/A	N/A	Yes	Yes	Yes	N/A
Nusphere PhpExpress	Maintained	Yes	N/A	N/A	N/A	N/A	N/A	N/A
Zend Opcache (ex. Zend Optimizer+)	Maintained	Yes	N/A	N/A	No	Yes	Yes	No
Zend Platform	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Windows Cache	N/A	Yes	Yes	Yes	Yes	N/A	Yes	N/A

Alternative PHP Cache (APC)

- A free, open source (PHP license) framework that caches the output of the PHP bytecode compiler in shared memory, thus reducing parsing and disk I/O overhead for later requests; and a shared memory cache for user data. For an application consisting of a large source code base such as Drupal, a 3x increase in page generation speed is possible as a result.
- It has been used at Facebook and has a mature codebase thanks to numerous contributors, including Facebook itself.

ionCube PHP Accelerator (PHPA)

- The first freely available PHP accelerator to compete with the commercial Zend Cache product. Created before ionCube Ltd. was founded and at a time when the performance of PHP was regarded as lackluster when compared to other popular web programming languages, PHPA showed that PHP can compete with other languages performance-wise.
- It now is discontinued and the development of a more advanced replacement has been announced.

XCache

- A fast, stable PHP opcode cacher that has been tested and is now running on production servers under high load.
- It is tested on Linux and FreeBSD and supported under Windows, for thread-safe and non-thread-safe versions of PHP.
- This relatively new opcode caching software has been developed by mOo, one of the developers of **Lighttpd**, to overcome some of the limitations of the existing solutions at that time; such as being able to use it with new PHP versions as they arrive.

Nusphere PhpExpress

- A free PHP opcode cache that loads both Nu-Coder (commercial) encoded and plain PHP files directly into the PHP engine, saving loading time and boosting performance of PHP applications. It's available on Windows, Linux, FreeBSD, NetBSD, Mac OS X, and Solaris.

Zend Opcache

- An open source component of Zend Server and Zend Server Community Edition. Zend Opcache speeds up PHP execution by opcode caching and optimization. It stores precompiled script bytecode in shared memory. This eliminates the stages of reading code from the disk and compiling it on future access. For further performance improvements, the stored bytecode is optimized for faster execution.
- It was called Zend Optimizer, which load files encoded by Zend Guard.
- PHP 5.5 integrated Zend Opcache.

Windows Cache Extension

- A free, open source (New BSD License), PHP accelerator developed by Microsoft for PHP under Windows.
- The extension includes
  - PHP opcode cache, file cache, resolve file path cache, object/session cache, file change notifications and lock/unlock API's.
- Combination of all these caches results in significant performance improvements for PHP applications hosted on Windows. The extension is primarily used with Internet Information Services and non-thread-safe build of PHP via FastCGI protocol.

PHP alternative platform implementations

- HipHop Virtual Machine (HHVM) – developed at Facebook and available as open source, it converts PHP code into a high-level bytecode (commonly known as an intermediate language), which is then translated into x86-64 machine code dynamically at runtime by a just-in-time (JIT) compiler, resulting in up to 6× performance improvements.
- Parrot – a virtual machine designed to run dynamic languages efficiently; Pipp transforms the PHP source code into the Parrot intermediate representation, which is then translated into the Parrot's bytecode and executed by the virtual machine.
- Phalanger – compiles PHP into Common Intermediate Language (CIL) bytecode
- HipHop – developed at Facebook and available as open source, it transforms the PHP scripts into C++ code and then compiles the resulting code, reducing the server load up to 50%. In early 2013, Facebook deprecated it in favor of HHVM due to multiple reasons, including deployment difficulties and lack of support for the whole PHP language, including the create_function() and eval() constructs.

PHP installation and configuration

- 2 primary ways for adding support for PHP to a web server as a
  - Native web server module or as a
  - CGI executable.
- PHP's direct module interface called
  - Server Application Programming Interface (SAPI)
    - Supported by many web servers including Apache HTTP Server, Microsoft IIS, Netscape (now defunct) and iPlanet.
    - OmniHTTPd support the Internet Server Application Programming Interface (ISAPI), which is a Microsoft's web server module interface.
    - PHP-FPM (FastCGI Process Manager) is an alternative FastCGI implementation for PHP, bundled with the official PHP distribution since version 5.3.3. When compared to the older FastCGI implementation, it contains some additional features, mostly useful for heavily loaded web servers.

PHP installation and configuration continuation

- PHP-FPM (FastCGI Process Manager) is an alternative FastCGI implementation for PHP, bundled with the official PHP distribution since version 5.3.3. When compared to the older FastCGI implementation, it contains some additional features, mostly useful for heavily loaded web servers.
- PHP can also be used for writing desktop graphical user interface (GUI) applications, by using the PHP-GTK extension. PHP-GTK is not included in the official PHP distribution, and as an extension it can be used only with PHP versions 5.1.0 and newer. The most common way of installing PHP-GTK is compiling it from the source code.

PHP installation and configuration continuation

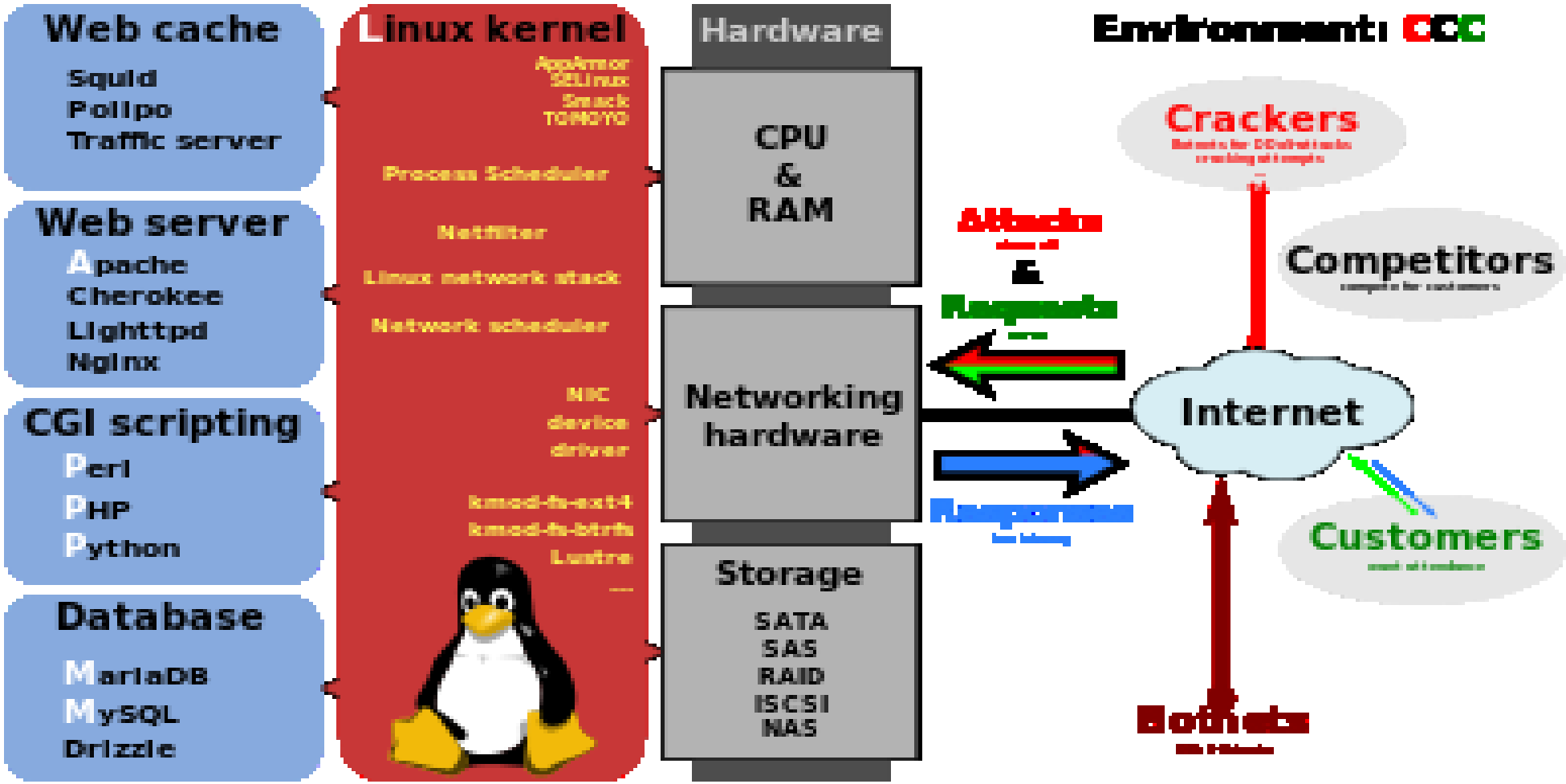
- When PHP is installed and used in cloud environments, software development kits (SDKs) are provided for using cloud-specific features.
- For example:
  - Amazon Web Services provides the AWS SDK for PHP,
  - Windows Azure can be used with the Windows Azure SDK for PHP.
- Can be deployed on most web servers, many operating systems and platforms, and can be used with many relational database management systems (RDBMS).
  - Evidently with many if not all webhosting providers support PHP for use by their customers.

Web development environment architecture (SW bundles)

- LAMP – Linux, Apache, MySQL and PHP or Python or Perl or mixed of these 3.
- MAMP – for Macintosh
- WAMP – for Windows

- What do you call yours?
  - Integrated, independent MS (Windows, SQL,), and PHP (**IMP**)

LAMP


Web cache
Squid
Polipo
Traffic server
Web server
Apache
Cherokee
Lighttpd
Nginx
CGI scripting
Perl
PHP
Python
Database
MariaDB
MySQL
Drizzle
Linux kernel
AppArmor
SELinux
Smack
TOMOYO
Process Scheduler
Netfilter
Linux network stack
Network scheduler
NIC
device
driver
kmod-fs-ext4
kmod-fs-btrfs
Lustre
Hardware
CPU
&
RAM
Networking
hardware
Storage
SATA
SAS
RAID
iSCSI
NAS
Environment: CCC
Crackers
Competitors
Internet
Customers

SQL

Capability

MS- and My-SQL comparison