FAMP / LAMP

FreeBSD/Linux/Apache/MySQL/PHP

jnlin (2019-2021, CC BY)
? (?-2018)

交大資工系資訊中心
Computer Center of Department of Computer Science, NCTU

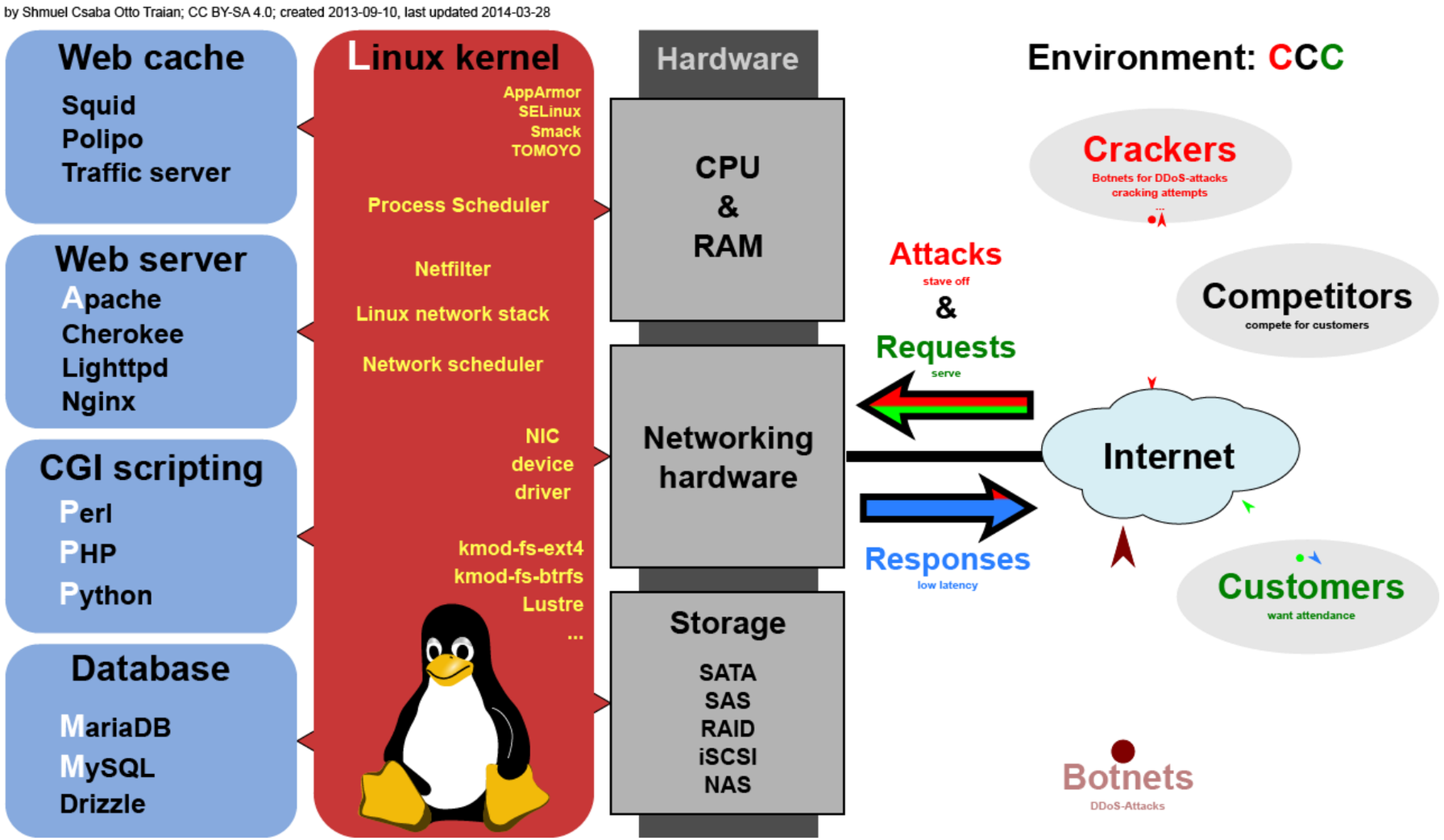
Introduction

- Web service
  - Apache
  - GWS, Nginx, IIS
- SQL service
  - MySQL, MariaDB
  - MS SQL, Oracle DB, PostgreSQL
- NoSQL service
  - MongoDB
- Web backend language
  - Golang, Python, Node.js, PHP

Outline

- Introduction
  - Apache
  - MySQL
  - PHP
- Installation and Administration
  - MySQL
  - Apache
  - PHP
- Appendix
  - phpMyAdmin
  - lighttpd
  - FastCGI

Overview

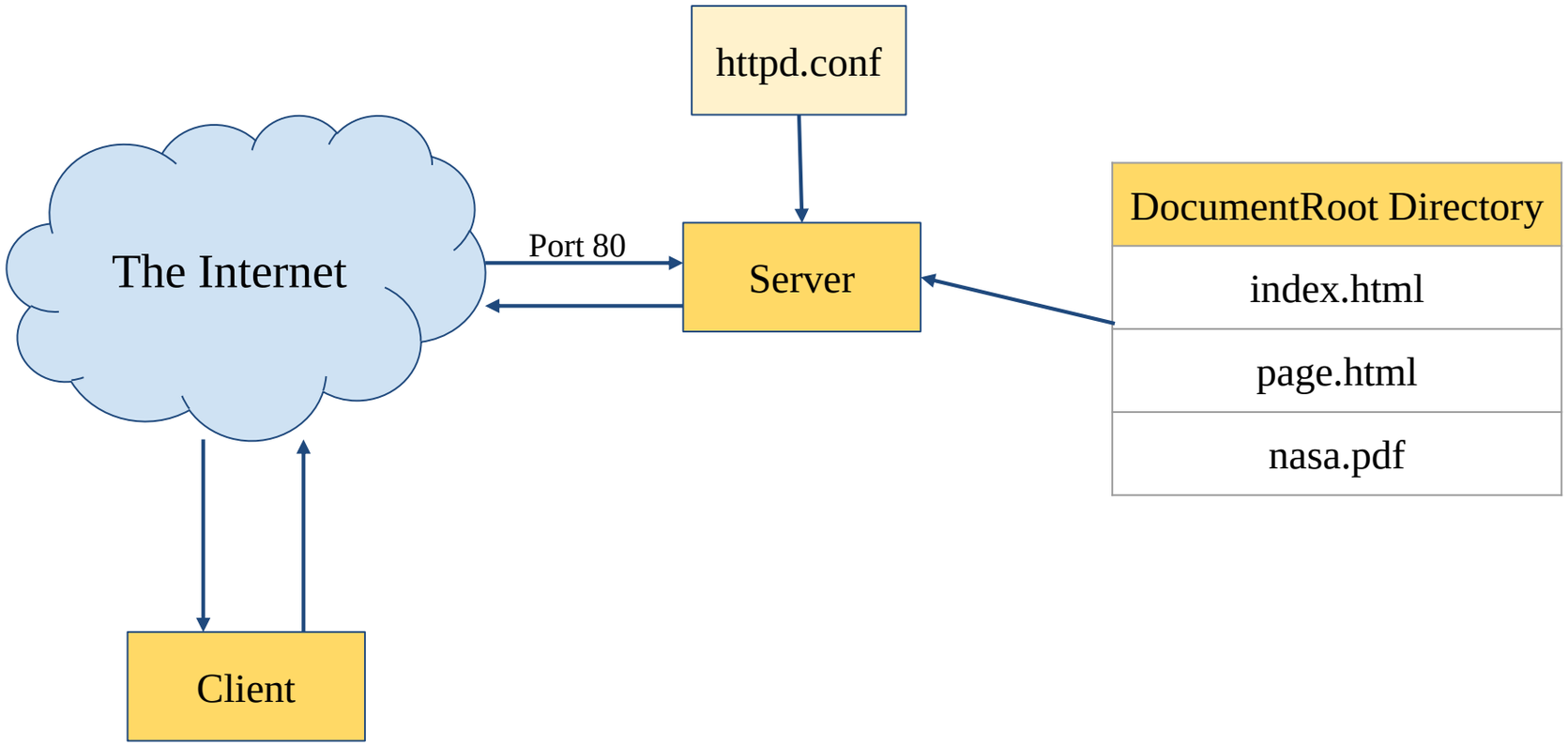


https://commons.wikimedia.org/w/index.php?curid=28224098

Apache

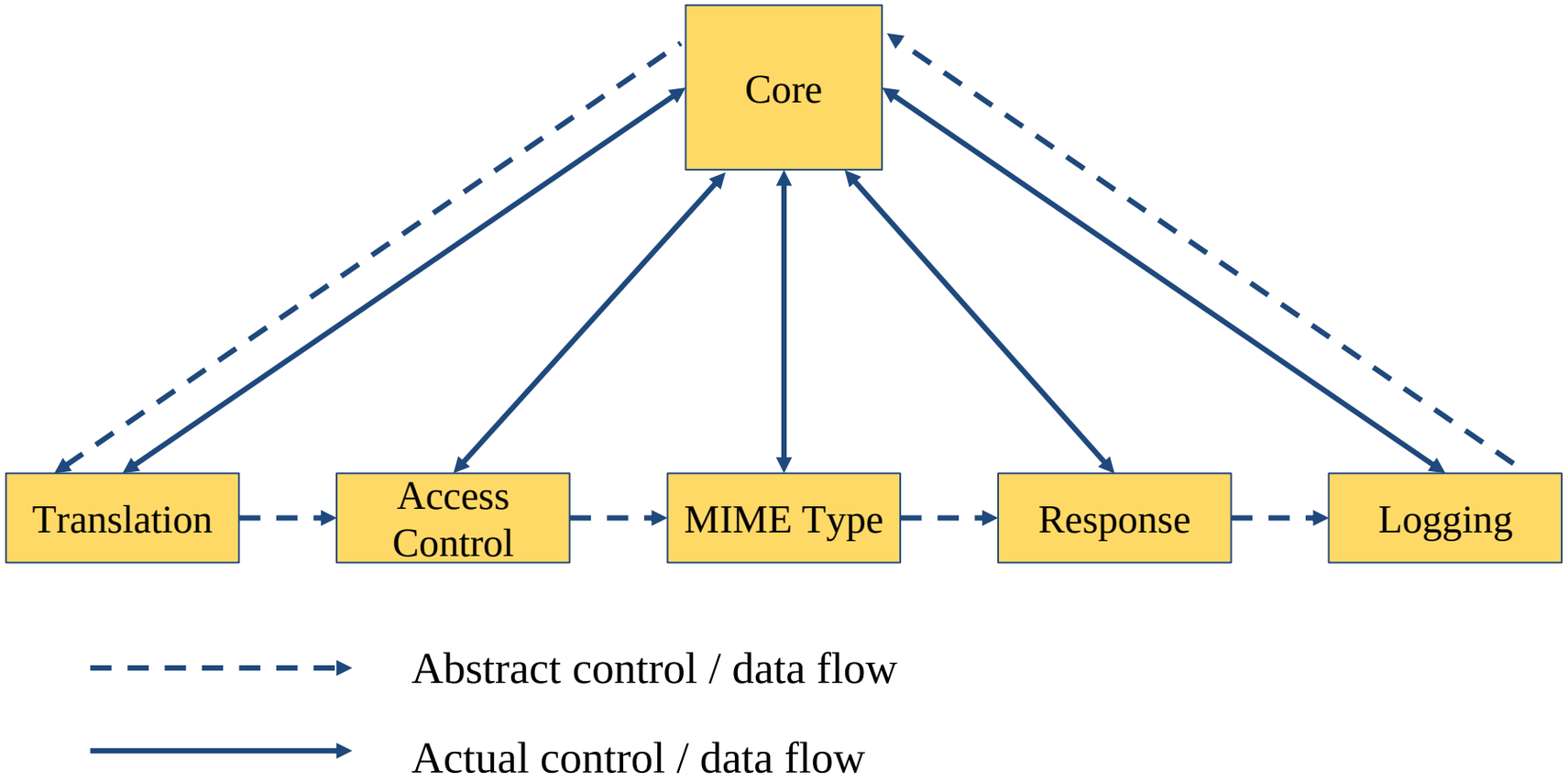
- Apache Software Foundation: http://www.apache.org/
- Apache HTTP Server Project: http://httpd.apache.org/
- Web httpd server that supports
  - HTTP/2
  - Modular design
  - Can be customized by writing modules using Apache module API
  - Freely available across many platforms
- Two main parts
  - Core: implements basic functions and provide the interface for Apache modules
  - Modules: extends or overrides the function of Core
    - Example: Access control, logging, CGI, proxy, cache control, PHP…

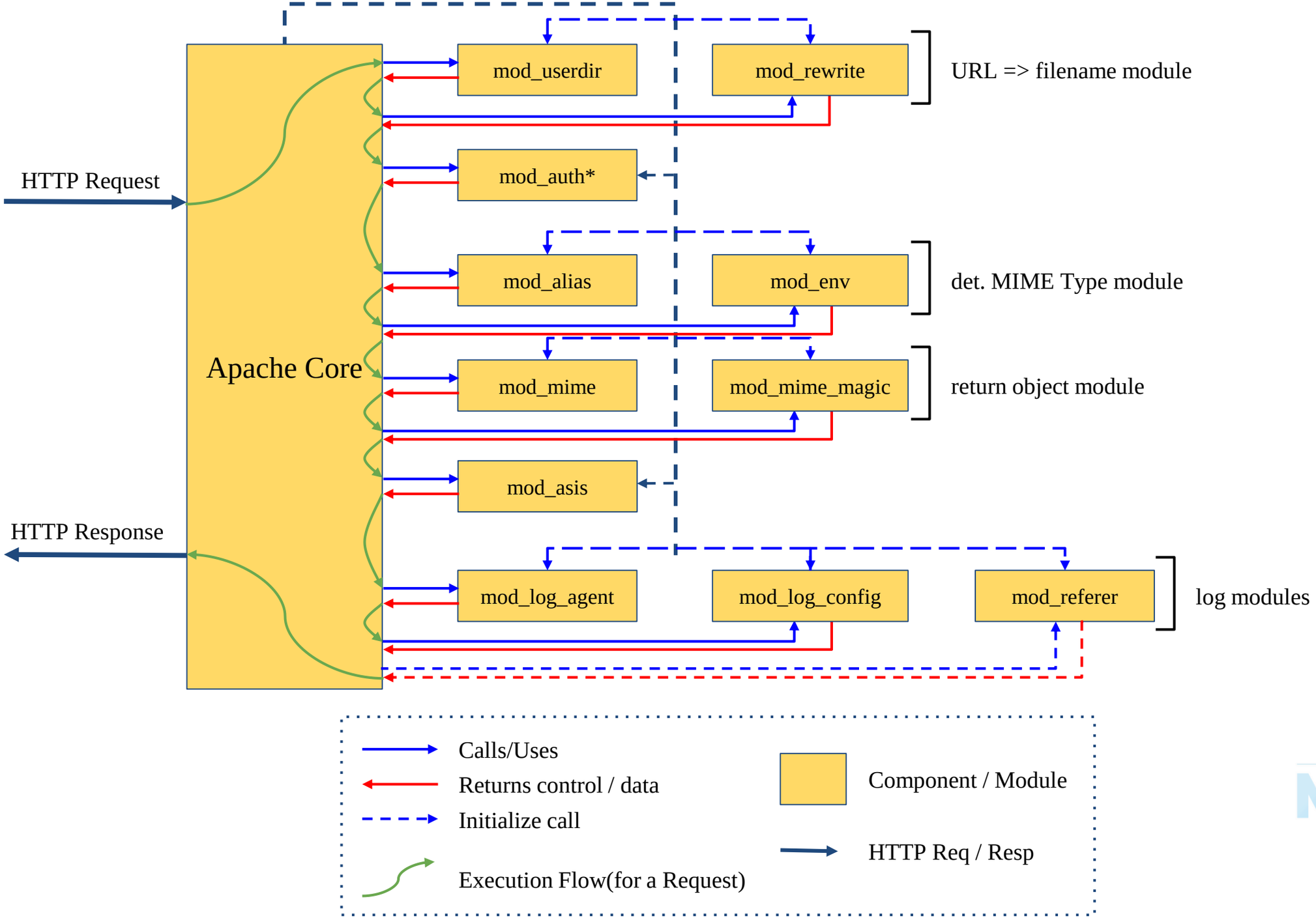
How Apache Works – request and response



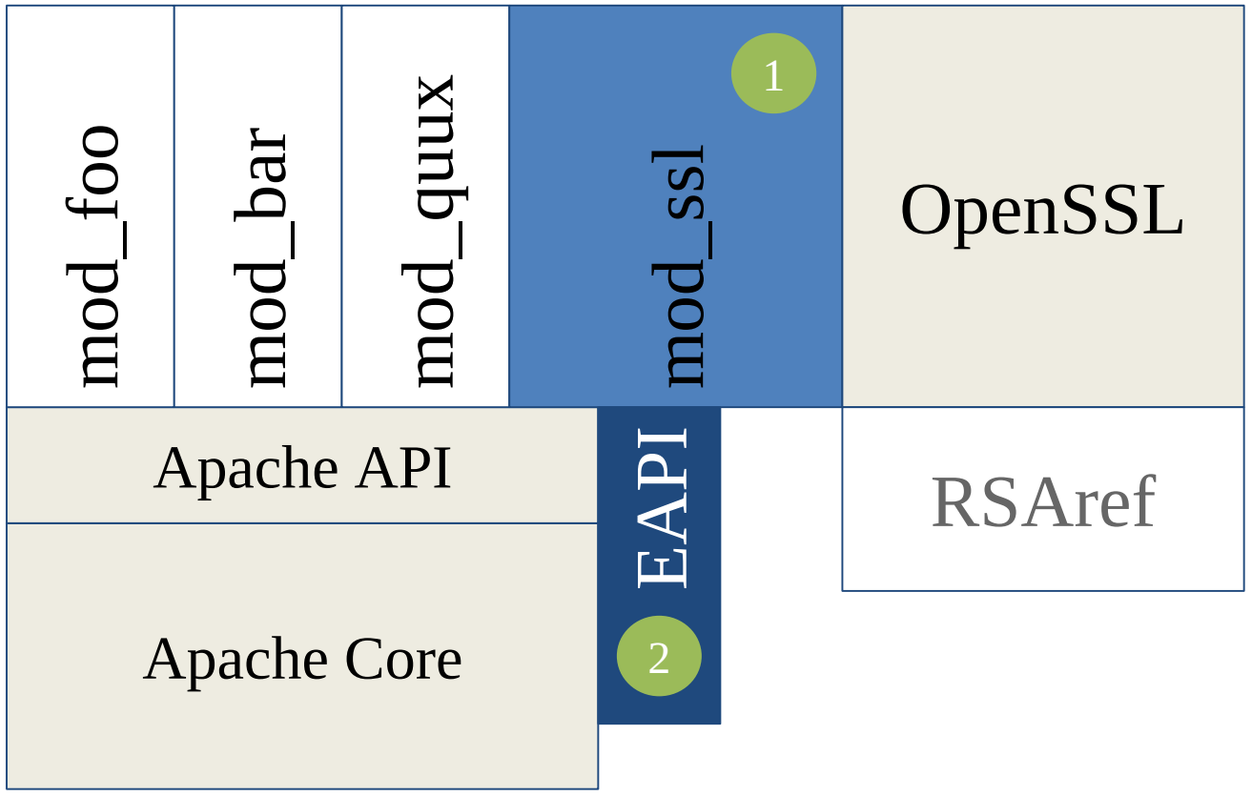
How Apache Works – each request-response

- Apache breaks client request into several steps which are implemented as modules




HTTP Request
HTTP Response
Apache Core
mod_userdir
mod_rewrite
URL => filename module
mod_auth*
mod_alias
mod_env
det. MIME Type module
mod_mime
mod_mime_magic
return object module
mod_asis
mod_log_agent
mod_log_config
mod_referer
log modules
Calls/Uses
Returns control / data
Initialize call
Execution Flow(for a Request)
Component / Module
HTTP Req / Resp

Apache with mod_ssl



MySQL (1)

- SQL (Structured Query Language)
  - The most popular computer language used to create, modify, retrieve and manipulate data from relational database management systems.
  - Introduction to SQL: http://www.1keydata.com/tw/sql/sql.html
- A multithreaded, multi-user, SQL Database Management System.
- Owned and sponsored by a Swedish company MySQL AB, acquired by Sun Microsystems 2008. Oracle acquired Sun in 2009.
  - Forked version: MariaDB, Percona Server
- Official Site: http://www.mysql.com
- Documentation: http://dev.mysql.com/doc

MySQL (2)

- Features:
  - Writing in C/C++, tested by many compilers, portable to many platforms.
    - AIX, FreeBSD, HP-UX, Linux, Mac OS, Solaris, Windows, …etc.
  - Providing APIs for C/C++, Java, Perl, PHP, Python, Ruby, Tcl, …etc.
  - Multi-threaded kernel, supporting systems with multiple CPUs.
  - Optimized algorithm for SQL Query.
  - Multi-Language (coding) Supports.
  - Lots of connecting method: TCP/IP, ODBC, JDBC, Unix domain socket.
  - Free Software (GNU General Public License version 2)
  - Popular for web applications

PHP

- PHP: Hypertext Preprocessor
  - A widely-used Open Source general-purpose scripting language.
  - Originally designed to create dynamic web pages, PHP's principal focus is server-side scripting.
  - PHP scripts can be embedded into HTML.
  - The LAMP architecture has become popular in the Web industry as a way of deploying inexpensive, reliable, scalable, secure web applications.

- Official Site: http://php.net/

Installation and Administration

MySQL, Apache, PHP, phpMyAdmin

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Installing MySQL (1)

- Steps
  - $ cd /usr/ports/databases/mysql57-server/
  - $ make OPTIONS install clean

```
You may use the following build options:

        WITH_CHARSET=charset Define the primary built-in charset (latin1).
        WITH_XCHARSET=list   Define other built-in charsets (may be 'all').
        WITH_COLLATION=collate  Define default collation (latin1_swedish_ci).
        WITH_OPENSSL=yes     Enable secure connections
                             (define WITHOUT_YASSL for backward compatibility).
        WITH_LINUXTHREADS=yes   Use the linuxthreads pthread library.
        WITH_PROC_SCOPE_PTH=yes Use process scope threads
                             (try it if you use libpthread).
        WITH_FAST_MUTEXES=yes   Replace mutexes with spinlocks.
        BUILD_OPTIMIZED=yes  Enable compiler optimizations
                             (use it if you need speed).
        BUILD_STATIC=yes     Build a static version of mysqld.
                             (use it if you need even more speed).
        WITH_NDB=yes         Enable support for NDB Cluster.
```

Installing MySQL (2)

- OPTIONS:
  - WITH_CHARSET=utf8
  - WITH_XCHARSET=ascii,big5,… (all)

- Installed…

```
===> SECURITY REPORT:
       This port has installed the following files which may act as network
       servers and may therefore pose a remote security risk to the system.
/usr/local/libexec/mysqld

       This port has installed the following startup scripts which may cause
       these network services to be started at boot time.
/usr/local/etc/rc.d/mysql-server
```

Installing MySQL (3)

- Startup script…

```
#
# Add the following line to /etc/rc.conf to enable mysql:
# mysql_enable (bool):  Set to "NO" by default.
#                       Set it to "YES" to enable MySQL.
# mysql_limits (bool):  Set to "NO" by default.
#                       Set it to yes to run `limits -e -U mysql`
#                       just before mysql starts.
# mysql_dbdir (str):    Default to "/var/db/mysql"
#                       Base database directory.
# mysql_args (str):     Custom additional arguments to be passed
#                       to mysqld_safe (default empty).
#
```

Managing MySQL (1)

- Configuration file
  - Copy config file
    - $ cd /usr/local/share/mysql
    - $ cp my-huge.cnf /usr/local/etc/my.cnf
  - Edit /usr/local/etc/my.cnf

- Start mysql daemon
  - Using startup script
    - $ /usr/local/etc/rc.d/mysql-server start

Managing MySQL (2)

- Test
  - $ mysql −u root −p
    - The initial password for root is empty

```
nasa [/usr/local/etc] -randy- mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 1
Server version: 5.1.41-log FreeBSD port: mysql-server-5.1.41

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> show databases;
+--------------------------+
| Database                 |
+--------------------------+
| information_schema       |
| mysql                    |
| test                     |
+--------------------------+
3 rows in set (0.06 sec)
```

Managing MySQL (3)

- Securing initial accounts
  - Two initial accounts
    - root
    - anonymous

```
mysql> SELECT Host, User From mysql.user;
+-------------------------------+------+
| Host                          | User |
+-------------------------------+------+
| 127.0.0.1                     | root |
| nasa.cs.nctu.edu.tw           |      |
| nasa.cs.nctu.edu.tw           | root |
| localhost                     |      |
| localhost                     | root |
+-------------------------------+------+
```

```
mysql> UPDATE mysql.user SET Password = PASSWORD('test123') WHERE User = 'root';
Query OK, 3 rows affected (0.08 sec)
Rows matched: 3  Changed: 3  Warnings: 0

mysql> FLUSH PRIVILEGES;              # Reload the grant tables
Query OK, 0 rows affected (0.00 sec)

mysql> SET PASSWORD FOR 'root'@'localhost' = PASSWORD('ttt123');
Query OK, 0 rows affected (0.02 sec)
```

Installing Apache (1)

- Steps
  - $ cd /usr/ports/www/apache24/
  - $ make install clean

- Options
  - A lot of options for modules
  - WITH_SSL (default)
  - WITH_MPM=worker
  - WITH_THREADS=yes
  - WITH_SUEXEC=yes

Installing Apache (2)

- Installed…

```
To run apache www server from startup, add apache22_enable="YES"
in your /etc/rc.conf. Extra options can be found in startup script.

Your hostname must be resolvable using at least 1 mechanism in
/etc/nsswitch typically DNS or /etc/hosts or apache might
have issues starting depending on the modules you are using.
```

```
===> SECURITY REPORT:
       This port has installed the following binaries which execute with
       increased privileges.
/usr/local/sbin/suexec
```

- Startup script
  - /usr/local/etc/rc.d/apache24
  - apache24_http_accept_enable

Apache configuration – Configuration files

- Location
  - The default location of apache (in ports) is /usr/local/etc/apache24
  - Major configuration file: httpd.conf
    - Other configuration files could be included. (setting in httpd.conf)
    - extra/httpd-*.conf, Includes/*.conf
- Two types
  - Global settings
    - Server configurations
    - Options of modules
  - Directory Configuration
    - Local setting for certain directory

Apache configuration – Global Settings (httpd.conf)

- Server configuration
  - Listen 80
  - ServerAdmin liuyh@cs.nctu.edu.tw
  - ServerName nasa.cs.nctu.edu.tw
  - DocumentRoot "/home/wwwadm/data“
    - Remember create DocumentRoot directory if you modify it
- Options of modules
- Include supplemental configuration files
  - Include etc/apache22/extra/httpd-*.conf
  - Include etc/apache22/Includes/*.conf

Apache configuration – Directory Configuration (1)

- Configuration parameters
  - Options
    - All
    - ExecCGI
    - FollowSymLinks
    - Indexs
    - MultiViews
    - SymLinksIfOwnerMatch
  - http://httpd.apache.org/docs/2.4/mod/core.html#options

```
<Directory "/home/wwwadm/data">
        Options Indexes FollowSymLinks MultiViews
        AllowOverride None
        Order allow,deny
        Allow from all
</Directory>
```

Apache configuration – Directory Configuration (2)

- Configuration parameters
  - AllowOverride
    - All (Read .htaccess)
    - None (ignoring .htaccess)
  - Order
    - Solve collision of deny and allow rules
  - Deny/Allow
    - IP/DN (control access to this directory)

```
<Directory "/home/wwwadm/data">
        Options Indexes FollowSymLinks MultiViews
        AllowOverride None
        Order allow,deny
        Allow from all
</Directory>
```

Apache configuration – Options of Modules

- dir_module

```
<IfModule dir_module>
    DirectoryIndex index.html
</IfModule>
```

- alias_module (http://httpd.apache.org/docs/2.2/mod/mod_alias.html)

```
<IfModule alias_module>
       Redirect /foo http://www.example.com/bar
       Alias /webpath /full/filesystem/path
       ScriptAlias /cgi-bin/ "/usr/local/www/apache22/cgi-bin/"
</IfModule>
```

- mime_module

```
DefaultType text/plain
<IfModule mime_module>
       TypesConfig etc/apache22/mime.types
       AddType application/x-compress .Z
       AddHandler cgi-script .cgi
</IfModule>
```

Supplemental configuration – httpd-mpm.conf (Multi-Processing Module)

- Server-pool management (MPM specific)
  - Include etc/apache22/extra/httpd-mpm.conf
- WITH_MPM
  - prefork: non-threaded, pre-forking
  - worker: hybrid multi-process multi-threaded

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

Supplemental configuration – httpd-userdir.conf

- User home directories
  - Include etc/apache22/extra/httpd-userdir.conf

```
UserDir public_html
UserDir disabled root toor daemon operator bin tty kmem games news man sshd bind proxy
_pflogd _dhcp uucp pop www nobody mailnull smmsp

<Directory "/home/*/public_html">
        AllowOverride FileInfo AuthConfig Limit Indexes
        Options MultiViews Indexes SymLinksIfOwnerMatch IncludesNoExec
        <Limit GET POST OPTIONS>
        Order allow,deny
        Allow from all
        </Limit>
        <LimitExcept GET POST OPTIONS>
        Order deny,allow
        Deny from all
        </LimitExcept>
</Directory>
```

  - Methods: http://www.w3.org/Protocols/rfc2616/rfc2616-sec9.html

Supplemental configuration – httpd-vhosts.conf

- Virtual hosts
  - Include etc/apache24/extra/httpd-vhosts.conf
  - Name-based
    - NameVirtualHost
    - <VirtualHost>
  - IP-based
    - <VirtualHost>
  - ServerName
  - DocumentRoot
  - http://httpd.apache.org/docs/2.2/vhosts

```
Listen 80
Listen 8080

NameVirtualHost 172.20.30.40:80
NameVirtualHost 172.20.30.40:8080
<VirtualHost 172.20.30.40:80>
        ServerName www.example.com
        DocumentRoot /www/domain-80
</VirtualHost>
<VirtualHost 172.20.30.40:8080>
        ServerName www.example.com
        DocumentRoot /www/domain-8080
</VirtualHost>
<VirtualHost 172.20.30.40:80>
        ServerName www.example.org
        DocumentRoot /www/otherdomain-80
</VirtualHost>
<VirtualHost 172.20.30.40:8080>
        ServerName www.example.org
        DocumentRoot /www/otherdomain-8080
</VirtualHost>
```

Supplemental configuration – More…

- Multi-language error messages
  - httpd-multilang-errordoc.conf
- Fancy directory listings
  - httpd-autoindex.conf
- Language settings
  - httpd-languages.conf
- Real-time info on requests and configuration
  - httpd-info.conf
- Local access to the Apache HTTP Server Manual
  - httpd-manual.conf
- Various default settings
  - httpd-default.conf

Other configuration for Apache – log

- Rotate your log using newsyslog
- In httpd config
  - ErrorLog "/var/log/httpd-error.log"
  - TransferLog "/var/log/httpd-access.log"

```
/var/log/httpd-access.log    640  5  *  @T00  Z  /var/run/httpd.pid
/var/log/httpd-error.log     640  5  *  @T00  z  /var/run/httpd.pid
```

- In startup script
  - _pidprefix="/var/run/httpd"
  - pidfile="${_pidprefix}.pid"

.htaccess (1)

- .htaccess
  - Allow admin or users to control access to certain directory
- Usage
  - Modify httpd.conf
  - Create .htaccess file
  - Generate password database
  - Test

.htaccess (2)

- Example
  - Modify httpd.conf
  - Create .htaccess file
  - Generate password file

```
<Directory "/home/wwwadm/data/test1">
        Options None
        AllowOverride All
        Order allow,deny
        Allow from all
</Directory>
```

```
$ cat .htaccess
AuthName "SA-test1"
AuthType "Basic"
AuthUserFile "/home/wwwadm/data/test1/.htpasswd"
Require valid-user
Options Indexes
```

```
$ htpasswd -c ./.htpasswd SA-user1
New password:
Re-type new password:
Adding password for user SA-user1
```

.htaccess (3)

- You can use these tools to generate .htaccess
  - http://www.linuxkungfu.org/tools/htaccesser/index.php
  - http://www.htaccesseditor.com/

Installing PHP7 (1)

- Steps
  - $ pkg install php74 php74-mysqli mod_php74 php74-zlib \ php74-mbstring php74-gd php74-json php74-curl
  - $ vim /usr/local/etc/apache24/Includes/php.conf

```
<IfModule dir_module>
      DirectoryIndex index.php index.html
      <FilesMatch "\.php$">
      SetHandler application/x-httpd-php
      </FilesMatch>
      <FilesMatch "\.phps$">
      SetHandler application/x-httpd-php-source
      </FilesMatch>
</IfModule>
```

Test PHP7 in apache (2)

- Start apache
  - $ /usr/local/etc/rc.d/apache24 start
  - $ service apache24 restart
- Test PHP
  - $ vim /usr/local/www/apache24/data/index.php

```
<?
  phpinfo();
?>
```

phpinfo()

PHP Version 7.1.10

System	FreeBSD tbsdweicc 11.1-RELEASE FreeBSD 11.1-RELEASE #0 r321309: Fri Jul 21 02:08:28 UTC 2017 root@releng2.nyi.freebsd.org:/usr/obj/usr/src/sys/GENERIC amd64
Build Date	Nov 17 2017 07:06:25
Configure Command	'./configure' '--with-layout=GNU' '--localstatedir=/var' '--with-config-file-scan-dir=/usr/local/etc/php' '--disable-all' '--enable-libxml' '--enable-mysqlnd' '--with-libxml-dir=/usr/local' '--with-pcre-regex=/usr/local' '--program-prefix=' '--disable-cli' '--disable-cgi' '--with-apxs2=/usr/local/sbin/apxs' '--enable-dtrace' '--prefix=/usr/local' '--mandir=/usr/local/man' '--infodir=/usr/local/info/' '--build=amd64-portbld-freebsd11.0' 'build_alias=amd64-portbld-freebsd11.0' 'CFLAGS=-O2 -pipe -fstack-protector -fno-strict-aliasing' 'CPPFLAGS=' 'CPP=cpp'
Server API	Apache 2.0 Handler
Virtual Directory Support	disabled
Configuration File (php.ini) Path	/usr/local/etc
Loaded Configuration File	(none)
Scan this dir for additional .ini files	/usr/local/etc/php
Additional .ini files parsed	/usr/local/etc/php/ext-20-curl.ini, /usr/local/etc/php/ext-20-gd.ini, /usr/local/etc/php/ext-20-json.ini, /usr/local/etc/php/ext-20-mbstring.ini, /usr/local/etc/php/ext-20-mcrypt.ini, /usr/local/etc/php/ext-20-mysqli.ini, /usr/local/etc/php/ext-20-zlib.ini
PHP API	20160303
PHP Extension	20160303
Zend Extension	320160303
Zend Extension Build	API320160303,NTS
PHP Extension Build	API20160303,NTS
Debug Build	no
Thread Safety	disabled
Zend Signal Handling	enabled
Zend Memory Manager	enabled
Zend Multibyte Support	provided by mbstring
IPv6 Support	enabled
DTrace Support	available, disabled
Registered PHP Streams	php, file, glob, data, http, ftp, compress.zlib
Registered Stream Socket Transports	tcp, udp, unix, udg
Registered Stream Filters	string.rot13, string.toupper, string.tolower, string.strip_tags, convert.*, consumed, dechunk, mcrypt.*, mdecrypt.*, zlib.*

This program makes use of the Zend Scripting Language Engine:
Zend Engine v3.1.0, Copyright (c) 1998-2017 Zend Technologies

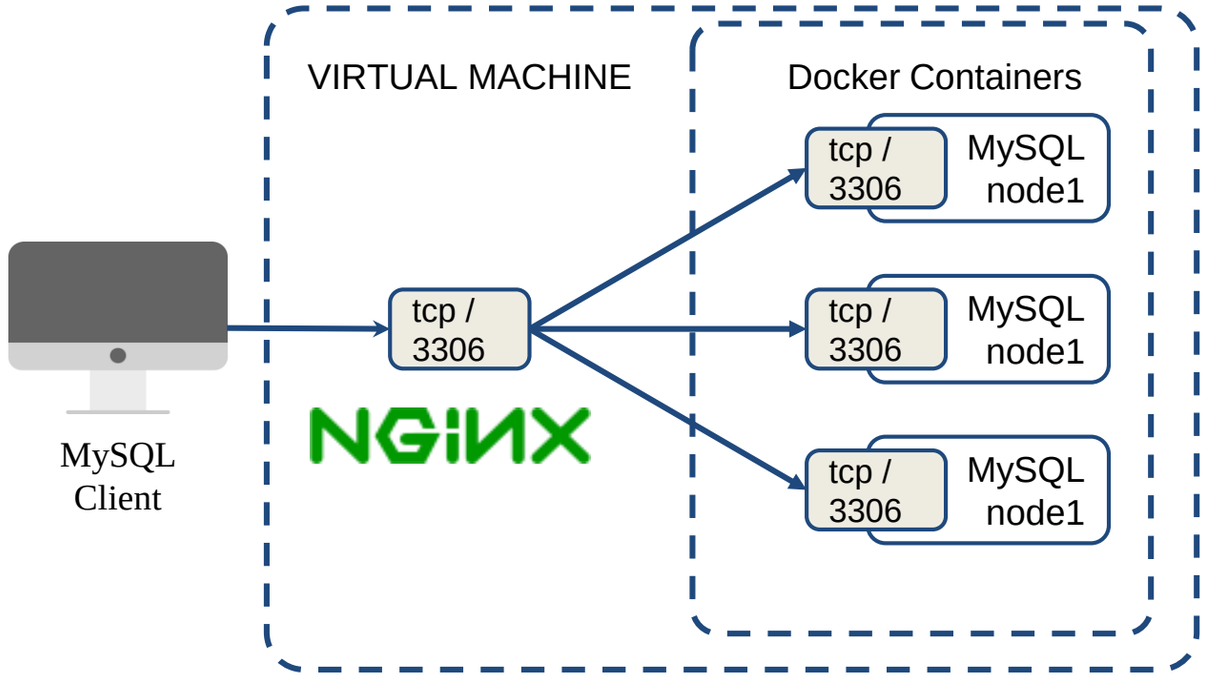
Architecture

Cluster, Server Load Balancer

Load balance

- Nginx proxy

```
upstream backend {
  server 172.16.1.1:3000;
  server 172.16.1.2:3000;
}
server {
  listen 80;
  server_name www.example.com;
  location / {
        proxy_pass
http://backend;
  }
}
```

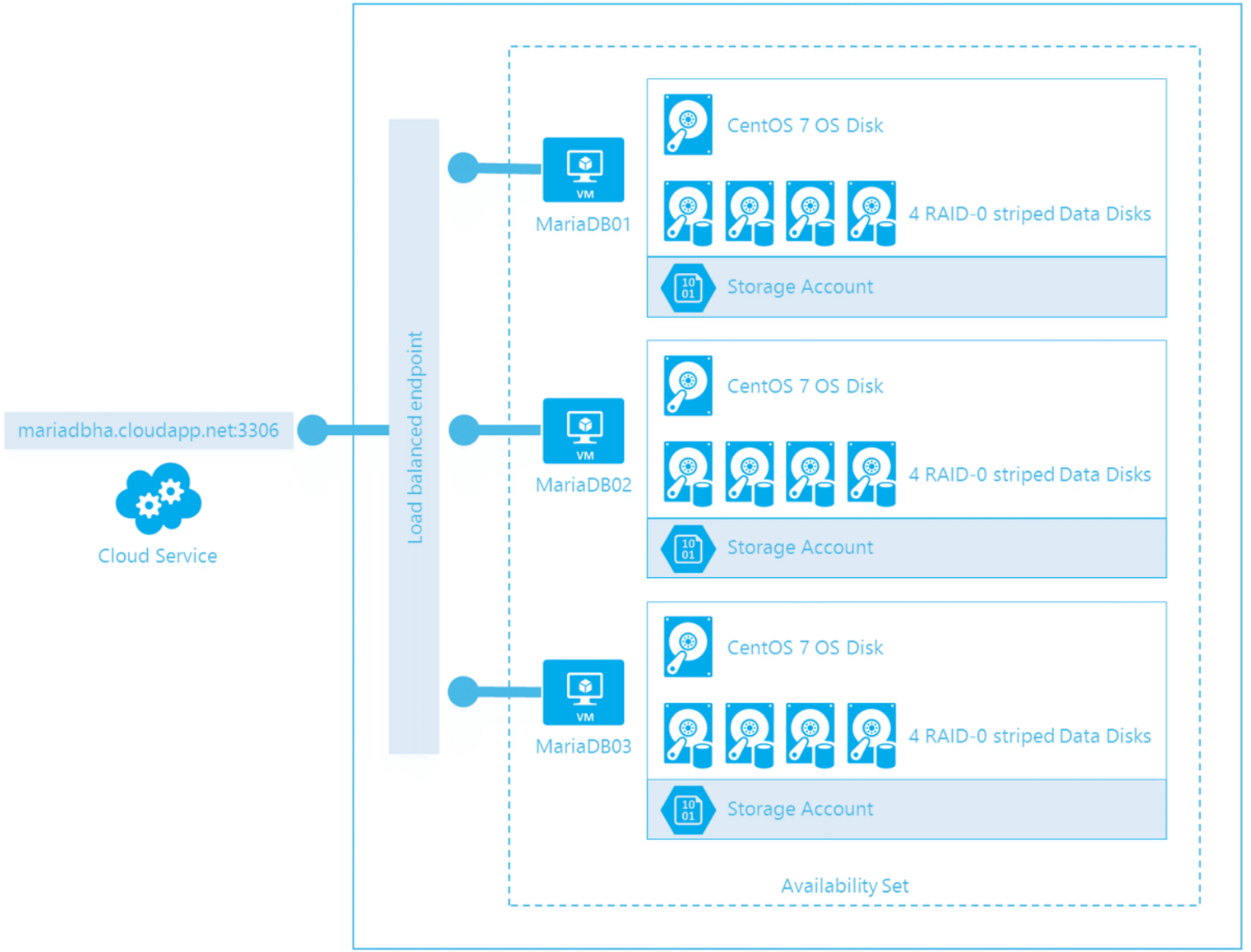


Load balance

- Open Source
  - haproxy - http://www.haproxy.org/
  - envoy - https://www.envoyproxy.io/

- Commercial
  - F5
  - A10
  - AWS ELB
  - Google Cloud Load Balance

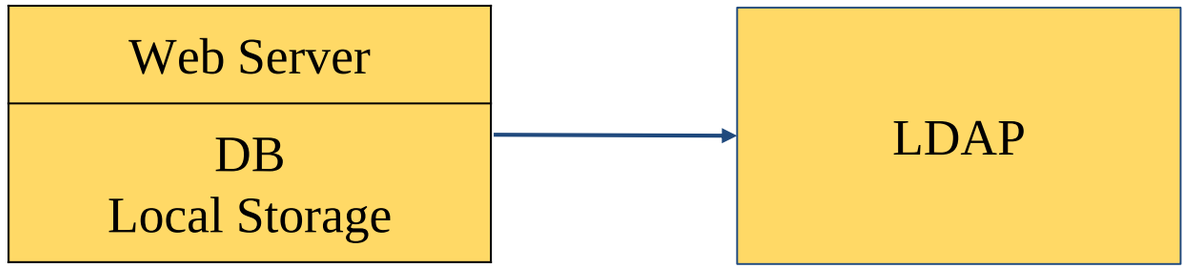
MySQL cluster



https://sabbour.me/running-a-mariadb-cluster-on-azure/

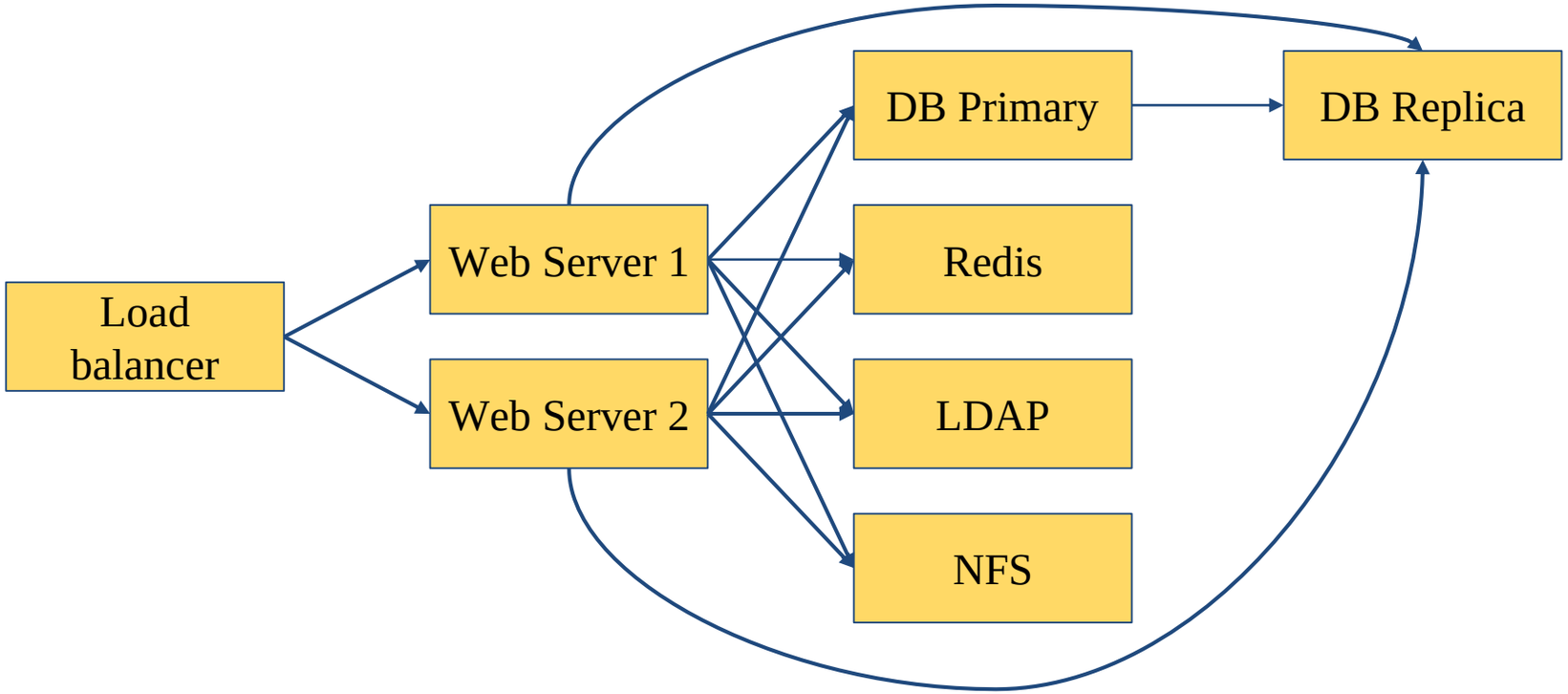
Up to 150 users

- One machine running the application server.
  - Web server
  - database server
  - local storage
- Authentication via an existing LDAP or Active Directory server.



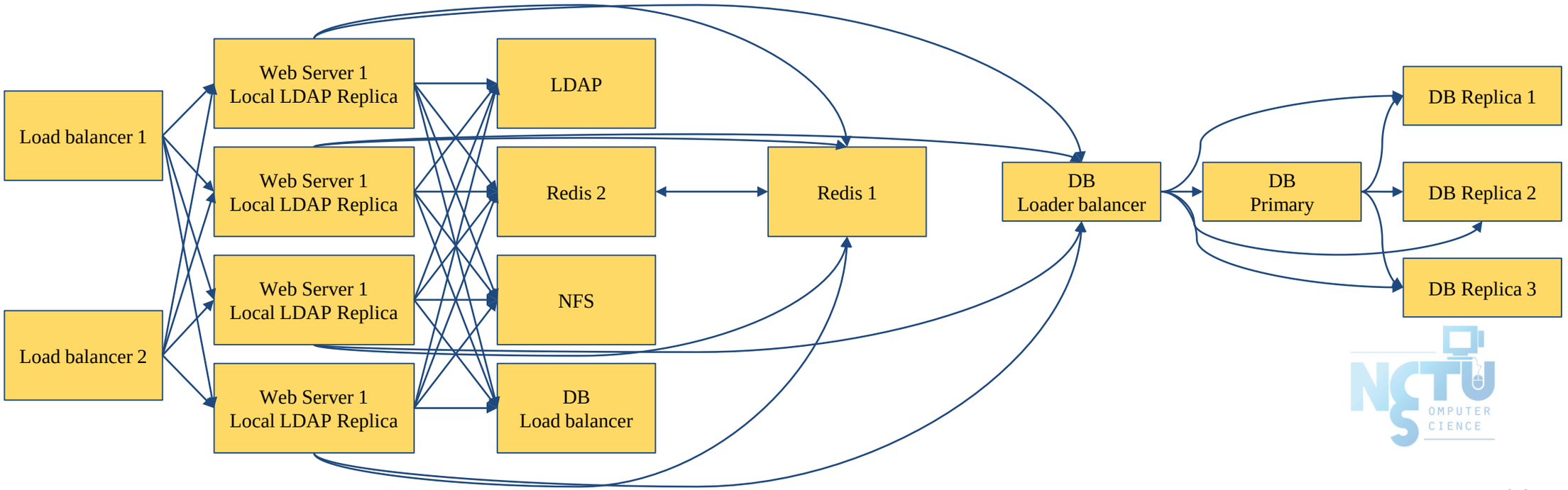
150 to 1,000 users

- High availability level
  - Every component is fully redundant and can fail without service interruption.
  - Backups without service interruption



5,000 to >100,000 users

- 4 to 20 application/Web servers.
- A cluster of two or more database servers
  - behind a load balancer to send all writes to the master and reads to the slaves.
- Storage is an NFS server, or an object store that is S3 compatible.



Appendix

phpMyAdmin / lighttpd / FastCGI

phpMyAdmin

- phpMyAdmin can manage a whole MySQL server as well as a single database over the World Wide Web.
- Official Site: http://www.phpmyadmin.net/
- Documentation: http://www.phpmyadmin.net/documentation/
- Features
  - Browser-based, Supporting PHP5.3+, MySQL 5.0+, Open Source
- There are four authentication modes offered:
  - http
  - cookie
  - signon
  - config (the less secure one, not recommended).

Installing phpMyAdmin (1)

- databases/phpmyadmin
  - $ make install clean
- Installed…

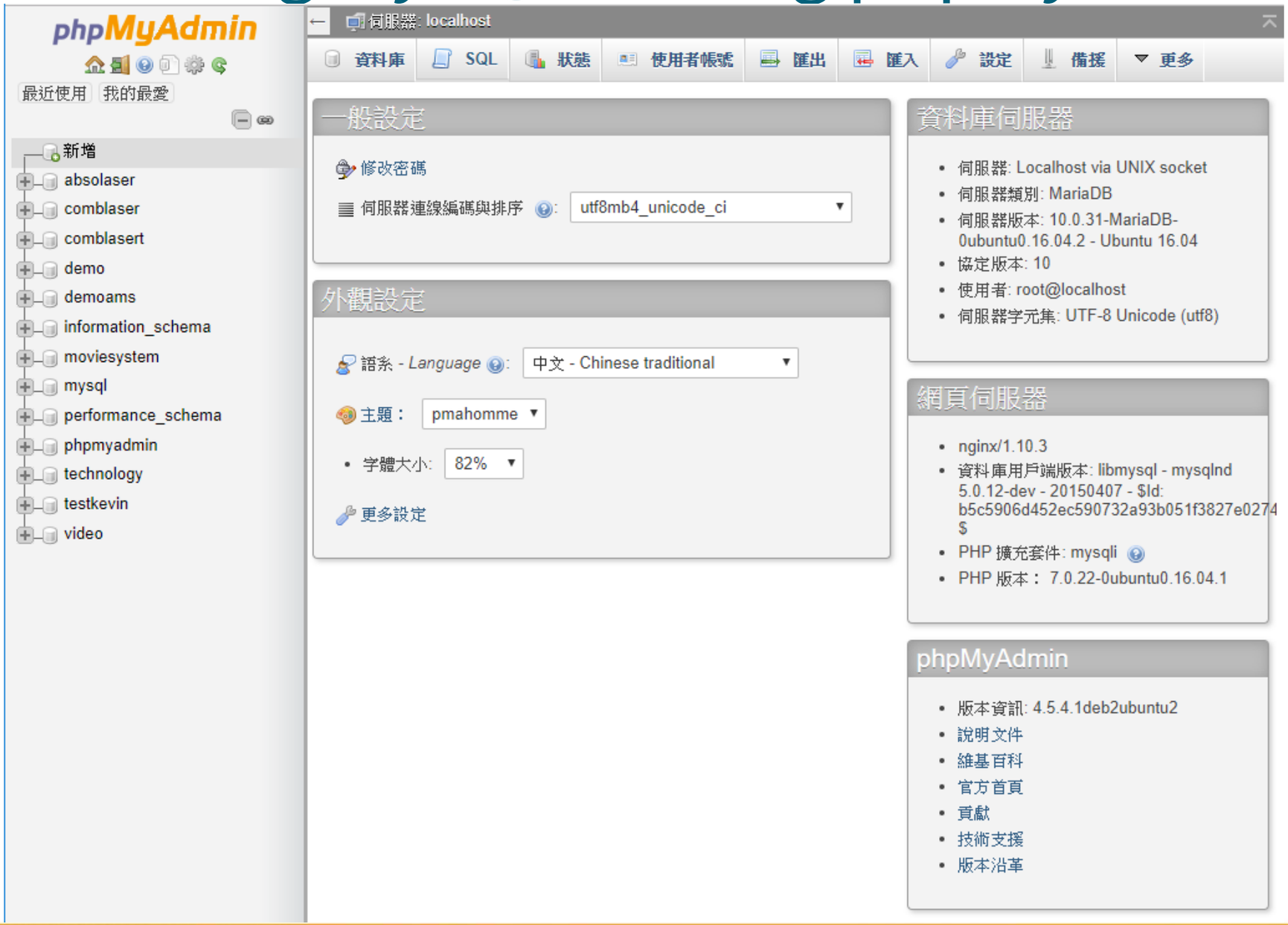
```
phpMyAdmin-4.7.4 has been installed into:
    /usr/local/www/phpMyAdmin

Please edit config.inc.php to suit your needs.

To make phpMyAdmin available through your web site, I suggest
that you add something like the following to httpd.conf:

    Alias /phpmyadmin/ "/usr/local/www/phpMyAdmin/"

    <Directory "/usr/local/www/phpMyAdmin/">
        Options none
        AllowOverride Limit

        Order Deny,Allow
        Deny from all
        Allow from 127.0.0.1 .example.com
    </Directory>
```

Installing phpMyAdmin (2)

- config.inc.php
  - Override libraries/config.default.php
- config.sample.inc.php
  - $cfg['blowfish_secret']

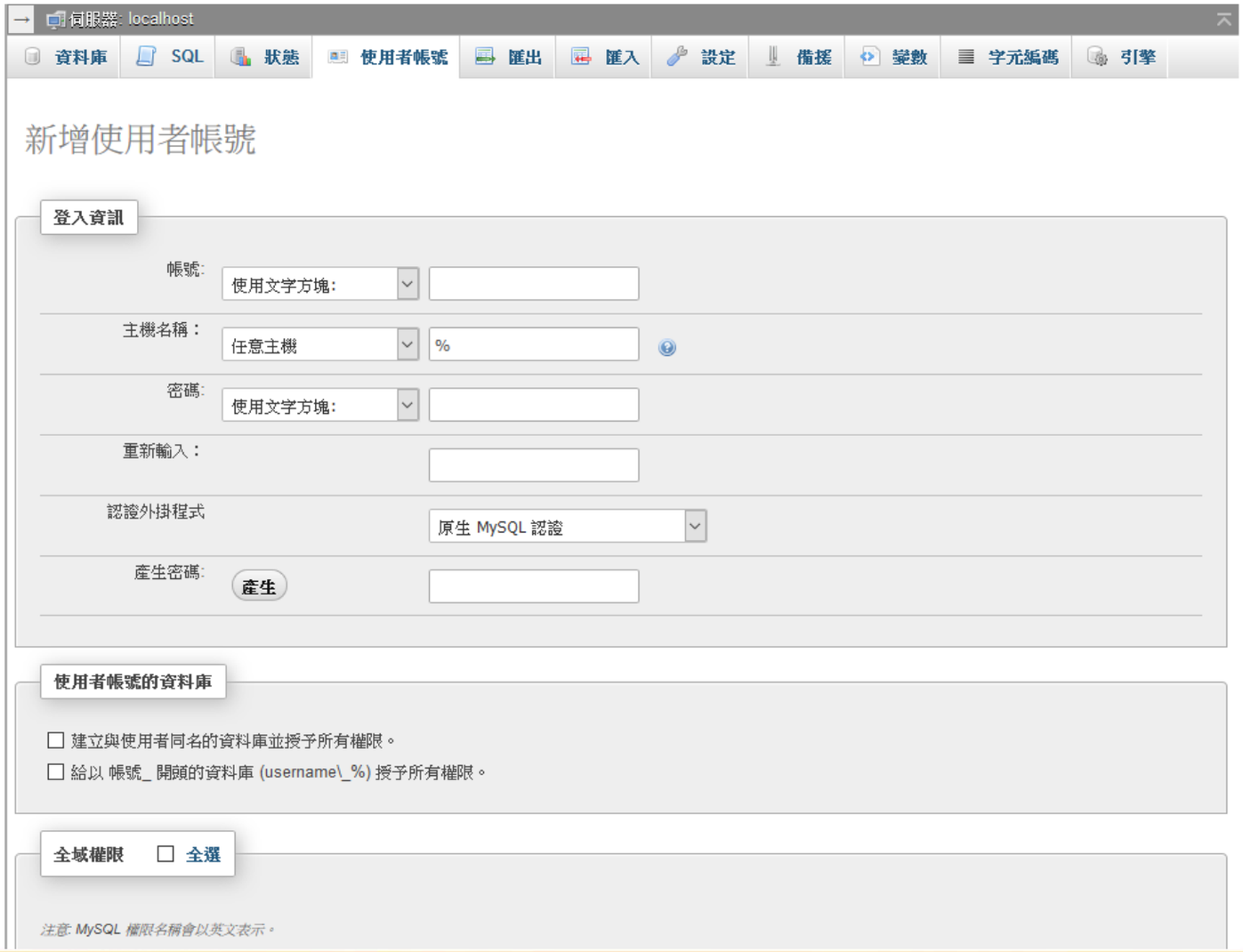
Administering MySQL – Using phpMyAdmin (3)

Administering MySQL – Using phpMyAdmin (4)

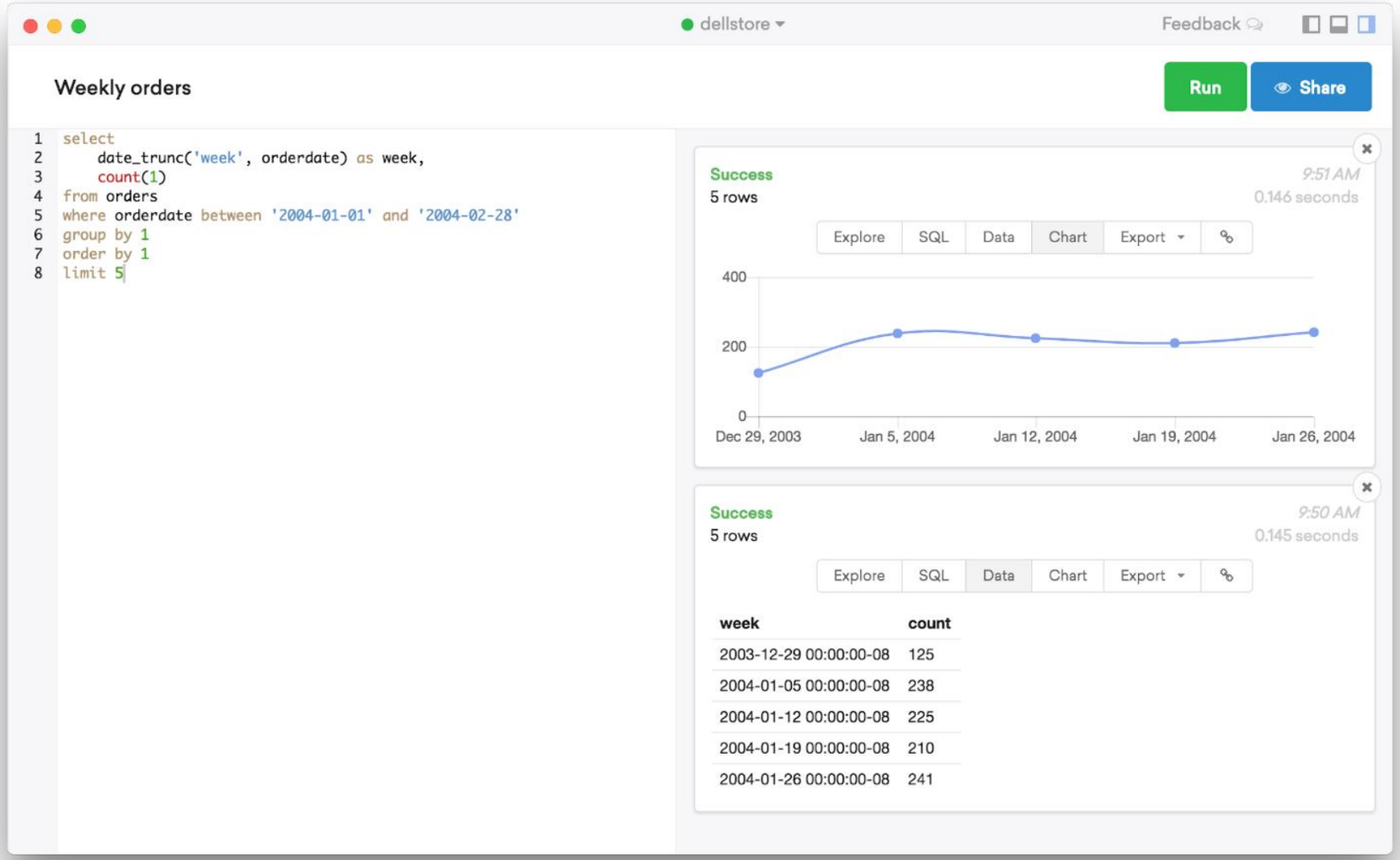


Administering MySQL – Using phpMyAdmin (5)

- Create another user with limited privilege

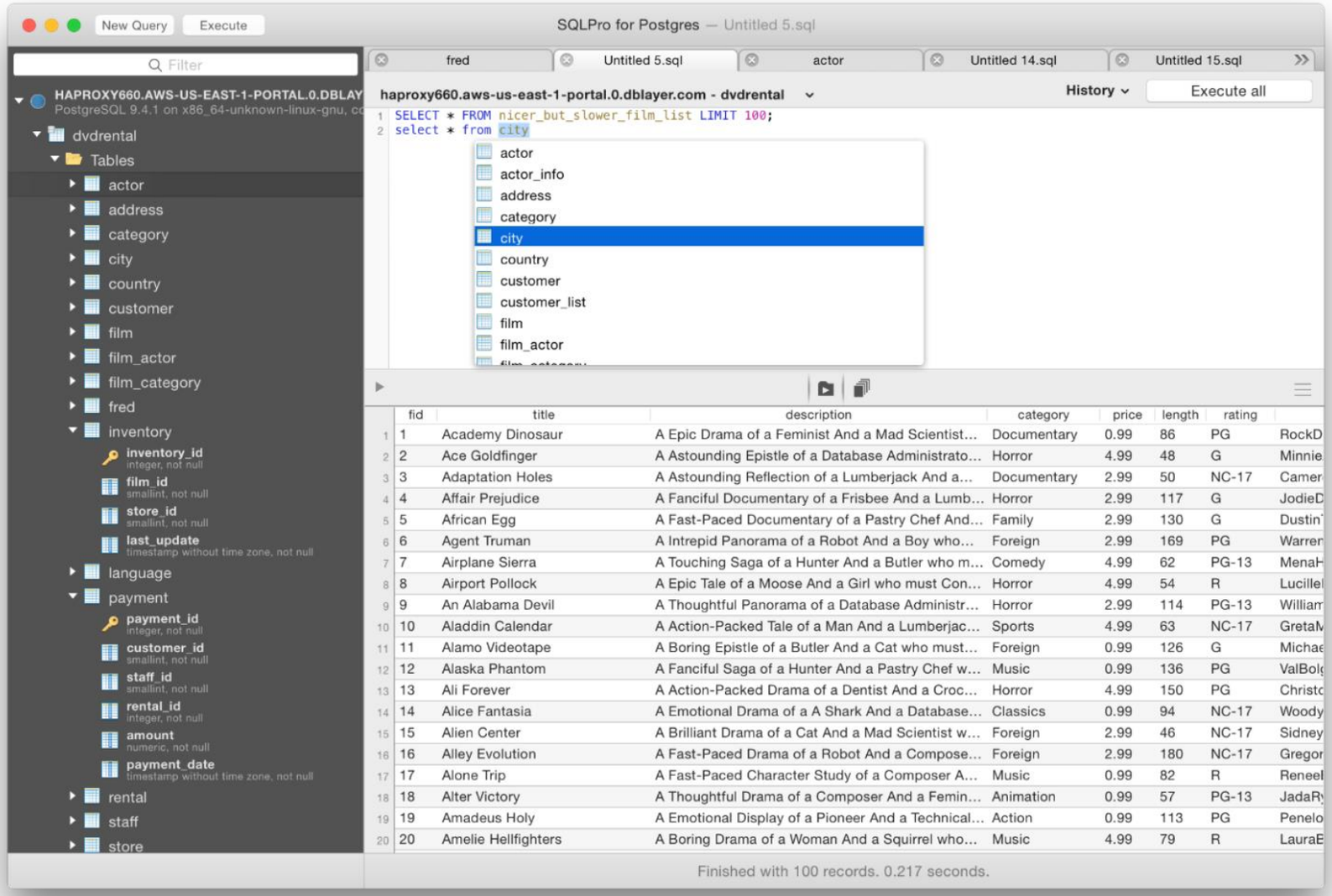


PopSQL & SQLpro (1)



https://popsql.io/

PopSQL & SQLpro (2)



https://www.compose.com/articles/tooltime-sqlpro-for-postgres-and-keylord-for-redis/

Installing lighttpd

- www/lighttpd
  - Official: http://www.lighttpd.net/
- Configuration files
  - /usr/local/etc/lighttpd/{lighttpd,modules}.conf
  - /usr/local/etc/lighttpd/{vhosts,conf}.d/
- Startup script
  - /usr/local/etc/rc.d/lighttpd
- Documentation:
  - /usr/ports/www/lighttpd/work/lighttpd-1.4.28/doc/*.txt
  - alias, cgi, dirlisting, fastcgi, ssl, userdir
  - Virtual hosts: evhost, mysqlvhost, simple-vhost

FastCGI

- FastCGI is actually CGI with only a few extensions.
  - FastCGI is language-independent.
  - FastCGI run applications in processes isolated from the core Web server, which provides greater security than APIs.
  - FastCGI developers are committed to propagating FastCGI as an open standard. (C/C++, Java, Perl, Tcl)
  - FastCGI is not tied to the internal architecture of any Web server and is therefore stable even when server technology changes.
- Benefits:
  - Distributed computing
  - Multiple and extensible roles
- Official site: http://www.fastcgi.com/drupal/