



# Computer Science 50

Introduction to Computer Science I

Harvard College

Week 11

David J. Malan  
malan@post.harvard.edu

# Life After 50

- :: CS 51: Introduction to Computer Science II
  - :: TuTh 1 – 2:30, Spring 2009
- :: CS 105: Privacy and Technology
  - :: TuTh 2:30 – 4, Spring 2009
- :: CS 124: Data Structures and Algorithms
  - :: TuTh 11:30 – 1, Spring 2009
- :: CS 171: Visualization
  - :: MW 1 – 2:30, Spring 2009

# Life After 50

- :: CS 61: Systems Programming and Machine Organization
  - :: TuTh 2:30 – 4, Fall 2009
- :: CS 121: Introduction to Formal Systems and Computation
  - :: TuTh 10 – 11:30, Fall 2009
- :: CS 141: Computing Hardware
  - :: MW 1 – 2:30, Fall 2009

# Life After 50

- :: Anthropology 1010: Introduction to Archaeology
  - :: MW(F) 10 – 11, Fall 2009
- :: Dramatic Arts 101: Introduction to Theatre
  - :: M 1:30 – 3:30, Fall 2009
- :: Government 1540: The American Presidency
  - :: TuTh 11:30 – 1, Fall 2009

# Domain Names



# Top-Level Domains (TLDs)

:: .biz	:: .aero	:: .us
:: .com	:: .asia	:: ...
:: .edu	:: .cat	
:: .gov	:: .coop	
:: .info	:: .jobs	
:: .int	:: .mobi	
:: .mil	:: .museum	
:: .name	:: .pro	
:: .net	:: .tel	
:: .org	:: .travel	

# DNS Records

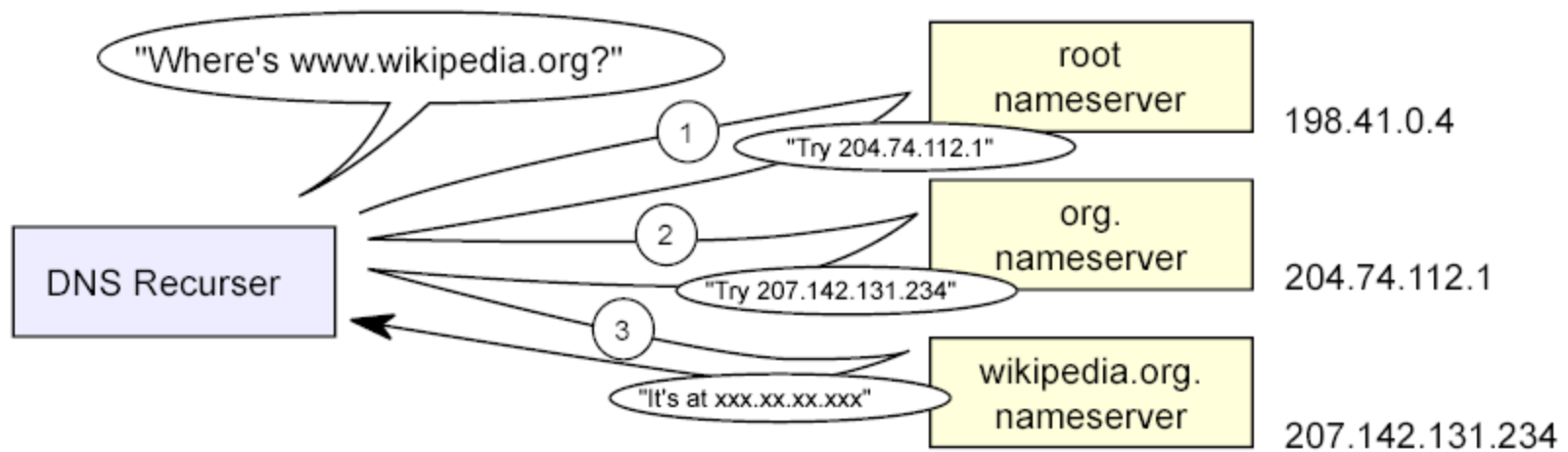
- :: A
- :: CNAME
- :: MX
- :: NS
- :: ...

# DNS Records

Name	Type	Value	Select
mail	A	64.131.79.130	<input type="checkbox"/>
malanrouge.com.	A	64.131.79.130	<input type="checkbox"/>
www	A	64.131.79.130	<input type="checkbox"/>
malanrouge.com.	NS	ns1.cs75.net.	<input type="checkbox"/>
malanrouge.com.	NS	ns2.cs75.net.	<input type="checkbox"/>
mail	MX	10	<input type="checkbox"/>
supernews	CNAME	cnn.com.	<input type="checkbox"/>
malanrouge.com.	TXT	"v=spf1 a mx ip4:64.131.79.130 ?all"	<input type="checkbox"/>



# DNS Lookups



# Web Hosting



# Vertical Scaling

- :: CPU
  - :: cores, L2 Cache, ...
- :: Disk
  - :: PATA, SATA, SAS, ...
  - :: RAID
- :: RAM
- :: ...

# Horizontal Scaling

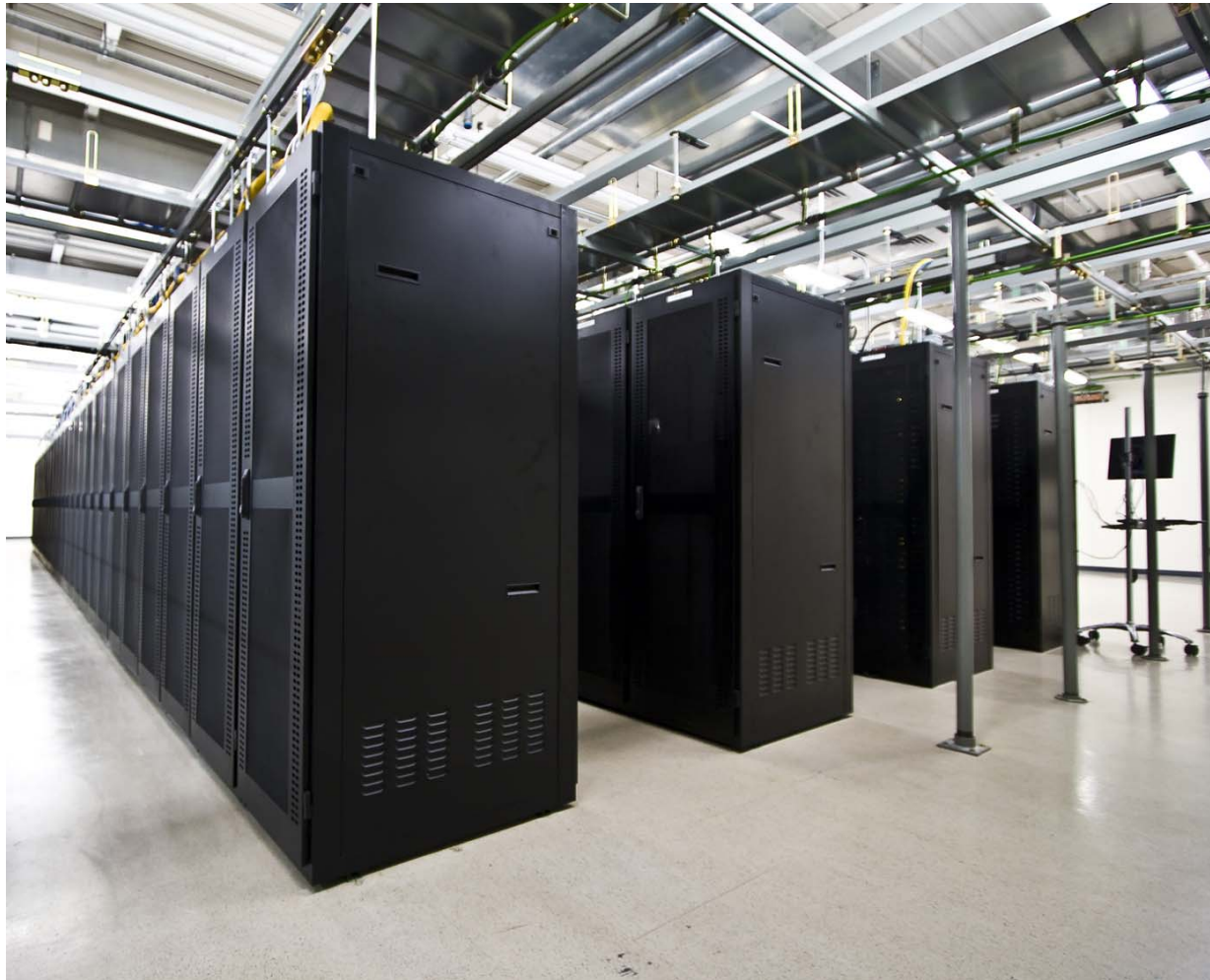


Image from singlehop.com.

# Horizontal Scaling

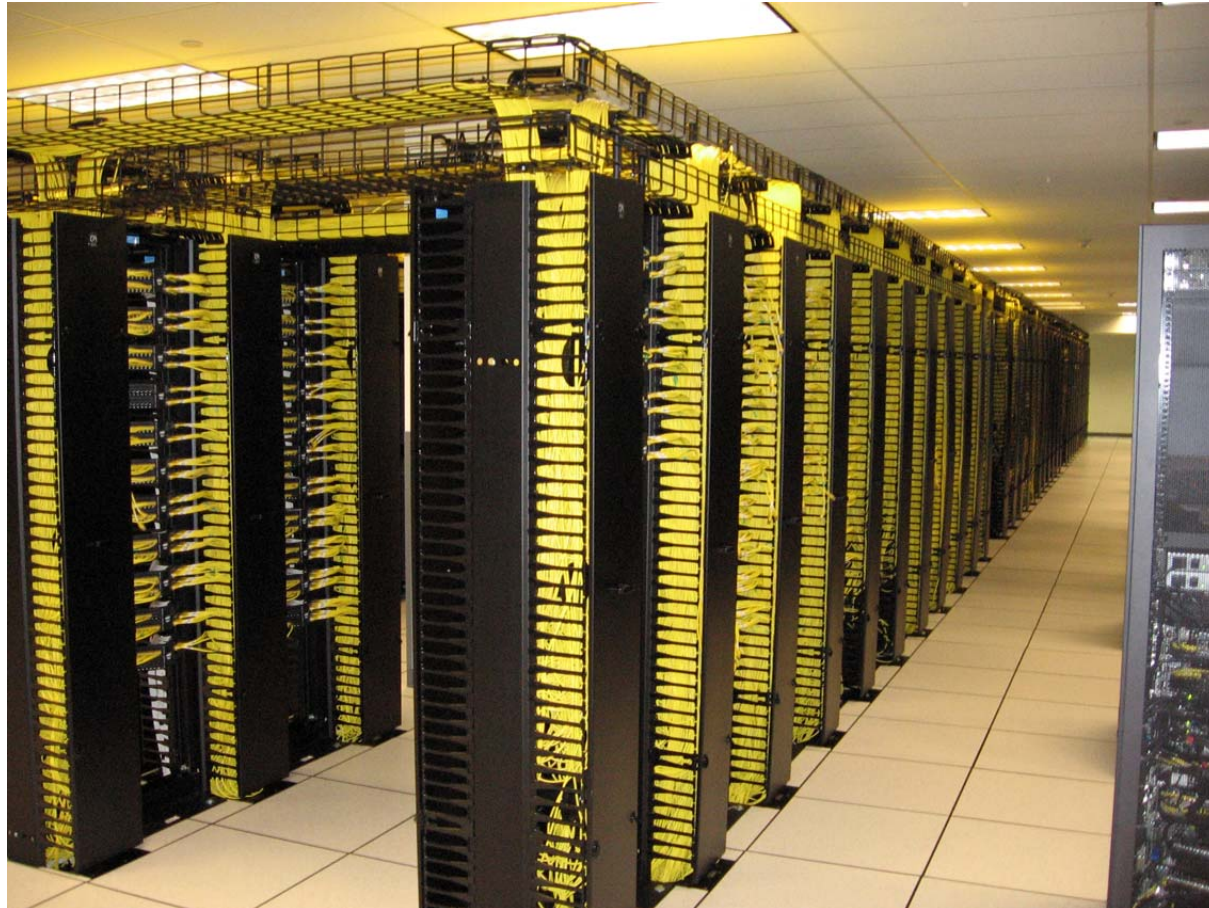
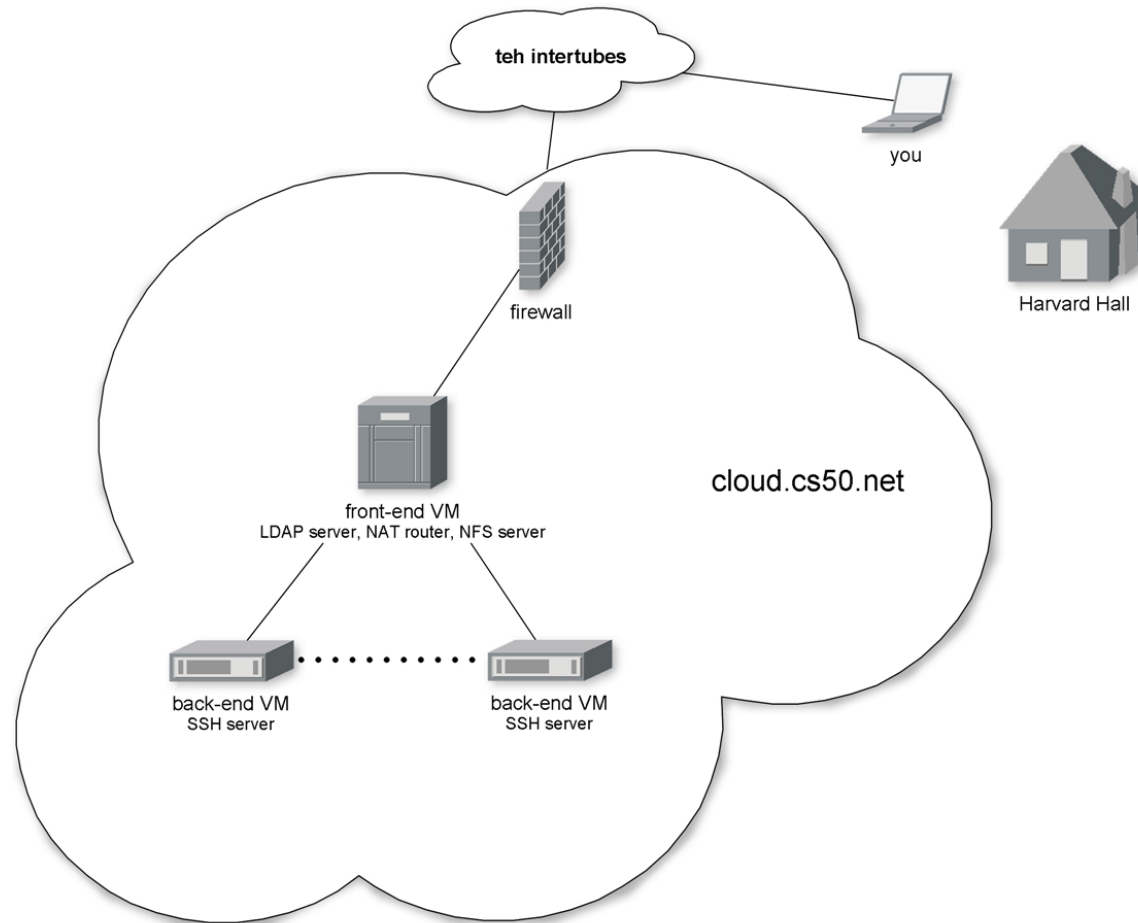


Image from singlehop.com.

# Virtualization

- :: Xen  
<http://www.xen.org/download/>
- :: VMware  
<http://www.vmware.com/download/server/sysadmins@cs50.net>
- :: Parallels (Virtuozzo)  
<http://www.parallels.com/download/>
- :: Virtual PC  
<http://www.microsoft.com/windows/downloads/virtualpc/>
- :: ...  
[http://en.wikipedia.org/wiki/Comparison\\_of\\_virtual\\_machines](http://en.wikipedia.org/wiki/Comparison_of_virtual_machines)

# Cloud Computing



# PHP Acceleration

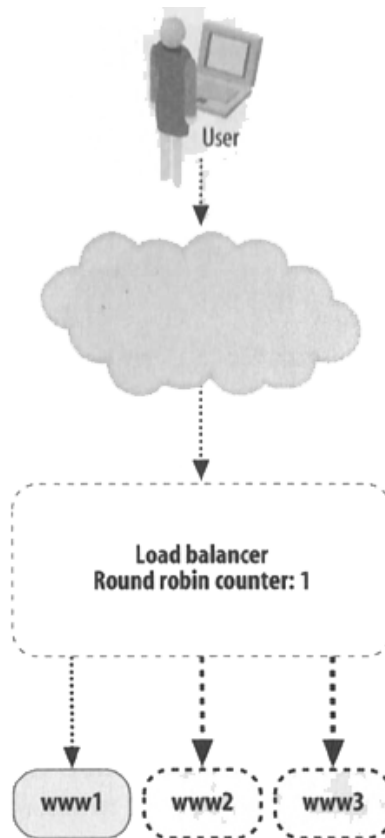
- :: Code Optimization
- :: Opcode Caching
- :: . . .



# PHP Accelerators

- :: Alternative PHP Cache (APC)  
<http://pecl.php.net/package/APC>
- :: eAccelerator  
<http://eaccelerator.net/>
- :: XCache  
<http://xcache.lighttpd.net/>
- :: Zend Platform  
<http://www.zend.com/en/products/platform/>
- :: . . .

# Load Balancing at Layer 4



# Load Balancing with BIND

```
cnn.com. IN A 157.166.224.25  
cnn.com. IN A 157.166.224.26  
cnn.com. IN A 157.166.226.25  
cnn.com. IN A 157.166.226.26
```

# Load Balancing at Layer 7

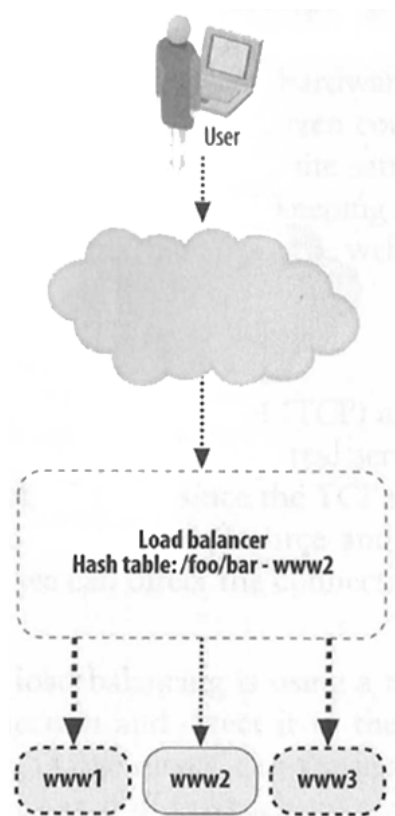


Image from *Building Scalable Websites*.

# Sticky Sessions

- :: Layer-7 Load Balancing?
- :: Shared Storage?  
FC, iSCSI, NFS, *etc.*
- :: Cookies?

# Load Balancers

- :: Software
  - :: LVS
  - :: Perlbal
  - :: Pirhana
  - :: Pound
  - :: Ultra Monkey
  - :: ...
- :: Hardware
  - :: Cisco
  - :: Citrix
  - :: F5
  - :: ...

# Caching

- :: `.html`
- :: MySQL Query Cache
- :: memcached
- :: ...

# .html

The screenshot shows a Mozilla Firefox browser window with the address bar displaying `http://boston.craigslist.org/gbs/web/640115588.html`. The page content includes a breadcrumb trail: `boston craigslist > boston/camb/brook > web design jobs`. A yellow warning banner reads: **Avoid scams and fraud by dealing locally!** Beware any deal involving Western Union, Moneygram, wire transfer, cashier check, money order, shipping, escrow, or any promise of transaction protection/certification/guarantee. [More info](#). A sidebar on the right contains a 'please flag with care:' section with links for [miscategorized](#), [prohibited](#), [spam/overpost](#), and [best of craigslist](#). The main heading is **PHP / MySQL Short Term Project (Cambridge)**. Below it, the text says: Reply to: [job-640115588@craigslist.org](mailto:job-640115588@craigslist.org), Date: 2008-04-12, 5:55PM EDT. The body text describes a project at Harvard Business School, mentioning a 50-100 hour commitment and a need for a candidate with strong PHP and MySQL skills. A bulleted list of details includes: Location: Cambridge; Compensation: Competitive with industry standards. Negotiable; This is a part-time job; This is a contract job; Principals only. Recruiters, please don't contact this job poster; Please, no phone calls about this job!; Please do not contact job poster about other services, products or commercial interests. The PostingID is 640115588. The footer contains copyright information for 2008 craigslist, inc. and links to [terms of use](#), [privacy policy](#), and [feedback forum](#).



# MySQL Query Cache

```
query_cache_type = 1
```

```
http://dev.mysql.com/doc/refman/5.0/en/query-cache.html
```

# memcached

```
$memcache = memcache_connect(HOST, PORT);  
$user = memcache_get($memcache, $id);  
if (is_null($user))  
{  
    mysql_connect(HOST, USER, PASS);  
    mysql_select_db(DB);  
    $result = mysql_query("SELECT * FROM users WHERE id=$id");  
    $user = mysql_fetch_object($result, User);  
    memcache_set($memcache, $user->id, $user);  
}
```

<http://www.danga.com/memcached/>

<http://us2.php.net/memcache>

# MySQL

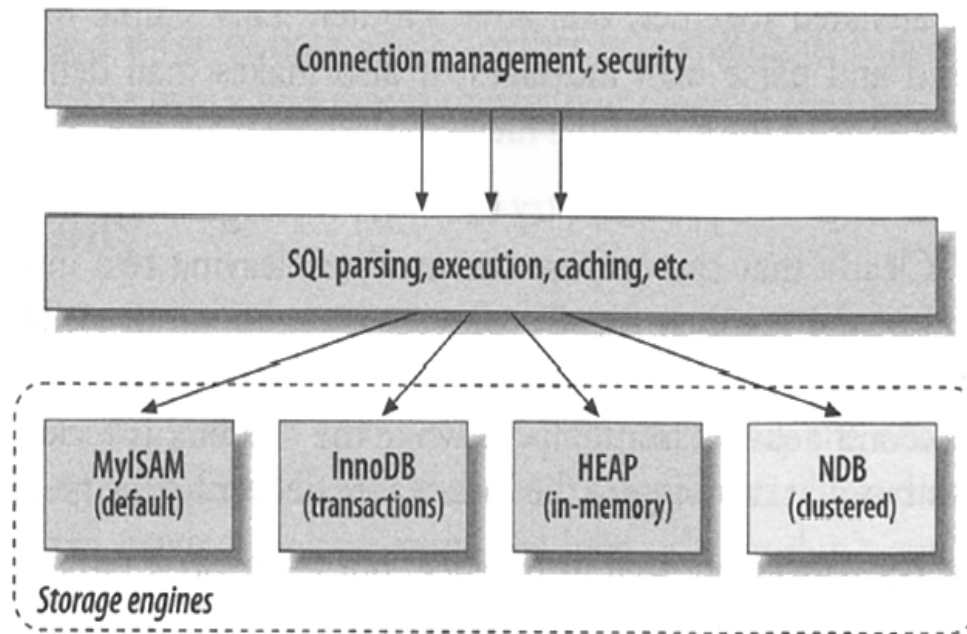


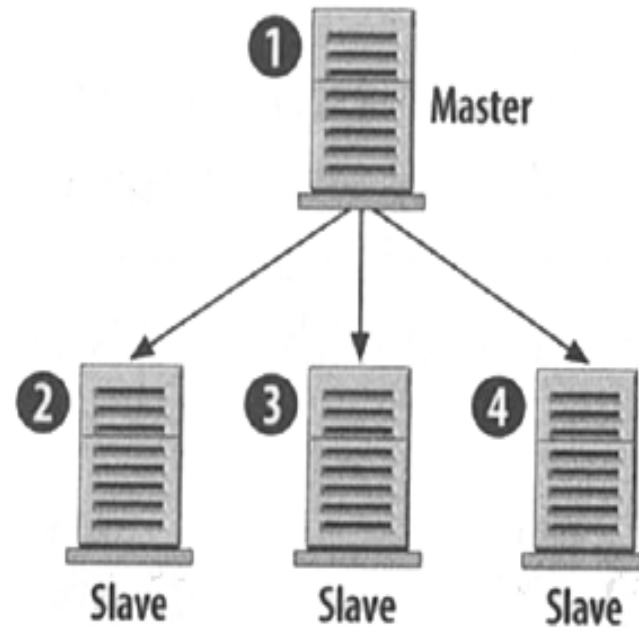
Image from *High Performance MySQL*.

# MySQL

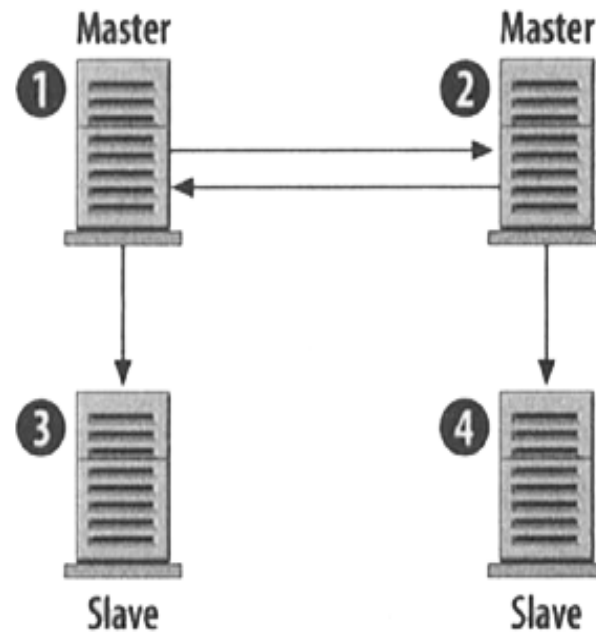
	MyISAM	InnoDB	MEMORY	NDB
Multi-statement transactions, ROLLBACK	-	X	-	X
Foreign key constraints	-	X	-	-
Locking level	table	row	table	row
BTREE indexes	X	X	-	X
FULLTEXT indexes	X	-	-	-
HASH lookups	-	X	X	X
Other in-memory tree-based index	-	-	4.1.0	-
GIS, RTREE indexes	4.1.0	-	-	-
Unicode	4.1.0	4.1.2	-	-
Merge (union views)	X	-	-	-
Compress read-only storage	X	-	-	-
Relative disk use	low	high	-	low
Relative memory use	low	high	low	high

Excerpted from [http://dev.mysql.com/tech-resources/articles/storage-engine/part\\_3.html](http://dev.mysql.com/tech-resources/articles/storage-engine/part_3.html).

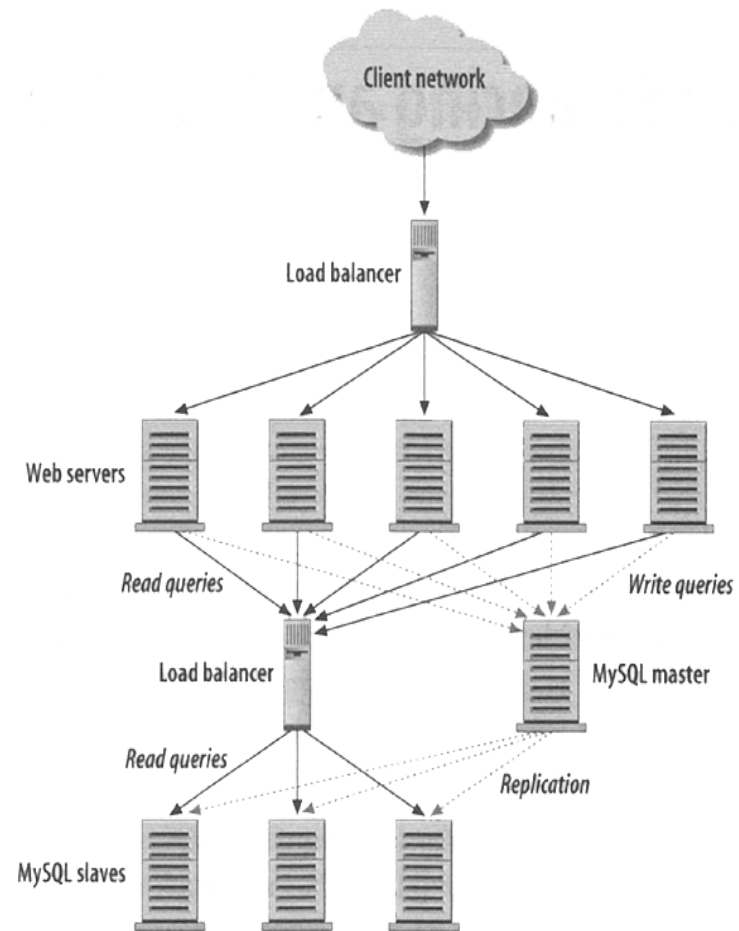
# Replication: Master-Slave



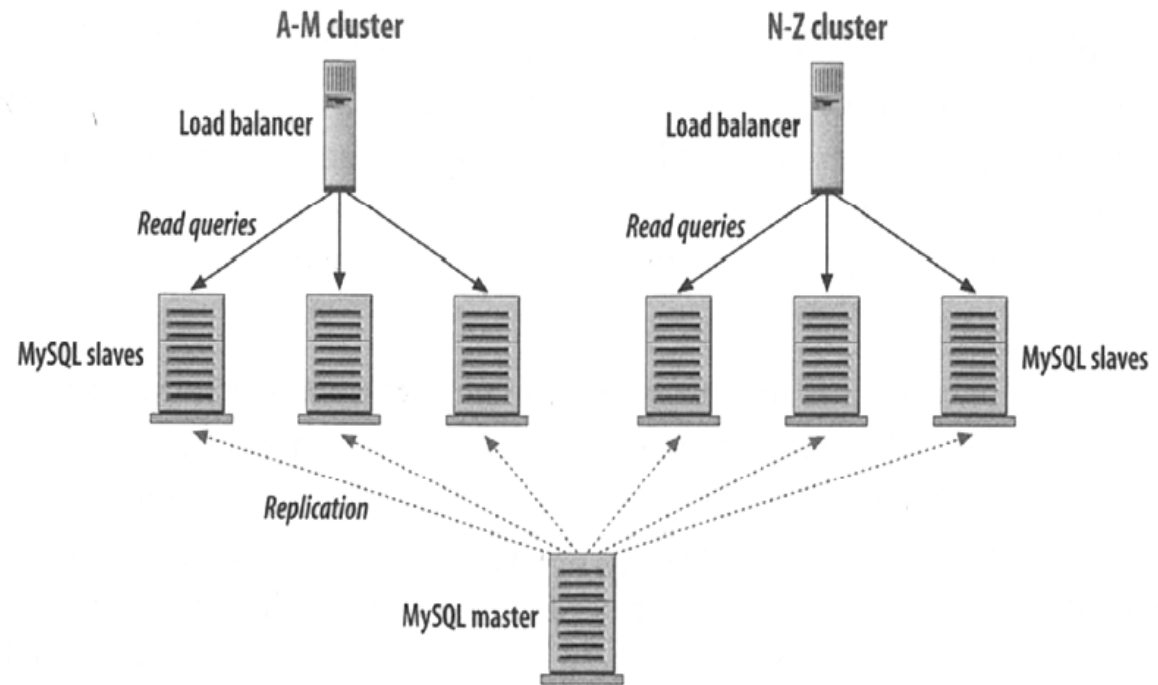
# Replication: Master-Master



# Load Balancing + Replication

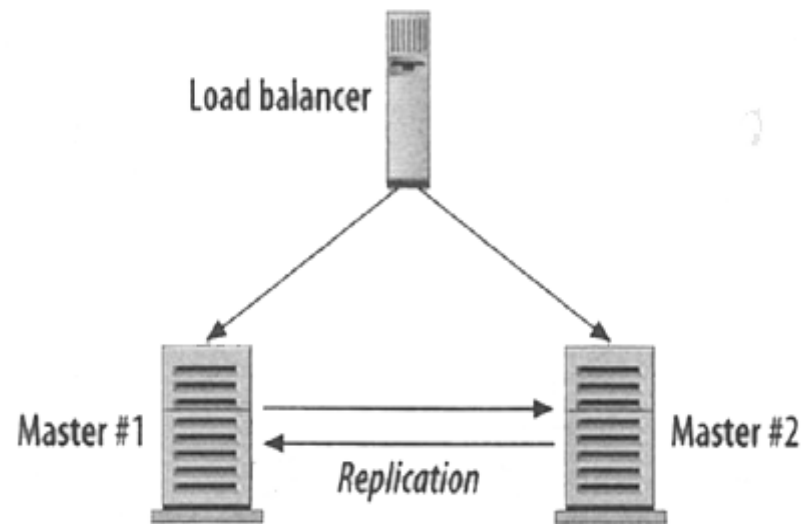


# ... + Partitioning

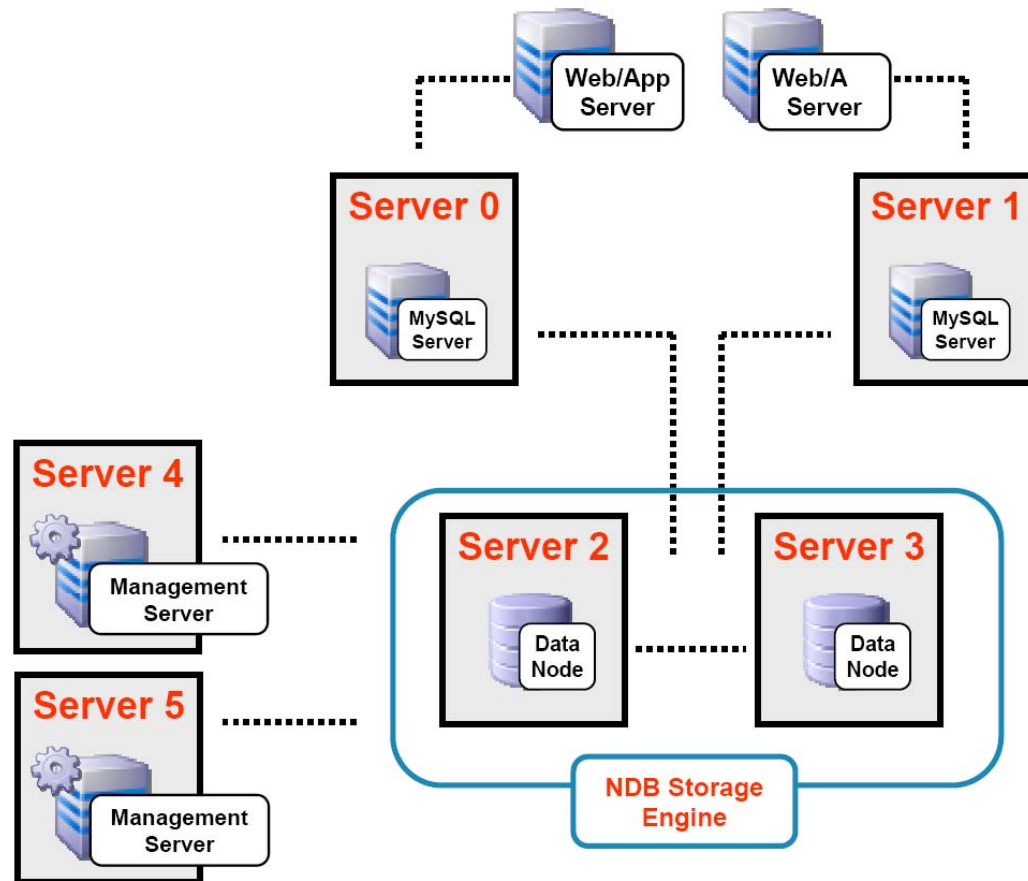




# High Availability



# MySQL Cluster





# Computer Science 50

Introduction to Computer Science I

Harvard College

Week 11

David J. Malan  
malan@post.harvard.edu