

Computer Science 50  
Introduction to Computer Science I

Harvard College

Week 11

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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

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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

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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

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Domain Names



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Top-Level Domains (TLDs)

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

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DNS Records

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

Image from <http://computer.howstuffworks.com/web-server1.htm>.

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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.cq75.net.	<input type="checkbox"/>
malanrouge.com.	NS	ns2.cq75.net.	<input type="checkbox"/>
mail	MX	10	<input type="checkbox"/>
supernews	CNAME	cn.com.	<input type="checkbox"/>
malanrouge.com.	TXT	"v=spf1 a mx ip4=64.131.79.130 ?all"	<input type="checkbox"/>

Image from <http://computer.howstuffworks.com/web-server1.htm>.

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DNS Lookups

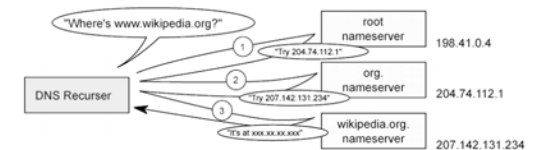


Image from <http://computer.howstuffworks.com/web-server1.htm>.

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## Web Hosting



...



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## Vertical Scaling

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

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## Horizontal Scaling

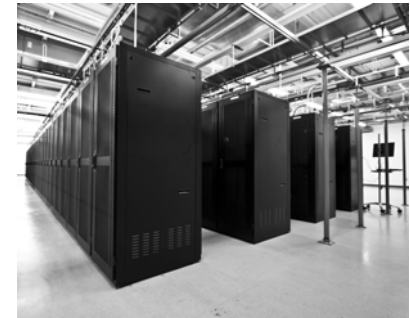


Image from singlehop.com.

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## Horizontal Scaling



Image from singlehop.com.

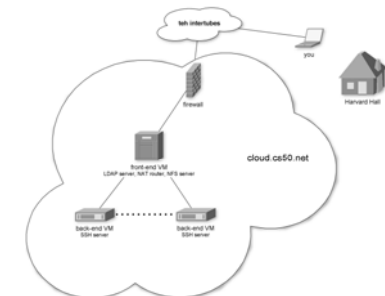
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## Virtualization

- :: 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)

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## Cloud Computing



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## PHP Acceleration

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

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## 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/>
- :: ...

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## Load Balancing at Layer 4

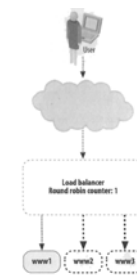


Image from Building Scalable Websites.

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## 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
    
```

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## Load Balancing at Layer 7

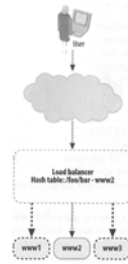


Image from Building Scalable Websites

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## Sticky Sessions

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

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## Load Balancers

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

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## Caching

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

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## .html



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## MySQL Query Cache

```
query_cache_type = 1
```

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

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## 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>

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## MySQL

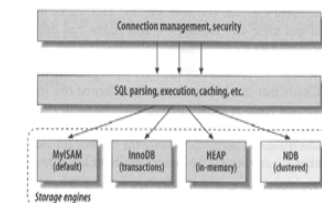


Image from High Performance MySQL

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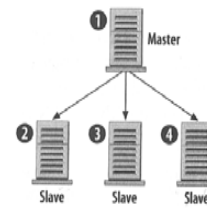
# MySQL

	MYISAM	InnoDB	MEMORY	NDB
Multi-statement transactions, ROLLBACK	-	X	-	X
Foreign key constraints	-	X	-	-
Locking level	table	row	table	row
B+TREE 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)

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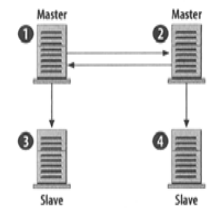
# Replication: Master-Slave



Excerpted from High Performance MySQL

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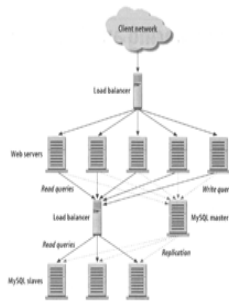
# Replication: Master-Master



Excerpted from High Performance MySQL

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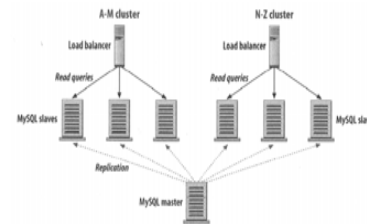
# Load Balancing + Replication



Excerpted from High Performance MySQL

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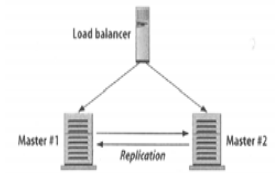
# ... + Partitioning



Excerpted from High Performance MySQL

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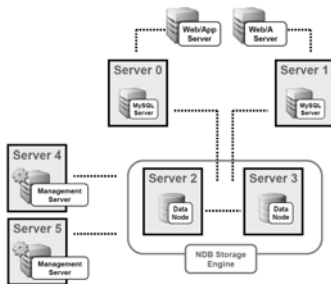
# High Availability



Excerpted from High Performance MySQL

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# MySQL Cluster



Excerpted from <http://www.mysql.com/news-and-events/on-demand-webinars/cluster-20081116.pdf>

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