Give Your Site A Boost With Memcache

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schematic

Why cache?

To make it faster.

“A cache is a collection of data duplicating original values stored elsewhere or computed earlier, where the original data is expensive to fetch (owing to longer access time) or to compute, compared to the cost of reading the cache. In other words, a cache is a temporary storage area where frequently accessed data can be stored for rapid access.”

— Wikipedia

Why cache?

- You want to reduce the number of retrieval queries made to the database
- You want to reduce the number of external requests (retrieving data from other web services)
- You want to cut down on filesystem access

Caching options

- Flat file caching
- Caching data in the database
- MySQL 4.x query caching
- Shared memory (APC)
- RAM disk
- memcached

What is memcached?

- Distributed Memory Object Caching System
- Caching daemon
- Developed by Danga Interactive for LiveJournal.com
- Uses RAM for storage
- Acts as a dictionary of stored data with key/value pairs

Is memcached fast?

- Stored in memory (RAM), not on disk
- Uses non-blocking network I/O (TCP/IP)
- Uses libevent to scale to any number of open connections
- Uses its own slab allocator and hash table to ensure virtual memory never gets externally fragmented and allocations are guaranteed O(1)

General usage

1. Set up a pool of memcached servers
2. Assign values to keys that are stored in the cluster
3. The memcache client hashes the key to a particular machine in the cluster
4. Subsequent requests for that key retrieve the value from the memcached server on which it was stored
5. Values time out after the specified TTL

Memcached principles

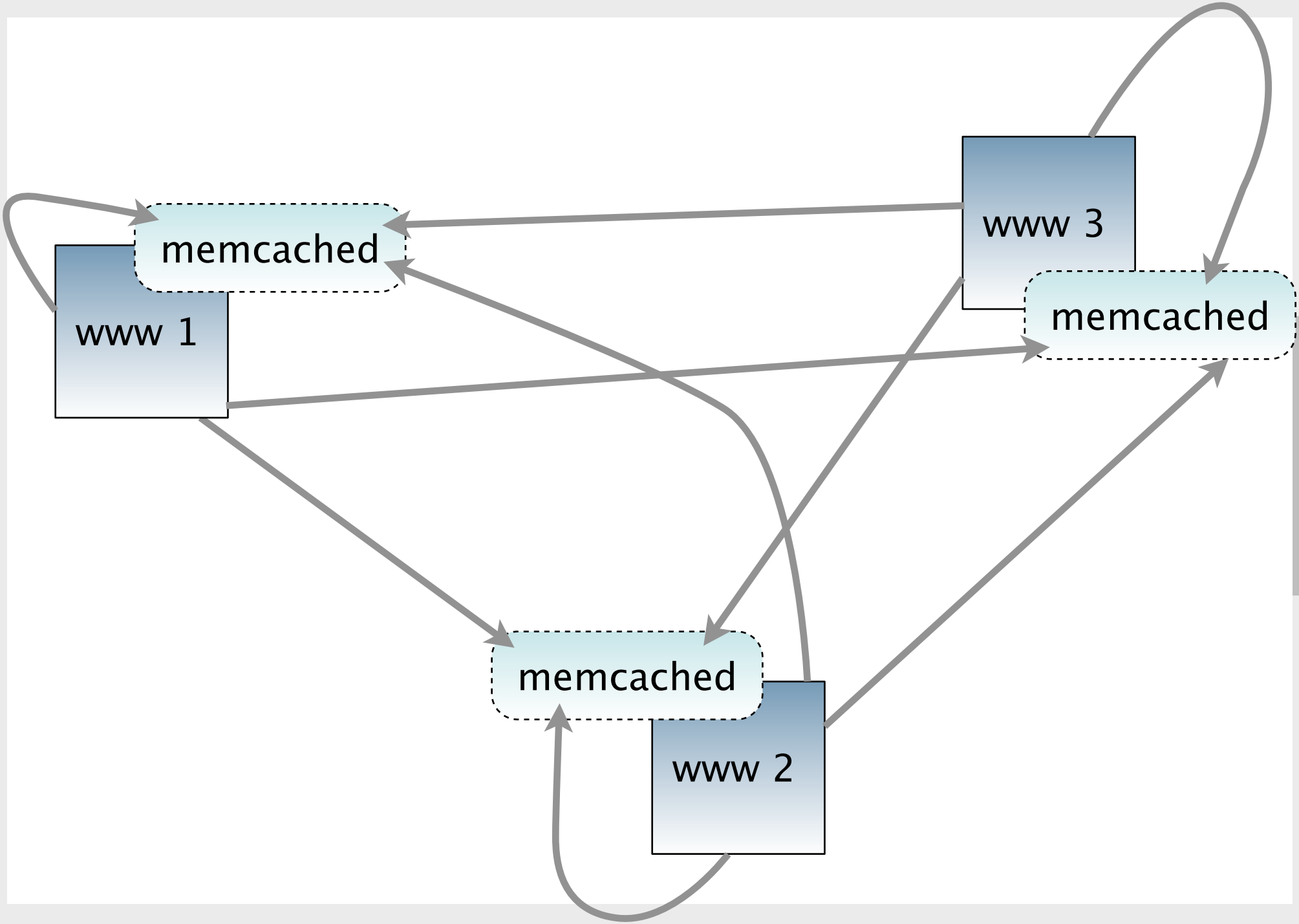
- It’s a non-blocking server
- It is not a database
- It does not provide redundancy
- It doesn't handle failover
- It does not provide authentication

Memcached principles

- Data is not replicated across the cluster
- Works great on a small and local-area network
- A single value cannot contain more than 1MB of data
- Keys are strings limited to 250 characters

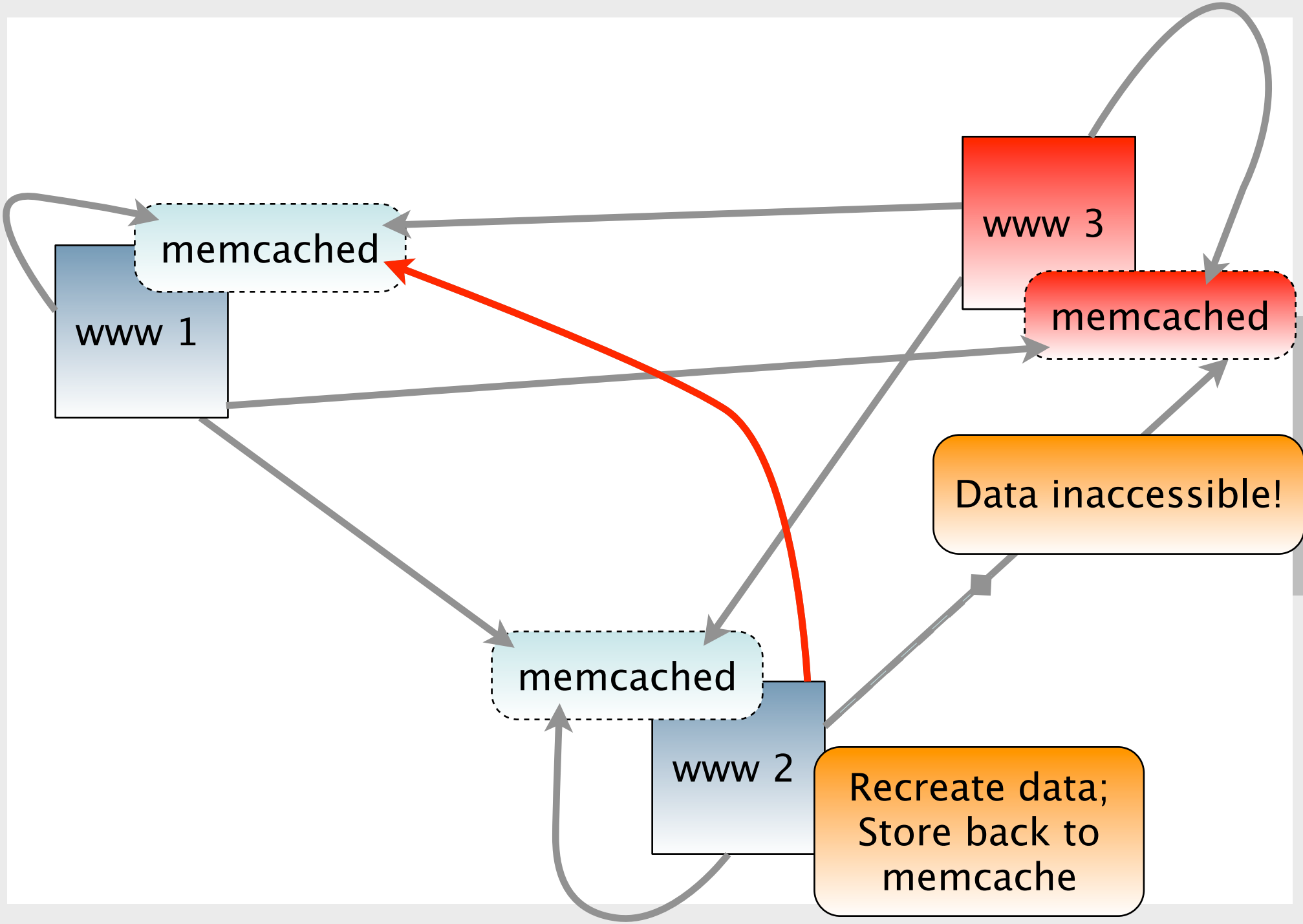
Storing data in the pool

- Advantage is in scalability
- To fully see the advantage, use a “pool”
- memcached itself doesn't know about the pool
- The pool is created by and managed from the client library


memcached
www 1
www 3
memcached
memcached
www 2

Deterministic failover

- When one server goes down, the system fails over to another server in the pool
- Memcached does not provide this
- Some memcache clients provide failover
- If you can't find the data in memcache, eat the look-up cost and retrieve from your data source again, storing it back to the cache


memcached
www 1
www 3
memcached
Data inaccessible!
memcached
www 2
Recreate data;
Store back to
memcache

The memcached protocol API

- Storage commands:
  `set`, `add`, `replace`, `append`, `prepend`, `cas`
- Retrieval command: `get`, `gets`
- Deletion command: `delete`
- Increment/decrement: `incr`, `decr`
- Other commands:
  `stats`, `flush_all`, `version`, `verbosity`, `quit`

```
$> telnet localhost 11211
Trying ::1...
Connected to localhost.
Escape character is '^]'.
set foobar 0 0 15
This is a test.
STORED
get foobar
VALUE foobar 0 15
This is a test.
END
quit
Connection closed by foreign host.
$>
```

Setting it up

- http://danga.com/memcached/
- `$> ./configure; make; make install`
- `$> memcached -d -m 2048 -p 11211`
- Done!
- Windows port of v1.2.4 at http://www.splinedancer.com/memcached-win32/

Memcached clients

- Perl, Python, Ruby, Java, C#
- C (libmemcached)
- PostgreSQL (access memcached from procs and triggers)
- MySQL (adds memcache_engine storage engine)
- PHP (pecl/memcache or pecl/memcached)

pecl/memcache

- The PHP client for connecting to memcached and managing a pool of memcached servers
- http://pecl.php.net/package/memcache
- `$> pecl install memcache`
- Stable: 2.2.3
  Beta: 3.0.1

```php
<?php

$memcache = new MemcachePool();
$memcache->addServer('192.168.1.10', 11211);
$memcache->addServer('192.168.1.11', 11211);
$memcache->addServer('192.168.1.12', 11211);

if (($fooObject = $memcache->get('key')) === false) {
    $tmpObject = new stdClass;
    $tmpObject->foo = 'bar';
    $tmpObject->baz = 'quz';

    $fooObject = $tmpObject;
    $memcache->set('key', $tmpObject, 0, 300);
}

// Do stuff with $fooObject
```

Features of pecl/memcache

- memcache.allow_failover
- memcache.hash_strategy
- memcache.hash_function
- memcache.protocol
- memcache.redundancy
- memcache.session_redundancy

pecl/memcache interface

- MemcachePool::connect()
- MemcachePool::addServer()
- MemcachePool::setServerParams()
- MemcachePool::get()
- MemcachePool::add()
- MemcachePool::set()
- MemcachePool::replace()
- MemcachePool::cas()

pecl/memcache interface

- MemcachePool::append()
- MemcachePool::prepend()
- MemcachePool::delete()
- MemcachePool::increment()
- MemcachePool::decrement()
- MemcachePool::setFailureCallback()

Key hashing

- Keys longer than 250 characters are truncated without warning
- Good practice to hash your key (with MD5 or SHA) at the userland level to ensure long keys don't get truncated
- Keys are "global"
- Use something to uniquely identify keys, e.g. a method signature or an SQL statement

Object serialization

- Objects are serialized before being stored to memcache:

```
get key
VALUE key 1 59
O:8:"stdClass":2:{s:3:"foo";s:3:"bar";s:
3:"baz";s:3:"quz";}
END
```

- Extension unserializes them before returning the object
- Only objects that can be serialized safely can be stored to memcache, i.e. problems with DOM, SimpleXML, etc.

Redundancy and failover

- memcache.redundancy & memcache.session_redundancy
- Implement redundancy at the userland level?
- Again, memcache is not a database

Extending MemcachePool

- Implement global values vs. page-specific values
- Ensure a single instance of the MemcachePool object
- Do complex key hashing, if you so choose
- Set a default expiration for all your data
- Add all of your servers upon object instantiation

Database techniques

- Create a wrapper for mysql_query() that checks the cache first and returns an array of database results
- Extend PDO to store results to the cache and get them when you execute a statement

Database techniques

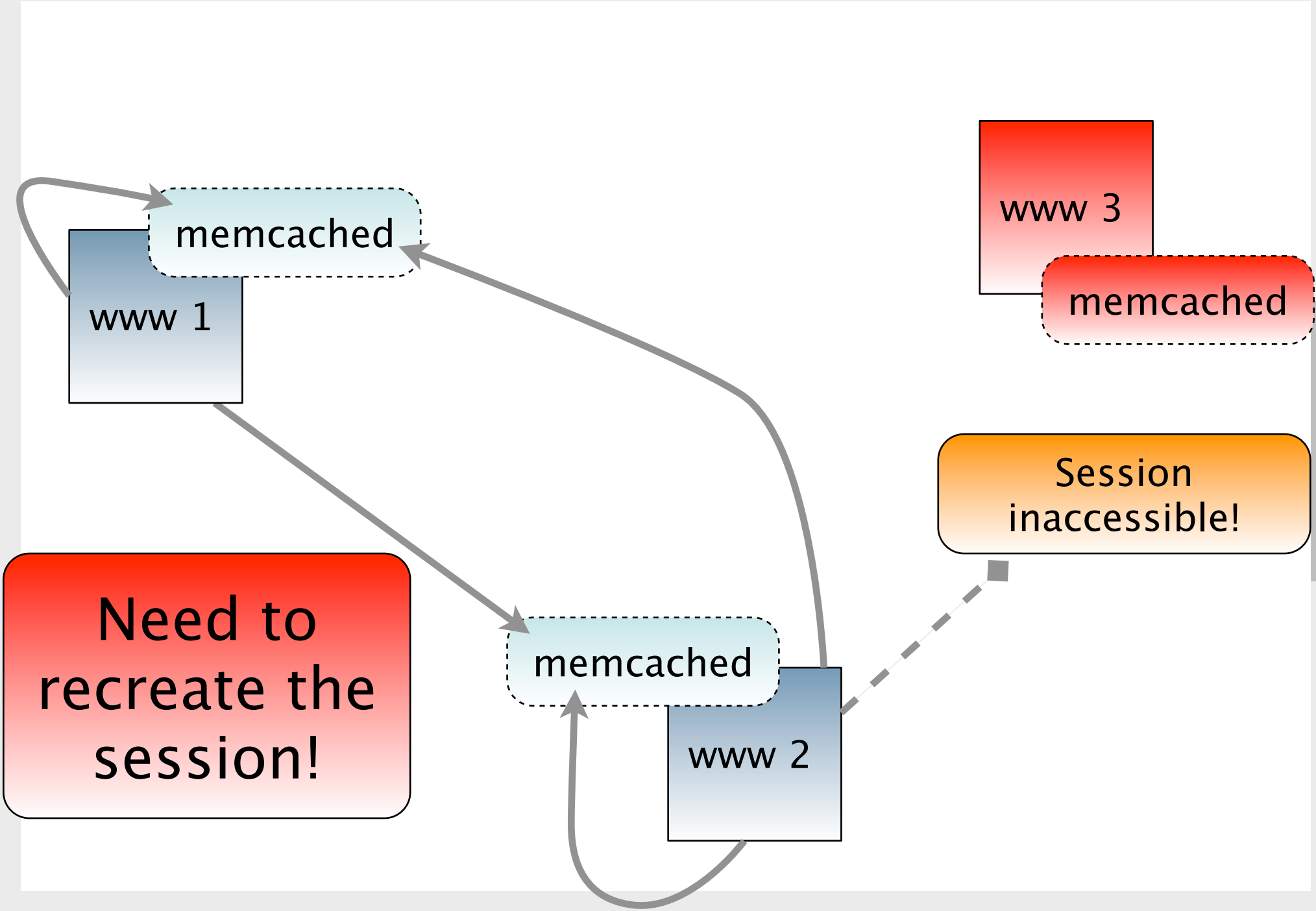
- For large datasets, run a scheduled query once an hour and store it to the cache
- Please note: memcached can store arrays, objects, etc., but it cannot store a resource, which some database functions (e.g. mysql_query()) return

Session storage

- As of 2.1.1, you can set the session save handler as “memcache” and all will work automagically

```
session.save_handler = memcache
session.save_path = "tcp://
192.168.1.10:11211,tcp://
192.168.1.11:11211,tcp://192.168.1.12:11211"
```

- Store sessions to both the database and memcache
- Write your own session handler that stores to the database and memcache


memcached
www 1
www 3
memcached
Session
inaccessible!
Need to
recreate the
session!
memcached
www 2

For more information...

http://danga.com/memcached/

http://pecl.php.net/package/memcache

http://pecl.php.net/package/memcached

http://www.socialtext.net/memcached/

Thank You

Slides available for download at benramsey.com.

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