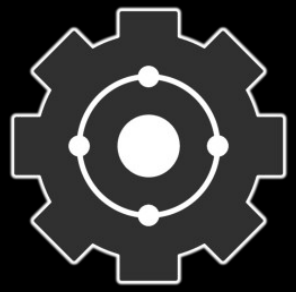
Map/Reduce & Queues for Everyone!

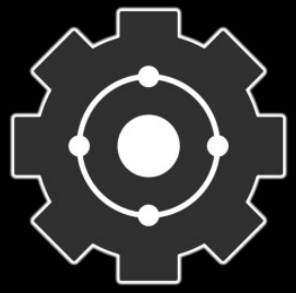
LCA 2010

Eric Day – http://oddments.org/

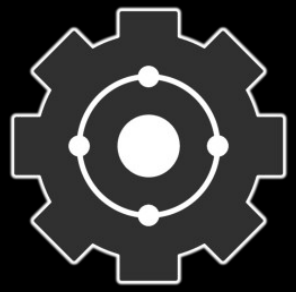


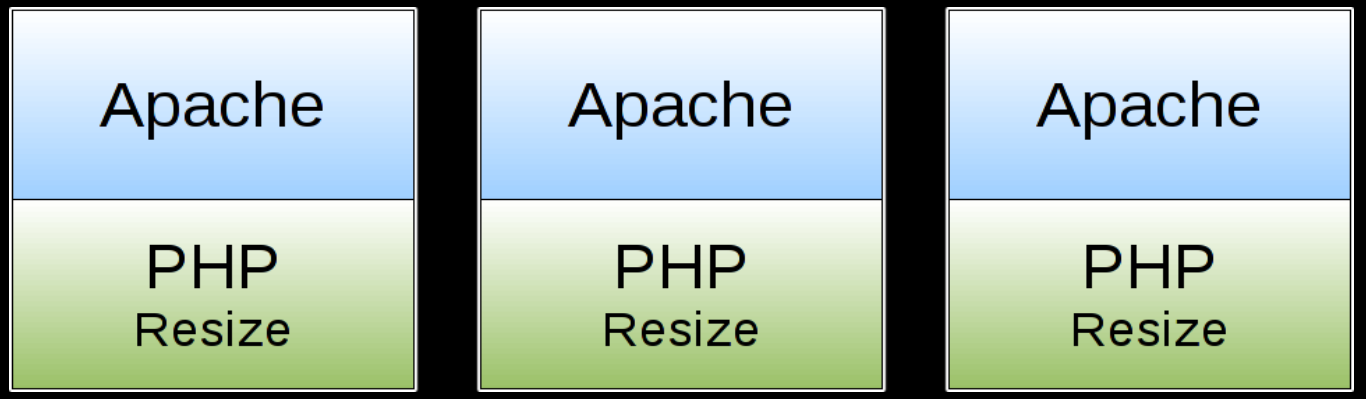
Map/Reduce & Queues

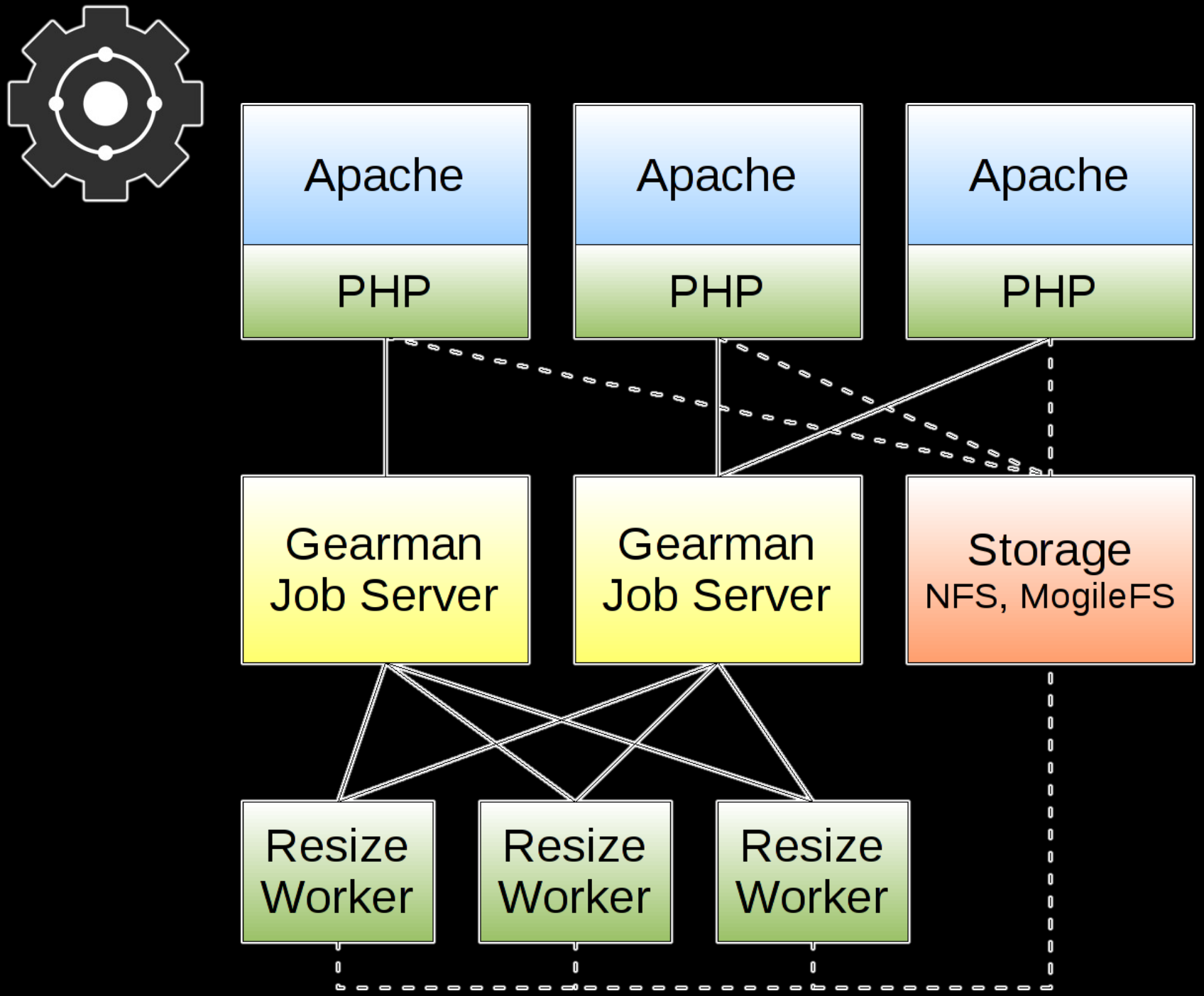
Step 1: Distributed Processing



LiveJournal.com Image Processing




Apache
PHP
Resize
Apache
PHP
Resize
Apache
PHP
Resize


Apache
PHP
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Gearman
Job Server
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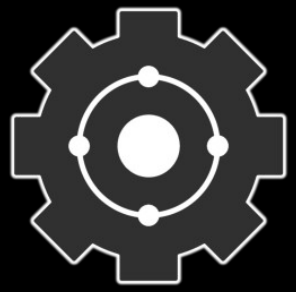
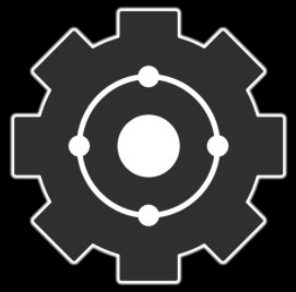
Job Server
Storage
NFS, MogileFS
Resize
Worker
Resize
Worker
Resize
Worker



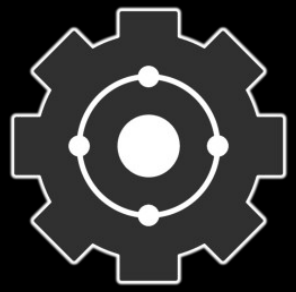
“The way I like to think of Gearman is as a massively distributed, massively fault tolerant fork mechanism.”

- Joe Stump, Digg



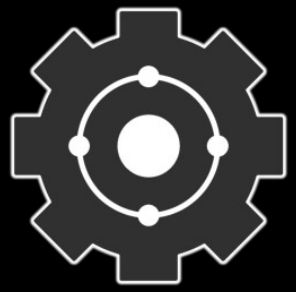
Gearman Overview

- History
- Basics
- Distributed Processing
- Map/Reduce
  - Web Pages
  - Log Processing
- Asynchronous Queues
- Roadmap



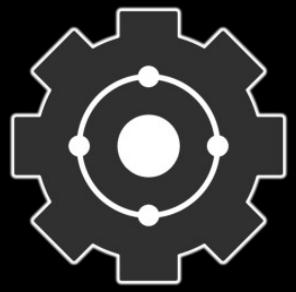
History

- Danga – Brad Fitzpatrick & Company
  - Related to memcached, MogileFS, ...
- Anagram for “manager”
  - Gearman, like managers, assign the tasks but do none of the real work themselves
- Digg: 45+ servers, 400K jobs/day
- Yahoo: 120+ servers, 12M jobs/day
- LiveJournal, SixApart, DealNews, xing.com, ...



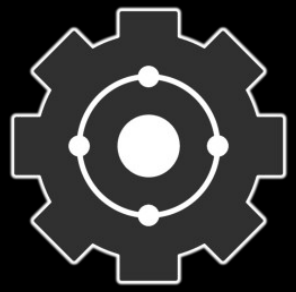
Recent Development

- Rewrite in C
- New Language Bindings
  - PHP/C, Perl/C, Drizzle, MySQL, PostgreSQL, Java, JMS, Python/C, Twisted Python, OCaml, ...
- Command line tool
- Multi-threaded (50k jobs/second)
- Persistent Queues
- Pluggable Protocol (HTTP)



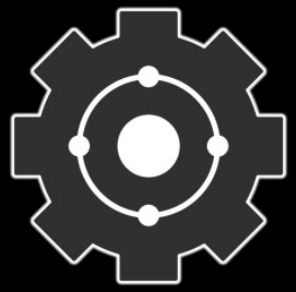
Features

- **Open Source**
- **Simple & Fast**
- **Multi-language**
  - Mix clients and workers from different APIs
- **Flexible Application Design**
  - Not restricted to a single distributed model
- **Embeddable**
  - Small & lightweight for applications of all sizes
- **No Single Point of Failure**

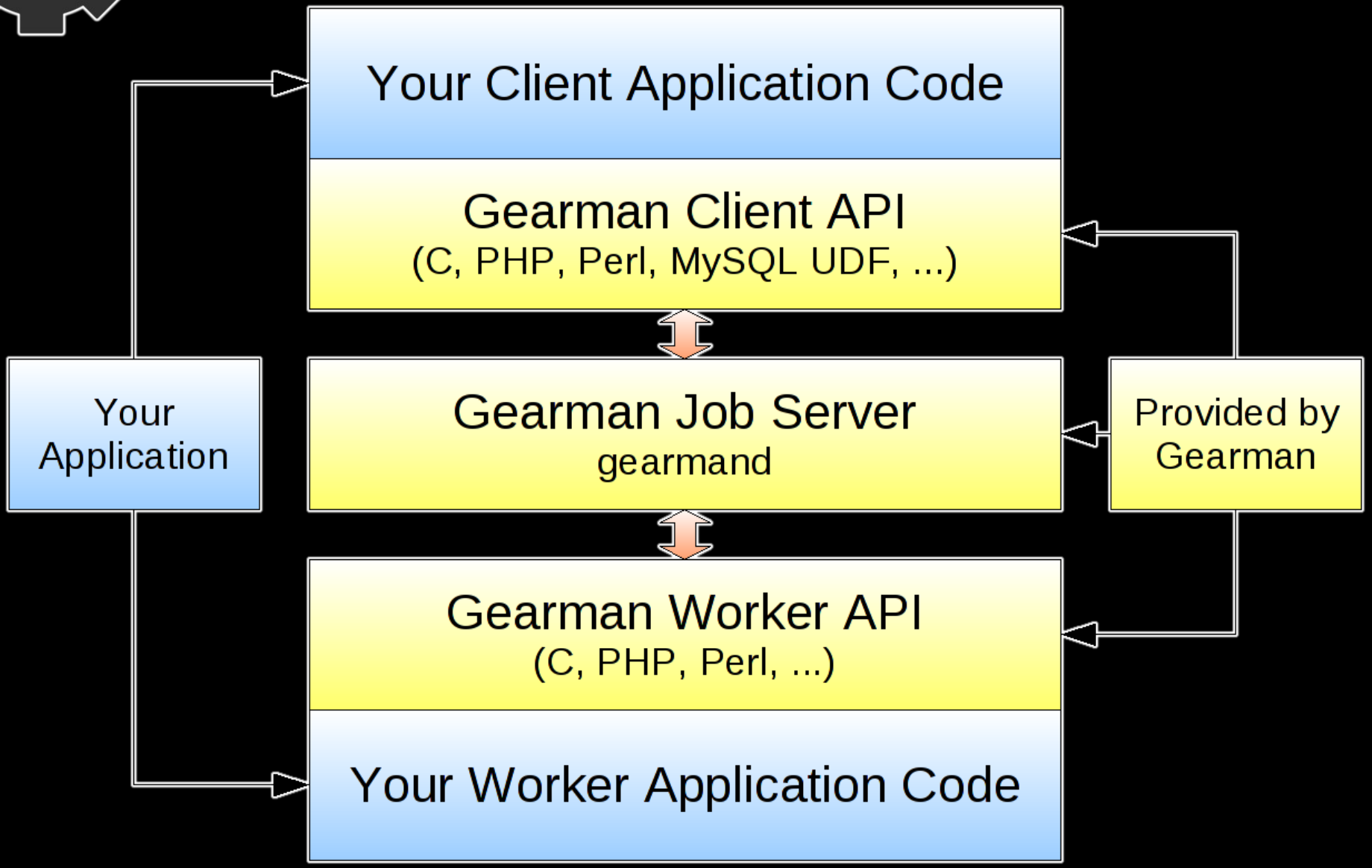


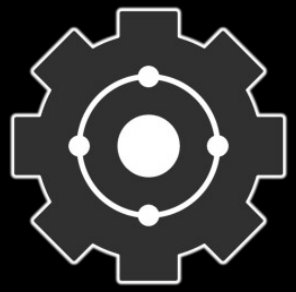
Basics

- Uses TCP port 4730 (was port 7003)
- **Client** – Create jobs to be run and send them to a job server
- **Worker** – Register with a job server and grab jobs to run
- **Job Server** – Coordinate the assignment from clients to workers, handle restarts

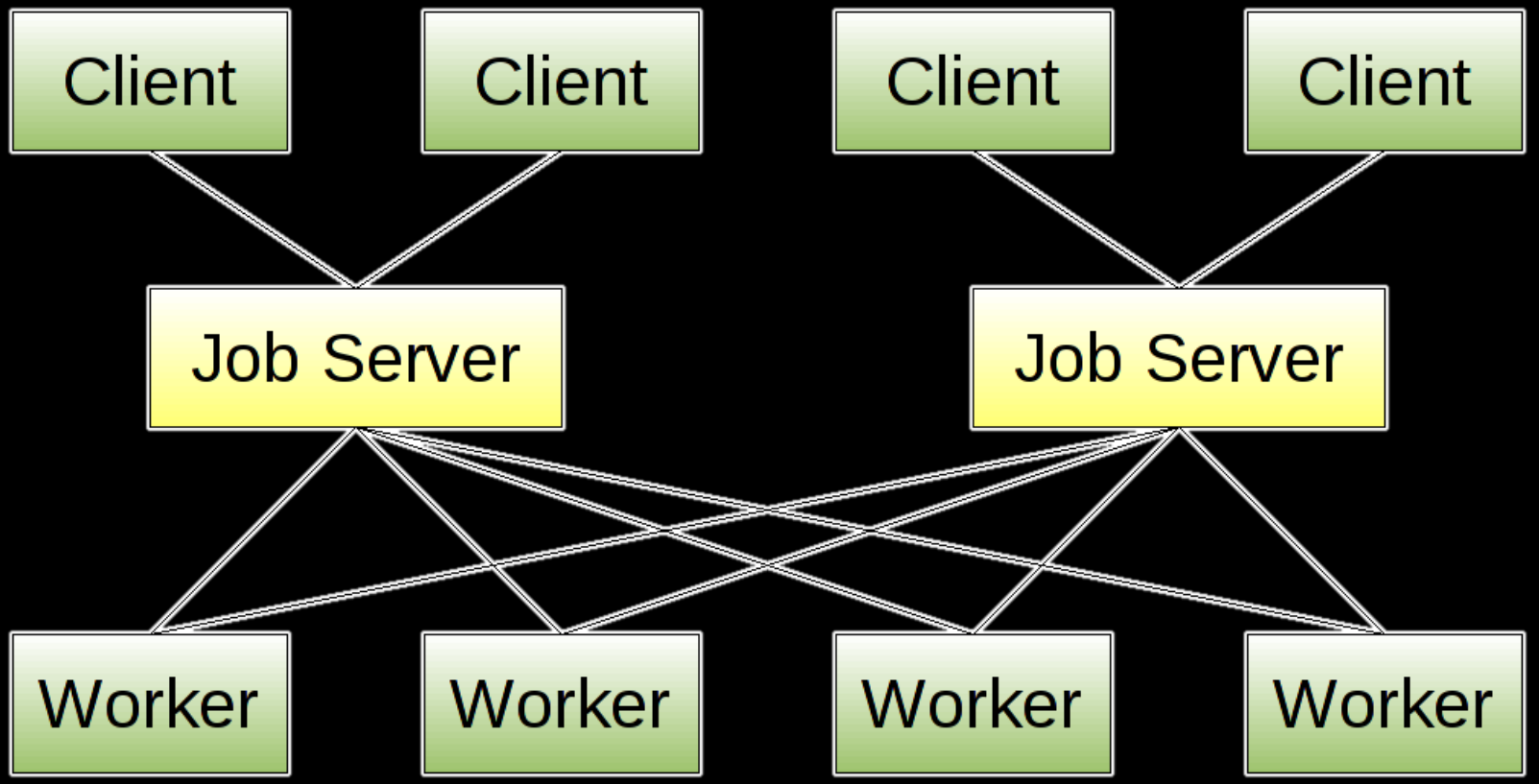


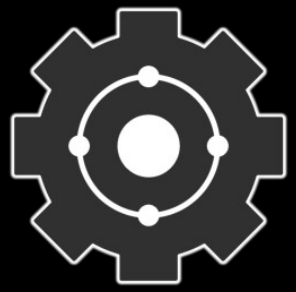
Gearman Stack





No Single Point of Failure

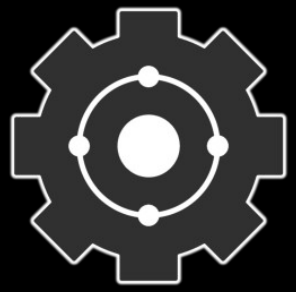




Hello World

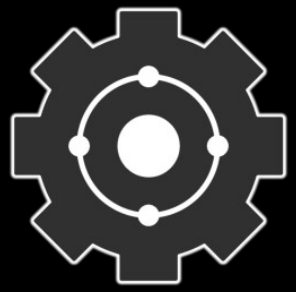
```
$client= new GearmanClient();
$client->addServer('127.0.0.1');
print $client->do('reverse', 'Hello World!');
```

```
$worker= new GearmanWorker();
$worker->addServer('127.0.0.1');
$worker->addFunction('reverse', 'my_reverse_function');
while ($worker->work());

function my_reverse_function($job)
{
  return strrev($job->workload());
}
```

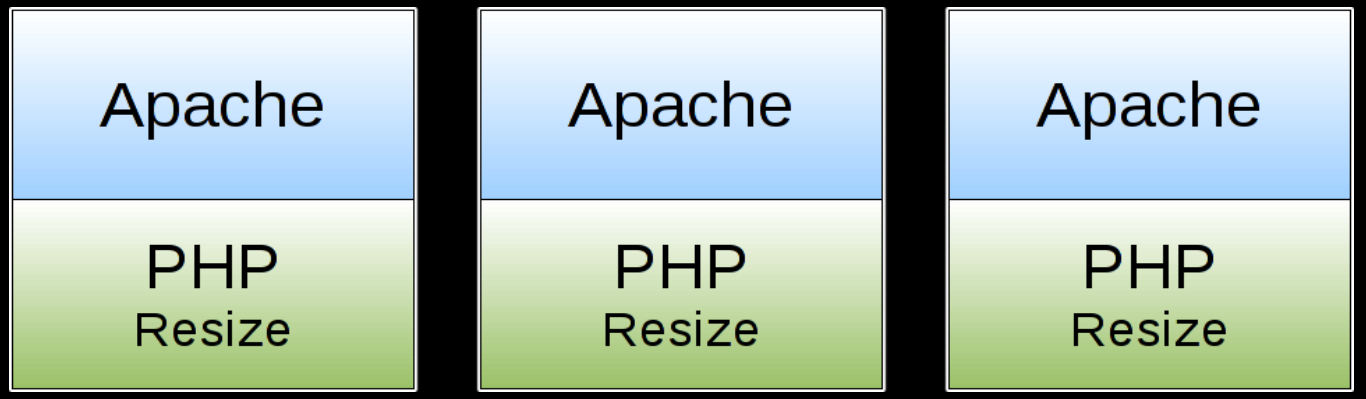


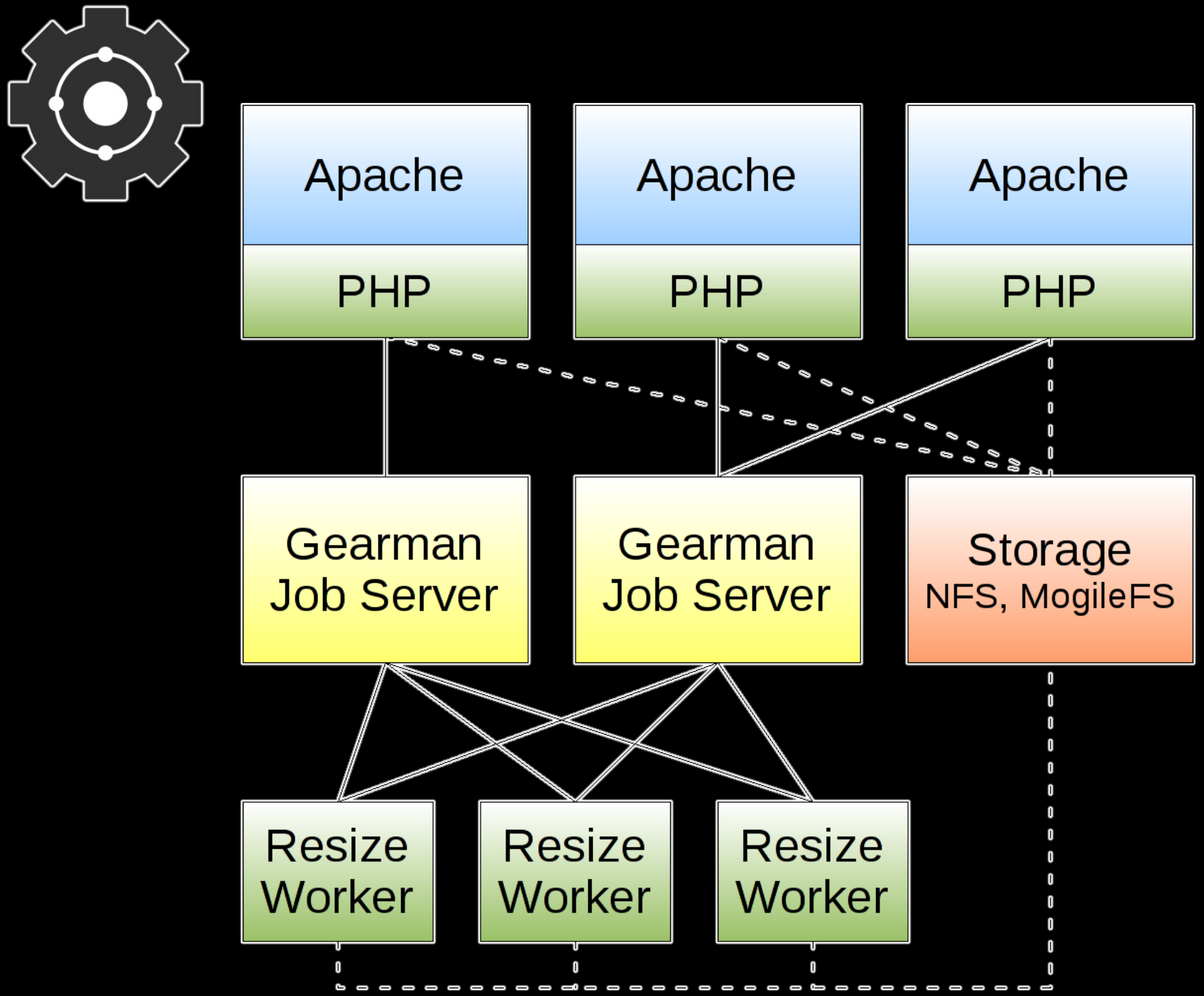
Hello World

```
shell$ gearmand -d

shell$ php worker.php &
[1] 17510

shell$ php client.php
!dlroW olleH
```



Distributed Processing
(Back to image processing)

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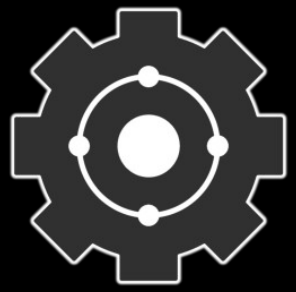


Image Resize Worker

```
$worker= new GearmanWorker();
$worker->addServer('127.0.0.1');
$worker->addFunction('resize', 'my_resize_function');
while ($worker->work());

function my_resize_function($job)
{
  $thumb = new Imagick();
  $thumb->readImageBlob($job->workload());
  $thumb->scaleImage(200, 150);
  return $thumb->getImageBlob();
}
```

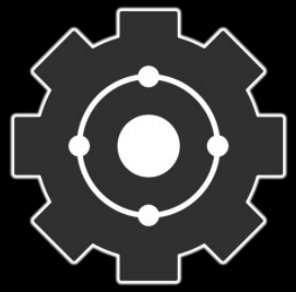
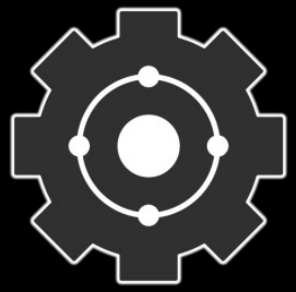
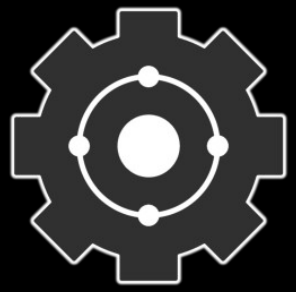


Image Resize Worker

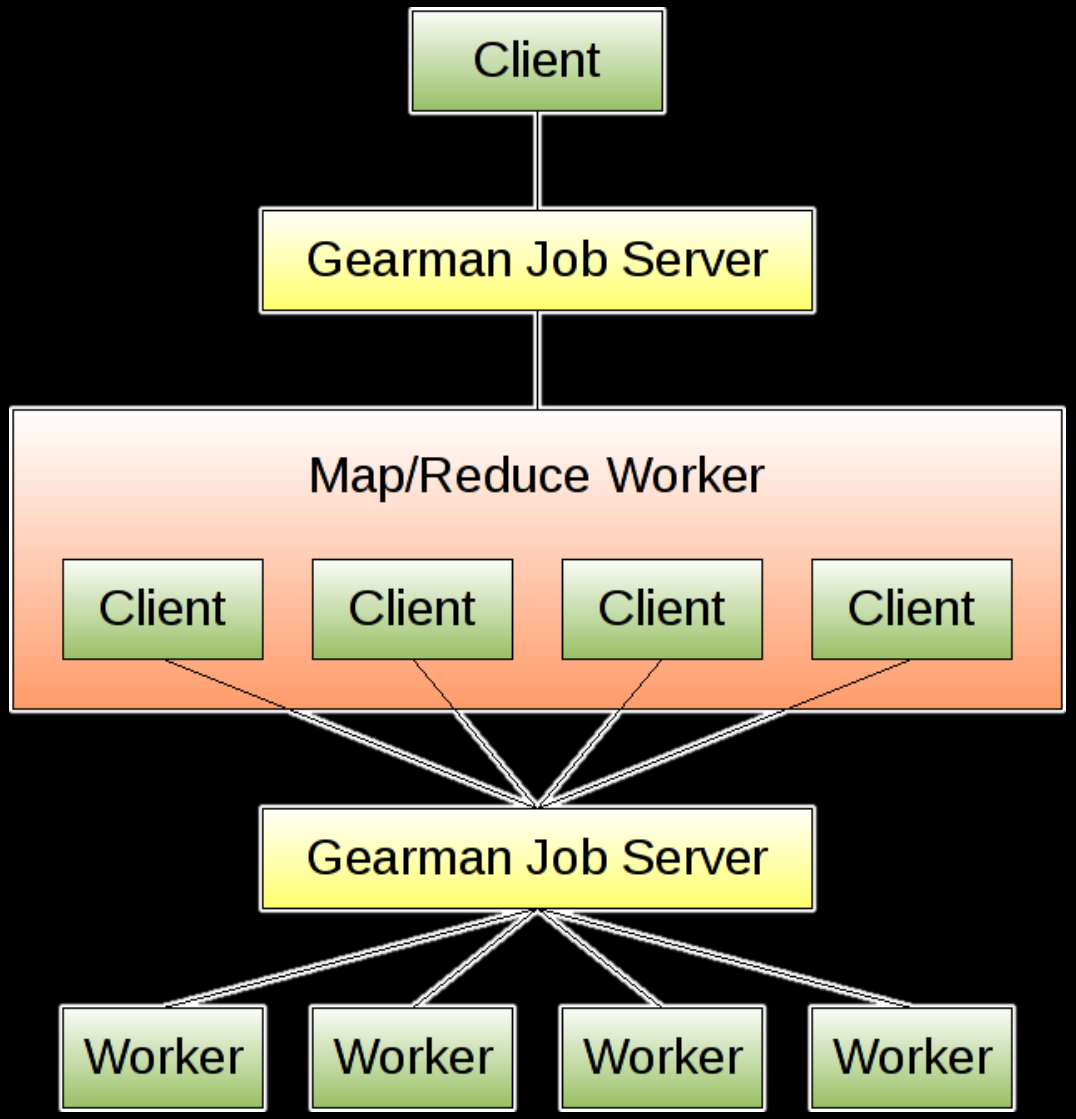
```
shell$ gearmand -d

shell$ php resize.php &
[1] 17524

shell$ gearman -f resize < large.jpg > thumb.jpg

shell$ ls -sh large.jpg thumb.jpg
3.0M large.jpg   32K thumb.jpg
```

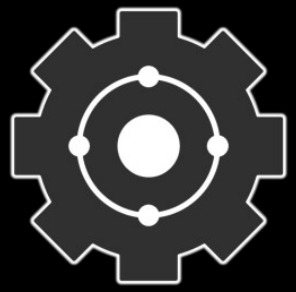


What else?



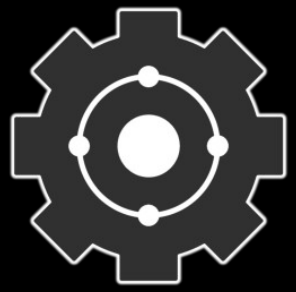
Map/Reduce


Client
Gearman Job Server
Map/Reduce Worker
Client
Client
Client
Client
Gearman Job Server
Worker
Worker
Worker
Worker



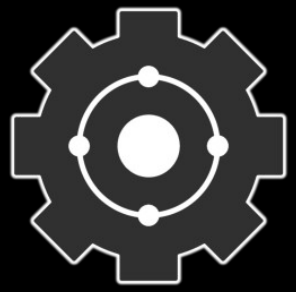
Map/Reduce for Web?

- Reduce page load time with concurrency
  - Gearman clients allow for concurrent jobs
- Push expensive operations off
  - Database queries
  - Expensive calculations (ad placement)
  - Data locality
  - Improved caching
- Start sending page back before blocking
  - Improve time to first byte



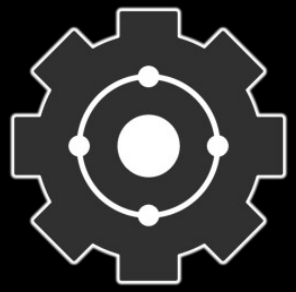
Map/Reduce for Web!

- Start request
  - Start non-blocking Gearman jobs
- Send first byte
- Block for required job result
  - Only block for results you need
  - Cache others until needed
  - Repeat
- Finish request



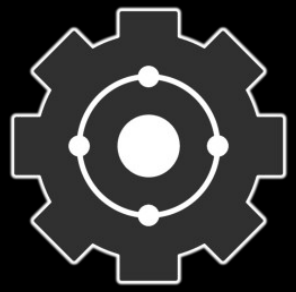
Log Processing

- Bring Map/Reduce to Apache logs
- Get log storage off Apache nodes
- Push processing to log storage nodes
- Combine data in some meaningful way
  - Summary
  - Distributed merge-sort algorithms

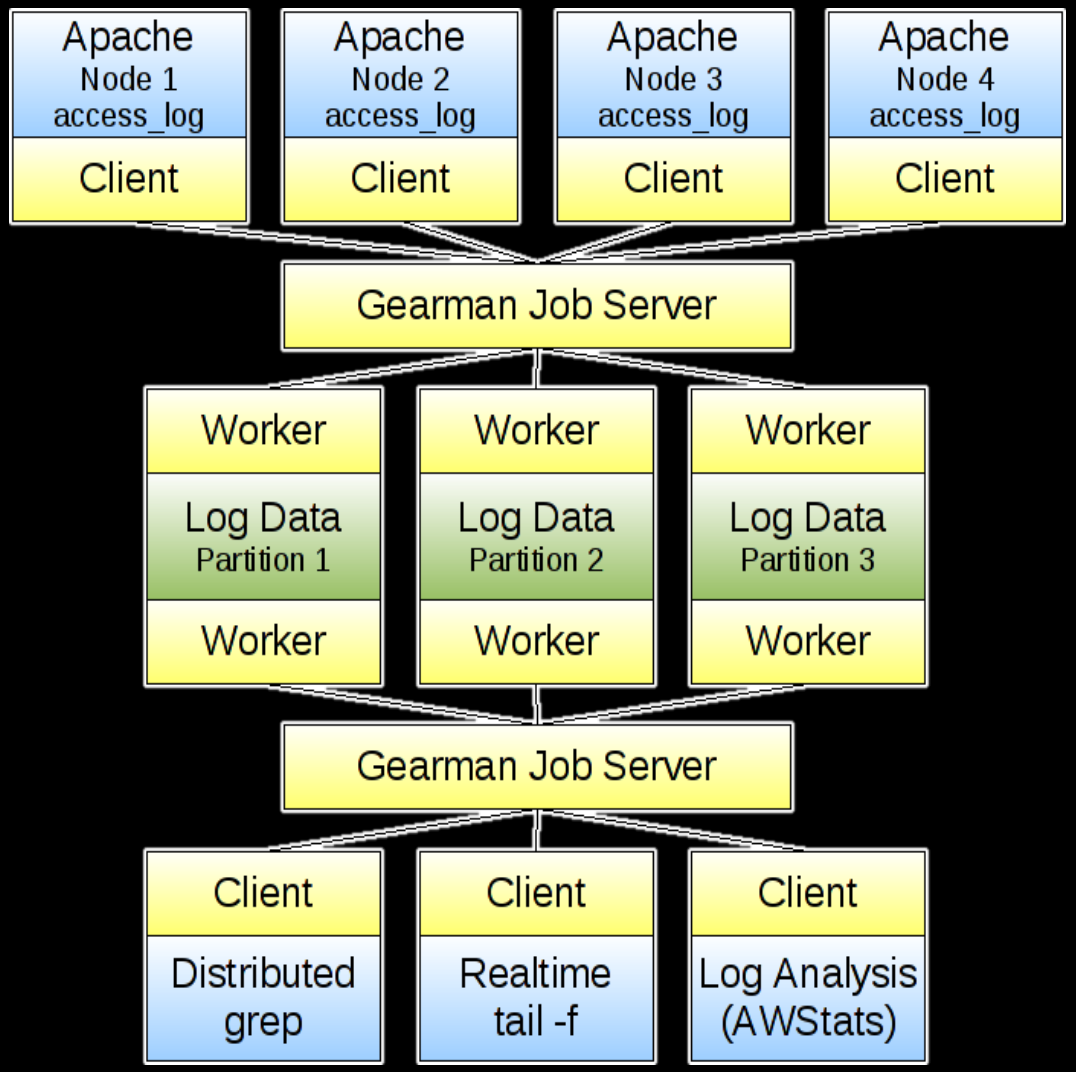


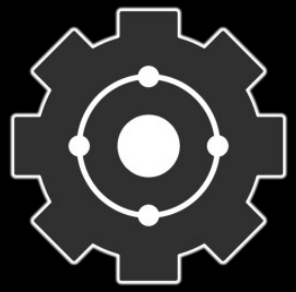
Log Processing

- Collection
  - tail -f access_log | gearman -n -f logger
  - CustomLog "| gearman -n -f logger" common
  - Write a Gearman Apache logging module
- Processing
  - Distributed/parallel grep
  - Log Analysis (AWStats, Webalizer, ...)
  - Custom data mining & click analysis



Log Processing

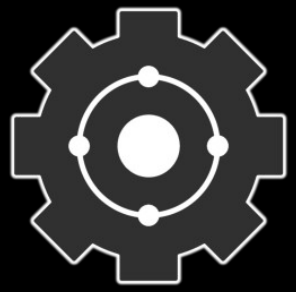




Log Processing

- Simple shell version
- Provide remote storage and distributed grep
- Send logs as mentioned before
  - tail -f access_log | gearman -h host -f logger
- On each log collection machine
  - gearman -w -h host -f logger > log_file
  - gearman -w -h host -f logger1 ./dgrep.sh

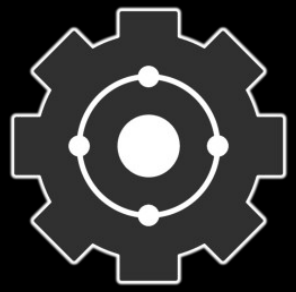
```
#!/bin/sh
read pattern
grep $pattern log_file
```



Log Processing

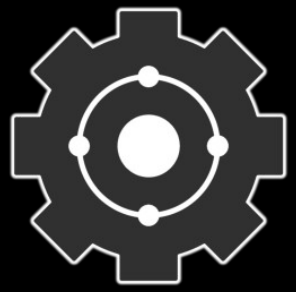
- Query logging machines
  - gearman -h host -f logger1 -f logger2 ... pattern

```
shell$ gearman -h host -f logger1 -f logger2 -f logger3 \
               news_archive | cut -f 4,5,7 -d' '

[06/Jul/2009:18:22:57 -0700] /bzr/narada/eday-dev/php/in
dex.php?q=&u=http%3A%2F%2Flocalhost%2Fsrc%2Fnwveg%2Fnews
_archive.php&s=Submit
[06/Jul/2009:18:23:03 -0700] /src/nwveg/news_archive.php
[06/Jul/2009:18:23:54 -0700] /src/nwveg/news_archive.php
[06/Jul/2009:18:24:12 -0700] /src/nwveg/news_archive.php
[06/Jul/2009:18:31:37 -0700] /bzr/narada/eday-dev/php/in
dex.php?q=news&s=Search&u=
...
```



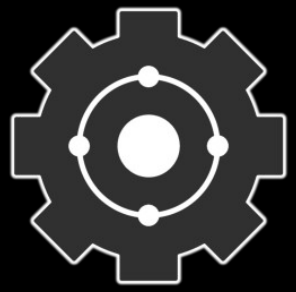
Asynchronous Queues

- Background Tasks
- They help you scale
- Distributed data storage
- Not everything needs immediate action
  - E-Mail notifications, stat counters, indexing, ...
- Allows for batch operations

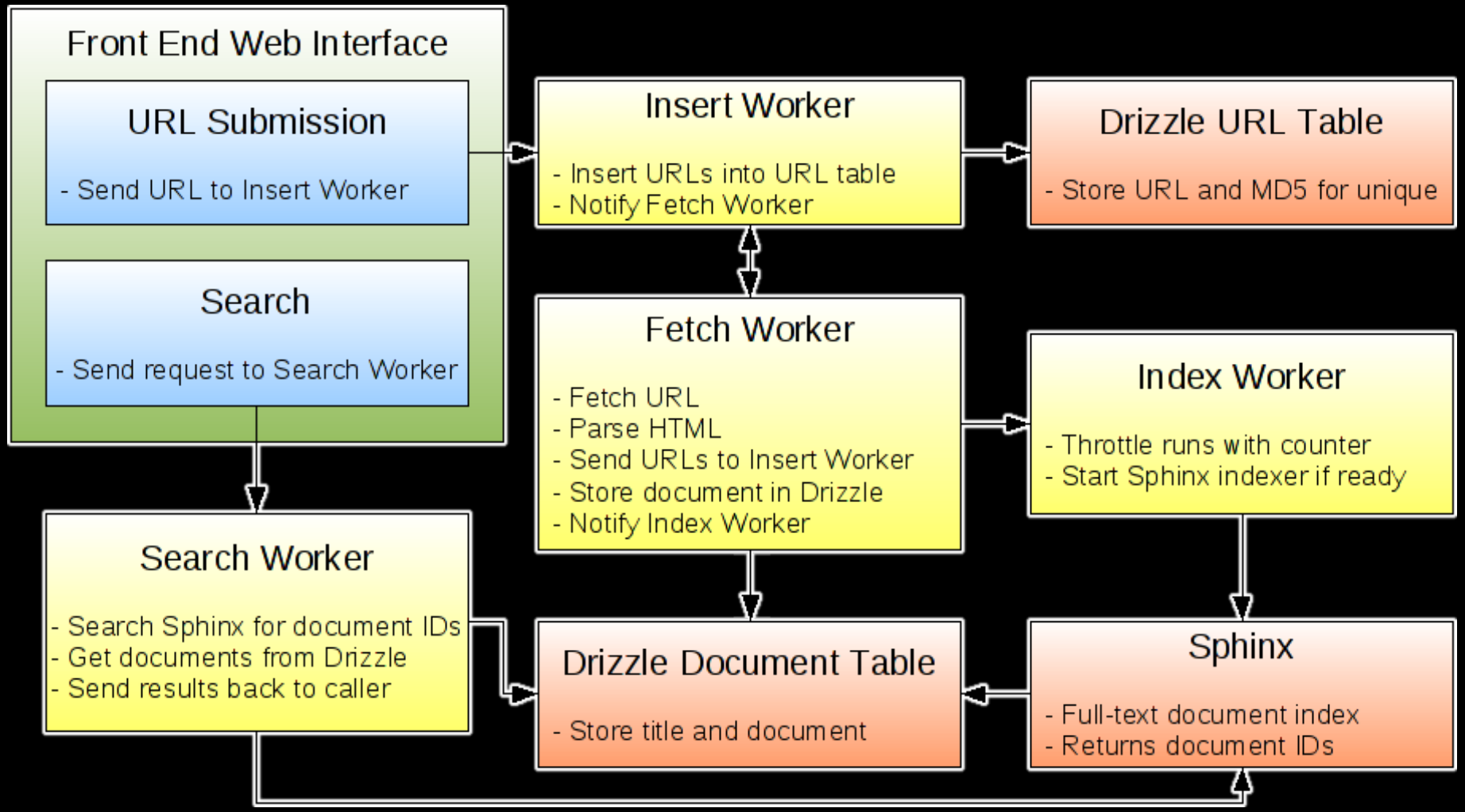


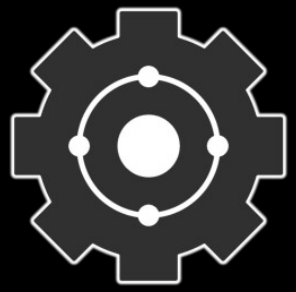
Narada

- Example in Patrick Galbraith's book
- Custom search engine
- PHP, Perl, and Java implementations
- Asynchronous queues
- Drizzle or MySQL
- Easy to integrate into existing projects
- https://launchpad.net/narada



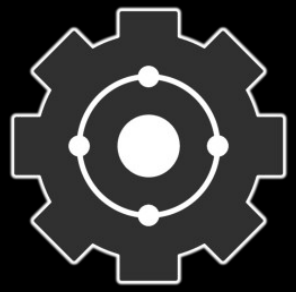
Narada


Front End Web Interface
URL Submission
- Send URL to Insert Worker
Search
- Send request to Search Worker
Insert Worker
- Insert URLs into URL table
- Notify Fetch Worker
Drizzle URL Table
- Store URL and MD5 for unique
Fetch Worker
- Fetch URL
- Parse HTML
- Send URLs to Insert Worker
- Store document in Drizzle
- Notify Index Worker
Index Worker
- Throttle runs with counter
- Start Sphinx indexer if ready
Search Worker
- Search Sphinx for document IDs
- Get documents from Drizzle
- Send results back to caller
Drizzle Document Table
- Store title and document
Sphinx
- Full-text document index
- Returns document IDs



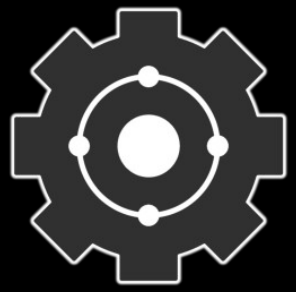
New Applications

- Think of scalable cloud architectures
- Not just LAMP on a virtual machine
- Accept new limitations of cloud
- Utilize power and flexibility cloud
- Elastic services (not just servers)



What's Next?

- Job result cache
- More protocols (memcached, XMPP, ...)
- TLS, SASL, multi-tenancy
- Replication
- More language interfaces
  - Suggestions?
- Improved statistics reporting
- Event notification hooks
- Monitor service



Get Involved!

- http://gearman.org/
- #gearman on irc.freenode.net
- http://groups.google.com/group/gearman
- Take a sticker!