Gearman Plugin

This plugin uses Gearman to support multiple Jenkins masters.

Plugin Information
View Gearman on the plugin site for more information.

The current version of this plugin may not be safe to use. Please review the following warnings before use:

- CSRF vulnerability and missing permission check

**** This project is hosted on git.openstack.org ****

Summary

We on Openstack infrastructure team use Jenkins extensively. Our jenkins servers, at peak load, runs 20,000+ jobs per day. At that load we require many jenkins slaves (900+) to process all of those build jobs. We have found that our requirement was pushing Jenkins beyond it's limits therefore we've decided to create the Gearman Plugin to support multiple Jenkins masters. The gearman plugin was designed to support extra slaves, allow load balancing of build jobs, and provide redundancy.

Jenkins core does not support multiple masters. You can setup multiple Jenkins masters but there is no coordination between them. One problem with scheduling builds on Jenkins master ("MasterA") server is that MasterA only knows about its connected slaves. If all slaves on MasterA are busy then MasterA will just put the next scheduled build on the jenkin server queue. Now MasterA needs to wait for an available slave to run the build. This will be very in-efficient if your builds take a long time to run. So.. what if there is another Jenkins master ("MasterB") that has free slaves to service the next scheduled build on the server's queue? Your probably saying.. "Then slaves on MasterB should run the build instead of waiting for slaves on MasterA to run them", then I would say "good thought!". However MasterB will never service the builds on MasterA's queue. The client that schedules the builds must know about MasterB and then schedule builds on MasterB. This is what we mean by lack of coordination between masters. This gearman-plugin attempts to fill the gap.

This plugin integrates Gearman with Jenkins and will make it so that any Jenkins slave on any Jenkins master can service a job in the queue. This plugin will essentially replace the Jenkins (master) build queue with the Gearman job queue. The job will stay in the Gearman queue until there is a Jenkins node (master or slave) that can run that job. The gearman job queue is shared by multiple jenkins masters therefore gearman can hand out jobs to the next available slave on any jenkins master.

Features

- High availability(ish). When one master goes down the other master(s) will continue to execute builds however the in flight jobs on the downed master will be lost.
- Slaves are (by default) always shared between masters. The only way to un-share is to offline or disconnect a slave.
- Horizontal scalability. Just continue to add more jenkins masters to distribute the job load between masters.
- Gearman jobs can start a jenkins build
- Gearman jobs can stop or abort a jenkins build
- Gearman jobs can change a build description
- Gearman jobs can pass in parameters to jenkins builds
- Gearman jobs can automatically set a slave to offline after running a build
- Gearman is aware of Jenkins project status: meaning that the gearman plugin will register/unregister projects when the project is enabled or disabled.
- Gearman is aware of slave status: meaning thatthe gearman will register/unregister slaves when a slave is set online/offline and connected /disconnected.
- Plugin reloads on jenkins restart: meaning that when jenkins restarts the gearman worker threads are automatically restarted and reconnect to a gearman server.

Known Issues

- Adding or removing executors on nodes will require restarting the gearman plugin. This is because Jenkins does NOT provide provide a way to listen for changes to executors therefore the gearman plugin does not know that it needs to re-register functions due to executor updates.
- The gearman plugin does NOT support Jenkins Matrix Projects. The gearman plugin relies on project and node labels to register functions correctly. Matrix projects use labels much differently than the freestyle and maven projects.
- Since Jenkins 1.651.2, build parameters must explicitly defined in the Jenkins job or whitelisted using system parameters, else they are strip by Jenkins. See https://wiki.jenkins-ci.org/display/SECURITY/Jenkins+Security+Advisory+2016-05-11 and this plugin issue: https://issues.jenkins-ci.org/browse/JENKINS-34885

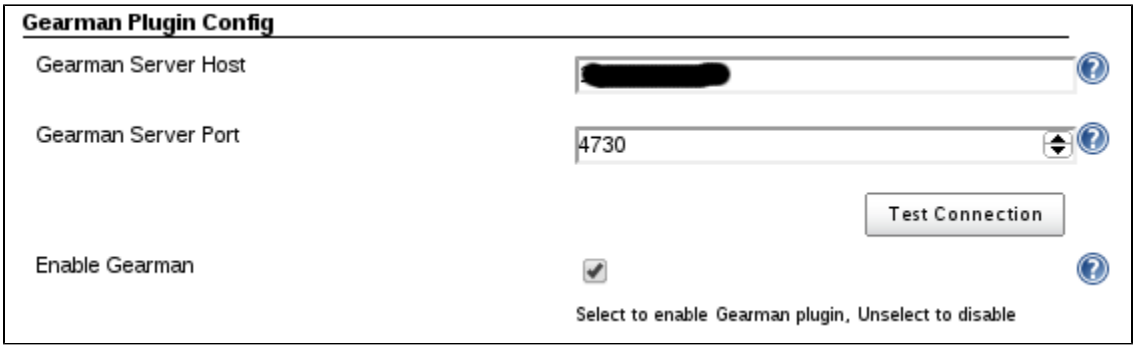
Getting Started

This assumes some familiarity with Jenkins and Gearman

Install

- If you don't already have a Gearman server up and running somewhere you should install one. Theoretically the plugin should work with any gearman server, but we've only used and tested it with the the python gear package. Install this gearman implementation and run the server. NOTE: the python gear implementation is only supported on Linux. Specifically we run on Ubuntu.
- Install the Gearman plugin like any other Jenkins plugin, refer to the Jenkins documentation. You can also get the plugin directly from the Jenkins CI Repository
- After installation the Gearman plugin the configuration should appear in the Jenkins global configuration page. Click on the help bubbles if you need additional help with the configuration. You should test the connection to your Gearman Server before saving your configuration. Select the 'Enable Gearman' checkbox and click save button will immediately start the gearman workers on the Jenkins server.

Configuration



Workflow

Starting the Gearman workers:

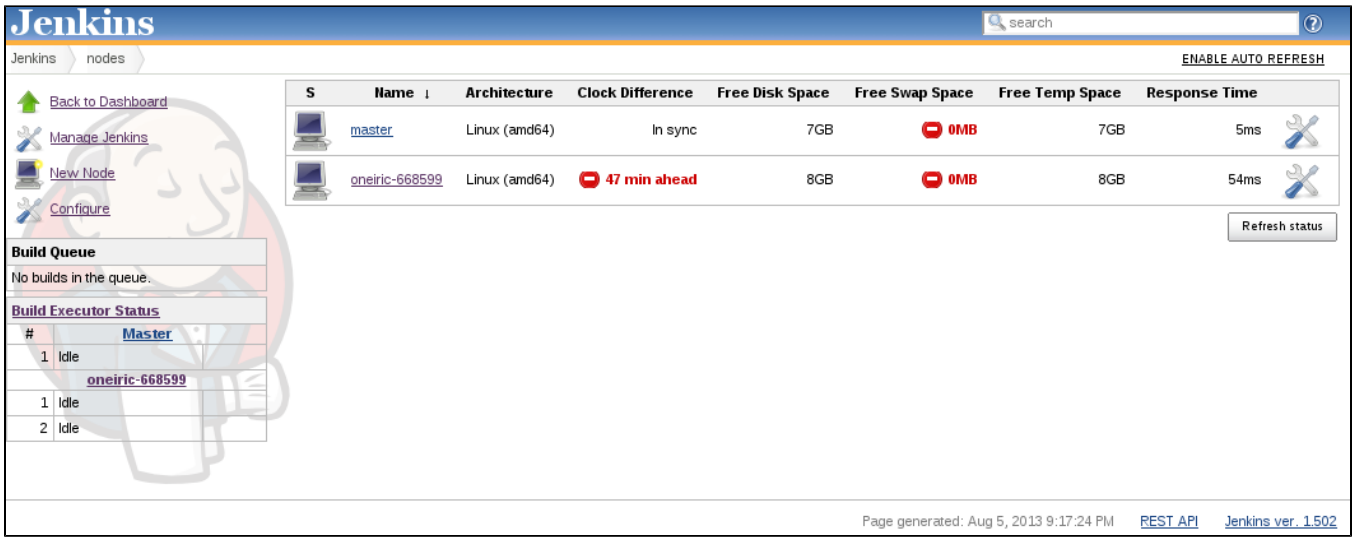
1. When the gearman plugin is enabled a gearman worker threads are spawned for each executor on the master and slave nodes. We'll call these "executor worker threads". Each executor worker thread is associated 1:1 with an executor on a jenkins node.
2. We spawn one more Gearman worker thread to handle job management (i.e. abort job/update description/etc..). We'll call it the "management worker thread" and it will register a "stop:$hostname" and "set_description:$hostname" function with the gearman server. We use these functions to manage jenkins builds.
3. The gearman plugin will register gearman a function for each Gearman executor depending on the projects, labels and nodes that have been setup on the Jenkins master. You can check the registered gearman functions using the administration protocol. It should look something like this..

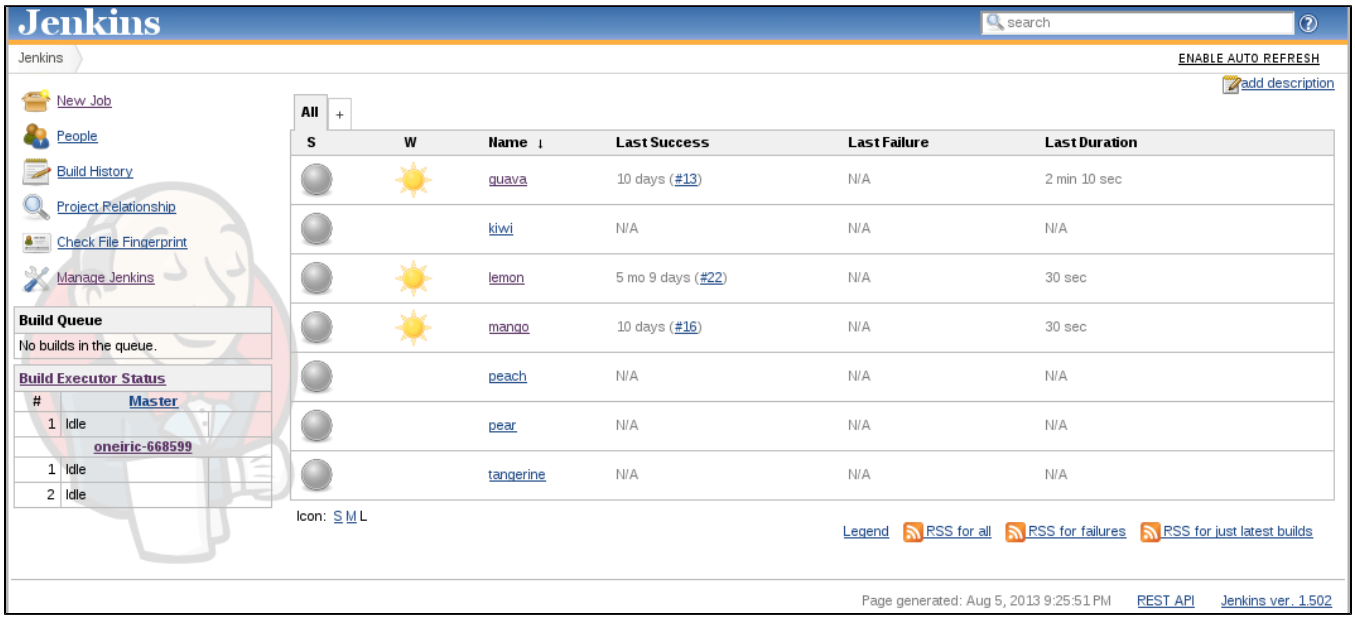
```
khaido@EliteBook:~$ telnet MyGearmanServer 4730
Trying MyGearmanServer...
Connected to MyGearmanServer.
Escape character is '^]'.
workers
35 34.210.224.90 - :
33 MyJenkinsServer MyGearmanServer_manager : set_description:MyGearmanServer stop:MyGearmanServer
32 MyJenkinsServer MyGearmanServer_exec-0 : build:mango:masterA build:mango
34 MyJenkinsServer oneiric-668599_exec-0 : build:guava:ubuntu build:guava
36 MyJenkinsServer oneiric-668599_exec-1 : build:guava:ubuntu build:guava
.
status
build:guava:ubuntu      0       0       2
build:guava     0       0       2
stop:MyGearmanServer    0       0       1
build:mango     0       0       1
set_description:MyGearmanServer 0       0       1
.
```

Notes:

1. Red text denotes gearman admin commands
2. Blue text denotes gearman workers. There is a default manager worker for the master and an executor worker for a jenkins executor on master. There are two gearman executor workers for oneiric-668599 slave (exec-0 & exec-1). These executor workers map to two jenkins executors on the oneiric-668599 slave.
3. Functions like "build:guava:ubuntu" map to build:$projectName:$nodeLabel"

Here's the corresponding Jenkins master UI:





Sample Clients

A gearman client can be written in any language. Here are a few sample clients that work with this plugin

- gearman-plugin-client is a simple test client (below examples use this client)
- Zuul client is the smart client we use in production. Documentation is available as well.
- java client is a simple client included with jenkins-plugin.hpi

Running a Jenkins build

To execute a Jenkins job the gearman client just needs to provide the Gearman hostname, port, function, and UUID to start a jenkins build.

Example:

```
python gear_client.py -s MyGearmanServer --function=build:myProject \
    --params='{"OFFLINE_NODE_WHEN_COMPLETE":"false","param1":"moon","param1":"sun"}'
```

Stopping/aborting a jenkins build

A Gearman request can stop/abort a jenkins build.

Example:

```
python gear_client.py -s MyGearmanServer --function=stop:MyGearmanSever \
    --params='{"name":"myProject","number":"130"}'
```

The job is stopped differently depending on the current state of the job. The table below explains the state, transitions and when cancellations happen.

State	Transitions	Cancellation
Gearman queue	Sending a job request to gearman puts it on the gearman queue	the job is removed from the gearman queue
Jenkins queue	jobs on the gearman queue will transition to the jenkins queue	the job is removed from the Jenkins queue
Jenkins executor	job on the jenkins queue transition to the jenkins executor to run	the build is aborted while on the jenkins executor

Updating a build description

You can send a gearman request to update a build's description. To do this you pass in the following parameters: name of project, build number, description.

Example:

```
python gear_client.py -s MyGearmanSever --function=set_description:MyGearmanSever \
    --params='{"name":"myProject","number":"105","html_description":"<h1>My New Description</h1>"}'
```

Set slave to offline after a build completes

Our infrastructure employees many 'single use slaves' so what we like to do is run a job and then immediately set the slave offline. You can do this by passing in the parameter `OFFLINE_NODE_WHEN_COMPLETE`.

Example:

```
python gear_client.py -s MyGearmanSever --function=build:myProject \
    --params='{"OFFLINE_NODE_WHEN_COMPLETE":"true"}'
```

Configuring Multiple Jenkins Masters

To configure the gearman plugin to work with multiple Jenkins masters you will need to do following:

- Install the gearman plugin on each Jenkins Master and configure it to connect to the Gearman server (steps above).
- Create the exact same jobs on each Jenkins master. The Jenkins Job Builder application is very handy for this purpose and it's what we use.

Now multiple Jenkins masters will be able to service the same jobs.

The typical workflow for this configuration is something like this:

1. The Gearman workers, running on the Jenkins Masters, are waiting to service the configured jenkins jobs
2. A Gearman client submits a request to the Gearman server to run a job.
3. The Gearman server tells the Gearman worker(s) (on a Jenkins Master) to execute the job(s).
4. The first Gearman worker that can service that request will execute the job. If all workers are busy then the request is placed on the gearman queue to be processed when a gearman worker is available.
5. The Gearman worker(s) continuously pull jobs off of the Gearman queue and execute each job.
6. The Gearman worker reports the job result to the Gearman server when complete.
7. The Gearman server reports the job result back to the Gearman client.
8. Loop back to step 1.

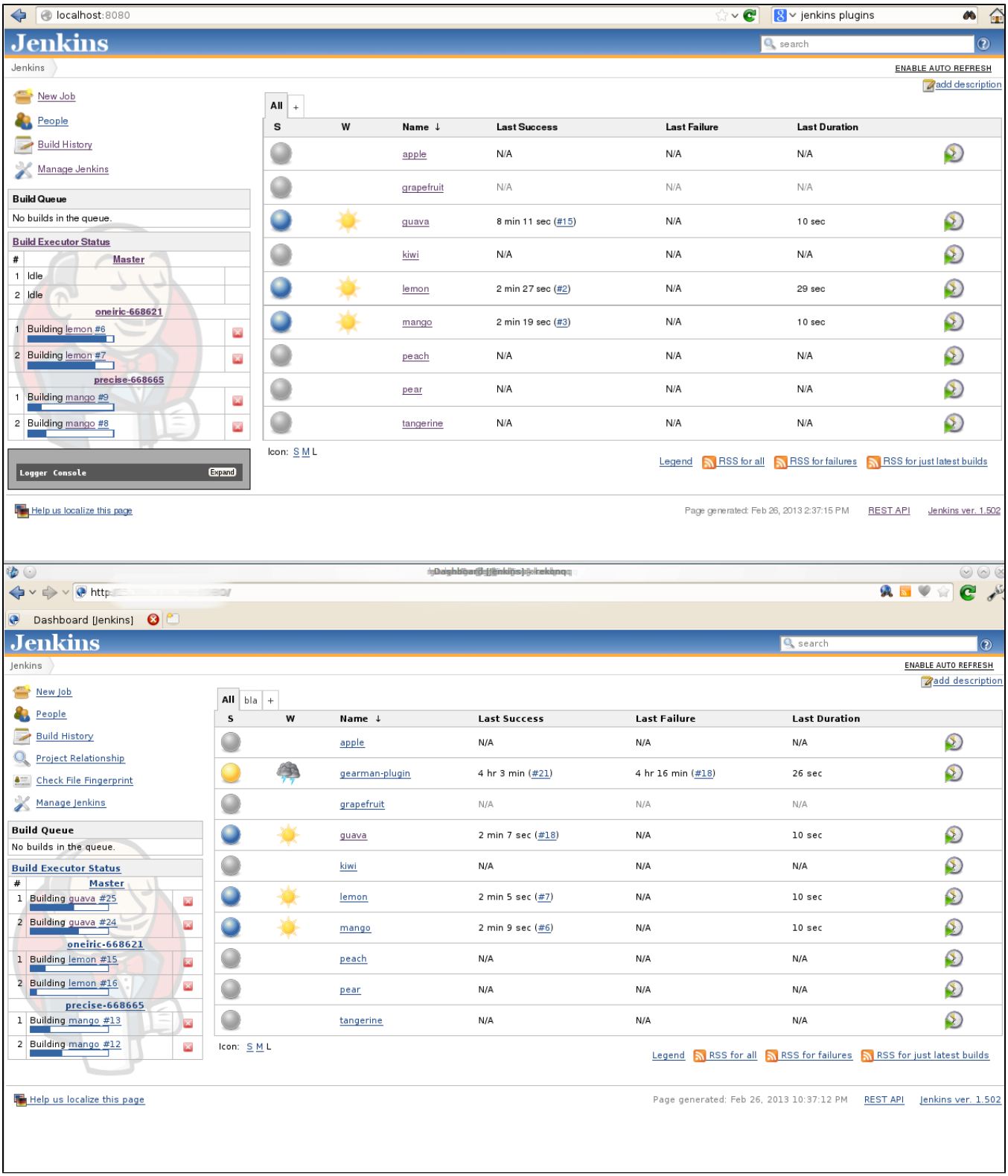
Configure logging

Instructions to make the gearman plugin send log messages to the Jenkins logger:

1. goto http://host:8080/log/levels
2. add "org.gearman.session.logger" with level "WARNING"
3. goto http://host:8080/log/all

Now you should see logs from gearman plugin.

Plugin In Action



Plugin In Production

The above images just show how the plugin might work in a simple case. To see the plugin used in production check out openstack jenkins servers, yes that's servers with an s:

- jenkins01 - we use this master to run operational jobs
- jenkins02 - we use this master to run openstack project builds
- jenkins03 - this is essentially a mirror of jenkins01.

All of the above masters use this plugin which means all of them can run any jobs that are sent to gearman server. We have lots of documentation on how we run the system in production.

References

- Presentation and Slides @ JUC 2013
- Scaling the opesntack environment
- Openstack infra wiki

Versions

- 0.2.0
  - Update for Jenkins 1.625.3 LTS and fix function registration.
  - When function changes, only register the delta instead of registering all functions for every node. This cut down the amount of CAN_DO update. New connection reset the state via RESET_ABILITIES to ensure a proper starting state.
- 0.1.3
  - Send node labels back on build completion
- 0.1.2
  - Fix race between adding job and registering (https://issues.jenkins-ci.org/browse/JENKINS-25867)
  - Fix deadlock from a WORK_FAIL event (https://issues.jenkins-ci.org/browse/JENKINS-28891)
  - Use TextParameterValue instead of String (https://review.openstack.org/#/c/104386/)
  - Stop sending status updates (https://review.openstack.org/#/c/180249/)
  - Protect against partially initialized executor workers (https://review.openstack.org/#/c/145828/)
- 0.1.1
  - Fix job result not being sent back to gearman client, check commit message for more info.
- 0.1.0
  - Update to work with Jenkins LTS ver 1.565.3, check commit message for more info.
- 0.0.7
  - Fix project-node registration. If a node matches any project label, register the generalized job and then also register it for each label in the intersection of project labels and node labels.
  - Supports Jenkins 1.502 to LTS 1.532.2
- 0.0.6
  - Fix function registration bug 1253429
- 0.0.5
  - Set a node offline even if there is an exception
  - Always return WORK_COMPLETE when a build finishes regardless of the result
- 0.0.4
  - Don't wait for the worker thread to join
  - remove restriction on slave to run single job at a time
  - Use more fine-grained synchronization in GearmanProxy
  - Rework starting/stopping executors
  - moved python examples to jenkins wiki
  - Add OFFLINE_NODE_WHEN_COMPLETE option
- 0.0.3
  - ignore non-deterministic build failure and log it
- 0.0.2
  - Bunch of fixes
  - ability to cancel gearman jobs from it's queue
  - ability to set jenkins job descriptions
- 0.0.1 - initial release.