
Locust

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1	Getting started	3
1.1	What is Locust?	3
1.1.1	Features	3
1.1.2	Background	4
1.1.3	Authors	4
1.1.4	License	4
1.2	Installation	4
1.2.1	Supported Python Versions	5
1.2.2	Installing Locust on Windows	5
1.2.3	Installing Locust on macOS	5
1.2.4	Increasing Maximum Number of Open Files Limit	6
1.3	Quick start	6
1.3.1	Example locustfile.py	6
1.3.2	Start Locust	7
1.3.3	Open up Locust's web interface	8
2	Writing Locust tests	9
2.1	Writing a locustfile	9
2.1.1	The Locust class	9
2.1.1.1	The <i>task_set</i> attribute	9
2.1.1.2	The <i>wait_time</i> attribute	9
2.1.1.3	The <i>weight</i> attribute	10
2.1.1.4	The <i>host</i> attribute	10
2.1.2	TaskSet class	10
2.1.2.1	Declaring tasks	11
2.1.2.2	tasks attribute	11
2.1.2.3	TaskSets can be nested	12
2.1.2.4	Referencing the Locust instance, or the parent TaskSet instance	13
2.1.3	TaskSequence class	13
2.1.4	Setups, Teardowns, on_start, and on_stop	14
2.1.4.1	Setups and Teardowns	14
2.1.4.2	The on_start and on_stop methods	14
2.1.4.3	Order of events	14
2.1.5	Making HTTP requests	14
2.1.5.1	Using the HTTP client	15
2.1.5.2	Safe mode	15

2.1.5.3	Manually controlling if a request should be considered successful or a failure	16
2.1.5.4	Grouping requests to URLs with dynamic parameters	16
2.1.6	Common libraries	16
3	Running your Locust tests	19
3.1	Running Locust distributed	19
3.1.1	Example	19
3.1.2	Options	20
3.1.2.1	--master	20
3.1.2.2	--slave	20
3.1.2.3	--master-host=X.X.X.X	20
3.1.2.4	--master-port=5557	20
3.1.2.5	--master-bind-host=X.X.X.X	20
3.1.2.6	--master-bind-port=5557	20
3.1.2.7	--expect-slaves=X	20
3.1.3	Running distributed with Docker	20
3.1.4	Running Locust distributed without the web UI	21
3.1.5	Increase Locust's performance	21
3.2	Running Locust without the web UI	21
3.2.1	Setting a time limit for the test	21
3.2.2	Running Locust distributed without the web UI	21
3.3	Increase Locust's performance with a faster HTTP client	21
3.3.1	How to use FastHttpLocust	22
3.3.2	API	22
3.3.3	FastHttpSession class	22
4	Other functionalities	25
4.1	Retrieve test statistics in CSV format	25
4.2	Testing other systems using custom clients	26
4.2.1	Sample XML-RPC Locust client	26
4.3	Extending Locust	27
4.3.1	Adding Web Routes	28
4.4	Logging	28
4.4.1	Options	28
4.4.1.1	--skip-log-setup	28
4.4.1.2	--loglevel	28
4.4.1.3	--logfile	28
5	API	29
5.1	API	29
5.1.1	Locust class	29
5.1.2	HttpLocust class	29
5.1.3	TaskSet class	30
5.1.4	task decorator	31
5.1.5	TaskSequence class	31
5.1.6	seq_task decorator	32
5.1.7	Built in wait_time functions	32
5.1.8	HttpSession class	33
5.1.9	Response class	35
5.1.10	ResponseContextManager class	37
5.1.11	InterruptTaskSet Exception	38
5.1.12	Event hooks	38
5.1.12.1	Available hooks	38
6	Third-party tools	41

6.1	Third party tools	41
6.1.1	Using other languages	41
6.1.1.1	Golang	41
6.1.1.2	Java	41
6.1.2	Configuration Management	41
7	Changelog	43
7.1	Changelog Highlights	43
7.1.1	0.13.4	43
7.1.2	0.13.3	43
7.1.3	0.13.2	43
7.1.4	0.13.1	43
7.1.5	0.13.0	44
7.1.6	0.12.2	44
7.1.7	0.12.1	44
7.1.8	0.10.0	45
7.1.9	0.9.0	45
7.1.10	0.8.1	45
7.1.11	0.8	45
7.1.12	0.7.5	45
7.1.13	0.7.4	46
7.1.14	0.7.3	46
7.1.15	0.7.2	46
7.1.16	0.7.1	46
7.1.17	0.7	46
7.1.17.1	HTTP client functionality moved to HttpLocust	46
7.1.17.2	msgpack for serializing master/slave data	47
7.1.17.3	requests updated to version 2.2	47
7.1.17.4	gevent updated to version 1.0	47
7.1.17.5	Big refactoring of request statistics code	47
7.1.17.6	Removed support for avg_wait	47
7.1.17.7	Removed support for ramping	47
7.1.17.8	Locust Event hooks now takes keyword argument	48
7.1.17.9	Other changes	48
7.1.18	0.6.2	48
7.1.19	0.6.1	48
7.1.20	0.6	49
7.1.20.1	SubLocust replaced by TaskSet and Locust class behaviour changed	49
7.1.20.2	Locust now uses Requests	50
7.1.20.3	Other improvements and bug fixes	51
7.1.20.4	Smaller API Changes	52
7.1.21	0.5.1	52
7.1.22	0.5	52
7.1.22.1	API changes	52
7.1.22.2	Improvements and bug fixes	52
7.1.23	0.4	53
7.1.23.1	API changes	53
7.1.23.2	Improvements and bug fixes	53
	Python Module Index	55
	Index	57

Everything you need to know about Locust

About locust

Locust is a scalable load testing framework written in Python

- **Website:** <https://locust.io/>
- **Source code:** <https://github.com/locustio/locust>
- **Twitter:** @locustio

1.1 What is Locust?

Locust is an easy-to-use, distributed, user load testing tool. It is intended for load-testing web sites (or other systems) and figuring out how many concurrent users a system can handle.

The idea is that during a test, a swarm of `locusts` will attack your website. The behavior of each locust (or test user if you will) is defined by you and the swarming process is monitored from a web UI in real-time. This will help you battle test and identify bottlenecks in your code before letting real users in.

Locust is completely event-based, and therefore it's possible to support thousands of concurrent users on a single machine. In contrast to many other event-based apps it doesn't use callbacks. Instead it uses light-weight processes, through `gevent`. Each locust swarming your site is actually running inside its own process (or greenlet, to be correct). This allows you to write very expressive scenarios in Python without complicating your code with callbacks.

1.1.1 Features

- **Write user test scenarios in plain-old Python**

No need for clunky UIs or bloated XML—just code as you normally would. Based on coroutines instead of callbacks, your code looks and behaves like normal, blocking Python code.

- **Distributed & Scalable - supports hundreds of thousands of users**

Locust supports running load tests distributed over multiple machines. Being event-based, even one Locust node can handle thousands of users in a single process. Part of the reason behind this is that even if you simulate that many users, not all are actively hitting your system. Often, users are idle figuring out what to do next. Requests per second != number of users online.

- **Web-based UI**

Locust has a neat HTML+JS user interface that shows relevant test details in real-time. And since the UI is web-based, it's cross-platform and easily extendable.

- **Can test any system**

Even though Locust is web-oriented, it can be used to test almost any system. Just write a client for what ever you wish to test and swarm it with locusts! It's super easy!

- **Hackable**

Locust is small and very hackable and we intend to keep it that way. All heavy-lifting of evented I/O and coroutines are delegated to `gevent`. The brittleness of alternative testing tools was the reason we created Locust.

1.1.2 Background

Locust was created because we were fed up with existing solutions. None of them are solving the right problem and to me, they are missing the point. We've tried both Apache JMeter and Tsung. Both tools are quite OK to use; we've used the former many times benchmarking stuff at work. JMeter comes with a UI, which you might think for a second is a good thing. But you soon realize it's a PITA to "code" your testing scenarios through some point-and-click interface. Secondly, JMeter is thread-bound. This means for every user you want to simulate, you need a separate thread. Needless to say, benchmarking thousands of users on a single machine just isn't feasible.

Tsung, on the other hand, does not have these thread issues as it's written in Erlang. It can make use of the light-weight processes offered by BEAM itself and happily scale up. But when it comes to defining the test scenarios, Tsung is as limited as JMeter. It offers an XML-based DSL to define how a user should behave when testing. I guess you can imagine the horror of "coding" this. Displaying any sorts of graphs or reports when completed requires you to post-process the log files generated from the test. Only then can you get an understanding of how the test went.

Anyway, we've tried to address these issues when creating Locust. Hopefully none of the above pain points should exist.

I guess you could say we're really just trying to scratch our own itch here. We hope others will find it as useful as we do.

1.1.3 Authors

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1.1.4 License

Open source licensed under the MIT license (see LICENSE file for details).

1.2 Installation

Locust is available on [PyPI](#) and can be installed with `pip`.

for Python 2.7:

```
$ python -m pip install locustio
```

for Python 3:

```
$ python3 -m pip install locustio
```

If you want the bleeding edge version, you can use pip to install directly from our Git repository. For example, to install the master branch using Python 3:

```
$ python3 -m pip install -e git://github.com/locustio/locust.git@master#egg=locustio
```

Once Locust is installed, a **locust** command should be available in your shell. (if you're not using virtualenv—which you should—make sure your python script directory is on your path).

To see available options, run:

```
$ locust --help
```

1.2.1 Supported Python Versions

Locust is supported on Python 2.7, 3.5, 3.6, 3.7, 3.8.

1.2.2 Installing Locust on Windows

On Windows, running `pip install locustio` *should* work.

However, if it doesn't, chances are that it can be fixed by first installing the pre built binary packages for `pymq`, `gevent` and `greenlet`.

You can find an unofficial collection of pre built python packages for windows here: <http://www.lfd.uci.edu/~gohlke/pythonlibs/>

When you've downloaded a pre-built `.whl` file, you can install it with:

```
$ pip install name-of-file.whl
```

Once you've done that you should be able to just `pip install locustio`.

Note: Running Locust on Windows should work fine for developing and testing your load testing scripts. However, when running large scale tests, it's recommended that you do that on Linux machines, since `gevent`'s performance under Windows is poor.

1.2.3 Installing Locust on macOS

The following is currently the shortest path to installing `gevent` on OS X using Homebrew.

1. Install Homebrew.
2. Install `libev` (dependency for `gevent`):

```
brew install libev
```

1. Then follow the above instructions.

1.2.4 Increasing Maximum Number of Open Files Limit

Every HTTP connection on a machine opens a new file (technically a file descriptor). Operating systems may set a low limit for the maximum number of files that can be open. If the limit is less than the number of simulated users in a test, failures will occur.

Increase the operating system's default maximum number of files limit to a number higher than the number of simulated users you'll want to run. How to do this depends on the operating system in use.

1.3 Quick start

1.3.1 Example locustfile.py

Below is a quick little example of a simple `locustfile.py`:

```
from locust import HttpLocust, TaskSet, between

def login(l):
    l.client.post("/login", {"username":"ellen_key", "password":"education"})

def logout(l):
    l.client.post("/logout", {"username":"ellen_key", "password":"education"})

def index(l):
    l.client.get("/")

def profile(l):
    l.client.get("/profile")

class UserBehavior(TaskSet):
    tasks = {index: 2, profile: 1}

    def on_start(self):
        login(self)

    def on_stop(self):
        logout(self)

class WebsiteUser(HttpLocust):
    task_set = UserBehavior
    wait_time = between(5.0, 9.0)
```

Here we define a number of Locust tasks, which are normal Python callables that take one argument (a *Locust* class instance). These tasks are gathered under a *TaskSet* class in the *tasks* attribute. Then we have a *HttpLocust* class which represents a user, where we define how long a simulated user should wait between executing tasks, as well as what *TaskSet* class should define the user's "behaviour". *TaskSet* classes can be nested.

The *HttpLocust* class inherits from the *Locust* class, and it adds a *client* attribute which is an instance of *HttpSession* that can be used to make HTTP requests.

By default, we stop looking for proxy settings to improve performance. If you really want the test requests go through a HTTP proxy, you can inherit from the *HttpLocust* class and set the *trust_env* field to `True`. For further details, refer to the documentation of requests.

Another way we could declare tasks, which is usually more convenient, is to use the `@task` decorator. The following code is equivalent to the above:

```

from locust import HttpLocust, TaskSet, task, between

class UserBehavior(TaskSet):
    def on_start(self):
        """ on_start is called when a Locust start before any task is scheduled """
        self.login()

    def on_stop(self):
        """ on_stop is called when the TaskSet is stopping """
        self.logout()

    def login(self):
        self.client.post("/login", {"username":"ellen_key", "password":"education"})

    def logout(self):
        self.client.post("/logout", {"username":"ellen_key", "password":"education"})

    @task(2)
    def index(self):
        self.client.get("/")

    @task(1)
    def profile(self):
        self.client.get("/profile")

class WebsiteUser(HttpLocust):
    task_set = UserBehavior
    wait_time = between(5, 9)

```

The *Locust* class (as well as *HttpLocust* since it's a subclass) also allows one to specify the wait time between the execution of tasks (`wait_time = between(5, 9)`) as well as other user behaviours. With the `between` function the time is randomly chosen uniformly between the specified min and max values, but any user-defined time distributions can be used by setting `wait_time` to any arbitrary function. For example, for an exponentially distributed wait time with average of 1 second:

```

import random

class WebsiteUser(HttpLocust):
    task_set = UserBehaviour
    wait_time = lambda self: random.expovariate(1)*1000

```

1.3.2 Start Locust

To run Locust with the above Locust file, if it was named *locustfile.py* and located in the current working directory, we could run:

```
$ locust
```

If the Locust file is located under a subdirectory and/or named different than *locustfile.py*, specify it using `-f`:

```
$ locust -f locust_files/my_locust_file.py
```

To run Locust distributed across multiple processes we would start a master process by specifying `--master`:

```
$ locust -f locust_files/my_locust_file.py --master
```

and then we would start an arbitrary number of slave processes:

```
$ locust -f locust_files/my_locust_file.py --slave
```

If we want to run Locust distributed on multiple machines we would also have to specify the master host when starting the slaves (this is not needed when running Locust distributed on a single machine, since the master host defaults to 127.0.0.1):

```
$ locust -f locust_files/my_locust_file.py --slave --master-host=192.168.0.100
```

Parameters can also be set in a [config file](#) (locust.conf or ~/.locust.conf) or in env vars, prefixed by LOCUST_

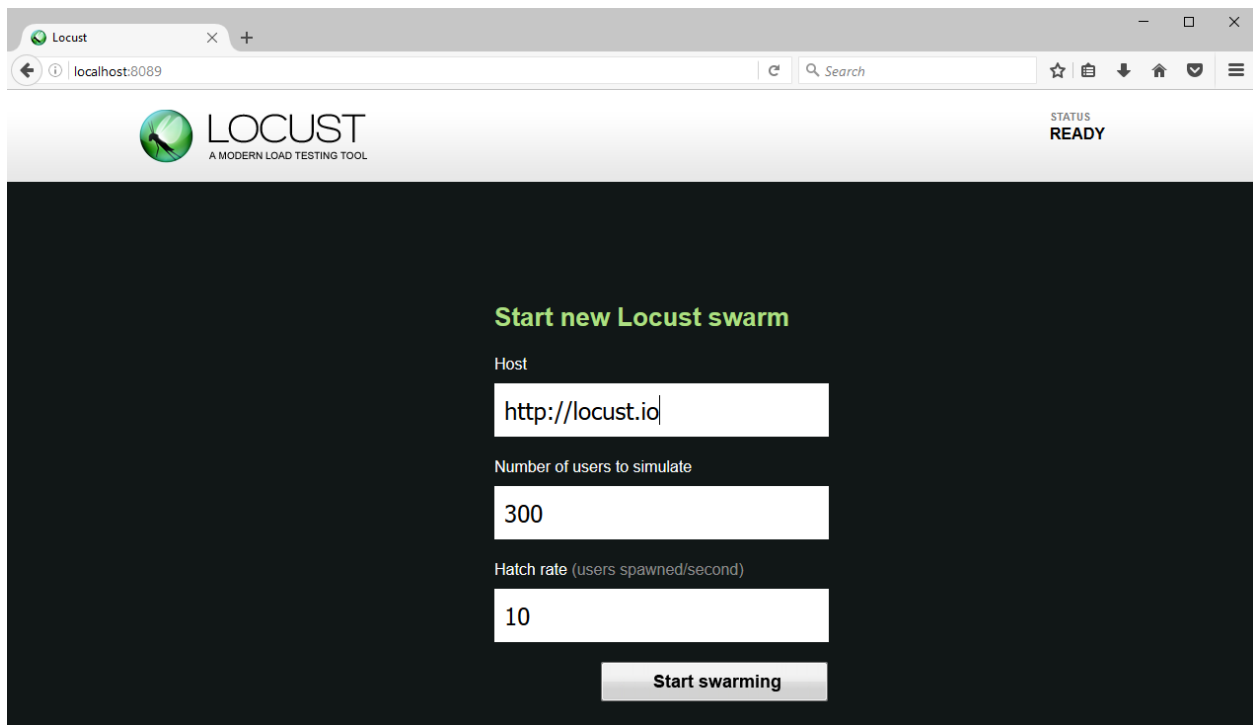
For example: (this will do the same thing as the previous command)

```
$ LOCUST_MASTER_HOST=192.168.0.100 locust
```

Note: To see all available options type: `locust --help`

1.3.3 Open up Locust's web interface

Once you've started Locust using one of the above command lines, you should open up a browser and point it to <http://127.0.0.1:8089> (if you are running Locust locally). Then you should be greeted with something like this:



2.1 Writing a locustfile

A locustfile is a normal python file. The only requirement is that it declares at least one class— let’s call it the locust class—that inherits from the class `Locust`.

2.1.1 The `Locust` class

A locust class represents one user (or a swarming locust if you will). Locust will spawn (hatch) one instance of the locust class for each user that is being simulated. There are a few attributes that a locust class should typically define.

2.1.1.1 The `task_set` attribute

The `task_set` attribute should point to a `TaskSet` class which defines the behaviour of the user and is described in more detail below.

2.1.1.2 The `wait_time` attribute

In addition to the `task_set` attribute, one should also declare a `wait_time` method. It’s used to determine for how long a simulated user will wait between executing tasks. Locust comes with a few built in functions that return a few common `wait_time` methods.

The most common one is `between`. It’s used to make the simulated users wait a random time between a min and max value after each task execution. Other built in wait time functions are `constant` and `constant_pacing`.

With the following locustfile, each user would wait between 5 and 15 seconds between tasks:

```
from locust import Locust, TaskSet, task, between

class MyTaskSet(TaskSet):
    @task
```

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```

def my_task(self):
    print("executing my_task")

class User(Locust):
    task_set = MyTaskSet
    wait_time = between(5, 15)

```

The `wait_time` method should return a number of seconds (or fraction of a second) and can also be declared on a `TaskSet` class, in which case it will only be used for that `TaskSet`.

It's also possible to declare your own `wait_time` method directly on a `Locust` or `TaskSet` class. The following locust class would start sleeping for one second and then one, two, three, etc.

```

class MyLocust(Locust):
    task_set = MyTaskSet
    last_wait_time = 0

    def wait_time(self):
        self.last_wait_time += 1
        return self.last_wait_time

```

2.1.1.3 The *weight* attribute

If more than one locust class exists in the file, and no locusts are specified on the command line, each new spawn will choose randomly from the existing locusts. Otherwise, you can specify which locusts to use from the same file like so:

```
$ locust -f locust_file.py WebUserLocust MobileUserLocust
```

If you wish to make one of these locusts execute more often you can set a `weight` attribute on those classes. Say for example, web users are three times more likely than mobile users:

```

class WebUserLocust(Locust):
    weight = 3
    ...

class MobileUserLocust(Locust):
    weight = 1
    ...

```

2.1.1.4 The *host* attribute

The `host` attribute is a URL prefix (i.e. “`http://google.com`”) to the host that is to be loaded. Usually, this is specified in Locust's web UI or on the command line, using the `--host` option, when locust is started.

If one declares a `host` attribute in the locust class, it will be used in the case when no `--host` is specified on the command line or in the web request.

2.1.2 TaskSet class

If the `Locust` class represents a swarming locust, you could say that the `TaskSet` class represents the brain of the locust. Each `Locust` class must have a `task_set` attribute set, that points to a `TaskSet`.

A TaskSet is, like its name suggests, a collection of tasks. These tasks are normal python callables and—if we were load-testing an auction website—could do stuff like “loading the start page”, “searching for some product” and “making a bid”.

When a load test is started, each instance of the spawned Locust classes will start executing their TaskSet. What happens then is that each TaskSet will pick one of its tasks and call it. It will then wait a number of seconds, specified by the Locust class’ `wait_time` method (unless a `wait_time` method has been declared directly on the TaskSet, in which case it will use its own method instead). Then it will again pick a new task to be called, wait again, and so on.

2.1.2.1 Declaring tasks

The typical way of declaring tasks for a TaskSet it to use the `task` decorator.

Here is an example:

```
from locust import Locust, TaskSet, task

class MyTaskSet(TaskSet):
    @task
    def my_task(self):
        print("Locust instance (%r) executing my_task" % (self.locust))

class MyLocust(Locust):
    task_set = MyTaskSet
```

`@task` takes an optional weight argument that can be used to specify the task’s execution ratio. In the following example `task2` will be executed twice as much as `task1`:

```
from locust import Locust, TaskSet, task
from locust.wait_time import between

class MyTaskSet(TaskSet):
    wait_time = between(5, 15)

    @task(3)
    def task1(self):
        pass

    @task(6)
    def task2(self):
        pass

class MyLocust(Locust):
    task_set = MyTaskSet
```

2.1.2.2 tasks attribute

Using the `@task` decorator to declare tasks is a convenience, and usually the best way to do it. However, it’s also possible to define the tasks of a TaskSet by setting the `tasks` attribute (using the `@task` decorator will actually just populate the `tasks` attribute).

The `tasks` attribute is either a list of python callables, or a `<callable : int>` dict. The tasks are python callables that receive one argument—the TaskSet class instance that is executing the task. Here is an extremely simple example of a locustfile (this locustfile won’t actually load test anything):

```
from locust import Locust, TaskSet

def my_task(1):
    pass

class MyTaskSet(TaskSet):
    tasks = [my_task]

class MyLocust(Locust):
    task_set = MyTaskSet
```

If the `tasks` attribute is specified as a list, each time a task is to be performed, it will be randomly chosen from the `tasks` attribute. If however, `tasks` is a dict—with callables as keys and ints as values—the task that is to be executed will be chosen at random but with the int as ratio. So with a `tasks` that looks like this:

```
{my_task: 3, another_task: 1}
```

`my_task` would be 3 times more likely to be executed than `another_task`.

2.1.2.3 TaskSets can be nested

A very important property of TaskSets is that they can be nested, because real websites are usually built up in an hierarchical way, with multiple sub-sections. Nesting TaskSets will therefore allow us to define a behaviour that simulates users in a more realistic way. For example we could define TaskSets with the following structure:

- Main user behaviour
 - Index page
 - Forum page
 - Read thread
 - Reply
 - New thread
 - View next page
 - Browse categories
 - Watch movie
 - Filter movies
 - About page

The way you nest TaskSets is just like when you specify a task using the `tasks` attribute, but instead of referring to a python function, you refer to another TaskSet:

```
class ForumPage(TaskSet):
    @task(20)
    def read_thread(self):
        pass

    @task(1)
    def new_thread(self):
        pass

    @task(5)
```

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```

def stop(self):
    self.interrupt()

class UserBehaviour(TaskSet):
    tasks = {ForumPage:10}

    @task
    def index(self):
        pass

```

So in the above example, if the ForumPage would get selected for execution when the UserBehaviour TaskSet is executing, then the ForumPage TaskSet would start executing. The ForumPage TaskSet would then pick one of its own tasks, execute it, wait, and so on.

There is one important thing to note about the above example, and that is the call to `self.interrupt()` in the ForumPage's stop method. What this does is essentially to stop executing the ForumPage task set and the execution will continue in the UserBehaviour instance. If we didn't have a call to the `interrupt()` method somewhere in ForumPage, the Locust would never stop running the ForumPage task once it has started. But by having the interrupt function, we can—together with task weighting—define how likely it is that a simulated user leaves the forum.

It's also possible to declare a nested TaskSet, inline in a class, using the `@task` decorator, just like when declaring normal tasks:

```

class MyTaskSet(TaskSet):
    @task
    class SubTaskSet(TaskSet):
        @task
        def my_task(self):
            pass

```

2.1.2.4 Referencing the Locust instance, or the parent TaskSet instance

A TaskSet instance will have the attribute `locust` point to its Locust instance, and the attribute `parent` point to its parent TaskSet (it will point to the Locust instance, in the base TaskSet).

2.1.3 TaskSequence class

TaskSequence class is a TaskSet but its tasks will be executed in order. To define this order you should do the following:

```

class MyTaskSequence(TaskSequence):
    @seq_task(1)
    def first_task(self):
        pass

    @seq_task(2)
    def second_task(self):
        pass

    @seq_task(3)
    @task(10)
    def third_task(self):
        pass

```

In the above example, the order is defined to execute `first_task`, then `second_task` and lastly the `third_task` for 10 times. As you can see, you can compose `@seq_task` with `@task` decorator, and of course you can also nest TaskSets within TaskSequences and vice versa.

2.1.4 Setups, Teardowns, on_start, and on_stop

Locust optionally supports *Locust* level setup and teardown, *TaskSet* level setup and teardown, and *TaskSet* `on_start` and `on_stop`

2.1.4.1 Setups and Teardowns

`setup` and `teardown`, whether it's run on *Locust* or *TaskSet*, are methods that are run only once. `setup` is run before tasks start running, while `teardown` is run after all tasks have finished and Locust is exiting. This enables you to perform some preparation before tasks start running (like creating a database) and to clean up before the Locust quits (like deleting the database).

To use, simply declare a `setup` and/or `teardown` on the *Locust* or *TaskSet* class. These methods will be run for you.

2.1.4.2 The on_start and on_stop methods

A *TaskSet* class can declare an `on_start` method or an `on_stop` method. The `on_start` method is called when a simulated user starts executing that *TaskSet* class, while the `on_stop` `<locust.core.TaskSet.on_stop()` method is called when the *TaskSet* is stopped.

2.1.4.3 Order of events

Since many setup and cleanup operations are dependent on each other, here is the order which they are run:

1. Locust setup
2. TaskSet setup
3. TaskSet `on_start`
4. TaskSet tasks...
5. TaskSet `on_stop`
6. TaskSet teardown
7. Locust teardown

In general, the setup and teardown methods should be complementary.

2.1.5 Making HTTP requests

So far, we've only covered the task scheduling part of a Locust user. In order to actually load test a system we need to make HTTP requests. To help us do this, the *HttpLocust* class exists. When using this class, each instance gets a `client` attribute which will be an instance of *HttpSession* which can be used to make HTTP requests.

class HttpLocust

Represents an HTTP "user" which is to be hatched and attack the system that is to be load tested.

The behaviour of this user is defined by the `task_set` attribute, which should point to a *TaskSet* class.

This class creates a *client* attribute on instantiation which is an HTTP client with support for keeping a user session between requests.

client = None

Instance of `HttpSession` that is created upon instantiation of `Locust`. The client support cookies, and therefore keeps the session between HTTP requests.

When inheriting from the `HttpLocust` class, we can use its `client` attribute to make HTTP requests against the server. Here is an example of a locust file that can be used to load test a site with two URLs; `/` and `/about/`:

```
from locust import HttpLocust, TaskSet, task, between

class MyTaskSet(TaskSet):
    @task(2)
    def index(self):
        self.client.get("/")

    @task(1)
    def about(self):
        self.client.get("/about/")

class MyLocust(HttpLocust):
    task_set = MyTaskSet
    wait_time = between(5, 15)
```

Using the above `Locust` class, each simulated user will wait between 5 and 15 seconds between the requests, and `/` will be requested twice as much as `/about/`.

The attentive reader will find it odd that we can reference the `HttpSession` instance using `self.client` inside the `TaskSet`, and not `self.locust.client`. We can do this because the `TaskSet` class has a convenience property called `client` that simply returns `self.locust.client`.

2.1.5.1 Using the HTTP client

Each instance of `HttpLocust` has an instance of `HttpSession` in the `client` attribute. The `HttpSession` class is actually a subclass of `requests.Session` and can be used to make HTTP requests, that will be reported to `Locust`'s statistics, using the `get`, `post`, `put`, `delete`, `head`, `patch` and `options` methods. The `HttpSession` instance will preserve cookies between requests so that it can be used to log in to websites and keep a session between requests. The `client` attribute can also be referenced from the `Locust` instance's `TaskSet` instances so that it's easy to retrieve the `client` and make HTTP requests from within your tasks.

Here's a simple example that makes a GET request to the `/about` path (in this case we assume `self` is an instance of a `TaskSet` or `HttpLocust` class:

```
response = self.client.get("/about")
print("Response status code:", response.status_code)
print("Response content:", response.text)
```

And here's an example making a POST request:

```
response = self.client.post("/login", {"username":"testuser", "password":"secret"})
```

2.1.5.2 Safe mode

The HTTP client is configured to run in `safe_mode`. What this does is that any request that fails due to a connection error, timeout, or similar will not raise an exception, but rather return an empty dummy `Response` object. The request

will be reported as a failure in Locust's statistics. The returned dummy Response's *content* attribute will be set to None, and its *status_code* will be 0.

2.1.5.3 Manually controlling if a request should be considered successful or a failure

By default, requests are marked as failed requests unless the HTTP response code is OK (<400). Most of the time, this default is what you want. Sometimes however—for example when testing a URL endpoint that you expect to return 404, or testing a badly designed system that might return *200 OK* even though an error occurred—there's a need for manually controlling if locust should consider a request as a success or a failure.

One can mark requests as failed, even when the response code is OK, by using the *catch_response* argument and a *with* statement:

```
with self.client.get("/", catch_response=True) as response:
    if response.content != b"Success":
        response.failure("Got wrong response")
```

Just as one can mark requests with OK response codes as failures, one can also use **catch_response** argument together with a *with* statement to make requests that resulted in an HTTP error code still be reported as a success in the statistics:

```
with self.client.get("/does_not_exist/", catch_response=True) as response:
    if response.status_code == 404:
        response.success()
```

2.1.5.4 Grouping requests to URLs with dynamic parameters

It's very common for websites to have pages whose URLs contain some kind of dynamic parameter(s). Often it makes sense to group these URLs together in Locust's statistics. This can be done by passing a *name* argument to the *HttpRequest*'s different request methods.

Example:

```
# Statistics for these requests will be grouped under: /blog/?id=[id]
for i in range(10):
    self.client.get("/blog?id=%i" % i, name="/blog?id=[id]")
```

2.1.6 Common libraries

Often, people wish to group multiple locustfiles that share common libraries. In that case, it is important to define the *project root* to be the directory where you invoke locust, and it is suggested that all locustfiles live somewhere beneath the project root.

A flat file structure works out of the box:

- project root
 - commonlib_config.py
 - commonlib_auth.py
 - locustfile_web_app.py
 - locustfile_api.py
 - locustfile_ecommerce.py

The locustfiles may import common libraries using, e.g. `import commonlib_auth`. This approach does not cleanly separate common libraries from locust files, however.

Subdirectories can be a cleaner approach (see example below), but locust will only import modules relative to the directory in which the running locustfile is placed. If you wish to import from your project root (i.e. the location where you are running the locust command), make sure to write `sys.path.append(os.getcwd())` in your locust file(s) before importing any common libraries—this will make the project root (i.e. the current working directory) importable.

- project root
 - `__init__.py`
 - `common/`
 - * `__init__.py`
 - * `config.py`
 - * `auth.py`
 - `locustfiles/`
 - * `__init__.py`
 - * `web_app.py`
 - * `api.py`
 - * `ecommerce.py`

With the above project structure, your locust files can import common libraries using:

```
sys.path.append(os.getcwd())
import common.auth
```

Running your Locust tests

3.1 Running Locust distributed

Once a single machine isn't enough to simulate the number of users that you need, Locust supports running load tests distributed across multiple machines.

To do this, you start one instance of Locust in master mode using the `--master` flag. This is the instance that will be running Locust's web interface where you start the test and see live statistics. The master node doesn't simulate any users itself. Instead you have to start one or —most likely—multiple slave Locust nodes using the `--slave` flag, together with the `--master-host` (to specify the IP/hostname of the master node).

A common set up is to run a single master on one machine, and then run one slave instance per processor core, on the slave machines.

Note: Both the master and each slave machine, must have a copy of the locust test scripts when running Locust distributed.

Note: It's recommended that you start a number of simulated users that are greater than `number of locust classes * number of slaves` when running Locust distributed.

Otherwise - due to the current implementation - you might end up with a distribution of the Locust classes that doesn't correspond to the Locust classes' `weight` attribute. And if the hatch rate is lower than the number of slave nodes, the hatching would occur in "bursts" where all slave node would hatch a single user and then sleep for multiple seconds, hatch another user, sleep and repeat.

3.1.1 Example

To start locust in master mode:

```
locust -f my_locustfile.py --master
```

And then on each slave (replace 192.168.0.14 with IP of the master machine):

```
locust -f my_locustfile.py --slave --master-host=192.168.0.14
```

3.1.2 Options

3.1.2.1 `--master`

Sets locust in master mode. The web interface will run on this node.

3.1.2.2 `--slave`

Sets locust in slave mode.

3.1.2.3 `--master-host=X.X.X.X`

Optionally used together with `--slave` to set the hostname/IP of the master node (defaults to 127.0.0.1)

3.1.2.4 `--master-port=5557`

Optionally used together with `--slave` to set the port number of the master node (defaults to 5557). Note that locust will use the port specified, as well as the port number +1. So if 5557 is used, locust will use both port 5557 and 5558.

3.1.2.5 `--master-bind-host=X.X.X.X`

Optionally used together with `--master`. Determines what network interface that the master node will bind to. Defaults to * (all available interfaces).

3.1.2.6 `--master-bind-port=5557`

Optionally used together with `--master`. Determines what network ports that the master node will listen to. Defaults to 5557. Note that locust will use the port specified, as well as the port number +1. So if 5557 is used, locust will use both port 5557 and 5558.

3.1.2.7 `--expect-slaves=X`

Used when starting the master node with `--no-web`. The master node will then wait until X slave nodes has connected before the test is started.

3.1.3 Running distributed with Docker

See `running-locust-docker`

3.1.4 Running Locust distributed without the web UI

See *Running Locust distributed without the web UI*

3.1.5 Increase Locust's performance

If your planning to run large-scale load tests you might be interested to use the alternative HTTP client that's shipped with Locust. You can read more about it here: *Increase Locust's performance with a faster HTTP client*

3.2 Running Locust without the web UI

You can run locust without the web UI - for example if you want to run it in some automated flow, like a CI server - by using the `--no-web` flag together with `-c` and `-r`:

```
$ locust -f locust_files/my_locust_file.py --no-web -c 1000 -r 100
```

`-c` specifies the number of Locust users to spawn, and `-r` specifies the hatch rate (number of users to spawn per second).

3.2.1 Setting a time limit for the test

Note: This is a new feature in v0.9. For 0.8 use `-n` to specify the number of requests

If you want to specify the run time for a test, you can do that with `--run-time` or `-t`:

```
$ locust -f --no-web -c 1000 -r 100 --run-time 1h30m
```

Locust will shutdown once the time is up.

3.2.2 Running Locust distributed without the web UI

If you want to *run Locust distributed* without the web UI, you should specify the `--expect-slaves` option when starting the master node, to specify the number of slave nodes that are expected to connect. It will then wait until that many slave nodes have connected before starting the test.

3.3 Increase Locust's performance with a faster HTTP client

Locust's default HTTP client uses `python-requests`. The reason for this is that requests is a very well-maintained python package, that provides a really nice API, that many python developers are familiar with. Therefore, in many cases, we recommend that you use the default `HttpLocust` which uses requests. However, if you're planning to run really large scale tests, Locust comes with an alternative HTTP client, `FastHttpLocust` which uses `geventhttpclient` instead of requests. This client is significantly faster, and we've seen 5x-6x performance increases for making HTTP-requests. This does not necessarily mean that the number of users one can simulate per CPU core will automatically increase 5x-6x, since it also depends on what else the load testing script does. However, if your locust scripts are spending most of their CPU time in making HTTP-requests, you are likely to see significant performance gains.

3.3.1 How to use FastHttpLocust

Subclass FastHttpLocust instead of HttpLocust:

```
from locust import TaskSet, task, between
from locust.contrib.fasthttp import FastHttpLocust

class MyTaskSet(TaskSet):
    @task
    def index(self):
        response = self.client.get("/")

class MyLocust(FastHttpLocust):
    task_set = MyTaskSet
    wait_time = between(1, 60)
```

Note: FastHttpLocust uses a whole other HTTP client implementation, with a different API, compared to the default HttpLocust that uses python-requests. Therefore FastHttpLocust might not work as a drop-in replacement for HttpLocust, depending on how the HttpClient is used.

Note: SSL domain check is turned off in the FastHttpLocust's client implementation. So it will let through invalid SSL certificates without complaining.

3.3.2 API

3.3.3 FastHttpSession class

```
class FastHttpSession(base_url, **kwargs)
```

```
    __init__(base_url, **kwargs)
```

```
        x.__init__(...) initializes x; see help(type(x)) for signature
```

```
    get(path, **kwargs)
```

```
        Sends a GET request
```

```
    head(path, **kwargs)
```

```
        Sends a HEAD request
```

```
    options(path, **kwargs)
```

```
        Sends a OPTIONS request
```

```
    patch(path, data=None, **kwargs)
```

```
        Sends a POST request
```

```
    post(path, data=None, **kwargs)
```

```
        Sends a POST request
```

```
    put(path, data=None, **kwargs)
```

```
        Sends a PUT request
```

```
    request(method, path, name=None, data=None, catch_response=False, stream=False, headers=None, auth=None, **kwargs)
```

```
        Send and HTTP request Returns locust.contrib.fasthttp.FastResponse object.
```

Parameters

- **method** – method for the new `Request` object.
- **path** – Path that will be concatenated with the base host URL that has been specified. Can also be a full URL, in which case the full URL will be requested, and the base host is ignored.
- **name** – (optional) An argument that can be specified to use as label in Locust's statistics instead of the URL path. This can be used to group different URL's that are requested into a single entry in Locust's statistics.
- **catch_response** – (optional) Boolean argument that, if set, can be used to make a request return a context manager to work as argument to a `with` statement. This will allow the request to be marked as a fail based on the content of the response, even if the response code is ok (2xx). The opposite also works, one can use `catch_response` to catch a request and then mark it as successful even if the response code was not (i.e 500 or 404).
- **data** – (optional) Dictionary or bytes to send in the body of the request.
- **headers** – (optional) Dictionary of HTTP Headers to send with the request.
- **auth** – (optional) Auth (username, password) tuple to enable Basic HTTP Auth.
- **stream** – (optional) If set to true the response body will not be consumed immediately and can instead be consumed by accessing the `stream` attribute on the `Response` object. Another side effect of setting `stream` to `True` is that the time for downloading the response content will not be accounted for in the request time that is reported by Locust.

class FastResponse (*ghc_response, request=None, sent_request=None*)

content

Unzips if necessary and buffers the received body. Careful with large files!

headers = None

Dict like object containing the response headers

text

Returns the text content of the response as a decoded string (unicode on python2)

Other functionalities

4.1 Retrieve test statistics in CSV format

You may wish to consume your Locust results via a CSV file. In this case, there are two ways to do this.

First, when running Locust with the web UI, you can retrieve CSV files under the Download Data tab.

Secondly, you can run Locust with a flag which will periodically save two CSV files. This is particularly useful if you plan on running Locust in an automated way with the `--no-web` flag:

```
$ locust -f examples/basic.py --csv=example --no-web -t10m
```

The files will be named `example_response_times.csv` and `example_stats.csv` (when using `--csv=example`) and mirror Locust's built in stat pages.

You can also customize how frequently this is written if you desire faster (or slower) writing:

```
import locust.stats
locust.stats.CSV_STATS_INTERVAL_SEC = 5 # default is 2 seconds
```

This data will write two files with `_response_times.csv` and `_stats.csv` added to the name you give:

```
$ cat example_response_times.csv
"Name", "# requests", "50%", "66%", "75%", "80%", "90%", "95%", "98%", "99%", "99.9%", "99.99%",
↪ "100%"
"GET /", 31, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4
"/does_not_exist", 0, "N/A", "N/A", "N/A", "N/A", "N/A", "N/A", "N/A", "N/A", "N/A"
"GET /stats/requests", 38, 3, 4, 4, 4, 4, 5, 5, 5, 5, 5
"None Total", 69, 3, 4, 4, 4, 4, 4, 5, 5, 5, 5, 5
```

and:

```
$ cat example_stats.csv
"Type", "Name", "# requests", "# failures", "Median response time", "Average response time
↪", "Min response time", "Max response time", "Average Content Size", "Requests/s"
```

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```

"GET", "/", 51, 0, 4, 3, 2, 6, 12274, 0.89
"GET", "/does_not_exist", 0, 56, 0, 0, 0, 0, 0.00
"GET", "/stats/requests", 58, 0, 3, 3, 2, 5, 1214, 1.01
"None", "Total", 109, 56, 3, 3, 2, 6, 6389, 1.89

```

4.2 Testing other systems using custom clients

Locust was built with HTTP as its main target. However, it can easily be extended to load test any request/response based system, by writing a custom client that triggers `request_success` and `request_failure` events.

4.2.1 Sample XML-RPC Locust client

Here is an example of a Locust class, `XmlRpcLocust`, which provides an XML-RPC client, `XmlRpcClient`, and tracks all requests made:

```

import time
import xmlrpclib

from locust import Locust, TaskSet, events, task, between

class XmlRpcClient(xmlrpclib.ServerProxy):
    """
    Simple, sample XML RPC client implementation that wraps xmlrpclib.ServerProxy and
    fires locust events on request_success and request_failure, so that all requests
    gets tracked in locust's statistics.
    """
    def __getattr__(self, name):
        func = xmlrpclib.ServerProxy.__getattr__(self, name)
        def wrapper(*args, **kwargs):
            start_time = time.time()
            try:
                result = func(*args, **kwargs)
            except xmlrpclib.Fault as e:
                total_time = int((time.time() - start_time) * 1000)
                events.request_failure.fire(request_type="xmlrpc", name=name,
↳response_time=total_time, exception=e)
            else:
                total_time = int((time.time() - start_time) * 1000)
                events.request_success.fire(request_type="xmlrpc", name=name,
↳response_time=total_time, response_length=0)
                # In this example, I've hardcoded response_length=0. If we would want
↳the response length to be
                # reported correctly in the statistics, we would probably need to
↳hook in at a lower level

            return wrapper

class XmlRpcLocust(Locust):
    """
    This is the abstract Locust class which should be subclassed. It provides an XML-
↳RPC client

```

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```

    that can be used to make XML-RPC requests that will be tracked in Locust's
    ↪statistics.
    """
    def __init__(self, *args, **kwargs):
        super(XmlRpcLocust, self).__init__(*args, **kwargs)
        self.client = XmlRpcClient(self.host)

class ApiUser(XmlRpcLocust):

    host = "http://127.0.0.1:8877/"
    wait_time = between(0.1, 1)

    class task_set(TaskSet):
        @task(10)
        def get_time(self):
            self.client.get_time()

        @task(5)
        def get_random_number(self):
            self.client.get_random_number(0, 100)

```

If you've written Locust tests before, you'll recognize the class called *ApiUser* which is a normal Locust class that has a *TaskSet* class with *tasks* in its *task_set* attribute. However, the *ApiUser* inherits from *XmlRpcLocust* that you can see right above *ApiUser*. The *XmlRpcLocust* class provides an instance of *XmlRpcClient* under the *client* attribute. The *XmlRpcClient* is a wrapper around the standard library's `xmlrpclib.ServerProxy`. It basically just proxies the function calls, but with the important addition of firing `locust.events.request_success` and `locust.events.request_failure` events, which will make all calls reported in Locust's statistics.

Here's an implementation of an XML-RPC server that would work as a server for the code above:

```

import random
import time
from SimpleXMLRPCServer import SimpleXMLRPCServer

def get_time():
    time.sleep(random.random())
    return time.time()

def get_random_number(low, high):
    time.sleep(random.random())
    return random.randint(low, high)

server = SimpleXMLRPCServer(("localhost", 8877))
print("Listening on port 8877...")
server.register_function(get_time, "get_time")
server.register_function(get_random_number, "get_random_number")
server.serve_forever()

```

4.3 Extending Locust

Locust comes with a number of events that provides hooks for extending locust in different ways.

Event listeners can be registered at the module level in a locust file. Here's an example:

```
from locust import events

def my_success_handler(request_type, name, response_time, response_length, **kw):
    print "Successfully fetched: %s" % (name)

events.request_success += my_success_handler
```

Note: It's highly recommended that you add a wildcard keyword argument in your listeners (the `**kw` in the code above), to prevent your code from breaking if new arguments are added in a future version.

See also:

To see all available event, please see *Event hooks*.

4.3.1 Adding Web Routes

Locust uses Flask to serve the web UI and therefore it is easy to add web end-points to the web UI. Just import the Flask app in your locustfile and set up a new route:

```
from locust import web

@web.app.route("/added_page")
def my_added_page():
    return "Another page"
```

You should now be able to start locust and browse to http://127.0.0.1:8089/added_page

4.4 Logging

Locust comes with a basic logging configuration that optionally takes `--loglevel` and/or `--logfile` to modify the configuration. If you want to control the logging configuration you can supply the `--skip-log-setup` flag, which ignores the other parameters.

4.4.1 Options

4.4.1.1 `--skip-log-setup`

Disable Locust's logging setup. Instead, the configuration is provided by the Locust test or Python defaults.

4.4.1.2 `--loglevel`

Choose between DEBUG/INFO/WARNING/ERROR/CRITICAL. Default is INFO. The short-hand version is `-L`.

4.4.1.3 `--logfile`

Path to log file. If not set, log will go to stdout/stderr.

5.1 API

5.1.1 Locust class

class Locust

Represents a “user” which is to be hatched and attack the system that is to be load tested.

The behaviour of this user is defined by the `task_set` attribute, which should point to a *TaskSet* class.

This class should usually be subclassed by a class that defines some kind of client. For example when load testing an HTTP system, you probably want to use the *HttpLocust* class.

task_set = None

TaskSet class that defines the execution behaviour of this locust

wait_time = None

Method that returns the time (in seconds) between the execution of locust tasks. Can be overridden for individual TaskSets.

Example:

```
from locust import Locust, between
class User(Locust):
    wait_time = between(3, 25)
```

weight = 10

Probability of locust being chosen. The higher the weight, the greater is the chance of it being chosen.

5.1.2 HttpLocust class

class HttpLocust

Represents an HTTP “user” which is to be hatched and attack the system that is to be load tested.

The behaviour of this user is defined by the `task_set` attribute, which should point to a *TaskSet* class.

This class creates a *client* attribute on instantiation which is an HTTP client with support for keeping a user session between requests.

client = None

Instance of `HttpSession` that is created upon instantiation of `Locust`. The client support cookies, and therefore keeps the session between HTTP requests.

5.1.3 TaskSet class

class TaskSet (*parent*)

Class defining a set of tasks that a Locust user will execute.

When a `TaskSet` starts running, it will pick a task from the *tasks* attribute, execute it, and call its *wait_function* which will define a time to sleep for. This defaults to a uniformly distributed random number between *min_wait* and *max_wait* milliseconds. It will then schedule another task for execution and so on.

`TaskSets` can be nested, which means that a `TaskSet`'s *tasks* attribute can contain another `TaskSet`. If the nested `TaskSet` is scheduled to be executed, it will be instantiated and called from the current executing `TaskSet`. Execution in the currently running `TaskSet` will then be handed over to the nested `TaskSet` which will continue to run until it throws an `InterruptTaskSet` exception, which is done when `TaskSet.interrupt()` is called. (execution will then continue in the first `TaskSet`).

client

Reference to the `client` attribute of the root `Locust` instance.

interrupt (*reschedule=True*)

Interrupt the `TaskSet` and hand over execution control back to the parent `TaskSet`.

If *reschedule* is `True` (default), the parent `Locust` will immediately re-schedule, and execute, a new task

This method should not be called by the root `TaskSet` (the one that is immediately, attached to the `Locust` class' *task_set* attribute), but rather in nested `TaskSet` classes further down the hierarchy.

locust = None

Will refer to the root `Locust` class instance when the `TaskSet` has been instantiated

parent = None

Will refer to the parent `TaskSet`, or `Locust`, class instance when the `TaskSet` has been instantiated. Useful for nested `TaskSet` classes.

schedule_task (*task_callable, args=None, kwargs=None, first=False*)

Add a task to the `Locust`'s task execution queue.

Arguments:

- *task_callable*: `Locust` task to schedule
- *args*: Arguments that will be passed to the task callable
- *kwargs*: Dict of keyword arguments that will be passed to the task callable.
- *first*: Optional keyword argument. If `True`, the task will be put first in the queue.

tasks = []

List with python callables that represents a locust user task.

If *tasks* is a list, the task to be performed will be picked randomly.

If *tasks* is a (*callable,int*) list of two-tuples, or a {*callable:int*} dict, the task to be performed will be picked randomly, but each task will be weighted according to it's corresponding int value. So in the following case `ThreadPage` will be fifteen times more likely to be picked than `write_post`:

```
class ForumPage(TaskSet):
    tasks = {ThreadPage:15, write_post:1}
```

wait_time()

Method that returns the time (in seconds) between the execution of tasks.

Example:

```
from locust import TaskSet, between
class Tasks(TaskSet):
    wait_time = between(3, 25)
```

5.1.4 task decorator

task (*weight=1*)

Used as a convenience decorator to be able to declare tasks for a TaskSet inline in the class. Example:

```
class ForumPage(TaskSet):
    @task(100)
    def read_thread(self):
        pass

    @task(7)
    def create_thread(self):
        pass
```

5.1.5 TaskSequence class

class TaskSequence (*parent*)

Class defining a sequence of tasks that a Locust user will execute.

When a TaskSequence starts running, it will pick the task in *index* from the *tasks* attribute, execute it, and call its *wait_function* which will define a time to sleep for. This defaults to a uniformly distributed random number between *min_wait* and *max_wait* milliseconds. It will then schedule the *index + 1 % len(tasks)* task for execution and so on.

TaskSequence can be nested with TaskSet, which means that a TaskSequence's *tasks* attribute can contain TaskSet instances as well as other TaskSequence instances. If the nested TaskSet is scheduled to be executed, it will be instantiated and called from the current executing TaskSet. Execution in the currently running TaskSet will then be handed over to the nested TaskSet which will continue to run until it throws an InterruptTaskSet exception, which is done when *TaskSet.interrupt()* is called. (execution will then continue in the first TaskSet).

In this class, tasks should be defined as a list, or simply define the tasks with the `@seq_task` decorator

client

Reference to the `client` attribute of the root Locust instance.

interrupt (*reschedule=True*)

Interrupt the TaskSet and hand over execution control back to the parent TaskSet.

If *reschedule* is True (default), the parent Locust will immediately re-schedule, and execute, a new task

This method should not be called by the root TaskSet (the one that is immediately, attached to the Locust class' *task_set* attribute), but rather in nested TaskSet classes further down the hierarchy.

schedule_task (*task_callable*, *args=None*, *kwargs=None*, *first=False*)

Add a task to the Locust's task execution queue.

Arguments:

- *task_callable*: Locust task to schedule
- *args*: Arguments that will be passed to the task callable
- *kwargs*: Dict of keyword arguments that will be passed to the task callable.
- *first*: Optional keyword argument. If True, the task will be put first in the queue.

wait_time ()

Method that returns the time (in seconds) between the execution of tasks.

Example:

```
from locust import TaskSet, between
class Tasks(TaskSet):
    wait_time = between(3, 25)
```

5.1.6 seq_task decorator

seq_task (*order*)

Used as a convenience decorator to be able to declare tasks for a TaskSequence inline in the class. Example:

```
class NormalUser(TaskSequence):
    @seq_task(1)
    def login_first(self):
        pass

    @seq_task(2)
    @task(25) # You can also set the weight in order to execute the task for_
    ↪ `weight` times one after another.
    def then_read_thread(self):
        pass

    @seq_task(3)
    def then_logout(self):
        pass
```

5.1.7 Built in wait_time functions

between (*min_wait*, *max_wait*)

Returns a function that will return a random number between *min_wait* and *max_wait*.

Example:

```
class User(Locust):
    # wait between 3.0 and 10.5 seconds after each task
    wait_time = between(3.0, 10.5)
```

constant (*wait_time*)

Returns a function that just returns the number specified by the *wait_time* argument

Example:

```
class User(Locust):
    wait_time = constant(3)
```

`constant_pacing` (*wait_time*)

Returns a function that will track the run time of the tasks, and for each time it's called it will return a wait time that will try to make the total time between task execution equal to the time specified by the `wait_time` argument.

In the following example the task will always be executed once every second, no matter the task execution time:

```
class User(Locust):
    wait_time = constant_pacing(1)
    class task_set(TaskSet):
        @task
        def my_task(self):
            time.sleep(random.random())
```

If a task execution exceeds the specified `wait_time`, the wait will be 0 before starting the next task.

5.1.8 HttpSession class

`class HttpSession` (*base_url, *args, **kwargs*)

Class for performing web requests and holding (session-) cookies between requests (in order to be able to log in and out of websites). Each request is logged so that locust can display statistics.

This is a slightly extended version of `python-request's requests.Session` class and mostly this class works exactly the same. However the methods for making requests (`get`, `post`, `delete`, `put`, `head`, `options`, `patch`, `request`) can now take a `url` argument that's only the path part of the URL, in which case the host part of the URL will be prepended with the `HttpSession.base_url` which is normally inherited from a Locust class' `host` property.

Each of the methods for making requests also takes two additional optional arguments which are Locust specific and doesn't exist in `python-requests`. These are:

Parameters

- **name** – (optional) An argument that can be specified to use as label in Locust's statistics instead of the URL path. This can be used to group different URL's that are requested into a single entry in Locust's statistics.
- **catch_response** – (optional) Boolean argument that, if set, can be used to make a request return a context manager to work as argument to a `with` statement. This will allow the request to be marked as a fail based on the content of the response, even if the response code is ok (2xx). The opposite also works, one can use `catch_response` to catch a request and then mark it as successful even if the response code was not (i.e 500 or 404).

`__init__` (*base_url, *args, **kwargs*)

`x.__init__(...)` initializes x; see `help(type(x))` for signature

`delete` (*url, **kwargs*)

Sends a DELETE request. Returns `Response` object.

Parameters

- **url** – URL for the new `Request` object.
- ****kwargs** – Optional arguments that `request` takes.

Return type `requests.Response`

`get` (*url, **kwargs*)

Sends a GET request. Returns `Response` object.

Parameters

- **url** – URL for the new `Request` object.
- ****kwargs** – Optional arguments that `request` takes.

Return type `requests.Response`

head (*url*, ***kwargs*)

Sends a HEAD request. Returns `Response` object.

Parameters

- **url** – URL for the new `Request` object.
- ****kwargs** – Optional arguments that `request` takes.

Return type `requests.Response`

options (*url*, ***kwargs*)

Sends a OPTIONS request. Returns `Response` object.

Parameters

- **url** – URL for the new `Request` object.
- ****kwargs** – Optional arguments that `request` takes.

Return type `requests.Response`

patch (*url*, *data=None*, ***kwargs*)

Sends a PATCH request. Returns `Response` object.

Parameters

- **url** – URL for the new `Request` object.
- **data** – (optional) Dictionary, list of tuples, bytes, or file-like object to send in the body of the `Request`.
- ****kwargs** – Optional arguments that `request` takes.

Return type `requests.Response`

post (*url*, *data=None*, *json=None*, ***kwargs*)

Sends a POST request. Returns `Response` object.

Parameters

- **url** – URL for the new `Request` object.
- **data** – (optional) Dictionary, list of tuples, bytes, or file-like object to send in the body of the `Request`.
- **json** – (optional) json to send in the body of the `Request`.
- ****kwargs** – Optional arguments that `request` takes.

Return type `requests.Response`

put (*url*, *data=None*, ***kwargs*)

Sends a PUT request. Returns `Response` object.

Parameters

- **url** – URL for the new `Request` object.
- **data** – (optional) Dictionary, list of tuples, bytes, or file-like object to send in the body of the `Request`.

- ****kwargs** – Optional arguments that `request` takes.

Return type `requests.Response`

request (*method, url, name=None, catch_response=False, **kwargs*)

Constructs and sends a `requests.Request`. Returns `requests.Response` object.

Parameters

- **method** – method for the new `Request` object.
- **url** – URL for the new `Request` object.
- **name** – (optional) An argument that can be specified to use as label in Locust's statistics instead of the URL path. This can be used to group different URL's that are requested into a single entry in Locust's statistics.
- **catch_response** – (optional) Boolean argument that, if set, can be used to make a request return a context manager to work as argument to a `with` statement. This will allow the request to be marked as a fail based on the content of the response, even if the response code is ok (2xx). The opposite also works, one can use `catch_response` to catch a request and then mark it as successful even if the response code was not (i.e 500 or 404).
- **params** – (optional) Dictionary or bytes to be sent in the query string for the `Request`.
- **data** – (optional) Dictionary or bytes to send in the body of the `Request`.
- **headers** – (optional) Dictionary of HTTP Headers to send with the `Request`.
- **cookies** – (optional) Dict or `CookieJar` object to send with the `Request`.
- **files** – (optional) Dictionary of 'filename': `file-like-objects` for multi-part encoding upload.
- **auth** – (optional) Auth tuple or callable to enable Basic/Digest/Custom HTTP Auth.
- **timeout** (*float or tuple*) – (optional) How long in seconds to wait for the server to send data before giving up, as a float, or a (`connect timeout, read timeout`) tuple.
- **allow_redirects** (*bool*) – (optional) Set to `True` by default.
- **proxies** – (optional) Dictionary mapping protocol to the URL of the proxy.
- **stream** – (optional) whether to immediately download the response content. Defaults to `False`.
- **verify** – (optional) if `True`, the SSL cert will be verified. A `CA_BUNDLE` path can also be provided.
- **cert** – (optional) if String, path to ssl client cert file (.pem). If Tuple, ('cert', 'key') pair.

5.1.9 Response class

This class actually resides in the `python-requests` library, since that's what Locust is using to make HTTP requests, but it's included in the API docs for locust since it's so central when writing locust load tests. You can also look at the `Response` class at the [requests documentation](#).

class Response

The `Response` object, which contains a server's response to an HTTP request.

`apparent_encoding`

The apparent encoding, provided by the `chardet` library.

close()

Releases the connection back to the pool. Once this method has been called the underlying `raw` object must not be accessed again.

Note: Should not normally need to be called explicitly.

content

Content of the response, in bytes.

cookies = None

A CookieJar of Cookies the server sent back.

elapsed = None

The amount of time elapsed between sending the request and the arrival of the response (as a timedelta). This property specifically measures the time taken between sending the first byte of the request and finishing parsing the headers. It is therefore unaffected by consuming the response content or the value of the `stream` keyword argument.

encoding = None

Encoding to decode with when accessing `r.text`.

headers = None

Case-insensitive Dictionary of Response Headers. For example, `headers['content-encoding']` will return the value of a 'Content-Encoding' response header.

history = None

A list of `Response` objects from the history of the Request. Any redirect responses will end up here. The list is sorted from the oldest to the most recent request.

is_permanent_redirect

True if this Response one of the permanent versions of redirect.

is_redirect

True if this Response is a well-formed HTTP redirect that could have been processed automatically (by `Session.resolve_redirects()`).

iter_content (*chunk_size=1, decode_unicode=False*)

Iterates over the response data. When `stream=True` is set on the request, this avoids reading the content at once into memory for large responses. The chunk size is the number of bytes it should read into memory. This is not necessarily the length of each item returned as decoding can take place.

`chunk_size` must be of type `int` or `None`. A value of `None` will function differently depending on the value of `stream`. `stream=True` will read data as it arrives in whatever size the chunks are received. If `stream=False`, data is returned as a single chunk.

If `decode_unicode` is `True`, content will be decoded using the best available encoding based on the response.

iter_lines (*chunk_size=512, decode_unicode=False, delimiter=None*)

Iterates over the response data, one line at a time. When `stream=True` is set on the request, this avoids reading the content at once into memory for large responses.

Note: This method is not reentrant safe.

json (***kwargs*)

Returns the json-encoded content of a response, if any.

Parameters ****kwargs** – Optional arguments that `json.loads` takes.

Raises **ValueError** – If the response body does not contain valid json.

links

Returns the parsed header links of the response, if any.

next

Returns a PreparedRequest for the next request in a redirect chain, if there is one.

ok

Returns True if `status_code` is less than 400, False if not.

This attribute checks if the status code of the response is between 400 and 600 to see if there was a client error or a server error. If the status code is between 200 and 400, this will return True. This is **not** a check to see if the response code is 200 OK.

raise_for_status ()

Raises stored HTTPError, if one occurred.

reason = None

Textual reason of responded HTTP Status, e.g. “Not Found” or “OK”.

request = None

The PreparedRequest object to which this is a response.

status_code = None

Integer Code of responded HTTP Status, e.g. 404 or 200.

text

Content of the response, in unicode.

If Response.encoding is None, encoding will be guessed using `chardet`.

The encoding of the response content is determined based solely on HTTP headers, following RFC 2616 to the letter. If you can take advantage of non-HTTP knowledge to make a better guess at the encoding, you should set `r.encoding` appropriately before accessing this property.

url = None

Final URL location of Response.

5.1.10 ResponseContextManager class

class ResponseContextManager (*response*)

A Response class that also acts as a context manager that provides the ability to manually control if an HTTP request should be marked as successful or a failure in Locust’s statistics

This class is a subclass of `Response` with two additional methods: `success` and `failure`.

failure (*exc*)

Report the response as a failure.

`exc` can be either a python exception, or a string in which case it will be wrapped inside a `CatchResponseError`.

Example:

```
with self.client.get("/", catch_response=True) as response:
    if response.content == b"":
        response.failure("No data")
```

success ()

Report the response as successful

Example:

```
with self.client.get("/does/not/exist", catch_response=True) as response:
    if response.status_code == 404:
        response.success()
```

5.1.11 InterruptTaskSet Exception

exception InterruptTaskSet (*reschedule=True*)
Exception that will interrupt a Locust when thrown inside a task

5.1.12 Event hooks

The event hooks are instances of the **locust.events.EventHook** class:

class EventHook
Simple event class used to provide hooks for different types of events in Locust.

Here's how to use the EventHook class:

```
my_event = EventHook()
def on_my_event(a, b, **kw):
    print "Event was fired with arguments: %s, %s" % (a, b)
my_event += on_my_event
my_event.fire(a="foo", b="bar")
```

If reverse is True, then the handlers will run in the reverse order that they were inserted

Note: It's highly recommended that you add a wildcard keyword argument in your event listeners to prevent your code from breaking if new arguments are added in a future version.

5.1.12.1 Available hooks

The following event hooks are available under the **locust.events** module:

request_success = <locust.events.EventHook object>
request_success is fired when a request is completed successfully.

Listeners should take the following arguments:

- *request_type*: Request type method used
- *name*: Path to the URL that was called (or override name if it was used in the call to the client)
- *response_time*: Response time in milliseconds
- *response_length*: Content-length of the response

request_failure = <locust.events.EventHook object>
request_failure is fired when a request fails

Event is fired with the following arguments:

- *request_type*: Request type method used
- *name*: Path to the URL that was called (or override name if it was used in the call to the client)
- *response_time*: Time in milliseconds until exception was thrown

- *response_length*: Content-length of the response
- *exception*: Exception instance that was thrown

locust_error = <locust.events.EventHook object>

locust_error is fired when an exception occurs inside the execution of a Locust class.

Event is fired with the following arguments:

- *locust_instance*: Locust class instance where the exception occurred
- *exception*: Exception that was thrown
- *tb*: Traceback object (from `sys.exc_info()[2]`)

report_to_master = <locust.events.EventHook object>

report_to_master is used when Locust is running in `-slave` mode. It can be used to attach data to the dicts that are regularly sent to the master. It's fired regularly when a report is to be sent to the master server.

Note that the keys "stats" and "errors" are used by Locust and shouldn't be overridden.

Event is fired with the following arguments:

- *client_id*: The client id of the running locust process.
- *data*: Data dict that can be modified in order to attach data that should be sent to the master.

slave_report = <locust.events.EventHook object>

slave_report is used when Locust is running in `-master` mode and is fired when the master server receives a report from a Locust slave server.

This event can be used to aggregate data from the locust slave servers.

Event is fired with following arguments:

- *client_id*: Client id of the reporting locust slave
- *data*: Data dict with the data from the slave node

hatch_complete = <locust.events.EventHook object>

hatch_complete is fired when all locust users has been spawned.

Event is fire with the following arguments:

- *user_count*: Number of users that was hatched

quitting = <locust.events.EventHook object>

quitting is fired when the locust process is exiting

6.1 Third party tools

6.1.1 Using other languages

A Locust master and a Locust slave communicate by exchanging `msgpack` messages, which is supported by many languages. So, you can write your Locust tasks in any languages you like. For convenience, some libraries do the job as a slave runner. They run your Locust tasks, and report to master regularly.

6.1.1.1 Golang

- Boomer

6.1.1.2 Java

- Locust4j
- Swarm

6.1.2 Configuration Management

Deploying Locust is easy, but here and there some tools can still provide a measure of convenience.

`tinx.locust` is an Ansible role to install, configure and control Locust as a systemd service, or to build Locust docker images using `ansible-container`. Also manages `locustfiles` and accompanying test data.

7.1 Changelog Highlights

For full details of the Locust changelog, please see <https://github.com/locustio/locust/blob/master/CHANGELOG.md>

7.1.1 0.13.4

Identical to previous version, but now built & deployed to Pypi using Travis.

7.1.2 0.13.3

- Unable to properly connect multiple slaves - <https://github.com/locustio/locust/issues/1176>
- Zero exit code on exception - <https://github.com/locustio/locust/issues/1172>
- `-stop-timeout` is not respected when changing number of running Users in distributed mode - <https://github.com/locustio/locust/issues/1162>

7.1.3 0.13.2

- Fixed bug that broke the Web UI's response time graph

7.1.4 0.13.1

- Fixed crash bug on Python 3.8.0
- Various other bug fixes and improvements.

7.1.5 0.13.0

- New API for specifying wait time - <https://github.com/locustio/locust/pull/1118>

Example of the new API:

```
from locust import HttpLocust, between
class User(HttpLocust):
    # wait between 5 and 30 seconds
    wait_time = between(5, 30)
```

There are three built in *wait time functions*: *between*, *constant* and *constant_pacing*.

- FastHttpLocust: Accept self signed SSL certificates, ignore host checks. Improved response code handling
- Add current working dir to sys.path - <https://github.com/locustio/locust/pull/484>
- Web UI improvements: Added 90th percentile to table, failure per seconds as a series in the chart
- Ability to specify host in web ui
- Added response_length to request_failure event - <https://github.com/locustio/locust/pull/1144>
- Added p99.9 and p99.99 to request stats distribution csv - <https://github.com/locustio/locust/pull/1125>
- Various other bug fixes and improvements.

7.1.6 0.12.2

- Added `-skip-log-setup` to disable Locust's default logging setup.
- Added `-stop-timeout` to allow tasks to finish running their iteration before stopping
- Added 99.9 and 99.99 percentile response times to csv output
- Allow custom clients to set request response time to None. Those requests will be excluded when calculating median, average, min, max and percentile response times.
- Renamed the last row in statistics table from "Total" to "Aggregated" (since the values aren't a sum of the individual table rows).
- Some visual improvements to the web UI.
- Fixed issue with simulating fewer number of locust users than the number of slave/worker nodes.
- Fixed bugs in the web UI related to the fact that the stats table is truncated at 500 entries.
- Various other bug fixes and improvements.

7.1.7 0.12.1

- Added new `FastHttpLocust` class that uses a faster HTTP client, which should be 5-6 times faster than the normal `HttpLocust` class. For more info see the documentation on *increasing performance*.
- Added ability to set the exit code of the locust process when exceptions has occurred within the user code, using the `--exit-code-on-error` parameter.
- Added TCP keep alive to master/slave communication sockets to avoid broken connections in some environments.
- Dropped support for Python 3.4
- Numerous other bug fixes and improvements.

7.1.8 0.10.0

- Python 3.7 support
- Added a status page to the web UI when running Locust distributed showing the status of slave nodes and detect down slaves using heartbeats
- Numerous bugfixes/documentation updates (see detailed changelog)

7.1.9 0.9.0

- Added detailed changelog (<https://github.com/locustio/locust/blob/master/CHANGELOG.md>)
- Numerous bugfixes (see detailed changelog)
- Added sequential task support - <https://github.com/locustio/locust/pull/827>
- Added support for user-defined wait_function - <https://github.com/locustio/locust/pull/785>
- By default, Locust no longer resets the statistics when the hatching is complete. Therefore `--no-reset-stats` has been deprecated (since it's now the default behaviour), and instead a new `--reset-stats` option has been added.
- Dropped support for Python 3.3
- Updated documentation

7.1.10 0.8.1

- Updated pyzmq version, and changed so that we don't pin a specific version. This makes it easier to install Locust on Windows.

7.1.11 0.8

- Python 3 support
- Dropped support for Python 2.6
- Added `--no-reset-stats` option for controlling if the statistics should be reset once the hatching is complete
- Added charts to the web UI for requests per second, average response time, and number of simulated users.
- Updated the design of the web UI.
- Added ability to write a CSV file for results via command line flag
- Added the URL of the host that is currently being tested to the web UI.
- We now also apply gevent's monkey patching of threads. This fixes an issue when using Locust to test Cassandra (<https://github.com/locustio/locust/issues/569>).
- Various bug fixes and improvements

7.1.12 0.7.5

- Use version 1.1.1 of gevent. Fixes an install issue on certain versions of python.

7.1.13 0.7.4

- Use a newer version of requests, which fixed an issue for users with older versions of requests getting ConnectionErrors (<https://github.com/locustio/locust/issues/273>).
- Various fixes to documentation.

7.1.14 0.7.3

- Fixed bug where POST requests (and other methods as well) got incorrectly reported as GET requests, if the request resulted in a redirect.
- Added ability to download exceptions in CSV format. Download links has also been moved to it's own tab in the web UI.

7.1.15 0.7.2

- Locust now returns an exit code of 1 when any failed requests were reported.
- When making an HTTP request to an endpoint that responds with a redirect, the original URL that was requested is now used as the name for that entry in the statistics (unless an explicit override is specified through the *name* argument). Previously, the last URL in the redirect chain was used to label the request(s) in the statistics.
- Fixed bug which caused only the time of the last request in a redirect chain to be included in the reported time.
- Fixed bug which caused the download time of the request body not to be included in the reported response time.
- Fixed bug that occurred on some linux dists that were tampering with the python-requests system package (removing dependencies which requests is bundling). This bug only occurred when installing Locust in the python system packages, and not when using virtualenv.
- Various minor fixes and improvements.

7.1.16 0.7.1

- Exceptions that occurs within TaskSets are now caught by default.
- Fixed bug which caused Min response time to always be 0 after all locusts had been hatched and the statistics had been reset.
- Minor UI improvements in the web interface.
- Handle messages from “zombie” slaves by ignoring the message and making a log entry in the master process.

7.1.17 0.7

7.1.17.1 HTTP client functionality moved to HttpLocust

Previously, the Locust class instantiated a *HttpSession* under the client attribute that was used to make HTTP requests. This functionality has now been moved into the *HttpLocust* class, in an effort to make it more obvious how one can use Locust to *load test non-HTTP systems*.

To make existing locust scripts compatible with the new version you should make your locust classes inherit from HttpLocust instead of the base Locust class.

7.1.17.2 msgpack for serializing master/slave data

Locust now uses `msgpack` for serializing data that is sent between a master node and its slaves. This addresses a possible attack that can be used to execute code remote, if one has access to the internal locust ports that are used for master-slave communication. The reason for this exploit was due to the fact that `pickle` was used.

Warning: Anyone who uses an older version should make sure that their Locust machines are not publicly accessible on port 5557 and 5558. Also, one should never run Locust as root.

Anyone who uses the `report_to_master` and `slave_report` events, needs to make sure that any data that is attached to the slave reports is serializable by `msgpack`.

7.1.17.3 requests updated to version 2.2

Locust updated `requests` to the latest major release.

Note: Requests 1.0 introduced some major API changes (and 2.0 just a few). Please check if you are using any internal features and check the documentation: [Migrating to 1.x](#) and [Migration to 2.x](#)

7.1.17.4 gevent updated to version 1.0

gevent 1.0 has now been released and Locust has been updated accordingly.

7.1.17.5 Big refactoring of request statistics code

Refactored `RequestStats`.

- Created `StatsEntry` which represents a single stats entry (URL).

Previously the `RequestStats` was actually doing two different things:

- It was holding track of the aggregated stats from all requests
- It was holding the stats for single stats entries.

Now `RequestStats` should be instantiated and holds the global stats, as well as a dict of `StatsEntry` instances which holds the stats for single stats entries (URLs)

7.1.17.6 Removed support for `avg_wait`

Previously one could specify `avg_wait` to `TaskSet` and `Locust` that Locust would try to strive to. However this can be sufficiently accomplished by using `min_wait` and `max_wait` for most use-cases. Therefore we've decided to remove the `avg_wait` as its use-case is not clear or just too narrow to be in the Locust core.

7.1.17.7 Removed support for ramping

Previously one could tell Locust, using the `-ramp` option, to try to find a stable client count that the target host could handle, but it's been broken and undocumented for quite a while so we've decided to remove it from the locust core and perhaps have it reappear as a plugin in the future.

7.1.17.8 Locust Event hooks now takes keyword argument

When *Extending Locust* by listening to *Event hooks*, the listener functions should now expect the arguments to be passed in as keyword arguments. It's also highly recommended to add an extra wildcard keyword arguments to listener functions, since they're then less likely to break if extra arguments are added to that event in some future version. For example:

```
from locust import events

def on_request(request_type, name, response_time, response_length, **kw):
    print "Got request!"

locust.events.request_success += on_request
```

The *method* and *path* arguments to *request_success* and *request_failure* are now called *request_type* and *name*, since it's less HTTP specific.

7.1.17.9 Other changes

- You can now specify the port on which to run the web host
- Various code cleanups
- Updated gevent/zmq libraries
- Switched to unittest2 discovery
- Added option `--only-summary` to only output the summary to the console, thus disabling the periodic stats output.
- Locust will now make sure to spawn all the specified locusts in distributed mode, not just a multiple of the number of slaves.
- Fixed the broken Vagrant example.
- Fixed the broken events example (`events.py`).
- Fixed issue where the request column was not sortable in the web-ui.
- Minor styling of the statistics table in the web-ui.
- Added options to specify host and ports in distributed mode using `--master-host`, `--master-port` for the slaves, `--master-bind-host`, `--master-bind-port` for the master.
- Removed previously deprecated and obsolete classes `WebLocust` and `SubLocust`.
- Fixed so that also failed requests count, when specifying a maximum number of requests on the command line

7.1.18 0.6.2

- Made Locust compatible with gevent 1.0rc2. This allows user to step around a problem with running Locust under some versions of CentOS, that can be fixed by upgrading gevent to 1.0.
- Added *parent* attribute to `TaskSet` class that refers to the parent `TaskSet`, or `Locust`, instance. Contributed by Aaron Daubman.

7.1.19 0.6.1

- Fixed bug that was causing problems when setting a maximum number of requests using the `-n` or `--num-request` command line parameter.

7.1.20 0.6

Warning: This version comes with non backward compatible changes to the API. Anyone who is currently using existing locust scripts and want to upgrade to 0.6 should read through these changes.

7.1.20.1 SubLocust replaced by TaskSet and Locust class behaviour changed

Locust classes does no longer control task scheduling and execution. Therefore, you no longer define tasks within Locust classes, instead the Locust class has a *task_set* attribute which should point to a *TaskSet* class. Tasks should now be defined in TaskSet classes, in the same way that was previously done in Locust and SubLocust classes. TaskSets can be nested just like SubLocust classes could.

So the following code for 0.5.1:

```
class User(Locust):
    min_wait = 10000
    max_wait = 120000

    @task(10)
    def index(self):
        self.client.get("/")

    @task(2)
    class AboutPage(SubLocust):
        min_wait = 10000
        max_wait = 120000

        def on_init(self):
            self.client.get("/about/")

        @task
        def team_page(self):
            self.client.get("/about/team/")

        @task
        def press_page(self):
            self.client.get("/about/press/")

        @task
        def stop(self):
            self.interrupt()
```

Should now be written like:

```
class BrowsePage(TaskSet):
    @task(10)
    def index(self):
        self.client.get("/")

    @task(2)
    class AboutPage(TaskSet):
        def on_init(self):
            self.client.get("/about/")

        @task
```

(continues on next page)

(continued from previous page)

```

def team_page(self):
    self.client.get("/about/team/")

@task
def press_page(self):
    self.client.get("/about/press/")

@task
def stop(self):
    self.interrupt()

class User(Locust):
    min_wait = 10000
    max_wait = 120000
    task_set = BrowsePage

```

Each TaskSet instance gets a `locust` attribute, which refers to the Locust class.

7.1.20.2 Locust now uses Requests

Locust's own `HttpBrowser` class (which was typically accessed through `self.client` from within a locust class) has been replaced by a thin wrapper around the `requests` library (<http://python-requests.org>). This comes with a number of advantages. Users can now take advantage of a well documented, well written, fully fledged library for making HTTP requests. However, it also comes with some small API changes which will require users to update their existing load testing scripts.

Gzip encoding turned on by default

The HTTP client now sends headers for accepting gzip encoding by default. The `-gzip` command line argument has been removed and if someone wants to disable the `Accept-Encoding` that the HTTP client uses, or any other HTTP headers you can do:

```

class MyWebUser(Locust):
    def on_start(self):
        self.client.headers = {"Accept-Encoding":""}

```

Improved HTTP client

Because of the switch to using `python-requests` in the HTTP client, the API for the client has also gotten a few changes.

- Additionally to the `get`, `post`, `put`, `delete` and `head` methods, the `HttpSession` class now also has `patch` and `options` methods.
- All arguments to the HTTP request methods, except for `url` and `data` should now be specified as keyword arguments. For example, previously one could specify headers using:

```
client.get("/path", {"User-Agent":"locust"}) # this will no longer work
```

And should now be specified like:

```
client.get("/path", headers={"User-Agent":"locust"})
```


- In general the whole HTTP client is now more powerful since it leverages on python-requests. Features that we're now able to use in Locust includes file upload, SSL, connection keep-alive, and more. See the [python-requests documentation](#) for more details.
- The new `HttpSession` class' methods now return python-request `Response` objects. This means that accessing the content of the response is no longer made using the `data` attribute, but instead the `content` attribute. The HTTP response code is now accessed through the `status_code` attribute, instead of the `code` attribute.

HttpSession methods' `catch_response` argument improved and `allow_http_error` argument removed

- When doing HTTP requests using the `catch_response` argument, the context manager that is returned now provides two functions, `success` and `failure` that can be used to manually control what the request should be reported as in Locust's statistics.

class ResponseContextManager (*response*)

A Response class that also acts as a context manager that provides the ability to manually control if an HTTP request should be marked as successful or a failure in Locust's statistics

This class is a subclass of `Response` with two additional methods: `success` and `failure`.

failure (*exc*)

Report the response as a failure.

`exc` can be either a python exception, or a string in which case it will be wrapped inside a `CatchResponseError`.

Example:

```
with self.client.get("/", catch_response=True) as response:
    if response.content == b"":
        response.failure("No data")
```

success ()

Report the response as successful

Example:

```
with self.client.get("/does/not/exist", catch_response=True) as response:
    if response.status_code == 404:
        response.success()
```

- The `allow_http_error` argument of the HTTP client's methods has been removed. Instead one can use the `catch_response` argument to get a context manager, which can be used together with a with statement.

The following code in the previous Locust version:

```
client.get("/does/not/exist", allow_http_error=True)
```

Can instead now be written like:

```
with client.get("/does/not/exist", catch_response=True) as response:
    response.success()
```

7.1.20.3 Other improvements and bug fixes

- Scheduled task callables can now take keyword arguments and not only normal function arguments.

- SubLocust classes that are scheduled using `locust.core.Locust.schedule_task()` can now take arguments and keyword arguments (available in `self.args` and `self.kwargs`).
- Fixed bug where the average content size would be zero when doing requests against a server that didn't set the content-length header (i.e. server that uses *Transfer-Encoding: chunked*)

7.1.20.4 Smaller API Changes

- The `require_once` decorator has been removed. It was an old legacy function that no longer fit into the current way of writing Locust tests, where tasks are either methods under a Locust class or SubLocust classes containing task methods.
- Changed signature of `locust.core.Locust.schedule_task()`. Previously all extra arguments that was given to the method was passed on to the task when it was called. It no longer accepts extra arguments. Instead, it takes an `args` argument (list) and a `kwargs` argument (dict) which are be passed to the task when it's called.
- Arguments for `request_success` event hook has been changed. Previously it took an HTTP Response instance as argument, but this has been changed to take the content-length of the response instead. This makes it easier to write custom clients for Locust.

7.1.21 0.5.1

- Fixed bug which caused `--logfile` and `--loglevel` command line parameters to not be respected when running locust without zeromq.

7.1.22 0.5

7.1.22.1 API changes

- Web interface is now turned on by default. The `--web` command line option has been replaced by `--no-web`.
- `locust.events.request_success()` and `locust.events.request_failure()` now gets the HTTP method as the first argument.

7.1.22.2 Improvements and bug fixes

- Removed `--show-task-ratio-confluence` and added a `--show-task-ratio-json` option instead. The `--show-task-ratio-json` will output JSON data containing the task execution ratio for the locust "brain".
- The HTTP method used when a client requests a URL is now displayed in the web UI
- Some fixes and improvements in the stats exporting:
- A file name is now set (using content-disposition header) when downloading stats.
- The order of the column headers for request stats was wrong.
- Thanks Benjamin W. Smith, Jussi Kuosa and Samuele Pedroni!

7.1.23 0.4

7.1.23.1 API changes

- WebLocust class has been deprecated and is now called just Locust. The class that was previously called Locust is now called LocustBase.
- The *catch_http_error* argument to `HttpClient.get()` and `HttpClient.post()` has been renamed to *allow_http_error*.

7.1.23.2 Improvements and bug fixes

- Locust now uses python's logging module for all logging
- Added the ability to change the number of spawned users when a test is running, without having to restart the test.
- Experimental support for automatically ramping up and down the number of locust to find a maximum number of concurrent users (based on some parameters like response times and acceptable failure rate).
- Added support for failing requests based on the response data, even if the HTTP response was OK.
- Improved master node performance in order to not get bottlenecked when using enough slaves (>100)
- Minor improvements in web interface.
- Fixed missing template dir in MANIFEST file causing locust installed with "setup.py install" not to work.

|

`locust.events`, 38

`locust.wait_time`, 32

Symbols

`__init__()` (*FastHttpSession* method), 22
`__init__()` (*HttpSession* method), 33

B

`between()` (*in module locust.wait_time*), 32

C

`client` (*HttpLocust* attribute), 30
`client` (*TaskSequence* attribute), 31
`client` (*TaskSet* attribute), 30
`constant()` (*in module locust.wait_time*), 32
`constant_pacing()` (*in module locust.wait_time*),
 33
`content` (*FastResponse* attribute), 23

D

`delete()` (*HttpSession* method), 33

E

`EventHook` (*class in locust.events*), 38

F

`failure()` (*ResponseContextManager* method), 37
`FastHttpSession` (*class in locust.contrib.fasthttp*),
 22
`FastResponse` (*class in locust.contrib.fasthttp*), 23

G

`get()` (*FastHttpSession* method), 22
`get()` (*HttpSession* method), 33

H

`hatch_complete` (*in module locust.events*), 39
`head()` (*FastHttpSession* method), 22
`head()` (*HttpSession* method), 34
`headers` (*FastResponse* attribute), 23
`HttpLocust` (*class in locust.core*), 29

`HttpSession` (*class in locust.clients*), 33

I

`interrupt()` (*TaskSequence* method), 31
`interrupt()` (*TaskSet* method), 30
`InterruptTaskSet`, 38

L

`Locust` (*class in locust.core*), 29
`locust` (*TaskSet* attribute), 30
`locust.events` (*module*), 38
`locust.wait_time` (*module*), 32
`locust_error` (*in module locust.events*), 39

O

`options()` (*FastHttpSession* method), 22
`options()` (*HttpSession* method), 34

P

`parent` (*TaskSet* attribute), 30
`patch()` (*FastHttpSession* method), 22
`patch()` (*HttpSession* method), 34
`post()` (*FastHttpSession* method), 22
`post()` (*HttpSession* method), 34
`put()` (*FastHttpSession* method), 22
`put()` (*HttpSession* method), 34

Q

`quitting` (*in module locust.events*), 39

R

`report_to_master` (*in module locust.events*), 39
`request()` (*FastHttpSession* method), 22
`request()` (*HttpSession* method), 35
`request_failure` (*in module locust.events*), 38
`request_success` (*in module locust.events*), 38
`ResponseContextManager` (*class in locust.clients*),
 37

S

`schedule_task()` (*TaskSequence method*), 31
`schedule_task()` (*TaskSet method*), 30
`seq_task()` (*in module locust.core*), 32
`slave_report` (*in module locust.events*), 39
`success()` (*ResponseContextManager method*), 37

T

`task()` (*in module locust.core*), 31
`task_set` (*Locust attribute*), 29
`tasks` (*TaskSet attribute*), 30
`TaskSequence` (*class in locust.core*), 31
`TaskSet` (*class in locust.core*), 30
`text` (*FastResponse attribute*), 23

W

`wait_time` (*Locust attribute*), 29
`wait_time()` (*TaskSequence method*), 32
`wait_time()` (*TaskSet method*), 31
`weight` (*Locust attribute*), 29