Performance

Outline

1. Load Testing
2. Frontend Tips
3. Server-side Tips

Load Testing

Load testing *is the process of putting demand on a system or device and measuring its response.* ***Load testing*** *is performed to determine a system's behavior under both normal and anticipated peak* ***load*** *conditions.*

Load Testing in High Level

Purpose

- **Predict** how your application will perform when a large number of users are using your application at the same time

How?

- Simulate **artificial** but **realistic** workloads

Load Testing Tools

- JMeter
  - Free and written in Java
- Tsung
  - Free and written in Erlang
- loader.io
  - Partially free; integrates with Heroku
- locust.io
  - Free and written in Python (Today's Focus)

locust.io

Advantages

- Write simple Python code to simulate a user behaviour
- Handles thousands of users on a single machine

Disadvantages

- Results are downloadable in CSV format

locust.io

Installation

```
pip install locustio
```

locust.io

Every HTTP connection will open a new file, but OS sets a limit for the max # of files that can be opened.
You need: # max open files >= # of user you want to test

Linux

```
ulimit -Sn <# max open files>  <- works up to ~64,000
```

Make sure to do this for both terminals running express.js and locust.io!!!

locust.io

1. Simulating a user

Write a class subclassing HttpLocust to define a user.

Example

```
class User(HttpLocust):
      task_set = UserTasks
      min_wait = 5000
      max_wait = 15000
```

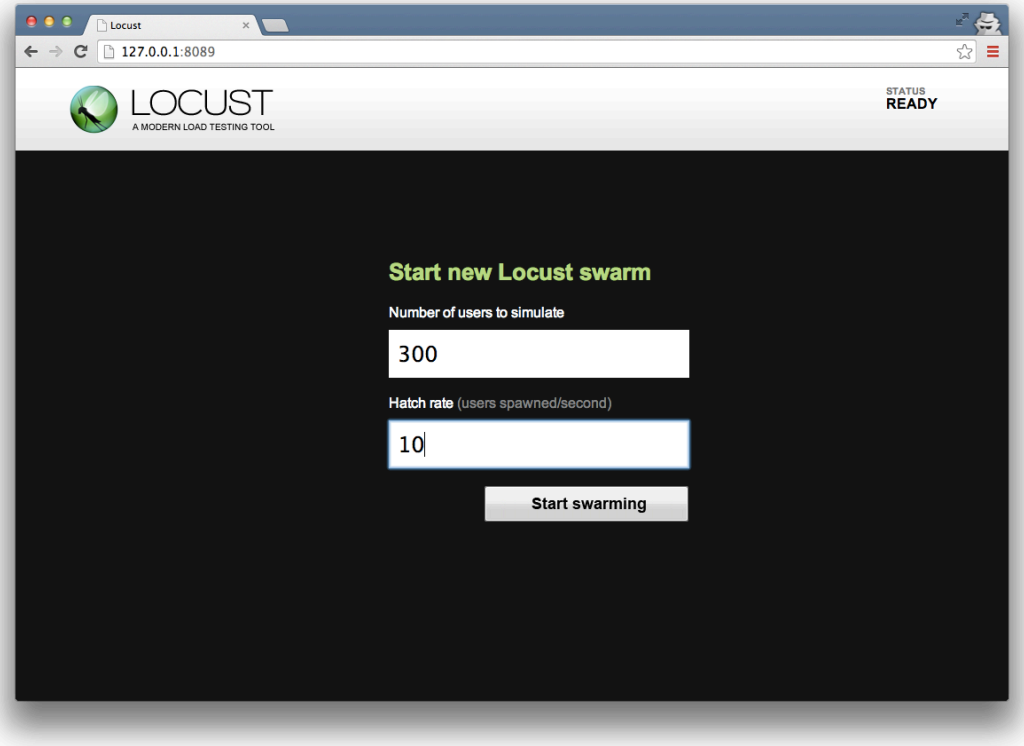
Explanation:
A user's behaviour will be defined in **UserTasks** class. The user will wait randomly between **5 to 15 secs** before sending a request to the application.

Example

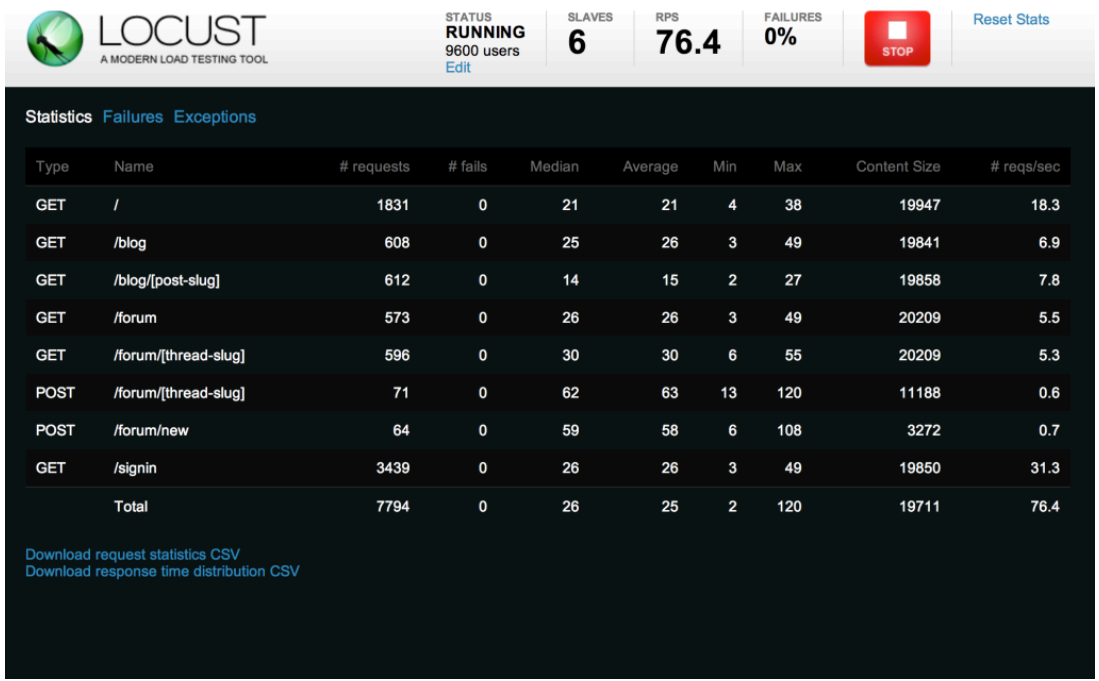
```
class UserTasks(TaskSet):
        @task(2)
        def index(self):

        self.client.get(“/”)

        @task(1)
        def about(self):
        self.client.get(“/
about/”)
```

Explanation:
A user will randomly send a GET request to “/” endpoint and a GET request to “/about/” endpoint. The user will send GET requests to “/” about twice as many times as GET requests to “/about/”.

locust.io Web Interface



locust.io Web Interface



Demo

Front-end Tips

1. gzip
2. cache control

gzip in express.js

- Use compress middleware (Version 3.x)

```
app.use(express.compress());
```

- Use compression middleware (Version 4.x)

```
var compress = require('compression');
app.use(compress());
```

Cache Control

- HTTP Header
- You can tell a user's browser to cache specific resources from your application
  - e.g. images, js files, css files, etc
- Reduce latency
  - a user will receive response faster
- Reduce network bandwidth
  - a network can handle more messages

Cache Control

Useful headers

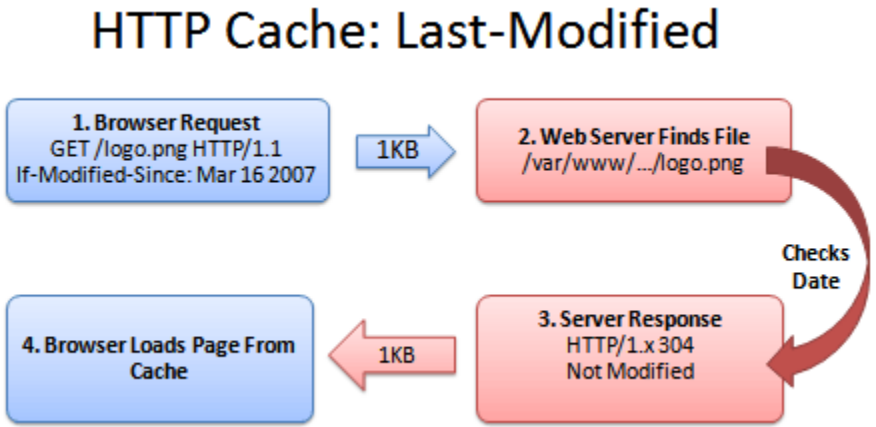
- max-age=[seconds]
  - max amount of time a resource will be considered fresh
- no-cache
  - forces server validation before releasing a cached copy
- no-store
  - disable caching a resource
- public/private
  - allow/disable caching a response to a public (shared) cache

Cache Control

- What happens if a resource seems stale?
  - Cache will try to validate its copy against your application
  - Uses Last-Modified or ETags header

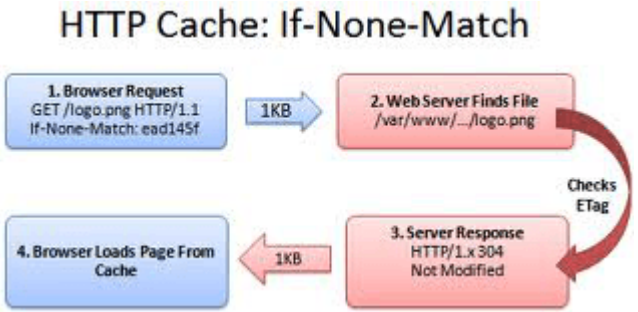
Last-Modified

How it works



ETags

How it works



ETag usually computes a hash of a resource to detect any changes made to it.

Cache Control in express.js

- Good News!
  - They are mostly built-in or easy to use!

Cache Control in express.js

- Static Files
  - Use `express.static()` with `maxAge` option

Example

```
app.use(express.static(__dirname + ‘/public’, {
      maxAge: 86400000
}));
```

Cache Control in express.js

- favicon
  - serve-favicon module

Example

```
var favicon = require('serve-favicon');
app.use(favicon(path.join(__dirname, 'public',
'favicon.ico'), {maxAge: 86400000}));
```

Cache Control in express.js

ETags

- express.js calculates ETags automatically
- However, if you want to customize it…

```
app.set('etag', function(body, encoding) {
      return calculateHash(body, encoding);
});
```

Cache Control in express.js

- response.send() does automatic cache control support
- http://expressjs.com/api.html for more information
- But you can always set these headers manually!

Backend Tips

1. Increase parallelism of node.js
2. Caching
3. DB index

Node.js

- Asynchronous + single threaded
  - Almost all computers are multi-core now
  - node.js (express.js) uses only **1 core** by default!

- Solution?
  - Run one node.js process per core of your machine

Cluster module

- cluster module makes your job of managing multiple node.js processes easier.
- https://nodejs.org/api/cluster.html for more information

Cluster module

```
var cluster = require(‘cluster’);
var numCPUs = require(‘os’).cpus().length;
if (cluster.isMaster) {
        for (var i = 0; i < numCPUs; i++) cluster.fork();
} else {
        var app = require(‘express’)();
        app.get(‘/’, function(req, res) {..});
        app.listen(3000);
}
```

Handling failures

```
if (cluster.isMaster) {
        for (var i = 0; i < numCPUs; i++) cluster.fork();
    cluster.on('exit', function(worker) {
                cluster.fork();
    });
}
```

Caching

Basic Idea:
Cache resources that are **costly** to generate and **frequently read** and **rarely modified**

Options:

- Redis, Memcached, Varnish, ...

Caching with Redis

- Key-value cache/store known to be very very fast! http://redis.io/

- Idea:
  - Store results from **expensive** computation in Redis for quick reuse (avoid computation)

Using Redis

- Installation instruction in http://redis.io/download
- Provides node.js driver similar to MongoDB
  - `npm install redis`

Example

```
app.get(‘/expensive’, function(req, res) {
      var result = 0;
      for(var i = 0; i < 100000; i++) {..}
      res.send(result);
});
```

Example

```
var redis = require('redis');
var client = redis.createClient();
app.get('/expensive', function(req, res) {
        client.get('result', function(err, val) {
                if (val) return res.send(val);
                else {
                        var result = 0;
                        for(var i=0; i<10000; i++) {..}
                        client.set('result', result);
                }
        });
});
```

MongoDB Index

- Lets you avoid scanning every document in a collection
- Speeds up your read operations
- However, they may hurt your write operations
  - Because it needs to write more data

MongoDB Index

- Indexes are just data structures that stores specific field values in sorted order

Example

```
db.collection(‘collection’).createIndex(
   {field: 1}
);
```