

Software at Scale

Software Architecture

Brae Webb

March 20, 2023

Question

How many concurrent users can your software handle?

Question

How many concurrent users can your software handle?

Answer

Maybe *400*? Maximum.

Question

How many concurrent users can your software handle?

Answer

Maybe *400*¹? Maximum.

¹HTTP server on a t2.micro EC2 instance

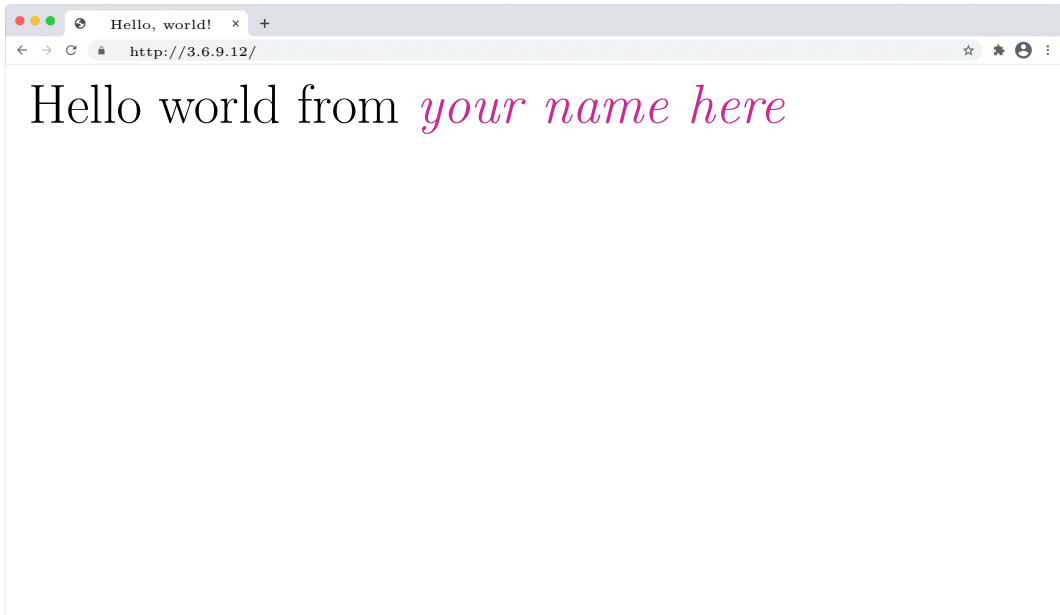
Definition 1. Stress Testing

Measure the robustness of software by pushing usage to an extreme.

Demonstration

Let's build 'hello world'

Our Goal





Hello world from Brae


```
>> cat hello-server.tf
```

```
1 resource "aws_instance" "hello-server" {  
2     ami = "ami-04902260ca3d33422"  
3     instance_type = "t2.micro"  
4 }
```

```
>> cat hello-server.tf
```

```
1 resource "aws_instance" "hello-server" {  
2     ami = "ami-04902260ca3d33422"  
3     instance_type = "t2.micro"  
  
5     user_data = file("./setup.sh")  
6 }
```

```
>> cat setup.sh
```

```
1  #!/bin/bash
2  yum -y install httpd
3  systemctl enable httpd
4  systemctl start httpd
5  echo '<html><title>Hello, world!</title><h1>Hello world from Brae</h1></html>' > /
    var/www/html/index.html
```

```
>> cat hello-server.tf
```

```
1 resource "aws_instance" "hello-server" {  
2     ami = "ami-04902260ca3d33422"  
3     instance_type = "t2.micro"  
  
5     user_data = file("./setup.sh")  
  
7     security_groups = [  
8         aws_security_group.hello-server.name  
9     ]  
10 }
```

```
>> cat hello-server.tf
```

```
1 resource "aws_instance" "hello-server" {
2     ami = "ami-04902260ca3d33422"
3     instance_type = "t2.micro"
4
5     user_data = file("./setup.sh")
6
7     security_groups = [
8         aws_security_group.hello-server.name
9     ]
10
11     tags = {
12         Name = "hello-server"
13     }
14 }
```

Starting the server

```
1 >> terraform init
2 >> terraform plan
3 >> terraform apply
```

Before



After



Question

How much traffic can this website handle?

```
>> cat stress-test.js
```

```
1  import http from 'k6/http';
2  import { check, sleep } from 'k6';

4  const IP = "http://3.6.9.12/";
5  export default function() {
6      const res = http.get(IP);
7      check(res, { 'status was 200': (r) => r.status == 200 });
8      sleep(1);
9  }
```

```
>> cat stress-test.js
```

```
1  import http from 'k6/http';
2  import { check, sleep } from 'k6';

4  const IP = "http://3.6.9.12/";
5  export const options = {
6    stages: [
7      { duration: '2m', target: 100 },
8    ],
9  };
10 export default function() {
11   const res = http.get(IP);
12   check(res, { 'status was 200': (r) => r.status == 200 });
13   sleep(1);
14 }
```

Run the tests

```
1 >> k6 run stress-test.js
```

Looks good so far

```
1  status was 200
2  100% - 347867 / 0

4  checks.....: 100%
5  data_received.....: 100 MB 44 kB/s
6  data_sent.....: 27 MB 12 kB/s
7  iterations.....: 347997 152.552084/s
8  vus.....: 1 min=1 max=400
```

Let's upgrade the traffic

```
>> cat stress-test.js
```

```
1 export const options = {
2   stages: [
3     { duration: '2m', target: 100 },
4     { duration: '5m', target: 100 },
5     { duration: '2m', target: 200 },
6     { duration: '5m', target: 200 },
7     { duration: '2m', target: 300 }, // around the breaking point
8     { duration: '5m', target: 300 },
9     { duration: '2m', target: 400 }, // beyond the breaking point
10    { duration: '5m', target: 400 },
11    { duration: '2m', target: 0 }, // scale down
12  ],
13 };
```

And run the tests again

```
1 >> k6 run stress-test.js
```

Oh no...

```
1 status was 200
2 99% - 347867 / 130

4 checks.....: 99.96%
5 data_received.....: 100 MB 44 kB/s
6 data_sent.....: 27 MB 12 kB/s
7 iterations.....: 347997 152.552084/s
8 vus.....: 1 min=1 max=400
```


Back to square one



Question

How can we fix this?

Question

How can we fix this?

Answer

More servers?

```
>> cat hello-server.tf
```

```
1 resource "aws_instance" "hello-server" {
2     ami = "ami-04902260ca3d33422"
3     instance_type = "t2.micro"
4
5     user_data = file("./setup.sh")
6
7     security_groups = [
8         aws_security_group.hello-server.name
9     ]
10
11     tags = {
12         Name = "hello-server"
13     }
14 }
```

```
>> cat hello-scale.tf
```

```
1 resource "aws_instance" "hello-server" {
2     count = 4

4     ami = "ami-04902260ca3d33422"
5     instance_type = "t2.micro"
6     user_data = file("${path.module}/setup.sh")

8     security_groups = [
9         aws_security_group.hello-server.name
10    ]

12    tags = {
13        Name = "hello-server-${count.index}"
14    }
15 }
```

Definition 2. Target Group

A collection of EC2 instances.

More specifically, a collection of network connection points to EC2 instances.

An empty HTTP target group

```
>> cat hello-scale.tf
```

```
1 resource "aws_lb_target_group" "hello-target" {  
2     name = "hello-target-group"  
3     port = 80  
4     protocol = "HTTP"  
5     vpc_id = aws_security_group.hello-server.vpc_id  
6 }
```

Definition 3. Health Check

Monitors attributes of hardware or software to detect deficiencies.

Add a health check

```
>> cat hello-scale.tf
```

```
1 resource "aws_lb_target_group" "hello-target" {
2     name = "hello-target-group"
3     port = 80
4     protocol = "HTTP"
5     vpc_id = aws_security_group.hello-server.vpc_id
6
7     health_check {
8         port = 80
9         protocol = "HTTP"
10        timeout = 5
11        interval = 10
12    }
13 }
```

Add our instances to the target group

```
>> cat hello-scale.tf
```

```
1 resource "aws_lb_target_group_attachment" "hello-target-link" {  
2     count = length(aws_instance.hello-server)  
3     target_group_arn = aws_lb_target_group.hello-target.arn  
4     target_id = aws_instance.hello-server[count.index].id  
5     port = 80  
6 }
```

Definition 4. Load Balancer

A networking tool to route and distribute traffic to targets.

Create a load balancer

```
>> cat hello-scale.tf
```

```
1 data "aws_subnet_ids" "nets" {
2     vpc_id = aws_security_group.hello-server.vpc_id
3 }
4
5 resource "aws_lb" "hello-balancer" {
6     name = "hello-balancer"
7     internal = false
8     load_balancer_type = "application"
9     subnets = aws_subnet_ids.nets.ids
10    security_groups = [
11        aws_security_group.hello-server.name
12    ]
13 }
```

Route load balancer traffic to the target group

```
>> cat hello-scale.tf
```

```
1 resource "aws_lb_listener" "app" {
2     load_balancer_arn = aws_lb.hello-balancer.arn
3     port = "80"
4     protocol = "HTTP"
5
6     default_action {
7         type = "forward"
8         target_group_arn = aws_lb_target_group.hello-target.arn
9     }
10 }
```

We're live!



Hello world from Brae

Exercise

Use *k6* to determine the new *load limits*