

Software at Scale

Software Architecture

Brae Webb

March 24, 2025

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 0. Stress Testing

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

Demonstration

Let's build 'hello world'

Our Goal



My 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"  
  
5     user_data = file("./setup.sh")  
  
7     security_groups = [  
8         aws_security_group.hello-server.name  
9     ]  
  
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"  
  
5     user_data = file("./setup.sh")  
  
7     security_groups = [  
8         aws_security_group.hello-server.name  
9     ]  
  
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 0. 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 0. 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 0. 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 }  
  
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"  
  
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*