

Software at Scale

Software Architecture

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Question

How many concurrent users can your software handle?

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Answer

Maybe *400*? Maximum.

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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



```
» 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"
4
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"
4
5     user_data = file("./setup.sh")
6
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
3
4   ami     = "ami-04902260ca3d33422"
5   instance_type = "t2.micro"
6   user_data = file("${path.module}/setup.sh")
7
8   security_groups = [
9     aws_security_group.hello-server.name
10  ]
11
12  tags = {
13    Name = "hello-server-${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"
5
6   default_action {
7     type = "forward"
8     target_group_arn = aws_lb_target_group.hello-target.arn
9   }
10 }
```

We're live!



Exercise

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