Distributed Computing I

Software Architecture

Brae Webb

March 20, 2023

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@mathiasverraes

There are only two hard problems in distributed systems: 2. Exactly-once delivery 1. Guaranteed order of messages 2. Exactly-once delivery

Previously in CSSE6400...

Service-based Architecture

Previously in CSSE6400...

- Simplicity For a distributed system 
- Modularity Services 
- Extensibility New services 
- Deployability Independent services 
- Testability Independent services 
- Security API layer 
- Reliability Independent services 
- Interoperability Service APIs 
- Scalability Coarse-grained services 

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Simplicity For a distributed system

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Previously in CSSE6400...

Simplicity *For a distributed system*

Previously in CSSE6400...

Simplicity

§ *Fallacies*

Question

What is a *fallacy*?

Definition 1. Fallacy

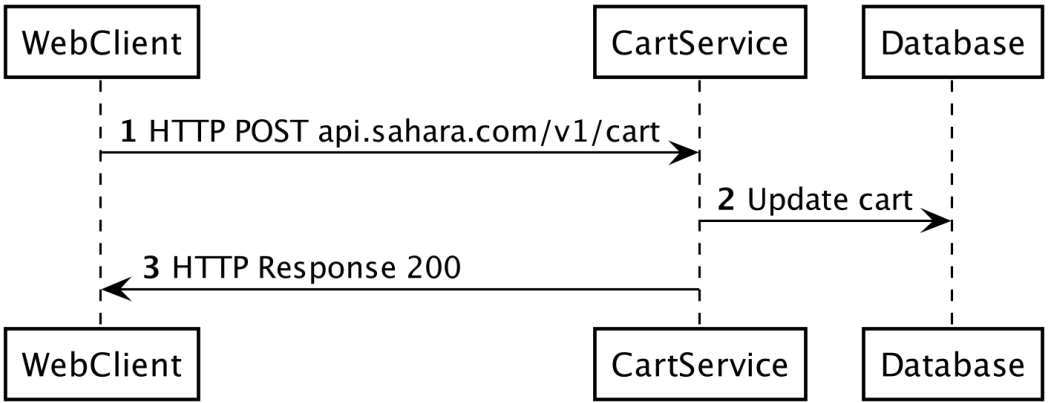
Something that is believed or assumed to be true but is not.

A few reasons for complexity

The Fallacies of *Distributed Computing*

Fallacy #1

The network is reliable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CartService
Database
1 HTTP POST api.sahara.com/v1/cart
2 Update cart
3 HTTP Response 200
WebClient
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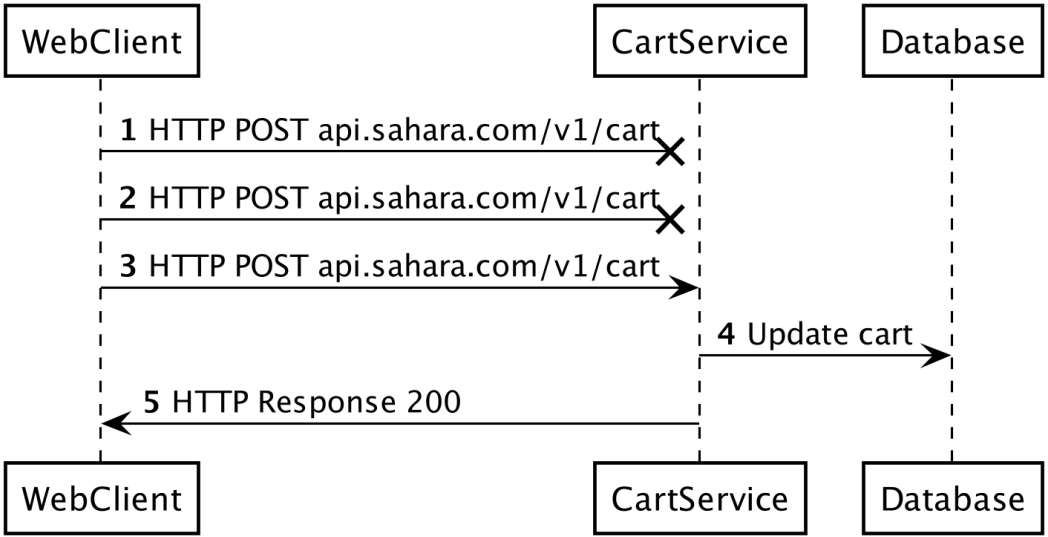
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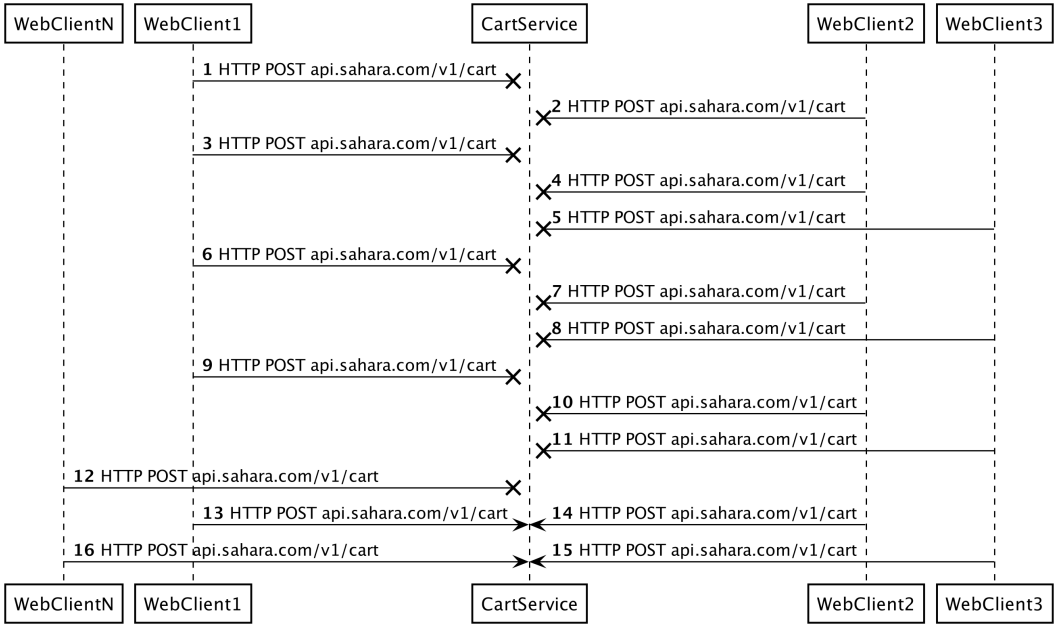
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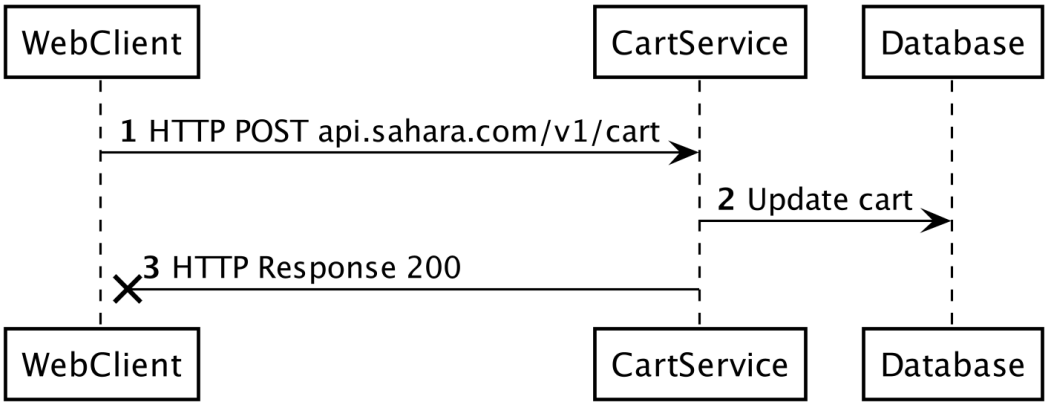
Exponential backoff

```
retry = True
do:
    status = service.request()

    if status != SUCCESS:
        wait(2 ** retries)
    else:
        retry = False
while (retry and retries < MAX_RETIRES)
```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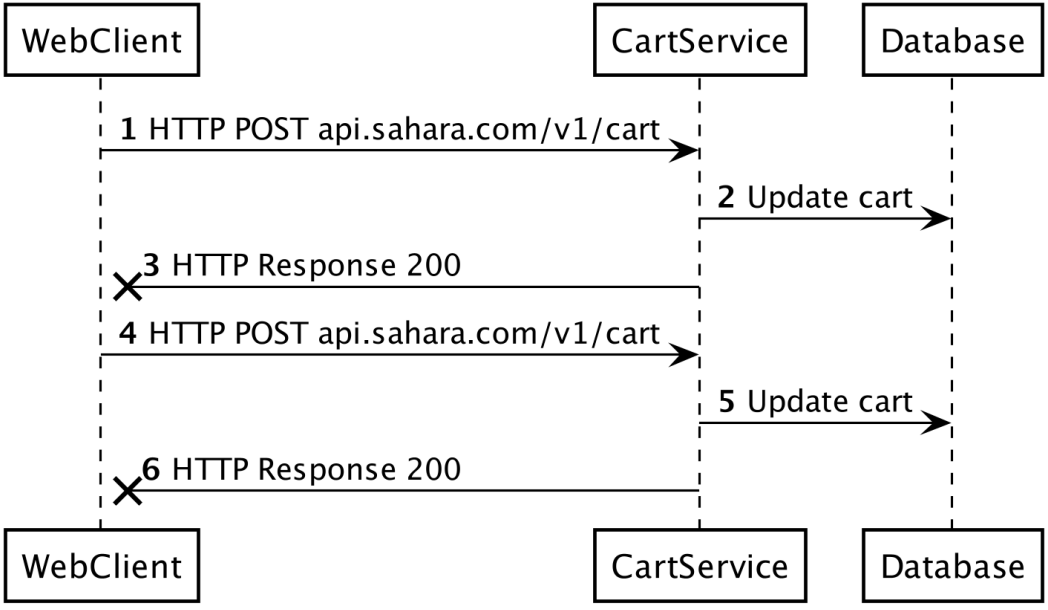
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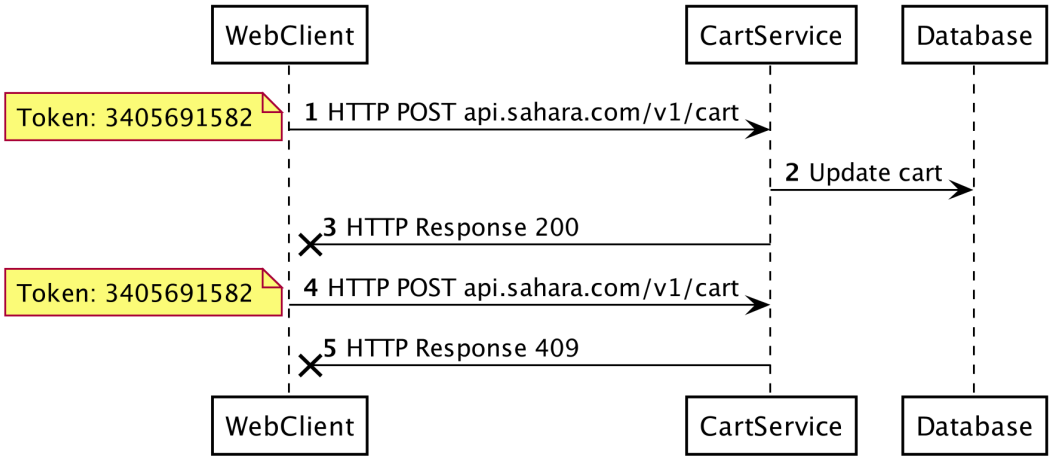
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4 HTTP POST api.sahara.com/v1/cart
5 HTTP Response 409
WebClient
CartService
Database

Fallacy #2

Latency is zero

Network Statistics

Home to UQ

Home to us-east-1

EC2 to EC2

Network Statistics

Home to UQ 20.025ms

Home to us-east-1

EC2 to EC2

Network Statistics

Home to UQ 20.025ms

Home to us-east-1 249.296ms

EC2 to EC2

Network Statistics

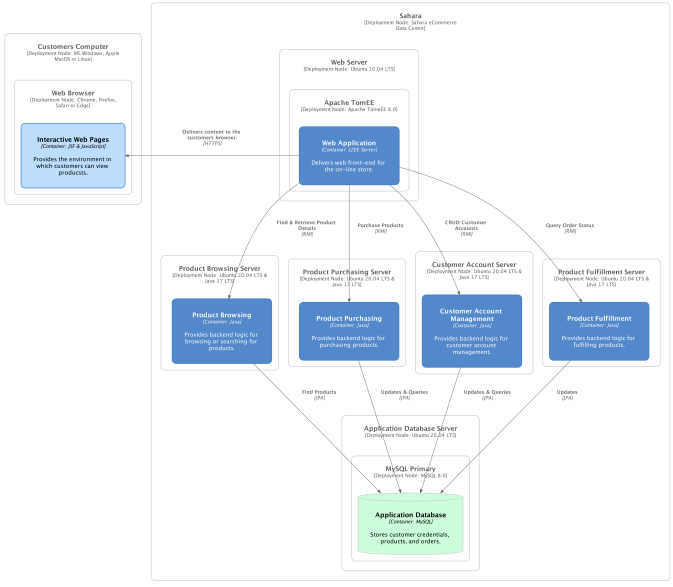
Home to UQ	20.025ms
Home to us-east-1	249.296ms
EC2 to EC2	0.662ms

Fallacy #3

Bandwidth is infinite

Fallacy #4

The network is secure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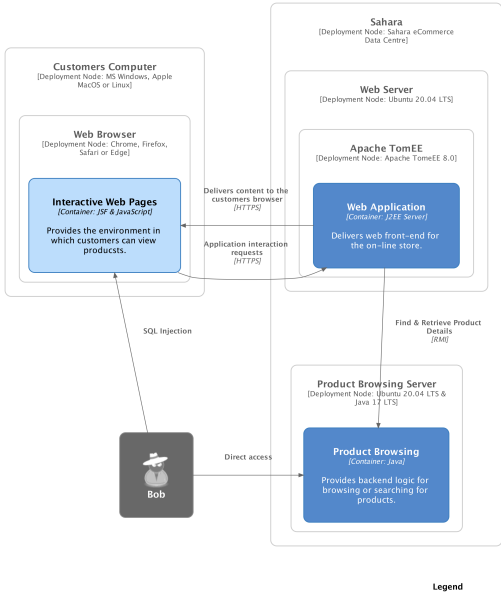
Legend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Bob
Direct access
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Legend

Fallacy #5

The topology never changes

Fallacy #6

There is only one administrator

Scenario

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- Sunday night users start complaining.

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- Who do you talk to?

Fallacy #7

Transport cost is zero

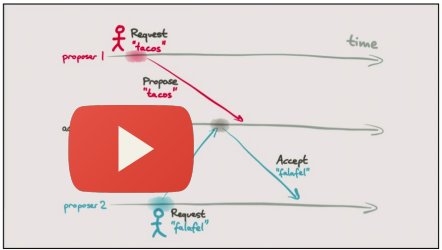
Remember

Distributed systems are *hard*.

Remember

Distributed systems are often *not your friend*.

When you need to, prove it



strangeloop

Sept 13-14, 2019
thestrangeloop.com

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https://youtube.com/watch?v=7w4KC6i9Yac

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Simplicity For a distributed system

Reliability Independent services

Scalability Coarse-grained services

Previously in CSSE6400...

Reliability Independent services

Question

What makes software *reliable*?

'Working' software

Satisfies the functional requirements

Definition 2. Reliable Software

Continues to work, even when things go wrong.

Definition 3. Fault

Something goes wrong.

Death, taxes, and computer system failure are all inevitable to some degree.
Plan for the event.

- Howard and LeBlanc

Reliable software is

Fault *tolerant*

Problem

Individual computers fail *all the time*

Solution

Spread the risk of faults over *multiple computers*

Spreading Risk

If you have software that works with *just one* computer, spreading the software over *two* computers *halves* the risk that your software will fail.

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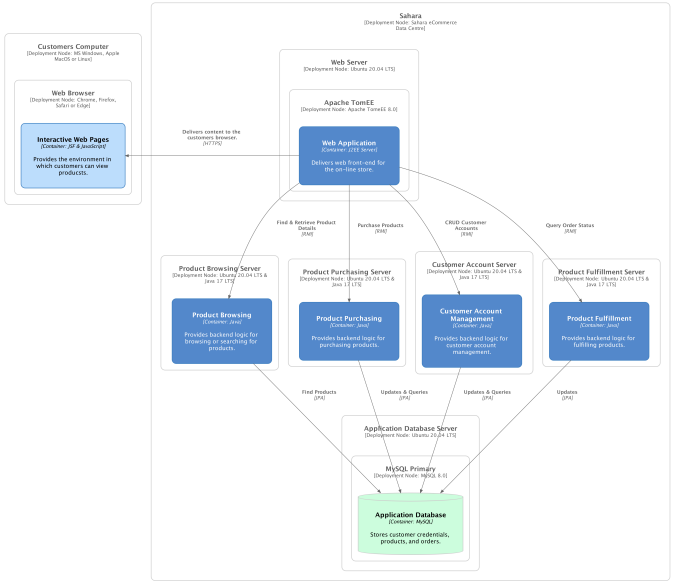
Of course, there are other reasons you might want run software on multiple computers.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Who has used *auto-scaling*?

Auto-scaling Terminology

Auto-scaling group A *collection of instances* managed by auto-scaling.

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Scaling Policy How to determine the desired capacity.

Minimum/Maximum Capacity *Hard limits* on the minimal and maximum amount of instances.

What we really want

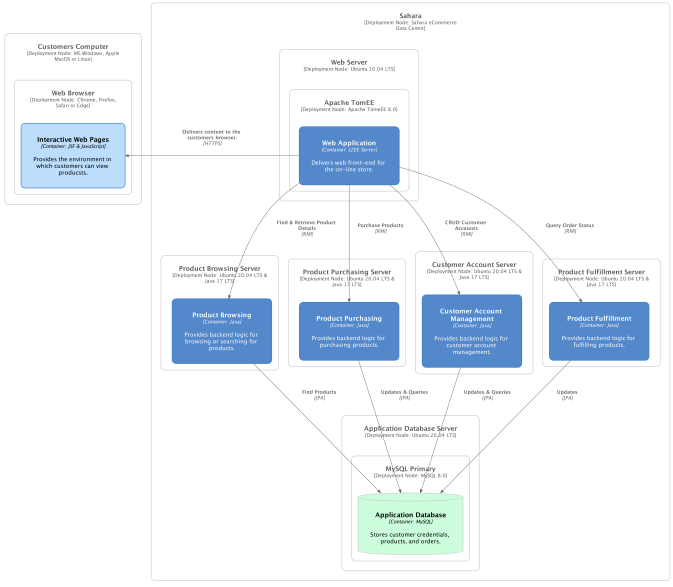
Desired Capacity Amount of *healthy* instances we want to have in an auto-scaling group.

Health check

User defined method to determine whether an instance is *healthy*.

Auto-scaling

An example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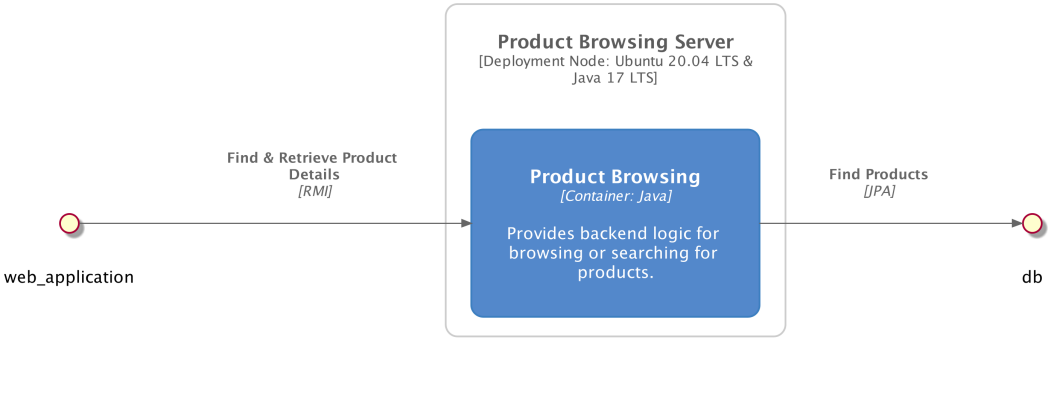
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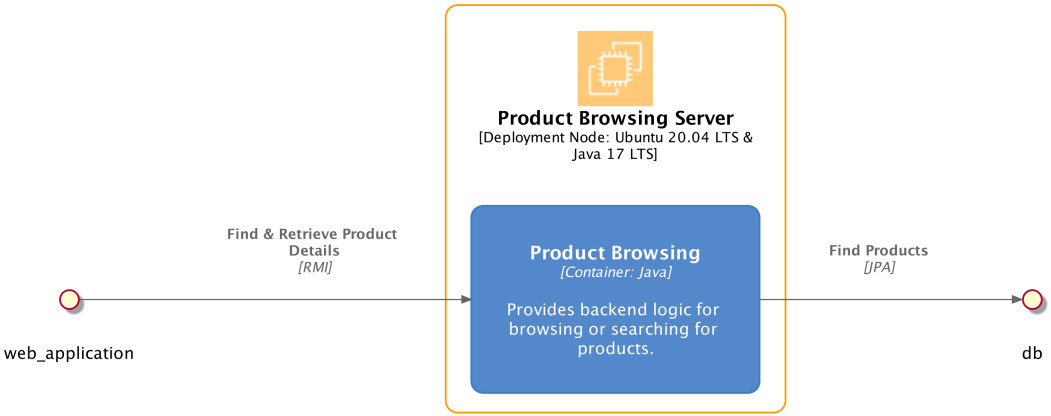
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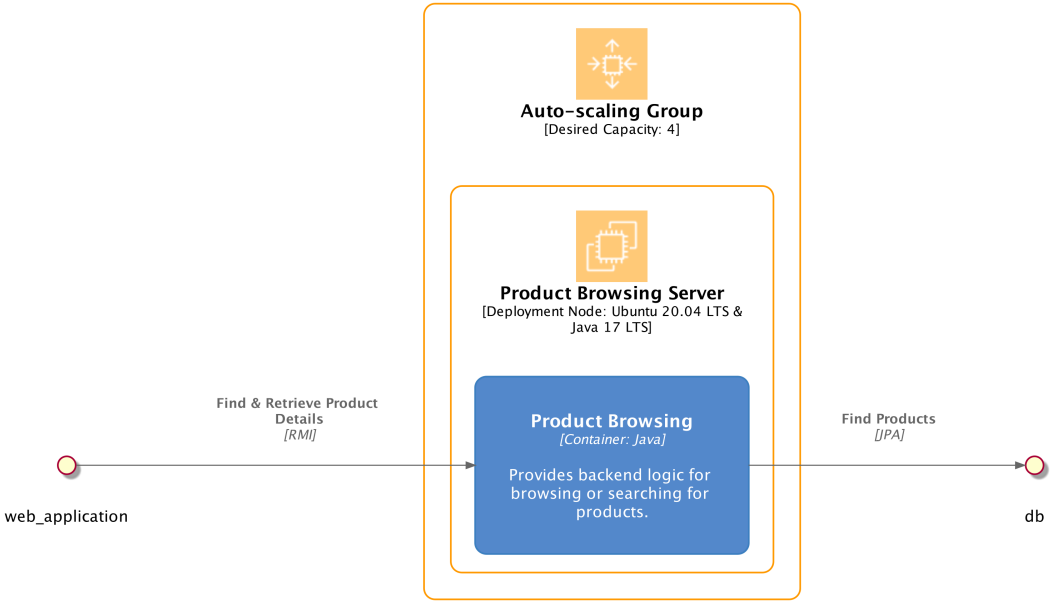
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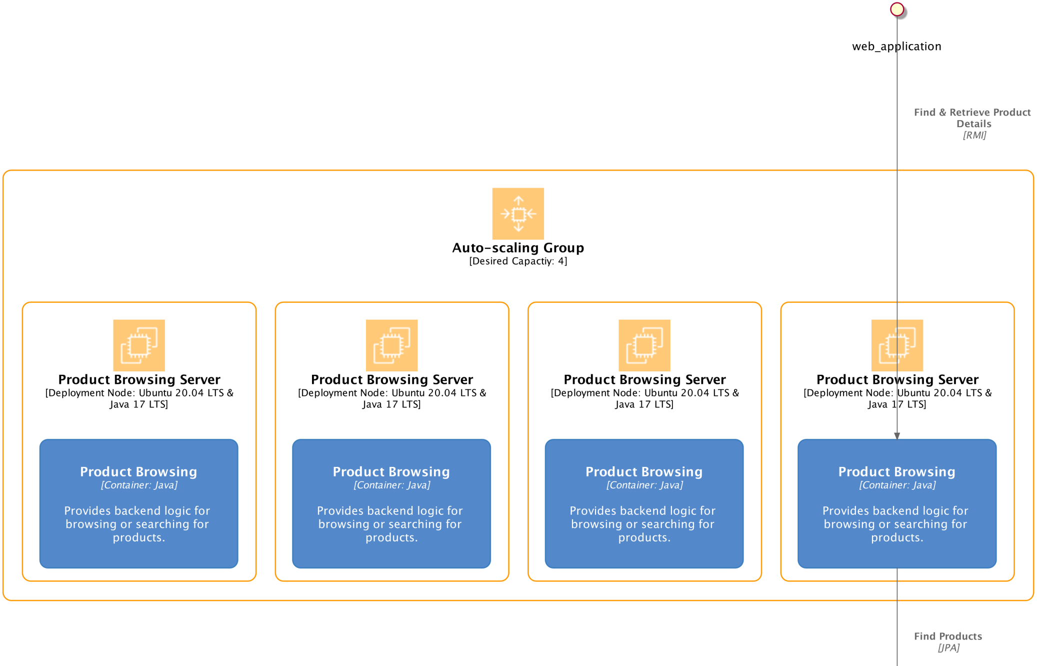
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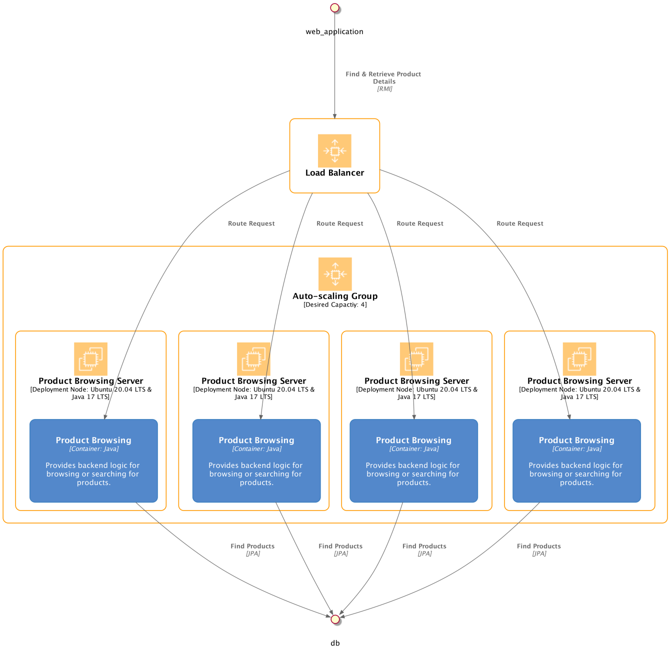
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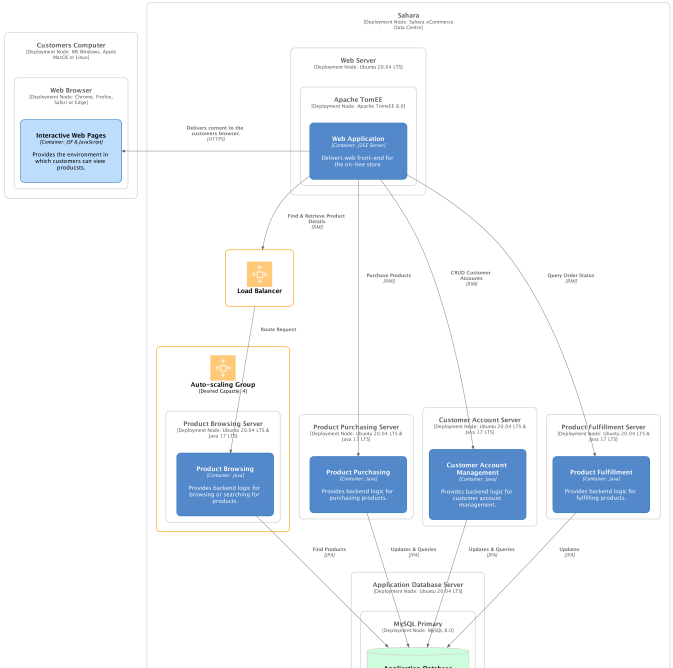
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Reliability Traffic is spread to various services, still *partially operational* if one goes down. Auto-scaling allows for *basic replication*.

Scalability Auto-scaling and load balancing allows *individual services to scale*. However, the *database is a bottle-neck*.