Distributed Computing I

CSSE6400

Brae Webb

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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

Re-visiting service-based architectures from last lecture

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 

Concluded on these attributes

Previously in CSSE6400…

Simplicity For a distributed system

Reliability Independent services

Scalability Coarse-grained services

Let's revisit these attributes

Previously in CSSE6400…

Simplicity *For a distributed system*

This condition on simplicity is doing a lot of work

Previously in CSSE6400…

Simplicity

We'll look at a few reasons that distributed systems are *fundamentally* quite challenging

Question

What is a *fallacy*?

Definition 1. Fallacy

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

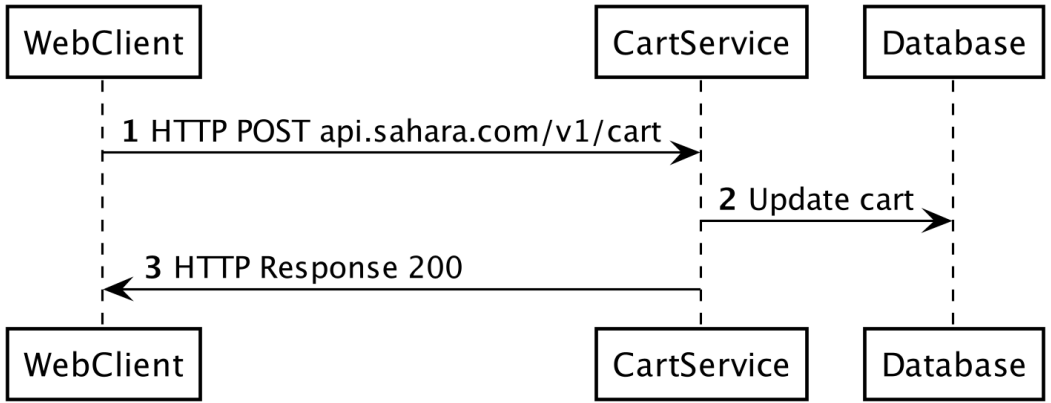
A *few* reasons for complexity

The Fallacies of *Distributed Computing*

Sun Microsystems in 1994, primarily accredited to Peter Deutsch (doy-ch)

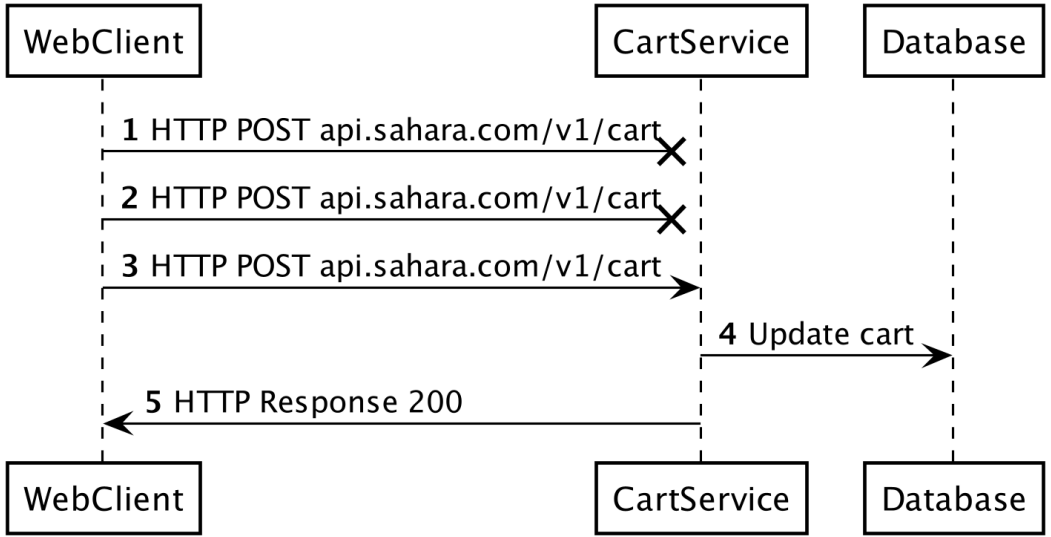
Fallacy #1

The network is reliable

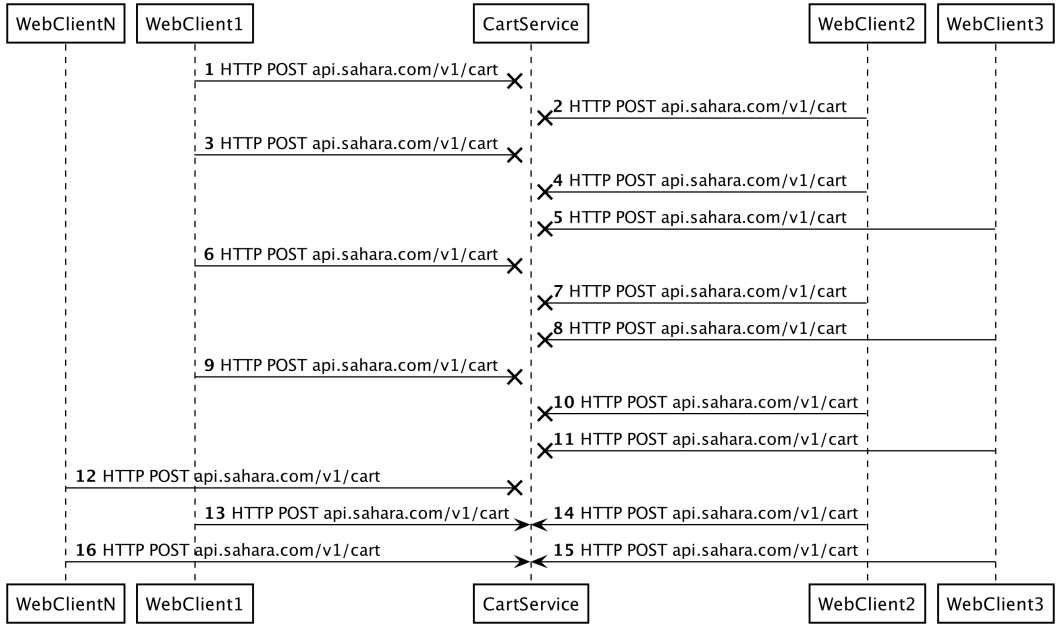


An expected interaction

Packet gets lost on way to CardService



Solve it by resending it

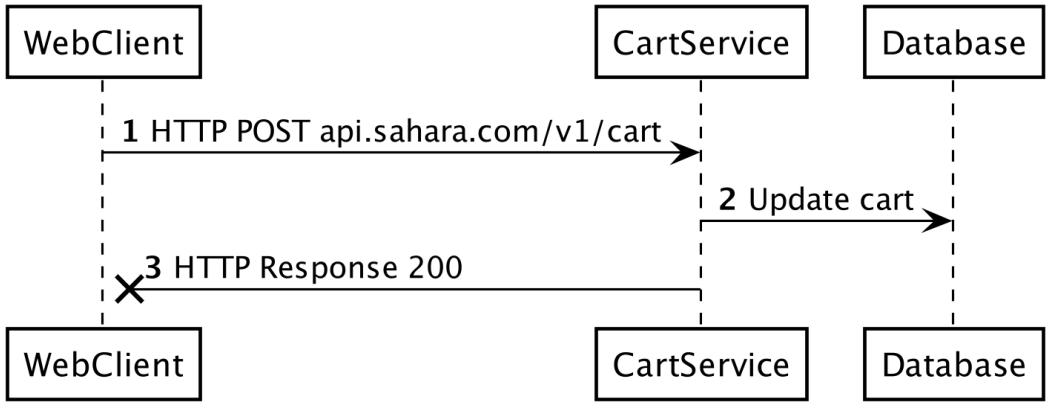


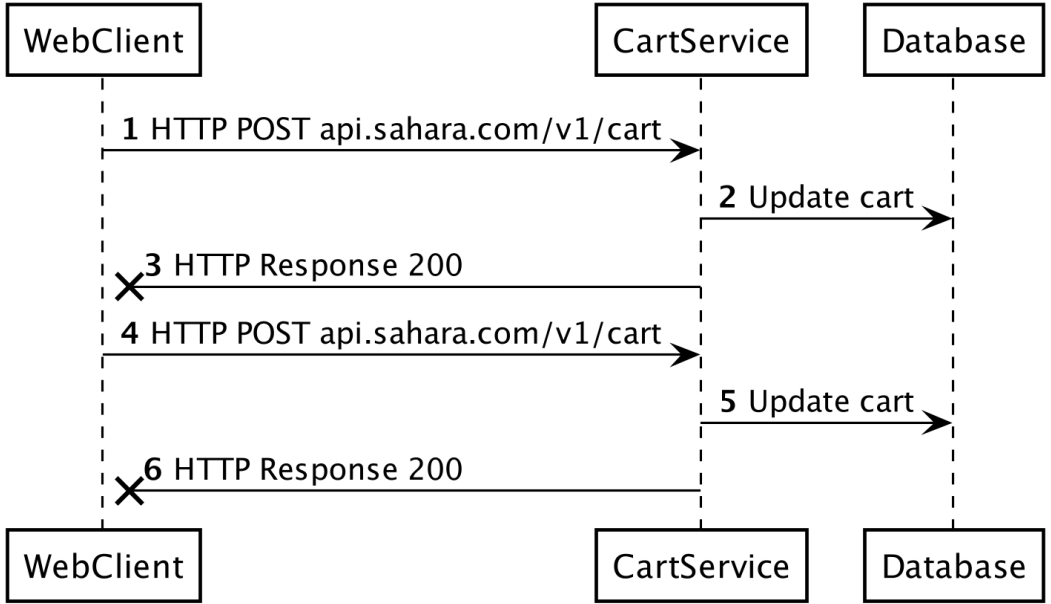
If the service goes down and all clients are re-trying, the service is in for a shock when it comes back, we solve this with *exponential backoff*

Exponential backoff

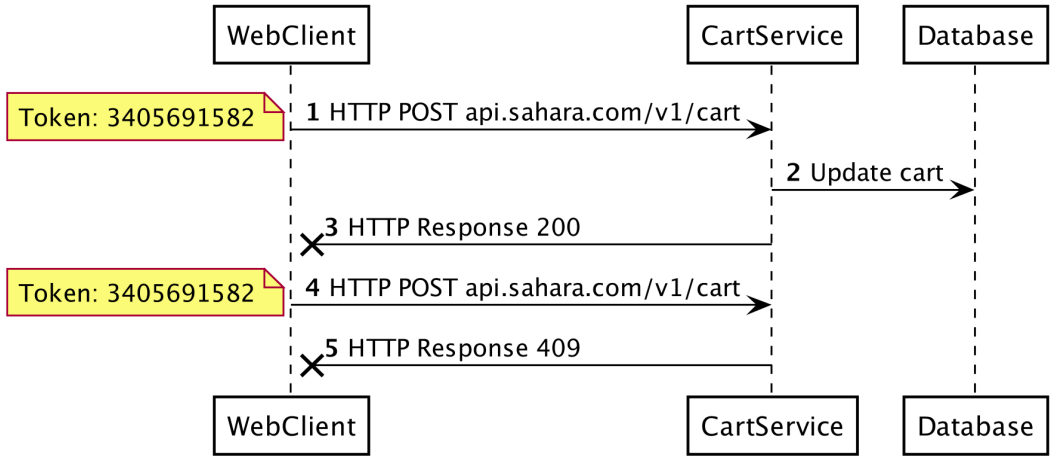
```
retry = True
do:
    status = service.request()

    if status != SUCCESS:
        wait(2 ** retries)
    else:
        retry = False
while (retry and retries < MAX_RETIRES)
```


WebClient
CartService
Database
1 HTTP POST api.sahara.com/v1/cart
2 Update cart
3 HTTP Response 200
WebClient
CartService
Database



Causes duplicate actions, problem for ordering/payments



Use tokens to prevent duplicates.

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

Be mindful when designing distributed systems. Network call much slower then local call.

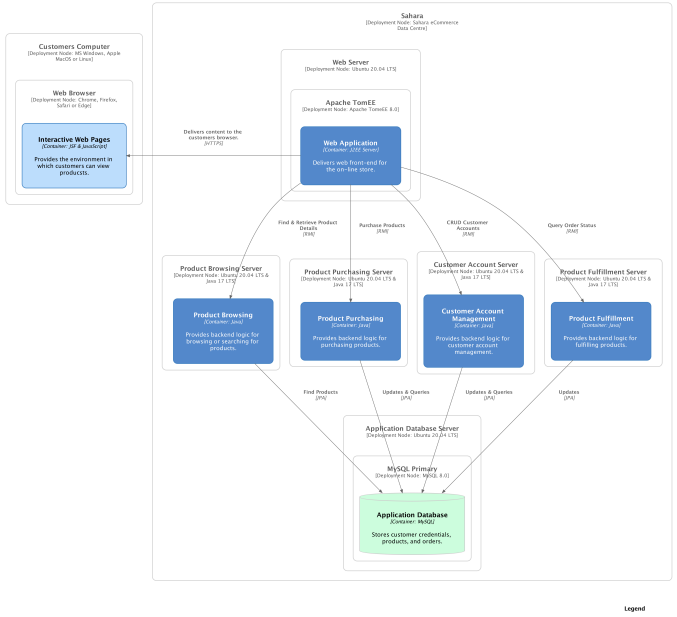
Fallacy #3

Bandwidth is infinite

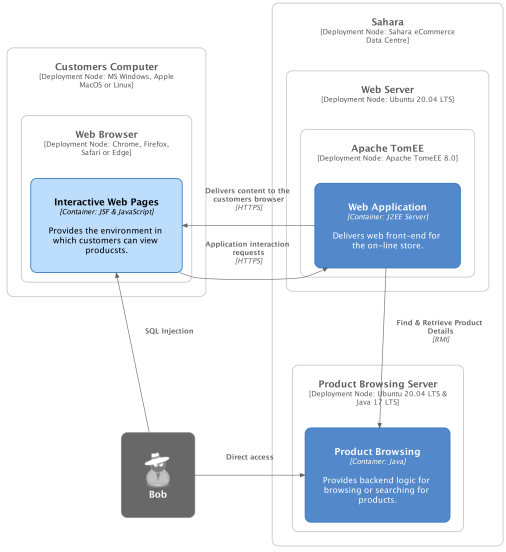
Similar to previous fallacy, be mindful, distributed calls clog up network.

Fallacy #4

The network is secure



Authentication only occurs when entering Sahara data centre



Bad actor gets access via one insecure node, network is compromised. Practice defence in depth.

Fallacy #5

The topology never changes

Topology changes all the time, cloud has just made this easier. Don't rely on static IPs. Don't assume consistent latency.

Fallacy #6

There is only one administrator

Scenario

- Deployments are banned on the weekend.

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- There have been no deployments since Friday.
- You can still access the system.
- Who do you talk to?

Things spontaniously break. Who can help you?

Fallacy #7

Transport cost is zero

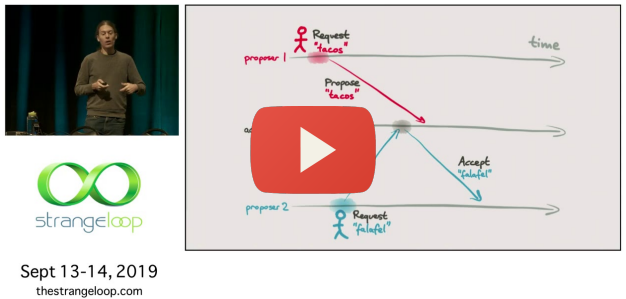
Remember

Distributed systems are *hard*.

Remember

Distributed systems are often *not your friend*.

When you need to, prove it



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

Previously in CSSE6400…

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Scalability Coarse-grained services

Previously in CSSE6400…

Reliability Independent services

Question

What makes software *unreliable*?

‘Working’ software

Satisfies the functional requirements

Definition 2. Reliable Software

Continues to work correctly, 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*

John von Neumann built fault tolerant hardware in the 50s.

Problem

Individual computers fail *all the time*

10-50 years hard-drive lifetime. 10,000 disks will fail daily.

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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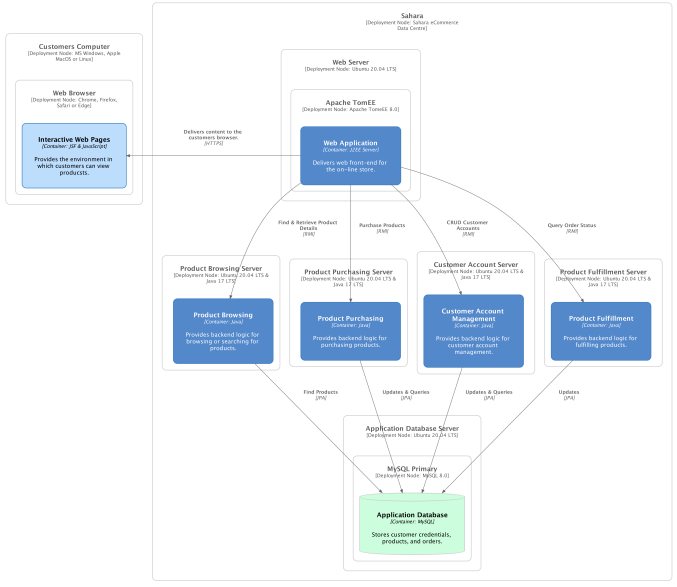
Of course, there are other reasons you might want run software on multiple computers.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Stores customer credentials, products, and orders.
Legend

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Who has used *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

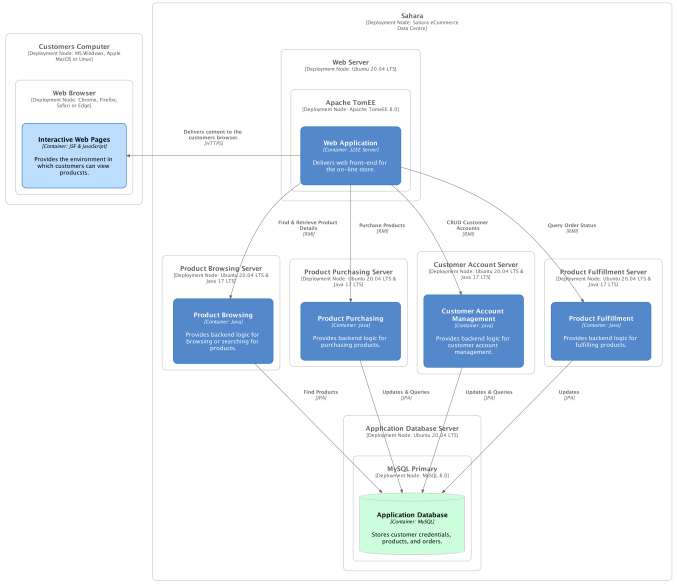
Desired Capacity Amount of *healthy* instances we should have in an auto-scaling group.

Health check

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

Auto-scaling

An example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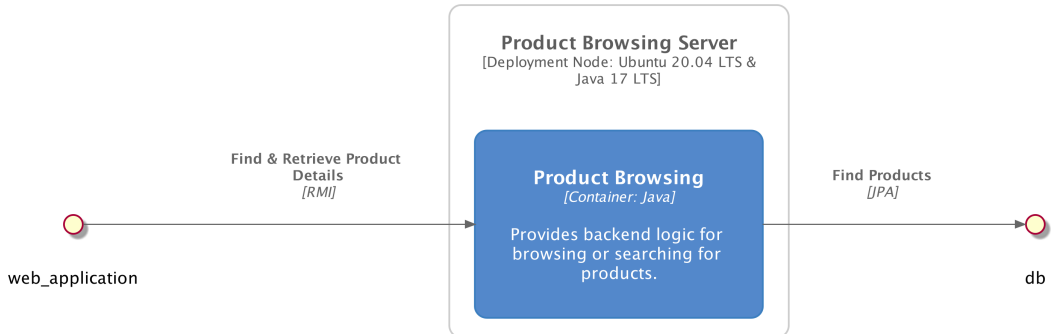
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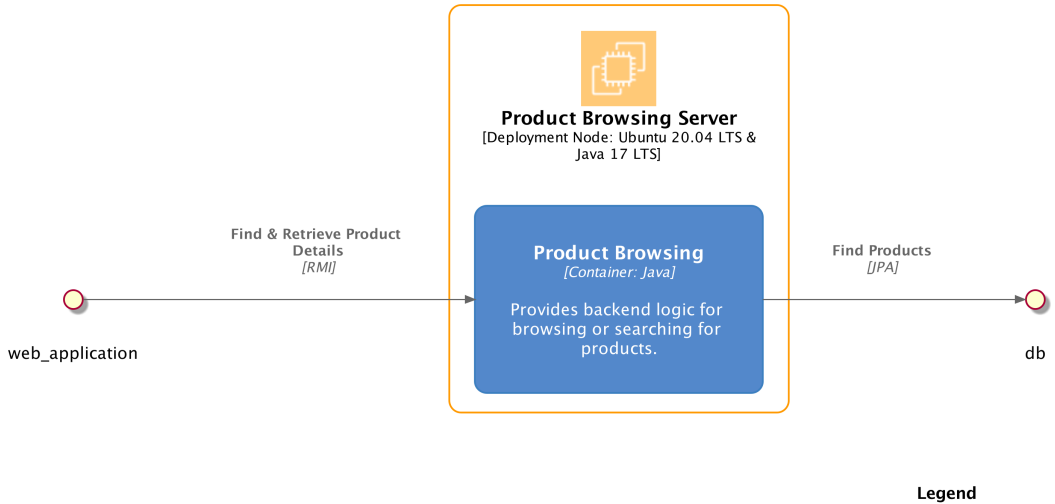
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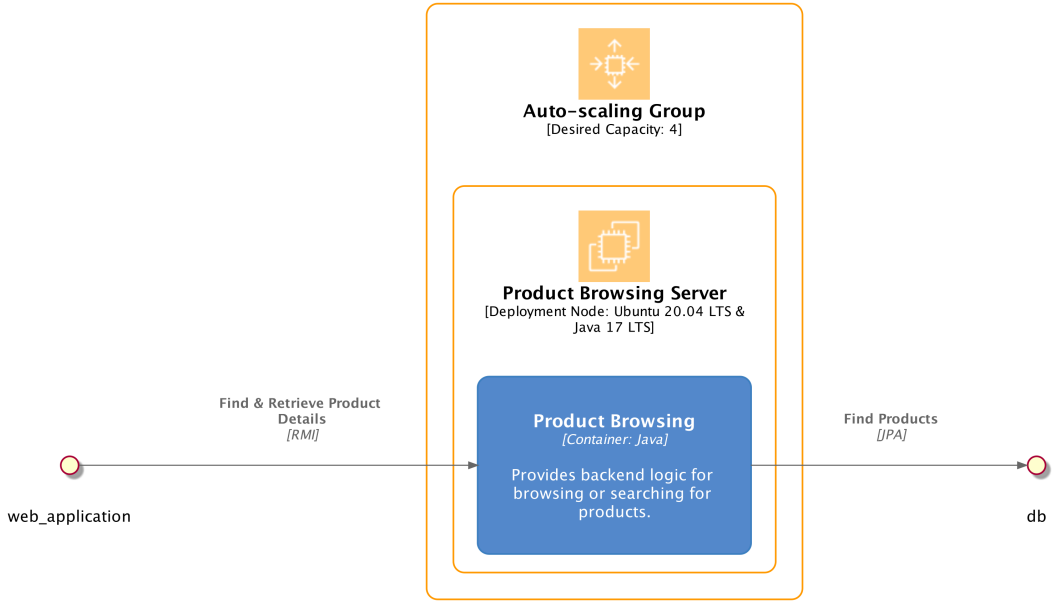
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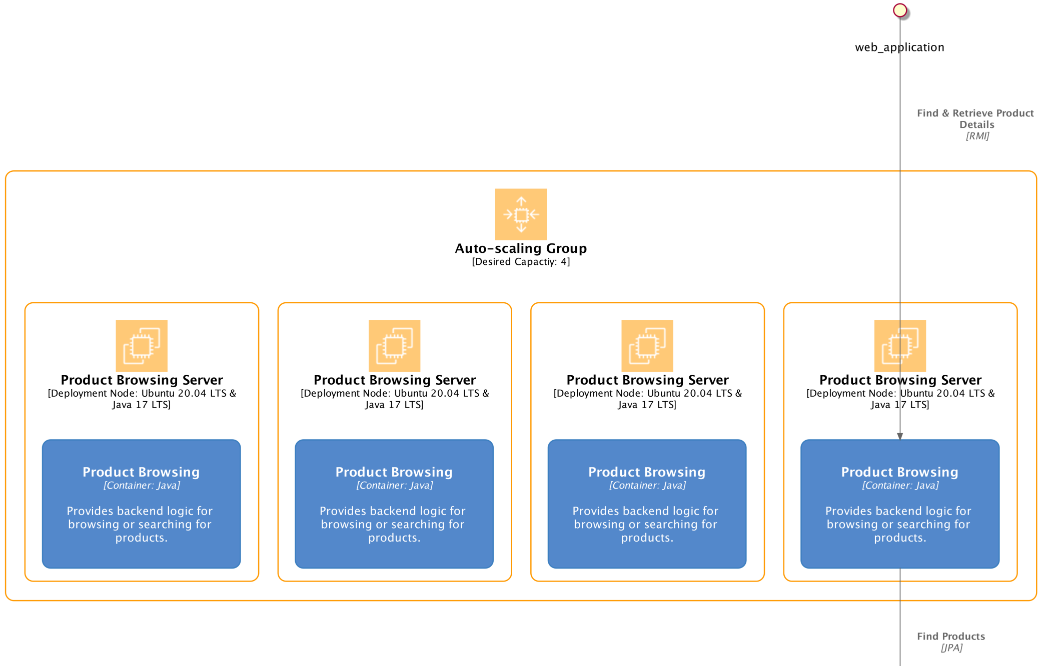

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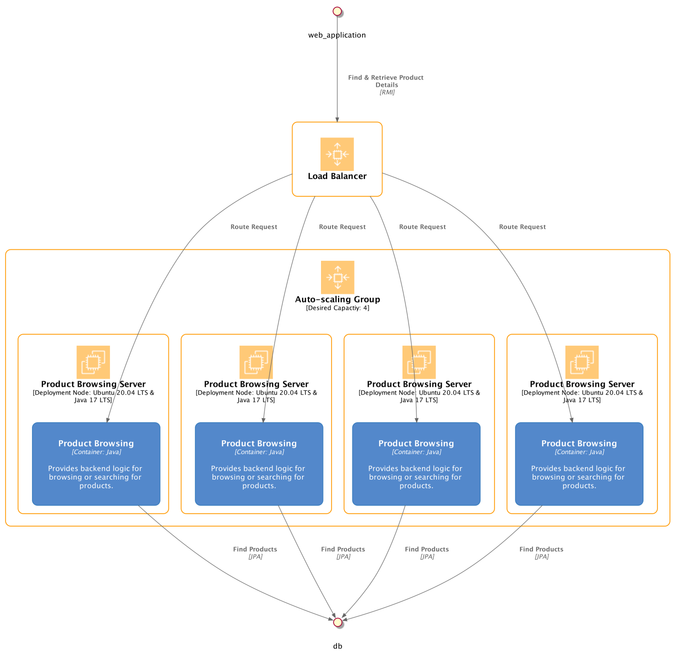
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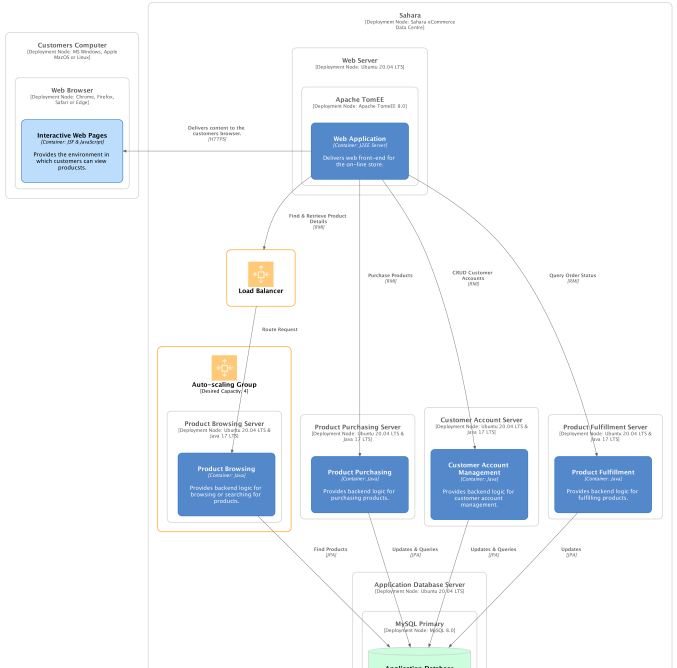
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In Summary

- Simplicity
- Reliability
- Scalability

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Reliability

Scalability

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Scalability

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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*.