

# Distributed Computing I

CSSE6400

Brae Webb

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**Mathias Verras**

@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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Previously in CSSE6400...

Simplicity *For a distributed system*



Previously in CSSE6400...

Simplicity



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

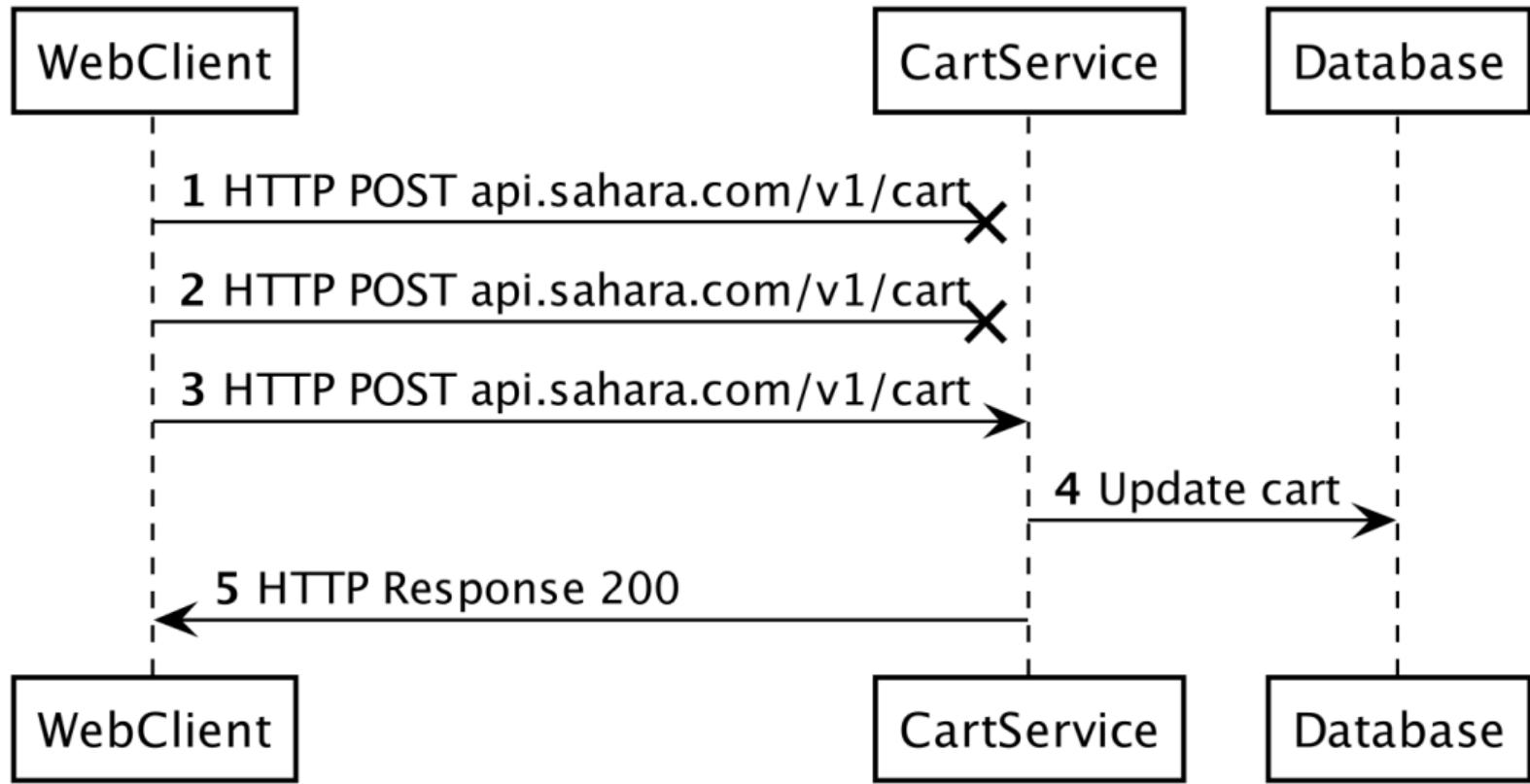
## The Fallacies of *Distributed Computing*

Fallacy #1

The network is reliable





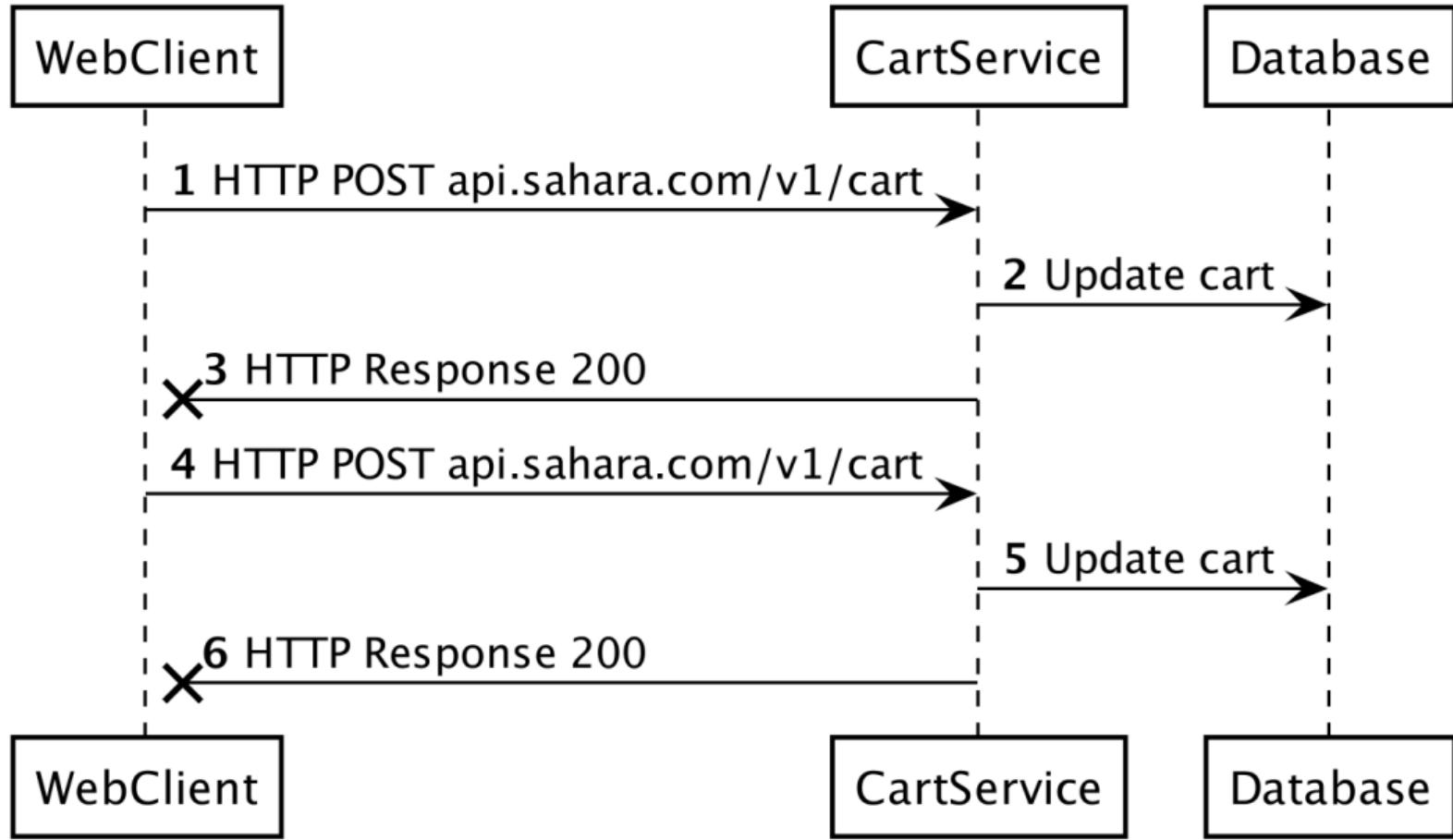




# Exponential backoff

```
1  retry = True
2  do:
3      status = service.request()
5
5      if status != SUCCESS:
6          wait(2 ** retries)
7      else:
8          retry = False
9  while (retry and retries < MAX_RETIRES)
```







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

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EC2 to EC2 0.662ms

Fallacy #3

**Bandwidth is infinite**

Fallacy #4

The network is secure



Legend



Fallacy #5

The topology never changes

Fallacy #6

**There is only one administrator**

## Scenario

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- Who do you talk to?

Fallacy #7

Transport cost is zero

Remember

Distributed systems are *hard*.

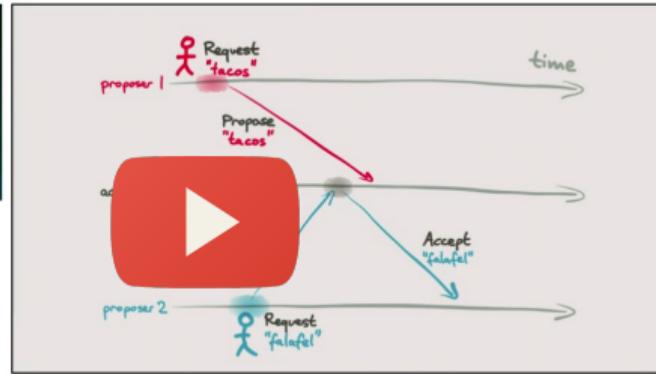
Remember

Distributed systems are often *not your friend.*

# When you need to, prove it



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[thestrangeloop.com](http://thestrangeloop.com)



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Simplicity For a distributed system



Reliability Independent services



Scalability Coarse-grained services



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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.



Legend

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Simplicity For a distributed system



Reliability Independent services



Scalability Coarse-grained services



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Scalability Coarse-grained services



Question

Who has used *auto-scaling*?

## Auto-scaling Terminology

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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

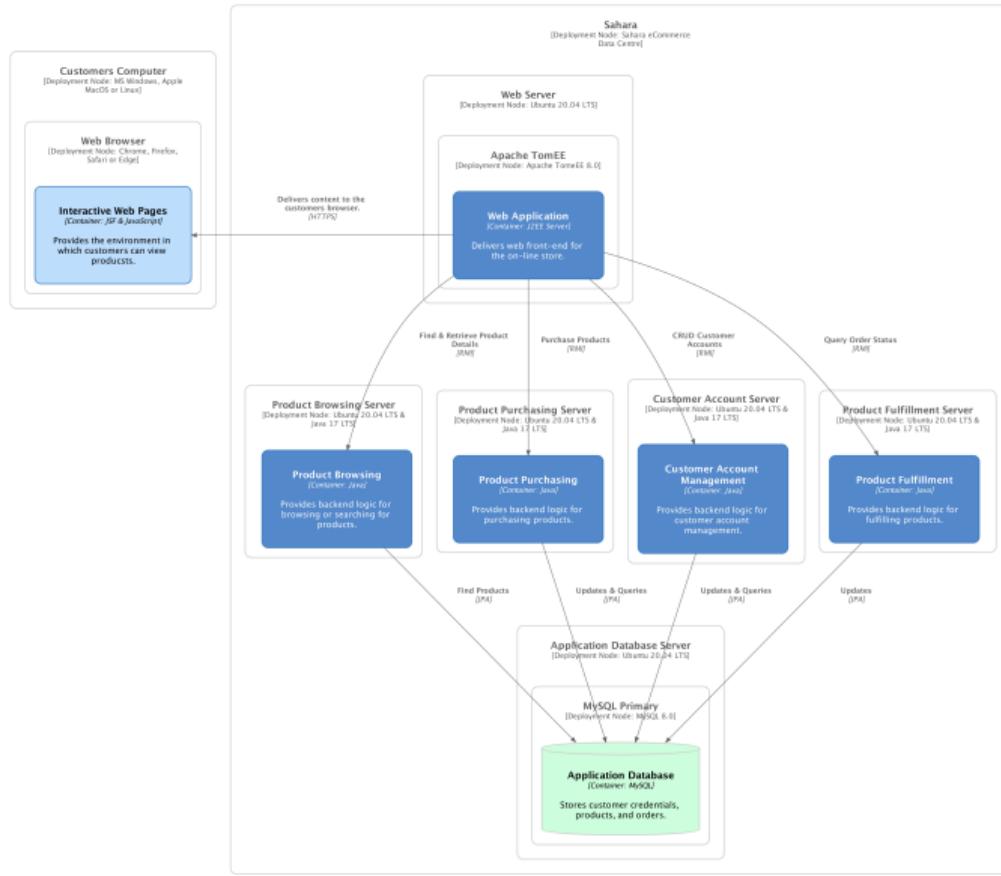
**Desired Capacity** Amount of *healthy* instances we want to have in an auto-scaling group.

## Health check

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

Auto-scaling

An example



Legend













## In Summary

Simplicity

Reliability

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

## In Summary

- Simplicity** *Minimal network communication* (compared to other distributed systems), less impacted by fallacies.
- 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*.