

Distributed Computing I

CSSE6400

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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

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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*



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

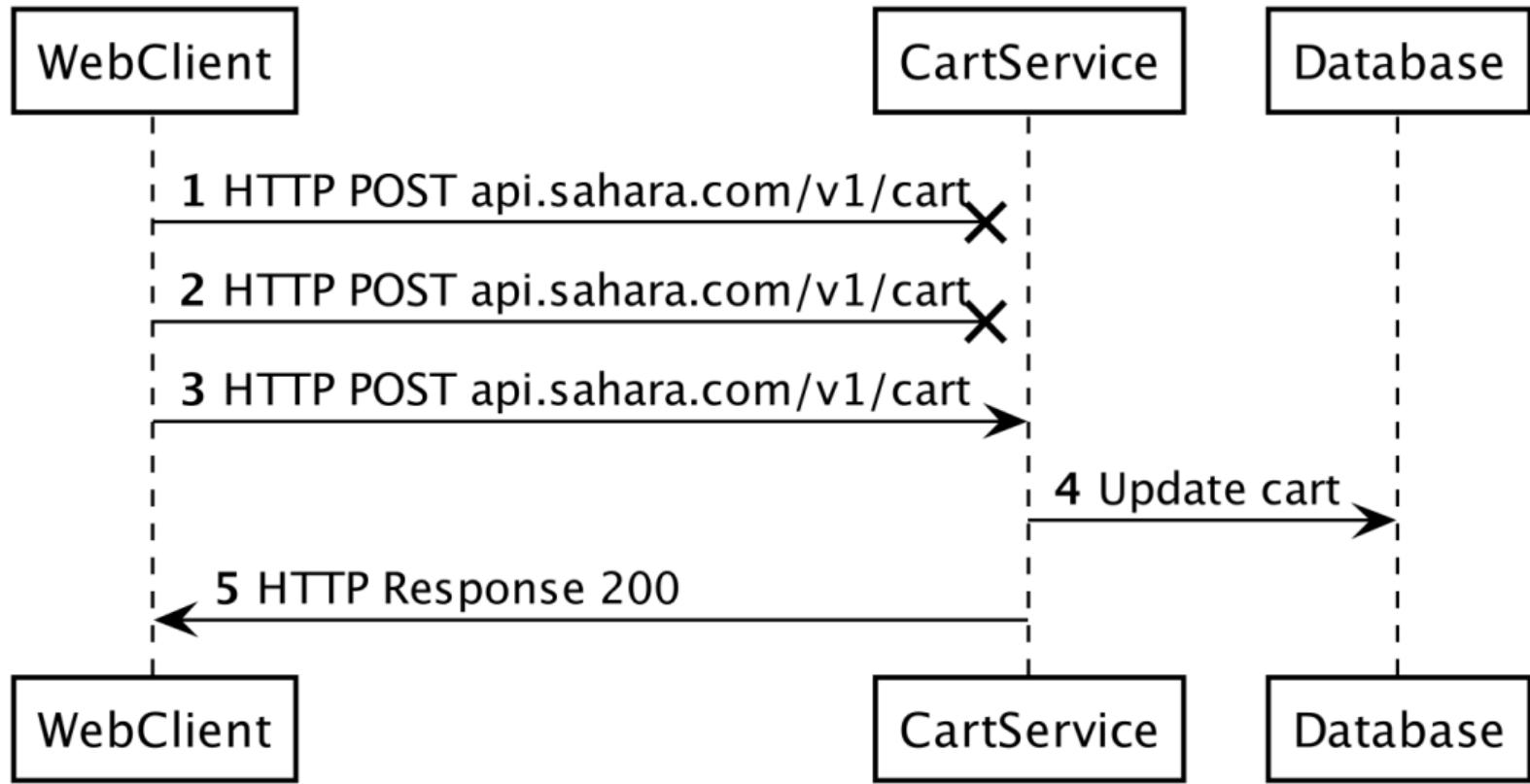
The Fallacies of *Distributed Computing*

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

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Network Statistics

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EC2 to EC2 0.662ms

Fallacy #3

Bandwidth is infinite

Fallacy #4

The network is secure



Legend



Legend

Fallacy #5

The topology never changes

Fallacy #6

There is only one administrator

Scenario

- Deployments are banned on the weekend.

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- Who do you talk to?

Fallacy #7

Transport cost is zero

Remember

Distributed systems are *hard*.

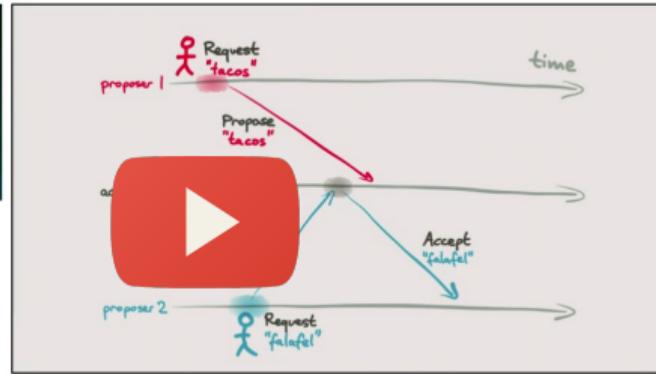
Remember

Distributed systems are often *not your friend.*

When you need to, prove it



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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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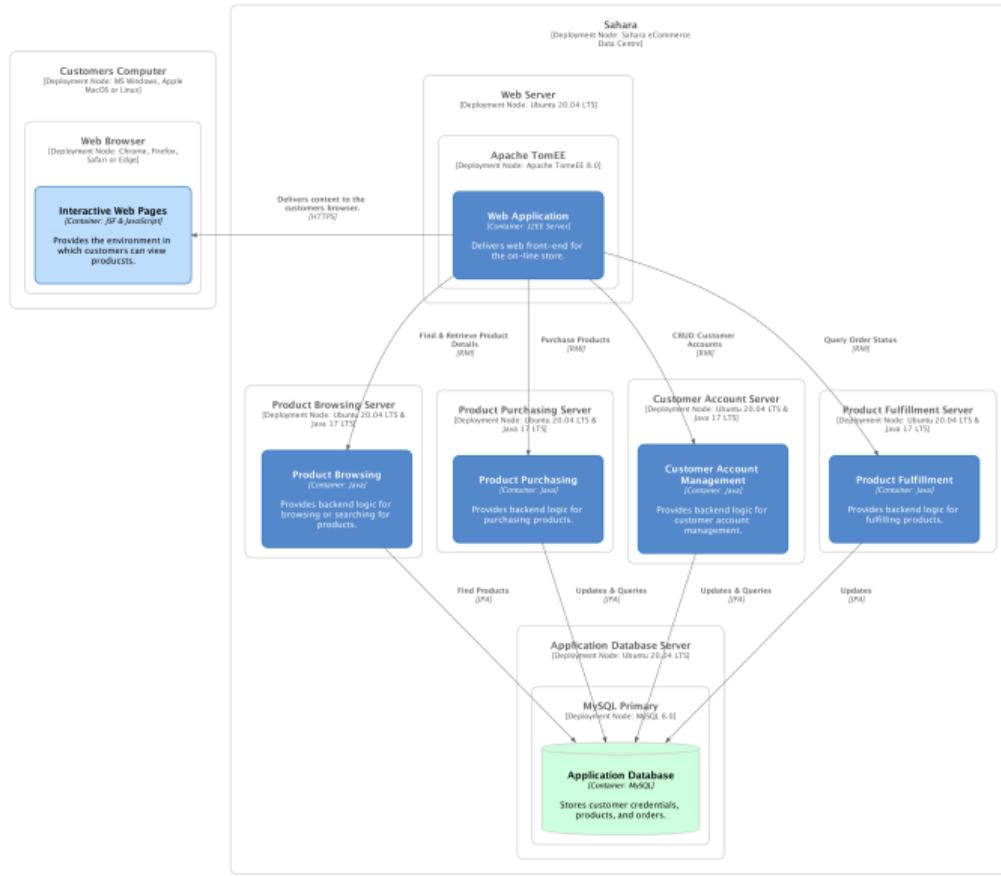
Adding *100* computers reduces the cuts the risk by *100*.

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

Adding *100* computers reduces the risk by *100*.

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

What we really want

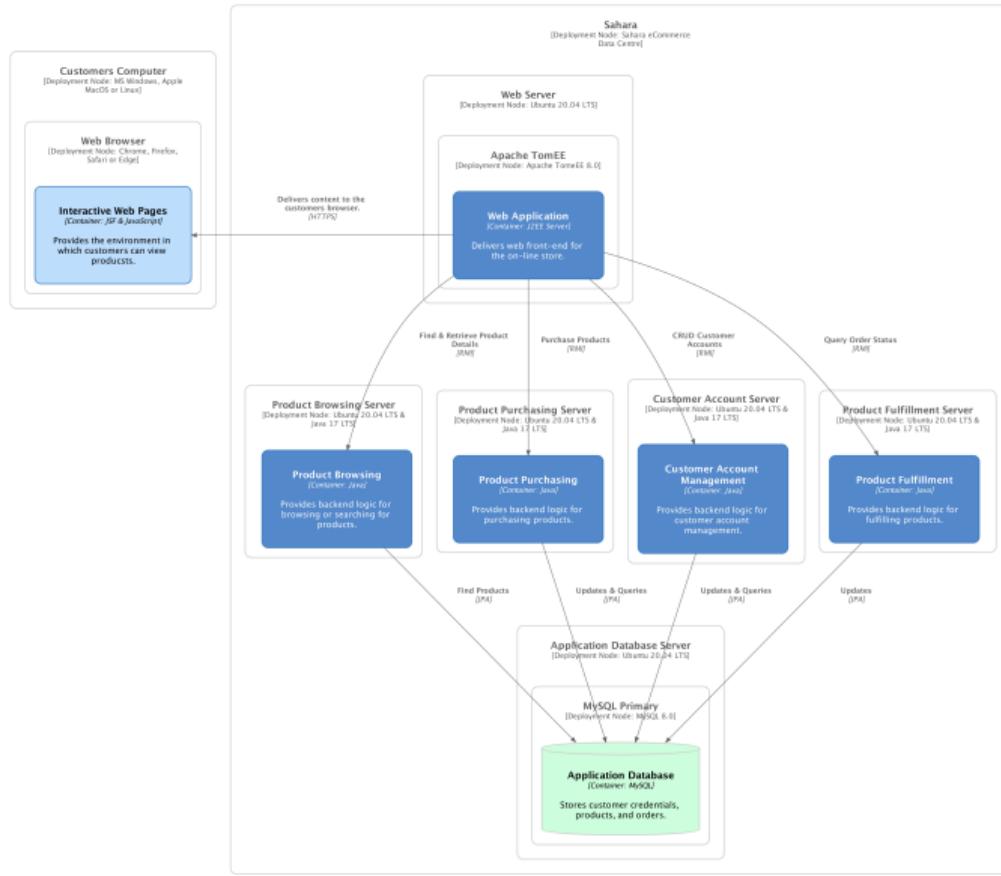
Desired Capacity Amount of *healthy* instances we want to have in an auto-scaling group.

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*.