

# CAP Theorem

The art of choice

@mlomnicki

# CAP Theorem

by Eric Brewer in 2000

Proven in 2002 by Seth Gilbert & Nancy Lynch

# CAP Theorem

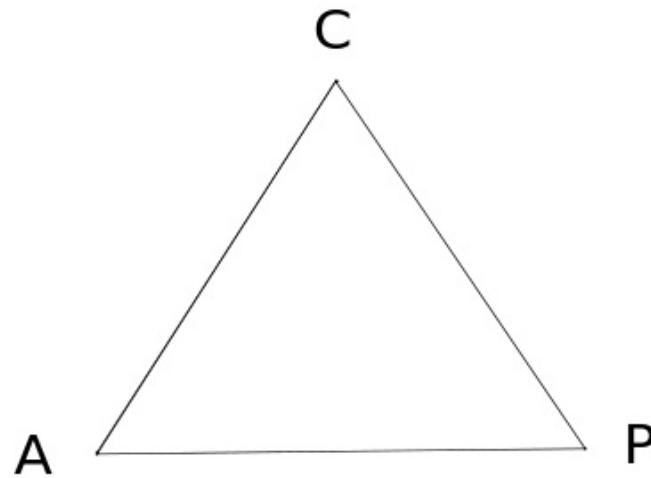
**C**onsistency

**A**vailability

**P**artition tolerance

At most **2 of 3** properties may be satisfied

# CAP Theorem

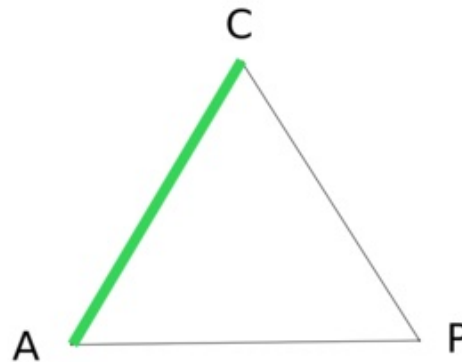


# RDBMS (single-site and cluster)

Consistency

Availability

~~Partition tolerance~~



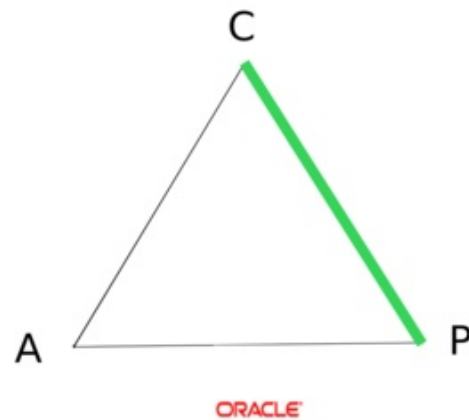
ORACLE

# Distributed RDBMS

Consistency

~~Availability~~

Partition tolerance

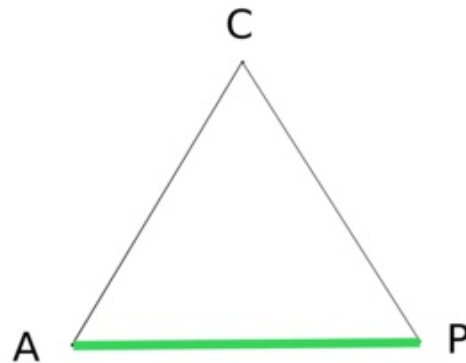


# NoSQL

~~Consistency~~

Availability

Partition tolerance



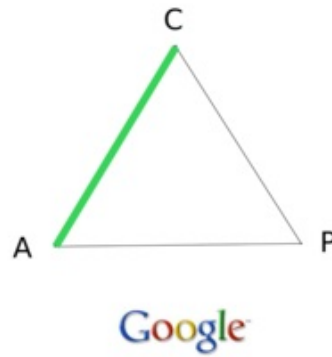
...also DNS is AP

# BigTable

Consistency

Availability

~~Partition tolerance~~



P is on GFS side

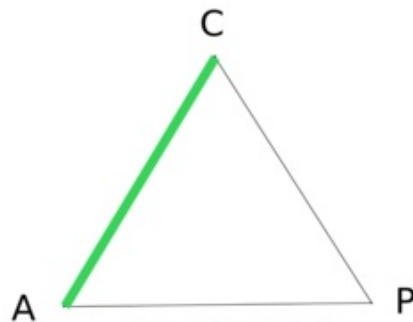


# Prevayler/Madeleine

Consistency

Availability

~~Partition tolerance~~

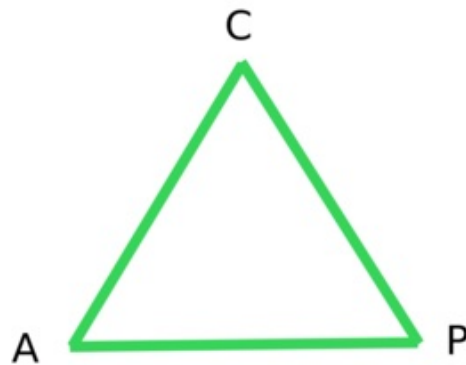


# NewSQL

Consistency

Availability

Partition tolerance

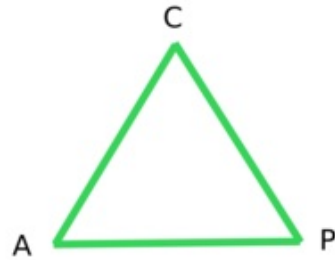


**VoltDB**

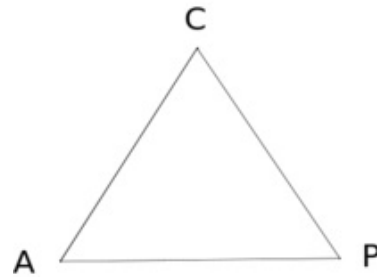
Impossible according to the theory  
...but Stonebraker doesn't agree

# Real life stories

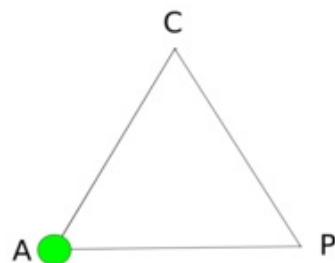
# What you think you have



# What you really have



..to be fair



# The art of choice

Scalability over Consistency

Consistency over Scalability

# Forfeit Partition Tolerance

Consistent system - easy

High Availability - hard

known & proven HA workarounds

Facebook - MySQL + memcache

Vertical scalability



# Forfeit Consistency

High Availability

Horizontal scalability - better

"Eventually consistent" (BASE)

HA = race conditions

workarounds?

# What you need

Extremely efficient

Reliable (in data sense)

# ACID

Atomicity

Consistency

Isolation

Durability

# BASE

**B**asically **A**vailable

**S**oft state

**E**ventual consistency

# ACID

people don't care

...but think data is consistent anyway

you can't enforce consistency at  
ActiveRecord level

# BASE

consistency relaxed

to make horizontal scalability easier

inconsistencies handled by developer

# beware of vendors

they don't always tell the truth

NoSQL is never ACID-compliant

NoSQL - lack of atomic operations  
across documents/collections

Prevaler - poor isolation

HBase - poor durability

# SQL is ACID

except MySQL with MyISAM

MVCC over locking

but must follow the rules

foreign keys, unique indexes

transaction isolation levels



# Links

[CAP preso](#)  
[CAP proof](#)  
[CAP explained](#)  
[CAP and NoSQL](#)  
[Comparision](#)  
[Stonbraker on CAP](#)  
[Sharding limits](#)  
[more on CAP](#)

Questions?