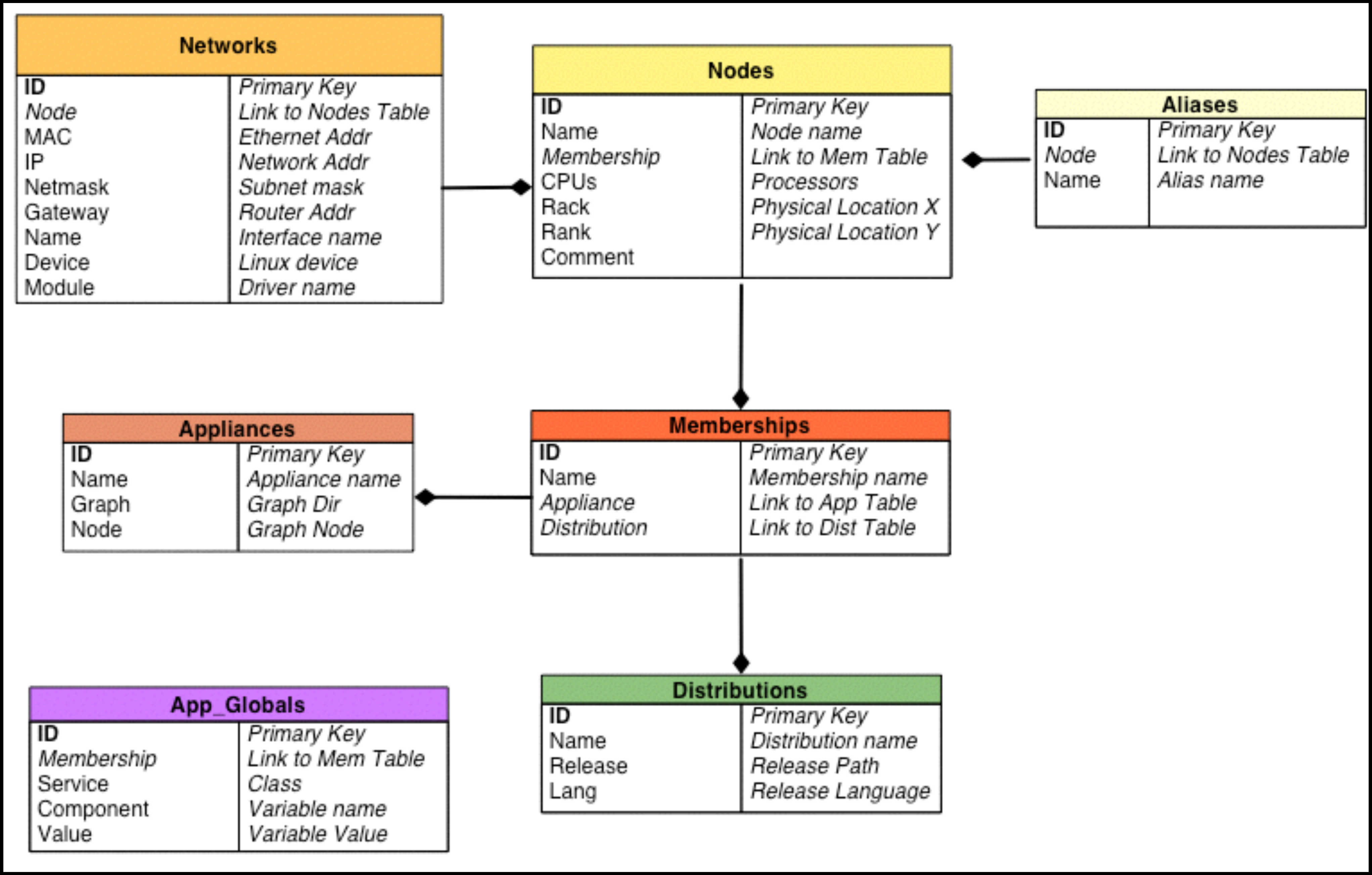
WOW

CPSC350

- “relational schemas”
- “table normalization”
- “practical use of relational algebraic operators”
- “tuple relational calculus”
- “and their expression in a declarative query language”



Networks

ID	*Primary Key*
Node	*Link to Nodes Table*
MAC	*Ethernet Addr*
IP	*Network Addr*
Netmask	*Subnet mask*
Gateway	*Router Addr*
Name	*Interface name*
Device	*Linux device*
Module	*Driver name*

Nodes

ID	*Primary Key*
Name	*Node name*
Membership	*Link to Mem Table*
CPUs	*Processors*
Rack	*Physical Location X*
Rank	*Physical Location Y*
Comment	

Aliases

ID	*Primary Key*
Node	*Link to Nodes Table*
Name	*Alias name*

Appliances

ID	*Primary Key*
Name	*Appliance name*
Graph	*Graph Dir*
Node	*Graph Node*

Memberships

ID	*Primary Key*
Name	*Membership name*
Appliance	*Link to App Table*
Distribution	*Link to Dist Table*

App_Globals

ID	*Primary Key*
Membership	*Link to Mem Table*
Service	*Class*
Component	*Variable name*
Value	*Variable Value*

Distributions

ID	*Primary Key*
Name	*Distribution name*
Release	*Release Path*
Lang	*Release Language*

relational schemas

CPSC350

- “relational schemas”
- “table normalization”
- “practical use of relational algebraic operators”
- “tuple relational calculus”
- “and their expression in a declarative query language”

Employee

Name	EmpId	DeptName
Harry	3415	Finance
Sally	2241	Sales
George	3401	Finance
Harriet	2202	Sales

Dept

DeptName	Manager
Finance	George
Sales	Harriet
Production	Charles

Employee $\bowtie$ ***Dept***

Name	EmpId	DeptName	Manager
Harry	3415	Finance	George
Sally	2241	Sales	Harriet
George	3401	Finance	George
Harriet	2202	Sales	Harriet

practical knowledge

the stuff you need to know to be a better software developer

An introduction to the non-SQL part of the course

Cloud Storage in a Post SQL World

Ian WIlkes ars technica

ars technica

Cloud storage in a post-SQL world

Since the rise of the Web, SQL-based relational databases have been the …

by **Ian Wilkes** - Feb 24 2010, 12:30am EST

70

“Since the rise of the Web, SQL-based relational databases have been the dominant structured storage technology behind online applications.”

“The past few years have seen the emergence of the cloud as a compelling environment for online application development, bringing true utility computing into the infrastructure pantheon”

“But the cloud and SQL do not mix well, and multiple efforts are now underway to offer viable alternatives to the venerable database.”

“while relational databases are by no means doomed, they will soon be joined in the cloud, and possibly out-shined by, new non-relational database technologies”

<disect>

more and more computing is in the cloud

- google docs
- dropbox

more and more computing is in the cloud

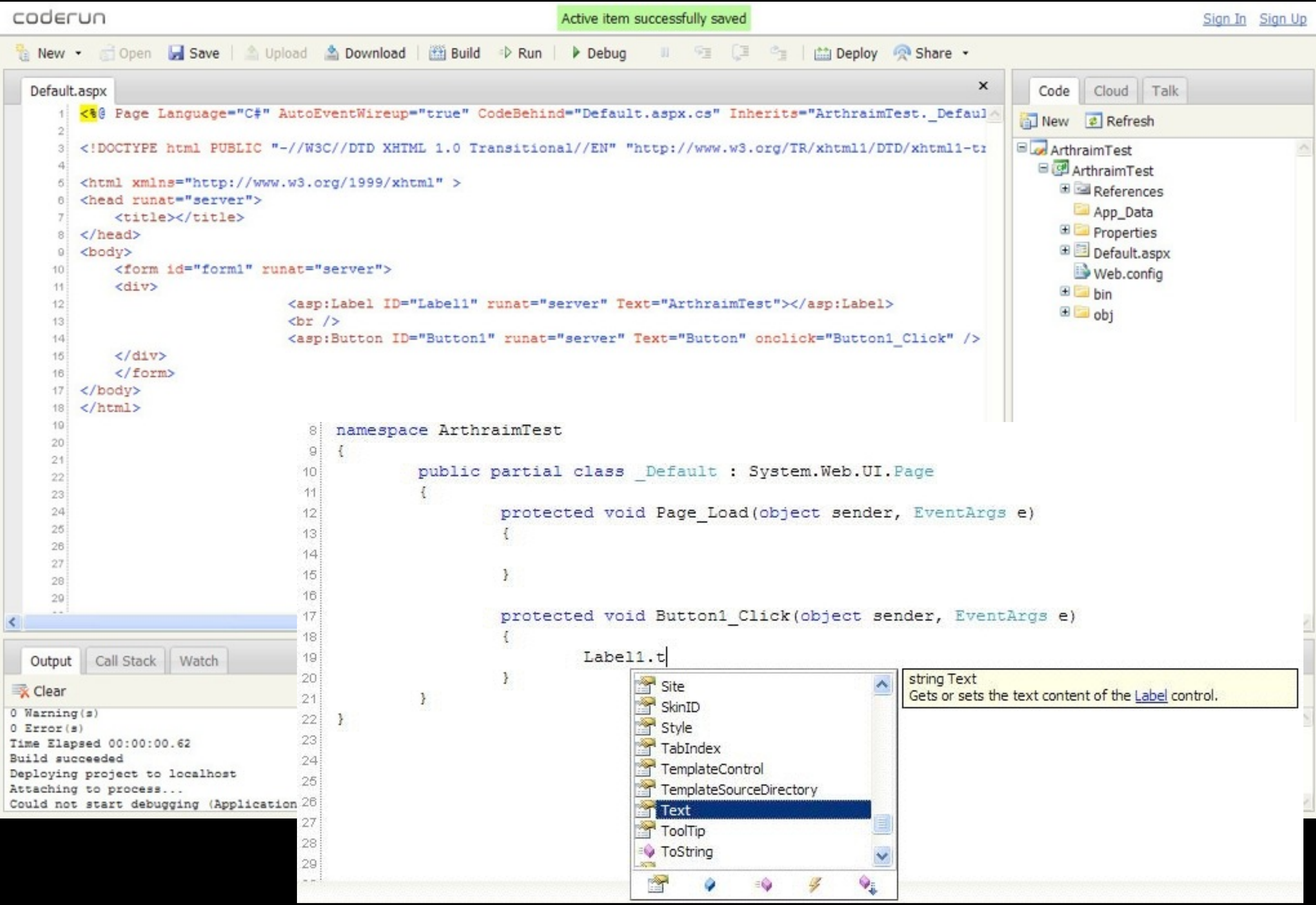
- google docs
- dropbox
- chromeOS
- Google Cr-48

more and more computing is in the cloud

- google docs
- dropbox
- chromeOS
- Google Cr-48
- iPad / Android / mobile computing

more and more computing is in the cloud

- Even cloud/browser based IDEs.



Active item successfully saved

```
<%@ Page Language="C#" AutoEventWireup="true" CodeBehind="Default.aspx.cs" Inherits="ArthraimTest._Defaul

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-tr

<html xmlns="http://www.w3.org/1999/xhtml" >
<head runat="server">
    <title></title>
</head>
<body>
    <form id="form1" runat="server">
    <div>
                        <asp:Label ID="Label1" runat="server" Text="ArthraimTest"></asp:Label>
                        <br />
                        <asp:Button ID="Button1" runat="server" Text="Button" onclick="Button1_Click" />
    </div>
    </form>
</body>
</html>
```

```
0 Warning(s)
0 Error(s)
Time Elapsed 00:00:00.62
Build succeeded
Deploying project to localhost
Attaching to process...
Could not start debugging (Application
```

```
namespace ArthraimTest
{
        public partial class _Default : System.Web.UI.Page
        {
                protected void Page_Load(object sender, EventArgs e)
                {

                }

                protected void Button1_Click(object sender, EventArgs e)
                {
                        Label1.t
                }
        }
}
```

string Text
Gets or sets the text content of the Label control.

Take a moment

do back of envelope calculation

what % of your computer time on cloud?

results

some believe the cloud and SQL do not mix well

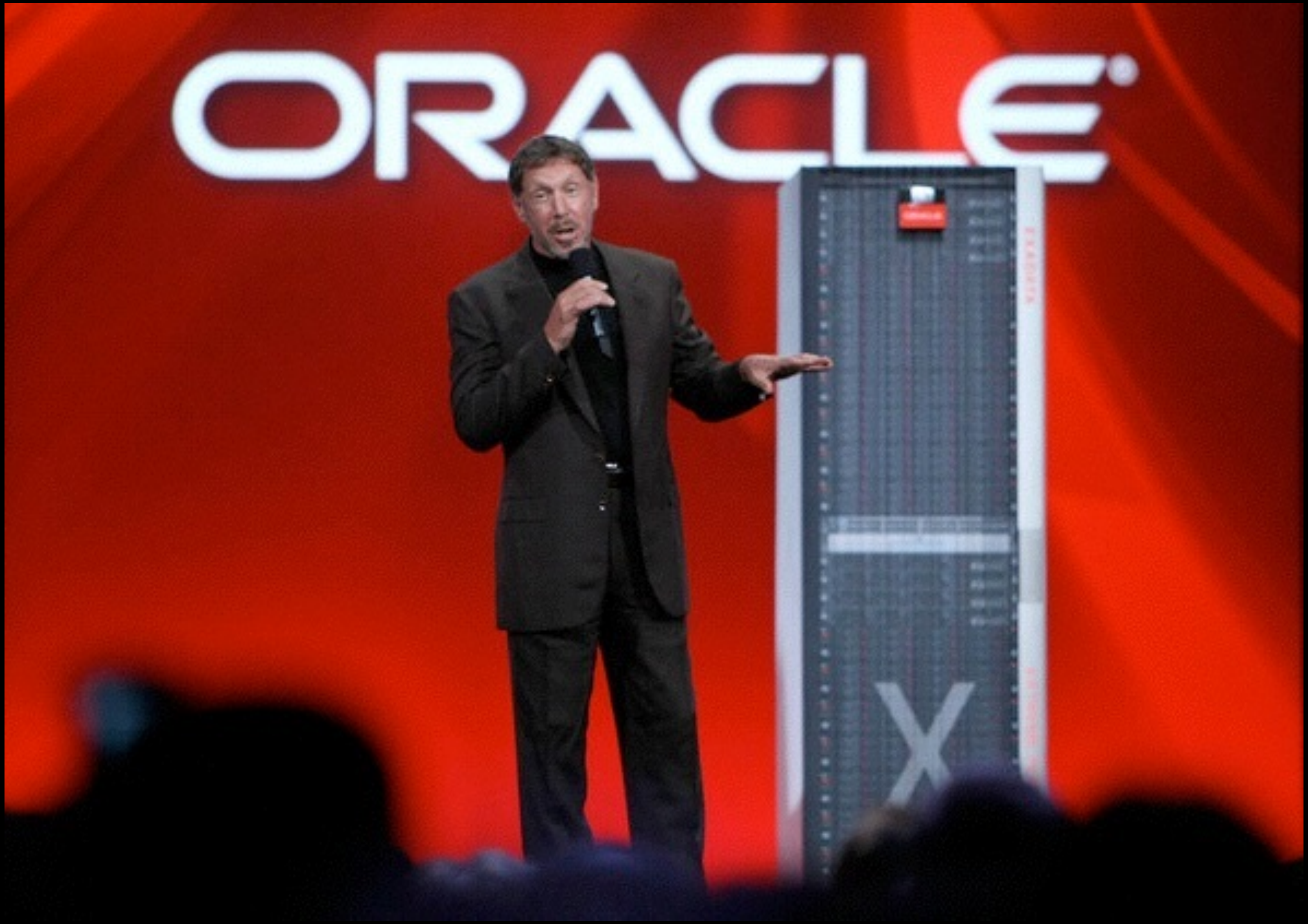
<on one side>

SQL databases work fine

- setup straightforward
- programming not that hard
- wide range of support
- for small projects XAMPP stack near plug and play.
- SQL on a Amazon ec2 instance easy to set up and work with

SQL can scale vertically

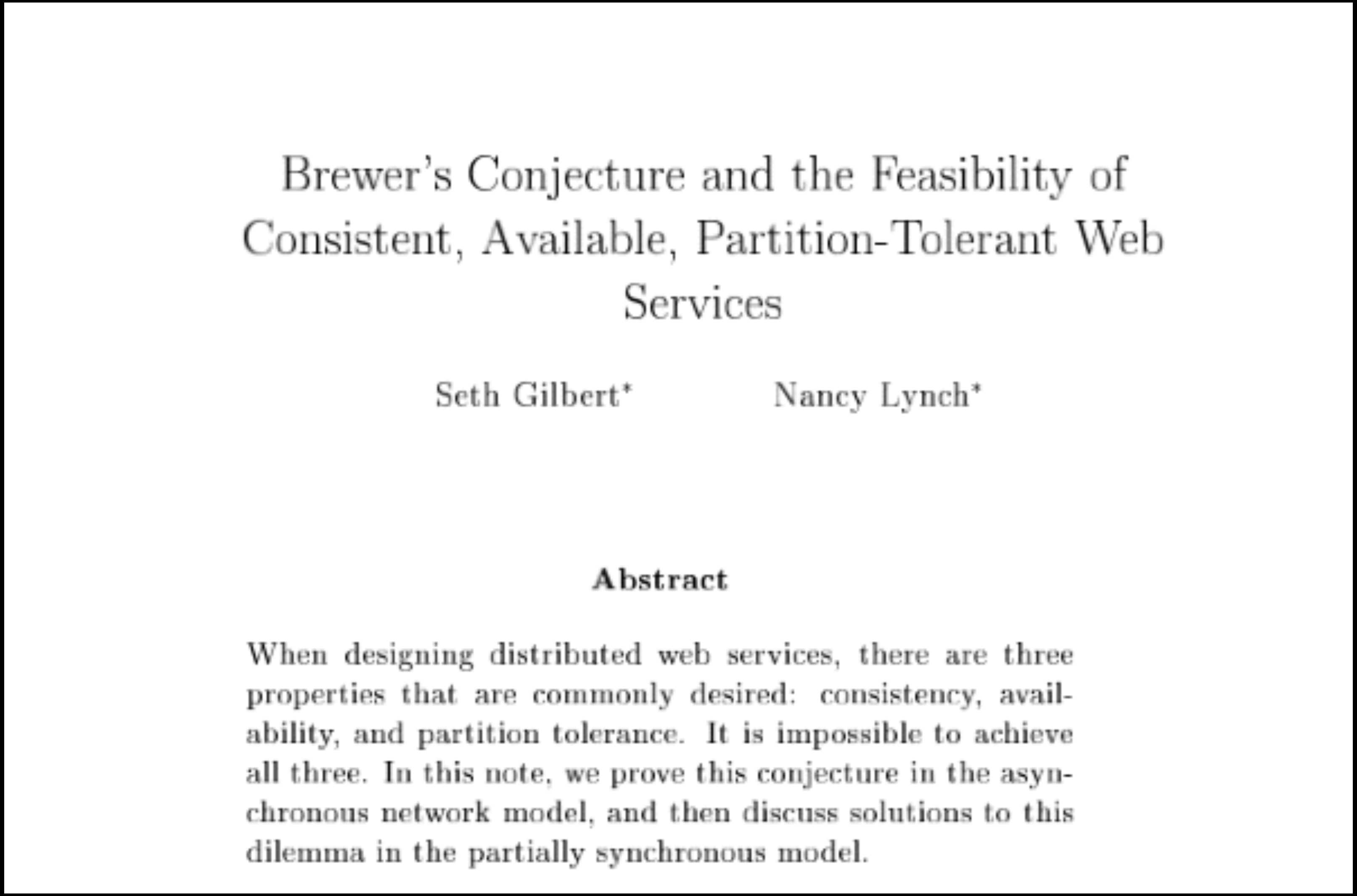
big iron



SQL can grow vertically

easily

SQL cannot ∨ grow horizontally



Brewer's Conjecture and the Feasibility of Consistent, Available, Partition-Tolerant Web Services

Seth Gilbert* Nancy Lynch*

Abstract

When designing distributed web services, there are three properties that are commonly desired: consistency, availability, and partition tolerance. It is impossible to achieve all three. In this note, we prove this conjecture in the asynchronous network model, and then discuss solutions to this dilemma in the partially synchronous model.

Brewer's Theorem
a.k.a. CAP Theorem

A system cannot have high consistency, availability, and partition tolerance simultaneously

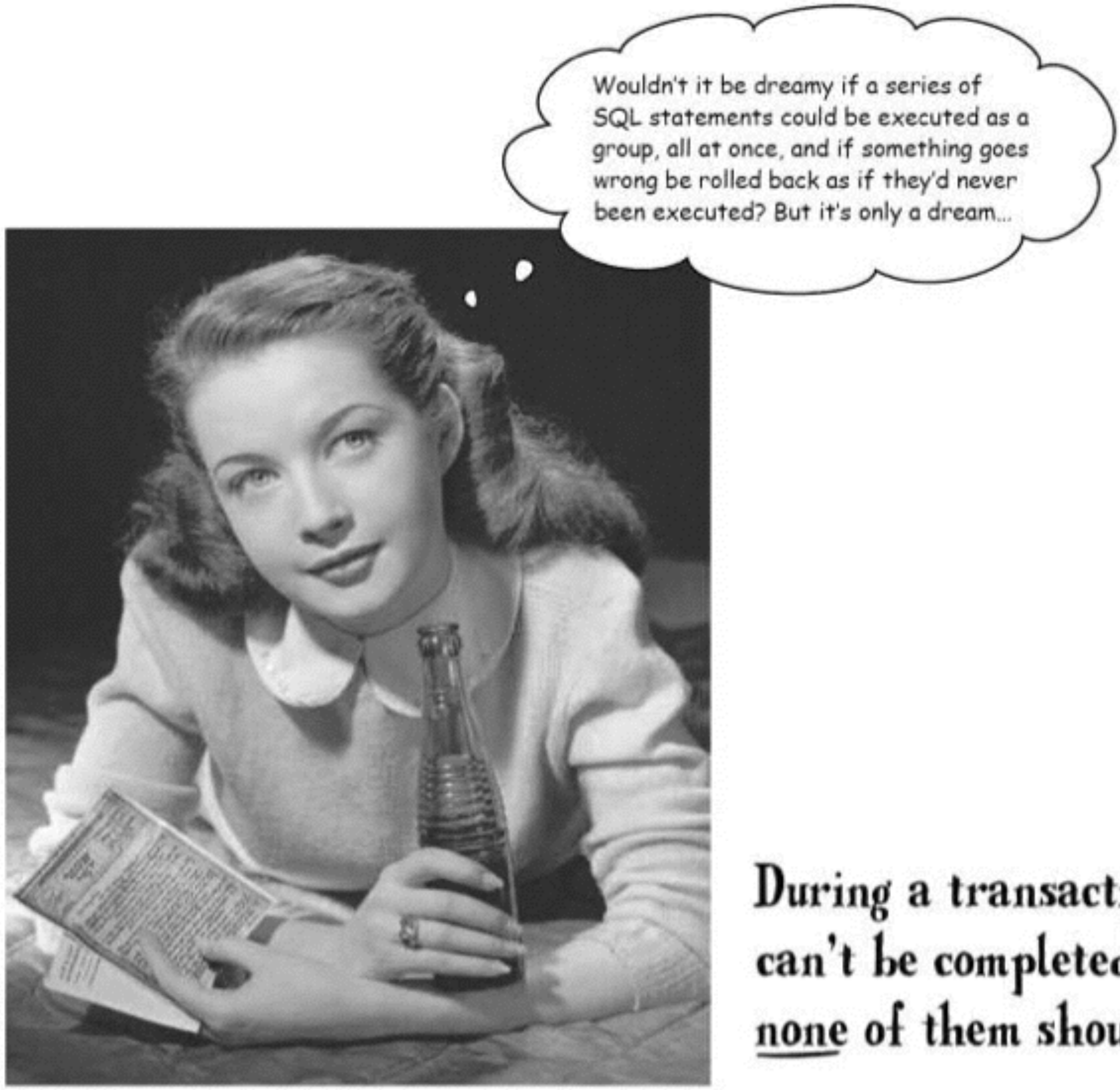
SQL focuses on consistency

SQL focuses on consistency

constraints on foreign keys

ACID semantics (ch11)

Wouldn't it be dreamy if a series of SQL statements could be executed as a group, all at once, and if something goes wrong be rolled back as if they'd never been executed? But it's only a dream...


Wouldn't it be dreamy if a series of SQL statements could be executed as a group, all at once, and if something goes wrong be rolled back as if they'd never been executed? But it's only a dream...

During a transaction, if all the steps can't be completed without interference, none of them should be completed.

ACID: ATOMICITY

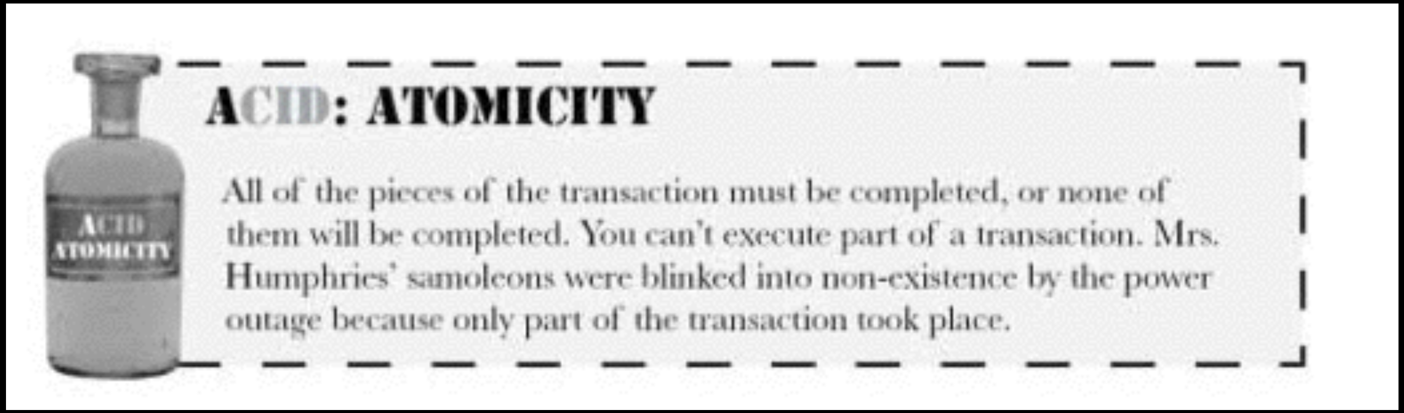
All of the pieces of the transaction must be completed, or none of them will be completed. You can't execute part of a transaction. Mrs. Humphries' samoleons were blinked into non-existence by the power outage because only part of the transaction took place.

ACID: ATOMICITY

All of the pieces of the transaction must be completed, or none of them will be completed. You can't execute part of a transaction. Mrs. Humphries' samoleons were blinked into non-existence by the power outage because only part of the transaction took place.

ACID: CONSISTENCY

A complete transaction leaves the database in a consistent state at the end of the transaction. At the end of both of the samoleon transactions, the money is in balance again. In the first case it's been transferred to savings; in the second it's been translated into cash. But no samoleons go missing.



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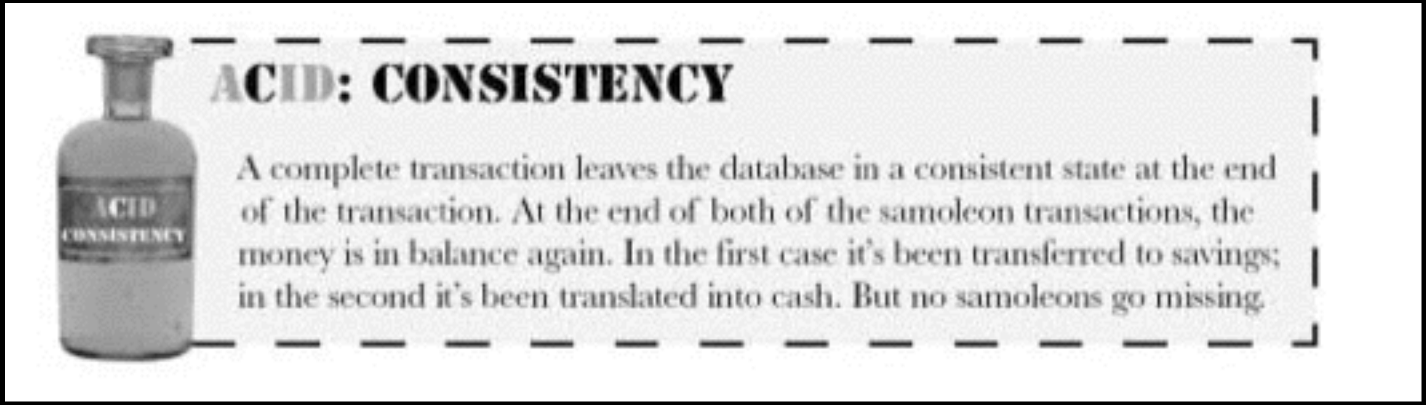

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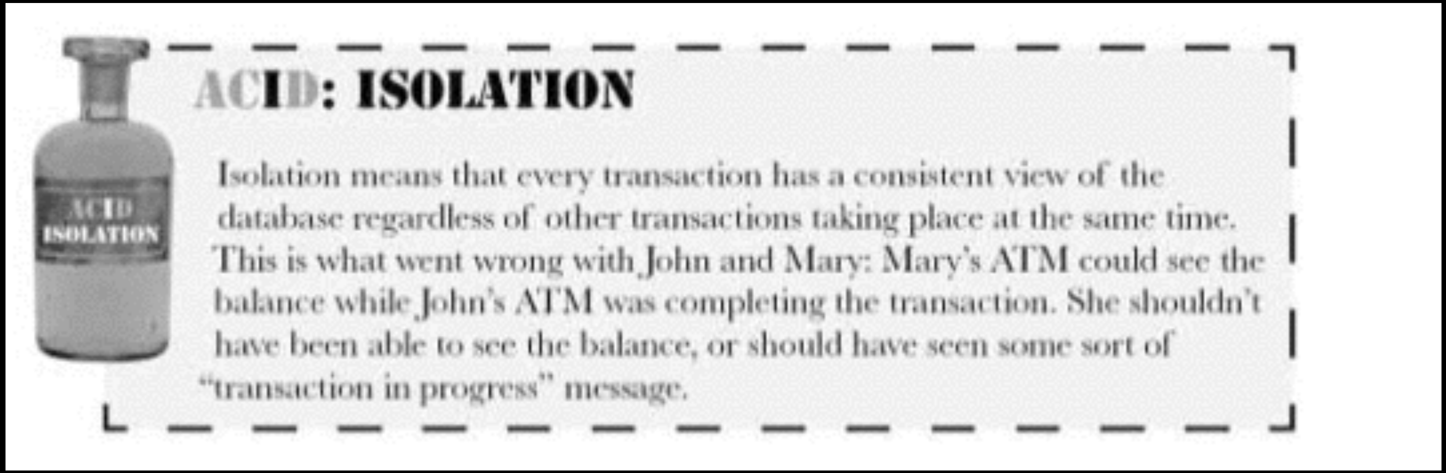

ACID: ISOLATION

Isolation means that every transaction has a consistent view of the database regardless of other transactions taking place at the same time. This is what went wrong with John and Mary: Mary's ATM could see the balance while John's ATM was completing the transaction. She shouldn't have been able to see the balance, or should have seen some sort of "transaction in progress" message.

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ACID: DURABILITY

After the transaction, the database needs to save the data correctly and protect it from power outages or other threats. This is generally handled through records of transactions saved to a different location than the main database. If a record of Mrs. Humphries' transaction had been kept somewhere, then she might have gotten her 1,000 samoleons back.

Brewer's Theorem
a.k.a. CAP Theorem

A system cannot have high consistency, availability, and partition tolerance simultaneously

availability

online web apps -
availability is a must

Brewer's Theorem
a.k.a. CAP Theorem

A system cannot have high consistency, availability, and partition tolerance simultaneously

mismatch

Clustered machines -- SQL semantics

BASE

instead of ACID semantics

BASE

Basically Available, Soft state,
Eventual consistency

Basically Available:

This constraint states that the system does guarantee the availability of the data as regards CAP Theorem; there will be a response to any request. But, that response could still be ‘failure’ to obtain the requested data or the data may be in an inconsistent or changing state, much like waiting for a check to clear in your bank account.

Soft state:

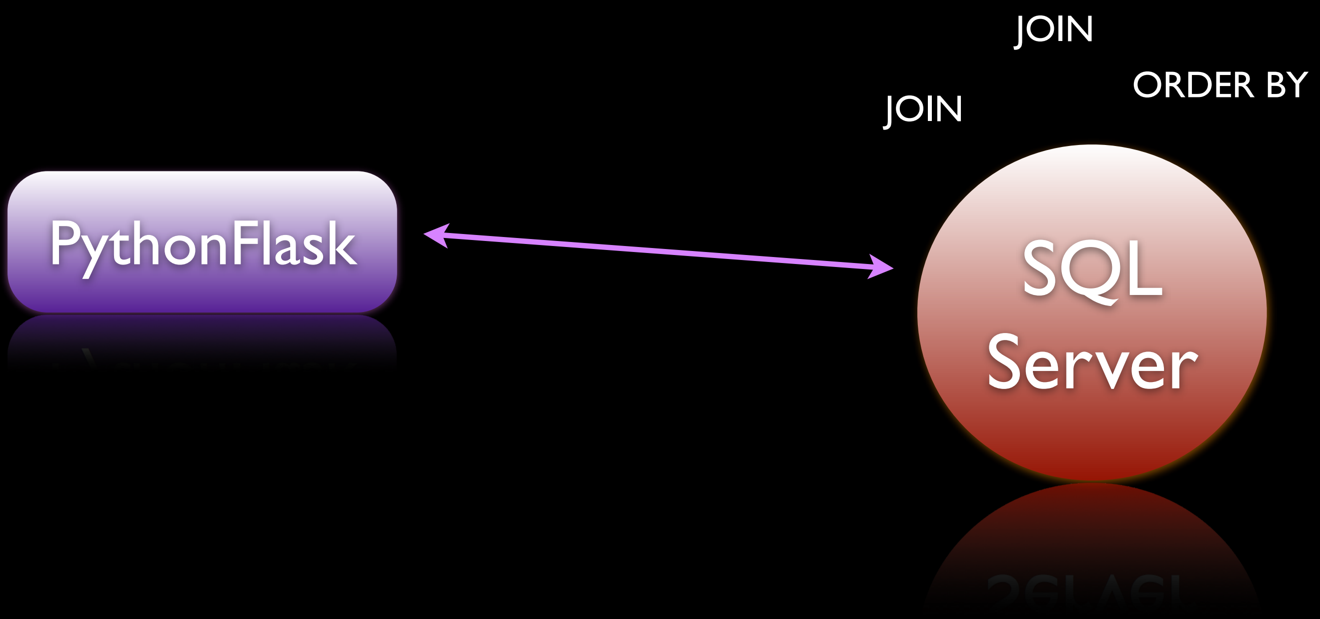
The state of the system could change over time, so even during times without input there may be changes going on due to ‘eventual consistency,’ thus the state of the system is always ‘soft.’

Eventual consistency:

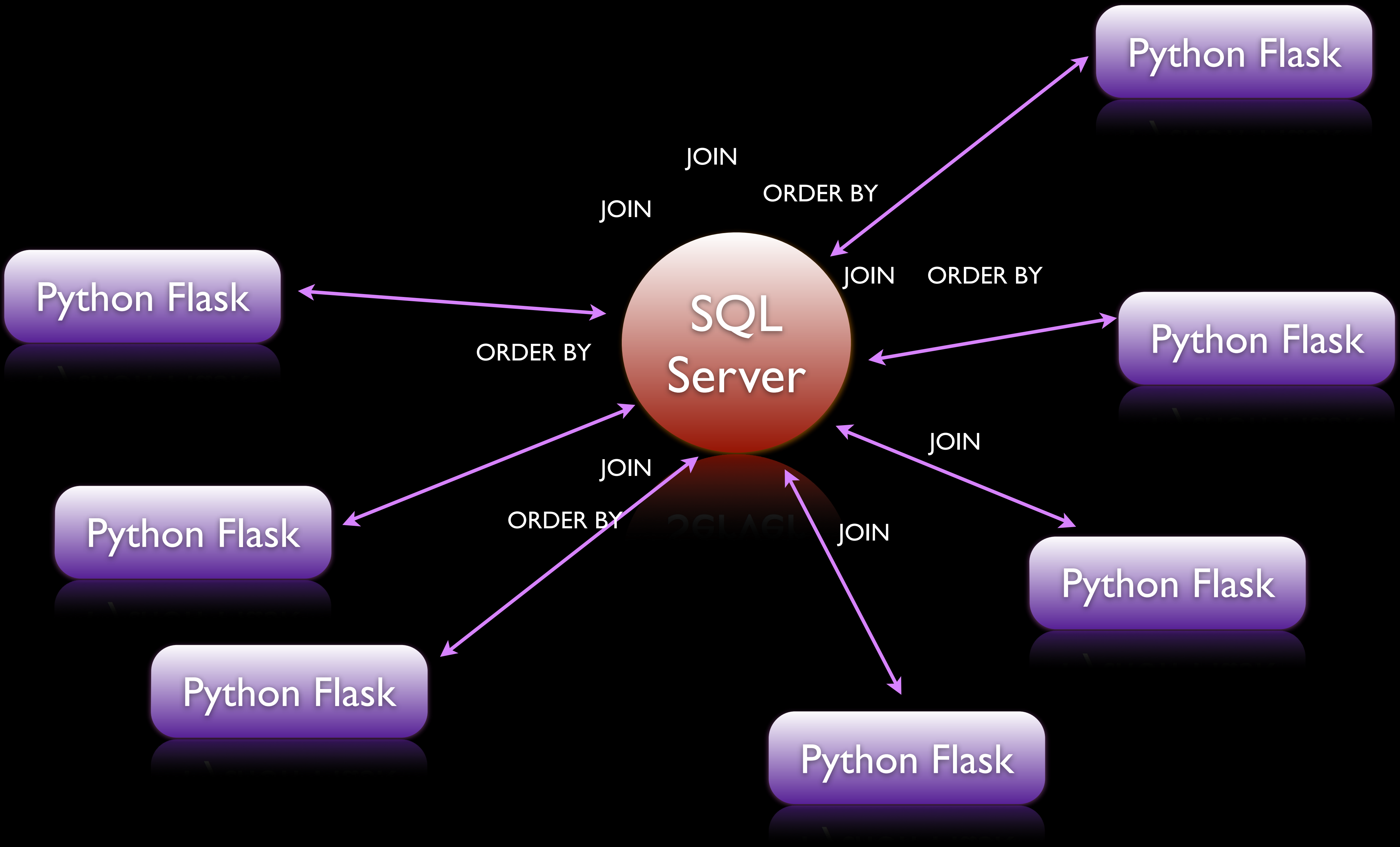
The system will eventually become consistent once it stops receiving input. The data will propagate to everywhere it should sooner or later, but the system will continue to receive input and is not checking the consistency of every transaction before it moves onto the next one.

Wait, there’s more

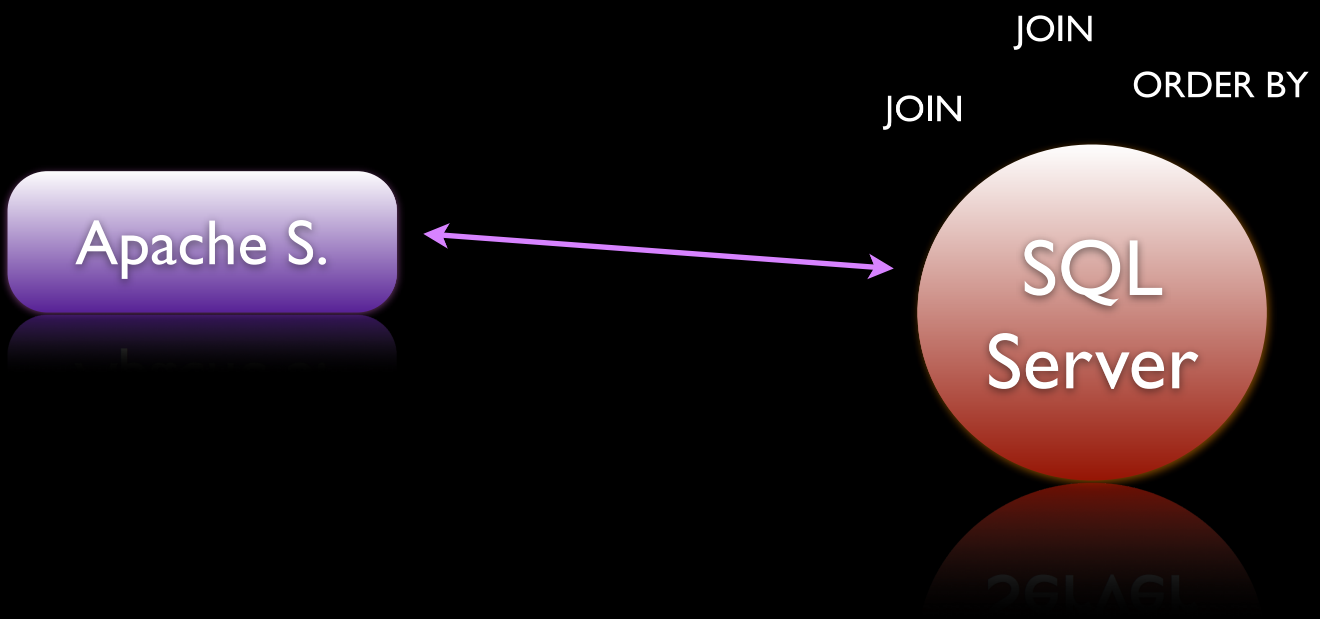
Our model



Extending our model



Our model



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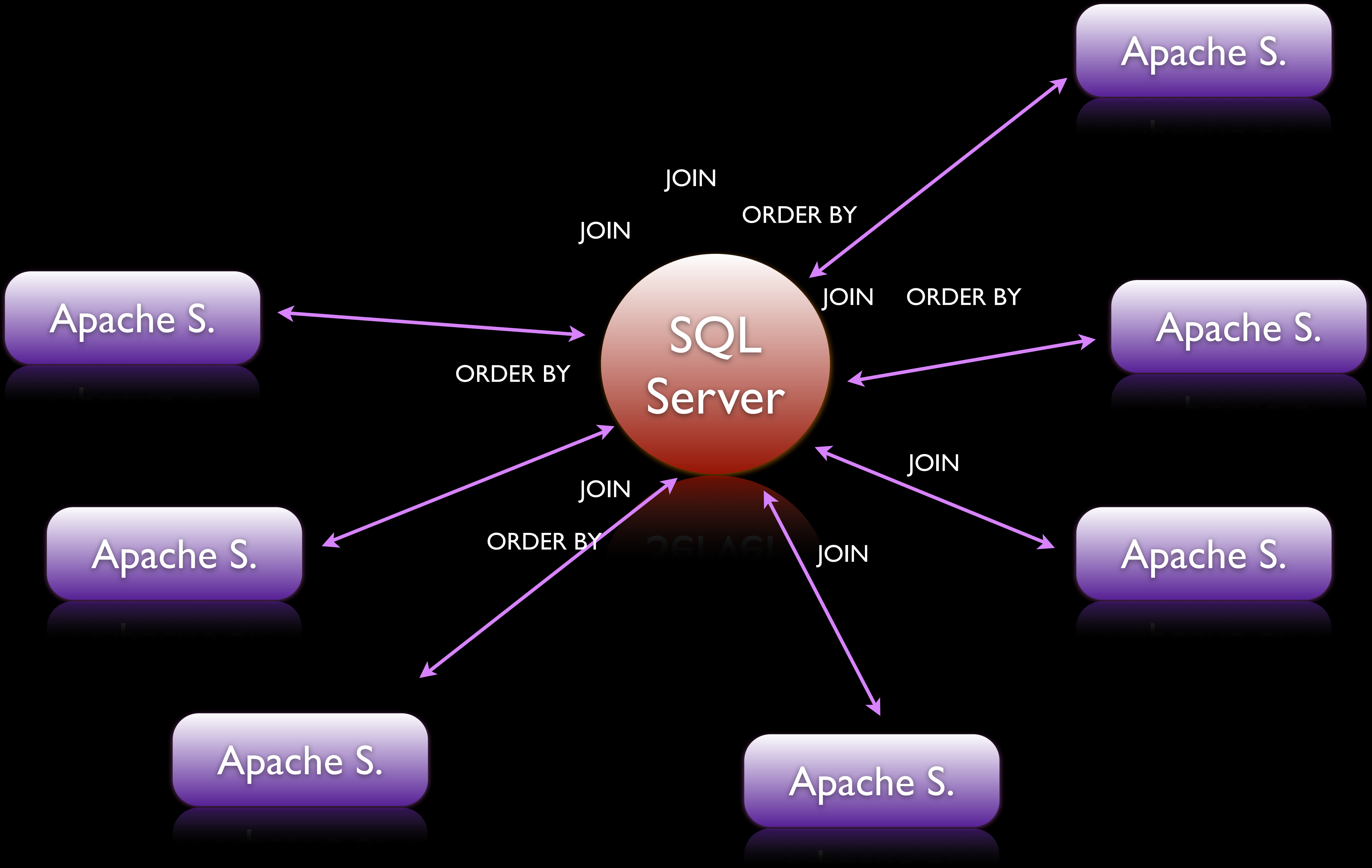


All data processing on database server

adds load to CPU

further inhibits scaling

Some SQL platform providers offer cloud relational db

- Amazon's mySQL based RDS
- Heroku's PostgreSQL
- but these more like managed hosting than true cloud (distributed) computing

push to NoSQL alternatives

sacrifice consistency in favor of scalability and availability

first implementations proprietary

- Google Big Table
- Amazon Dynamo

NoSQL features

- No schemas -- no fixed table structure, no fixed columns
  - little to no protection against invalid data

NoSQL features

- No or limited joins - no built in methods for connecting /joining entries.
  - must be done at application level

NoSQL features

- Restricted query interface - SQL has rich query interface. noSQL somewhat limited.
    - although some NoSQL systems (e.g., CouchDB) offer different views.

NoSQL features

- Limited transactions or locks - ACID transactions not distributed system friendly.

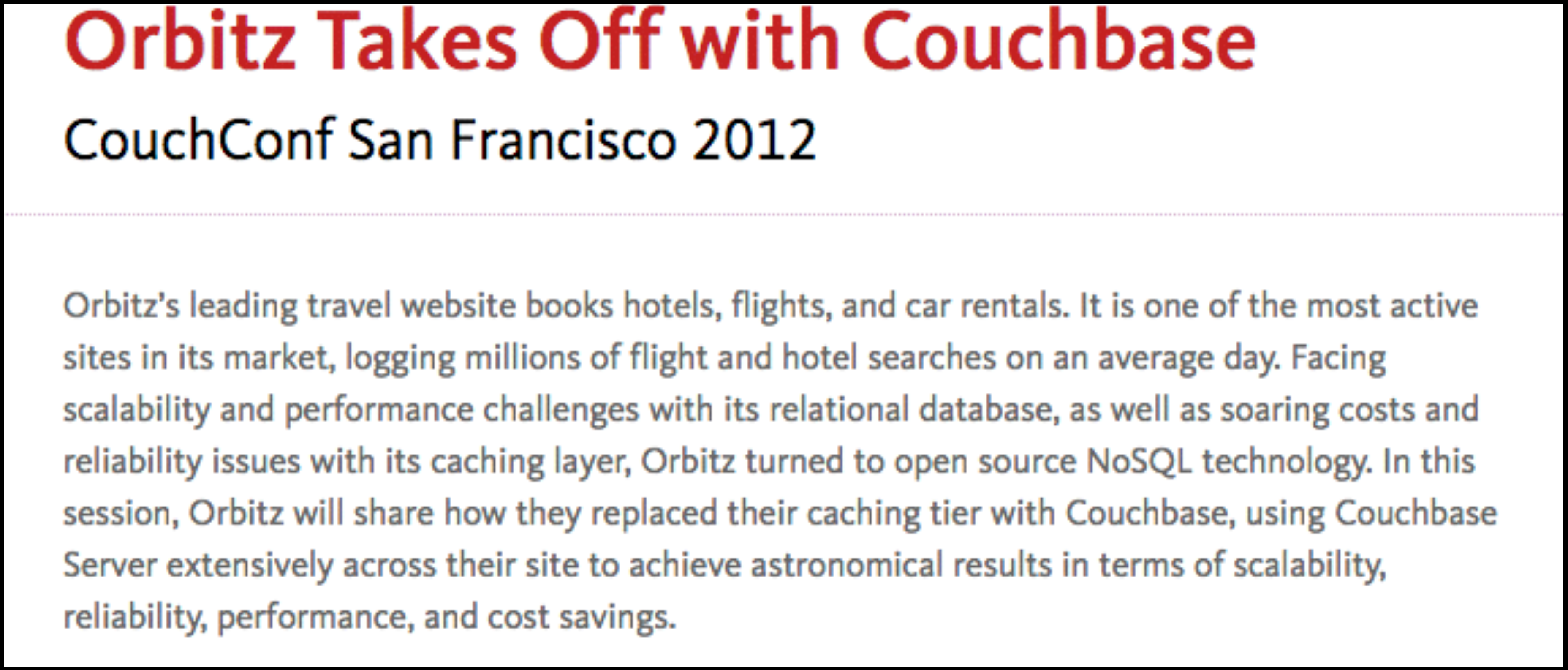
NoSQL open source projects

Cassandra

- developed by Facebook and used in-house
- now an Apache project
- used in a large number of production environments
  - Digg, Rackspace, Twitter (internally)
  - Netflix
  - Redit
  - CERN
  - not Facebook

CouchDB

- an Apache project
- operates on JSON documents
- the read state of the db is not always consistent with the latest writes.
- reasonably stable
- used by:
  - wego, BBC, World Wildlife Fund,
  - http://www.couchbase.com/customers/case-studies



Orbitz Takes Off with Couchbase

CouchConf San Francisco 2012

Orbitz's leading travel website books hotels, flights, and car rentals. It is one of the most active sites in its market, logging millions of flight and hotel searches on an average day. Facing scalability and performance challenges with its relational database, as well as soaring costs and reliability issues with its caching layer, Orbitz turned to open source NoSQL technology. In this session, Orbitz will share how they replaced their caching tier with Couchbase, using Couchbase Server extensively across their site to achieve astronomical results in terms of scalability, reliability, performance, and cost savings.

mongoDB

- operates on JSON documents
- considered faster than CouchDB.
- good stability
- used by
  - foursquare, bit.ly, intuit, shutterfly, nyTimes, Etsy, Cern (Large Hadron Collider)justin.tv

Voldemort

- developed by LinkedIn
- now open source
- bare-bones key-value pair db.
- all data management work done in the applications.

HBase

- A Big Table clone
- uses map-reduce

Amazon's simpleDB

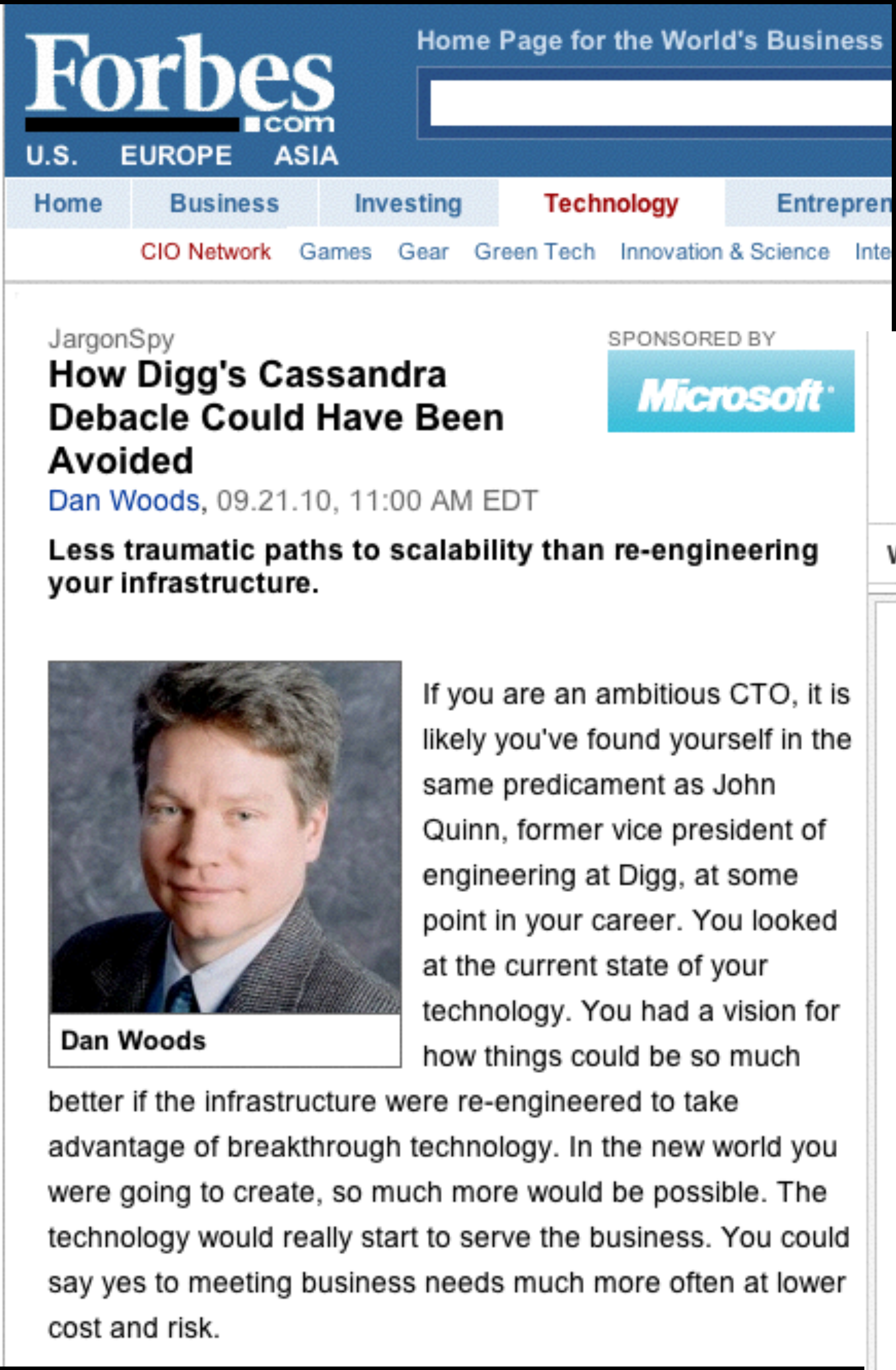
- not open source
- disappointing performance
- not mature

The top ones

- Cassandra
- CouchDB
- mongoDB
- Redis

Failure of NoSQL

DIGG



Forbes.com

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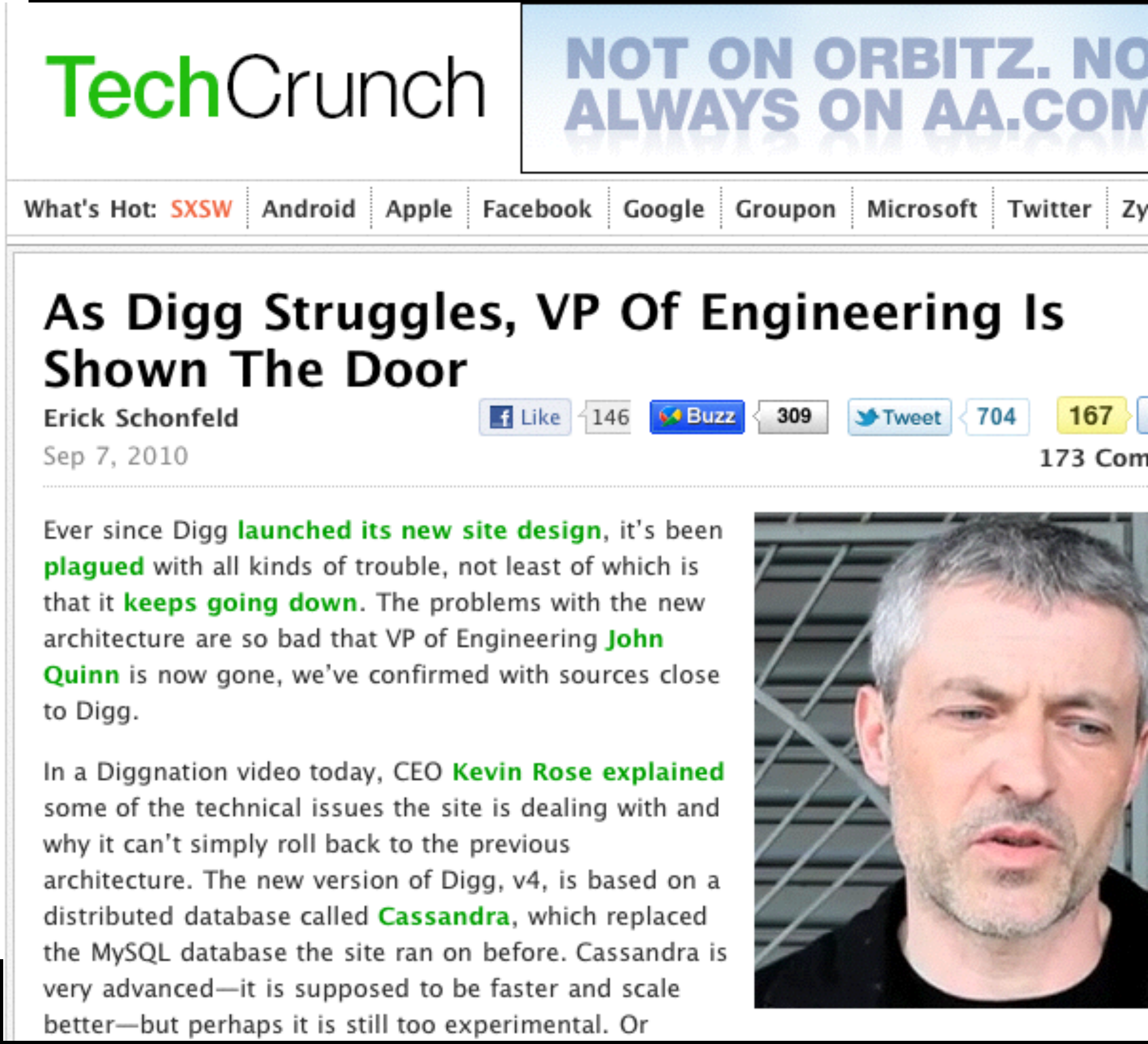
How Digg's Cassandra Debacle Could Have Been Avoided

Dan Woods, 09.21.10, 11:00 AM EDT

Less traumatic paths to scalability than re-engineering your infrastructure.

Dan Woods

If you are an ambitious CTO, it is likely you've found yourself in the same predicament as John Quinn, former vice president of engineering at Digg, at some point in your career. You looked at the current state of your technology. You had a vision for how things could be so much better if the infrastructure were re-engineered to take advantage of breakthrough technology. In the new world you were going to create, so much more would be possible. The technology would really start to serve the business. You could say yes to meeting business needs much more often at lower cost and risk.



TechCrunch

NOT ON ORBITZ. NO
ALWAYS ON AA.COM

What's Hot: SXSW | Android | Apple | Facebook | Google | Groupon | Microsoft | Twitter | Zy

As Digg Struggles, VP Of Engineering Is Shown The Door

Erick Schonfeld

Sep 7, 2010

Like 146 | Buzz 309 | Tweet 704 | 167

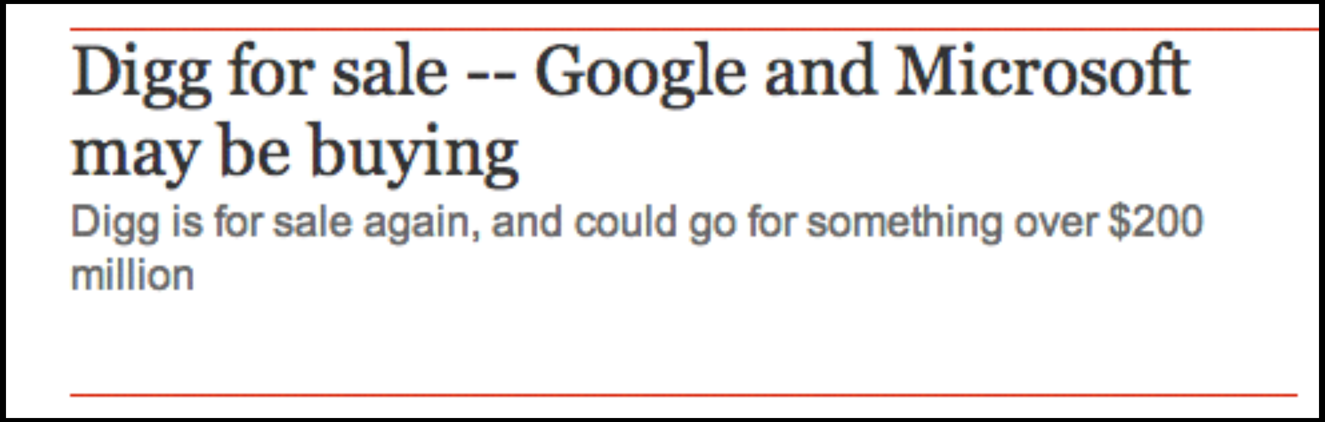
173 Com

Ever since Digg **launched its new site design**, it's been **plagued** with all kinds of trouble, not least of which is that it **keeps going down**. The problems with the new architecture are so bad that VP of Engineering **John Quinn** is now gone, we've confirmed with sources close to Digg.

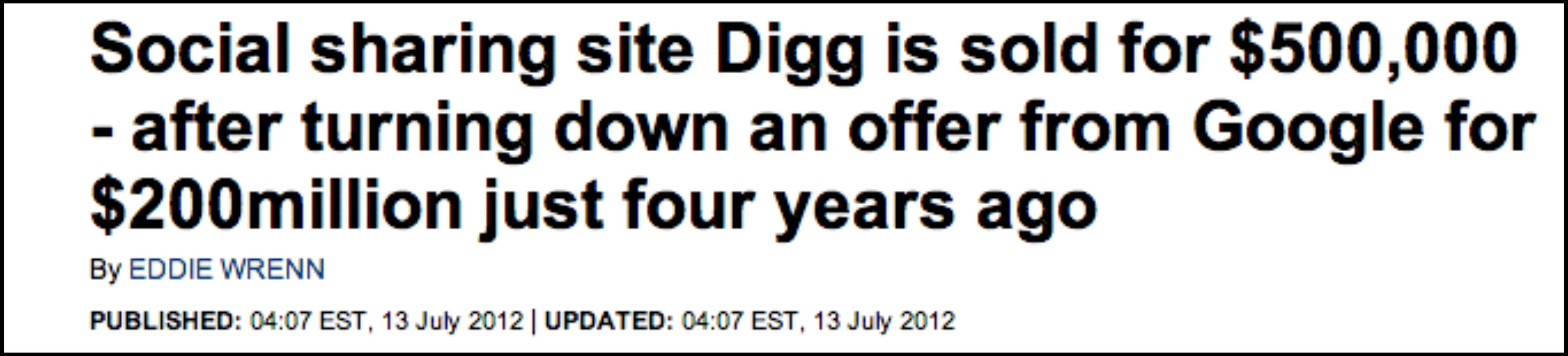
In a Diggnation video today, CEO **Kevin Rose explained** some of the technical issues the site is dealing with and why it can't simply roll back to the previous architecture. The new version of Digg, v4, is based on a distributed database called **Cassandra**, which replaced the MySQL database the site ran on before. Cassandra is very advanced—it is supposed to be faster and scale better—but perhaps it is still too experimental. Or

BusinessWeek
How This Kid Made $60 Million In 18 Months

Blue is the New Green
Water: a trillion-dollar opportunity
Inc.
The Handbook of the American Entrepreneur
6 EASY WAYS TO SOUP UP YOUR PC
PAGE 44
The Hottest Small Company in America
How Kevin Rose, founder of Digg, captured the hearts and minds of the most desirable
Part Steve Jobs, part Howard Stern— this guy could be the next Rupert Murdoch.


Digg for sale -- Google and Microsoft may be buying

Digg is for sale again, and could go for something over $200 million



Social sharing site Digg is sold for $500,000 - after turning down an offer from Google for $200million just four years ago

By EDDIE WRENN

PUBLISHED: 04:07 EST, 13 July 2012 | **UPDATED:** 04:07 EST, 13 July 2012

Road Map for remainder of course

- mongoDB
- CouchDB
- Redis