

Cloud Computing and Big Data

Cloud and Big Data Pulling it all together

Oxford University
Software Engineering
Programme
July 2021

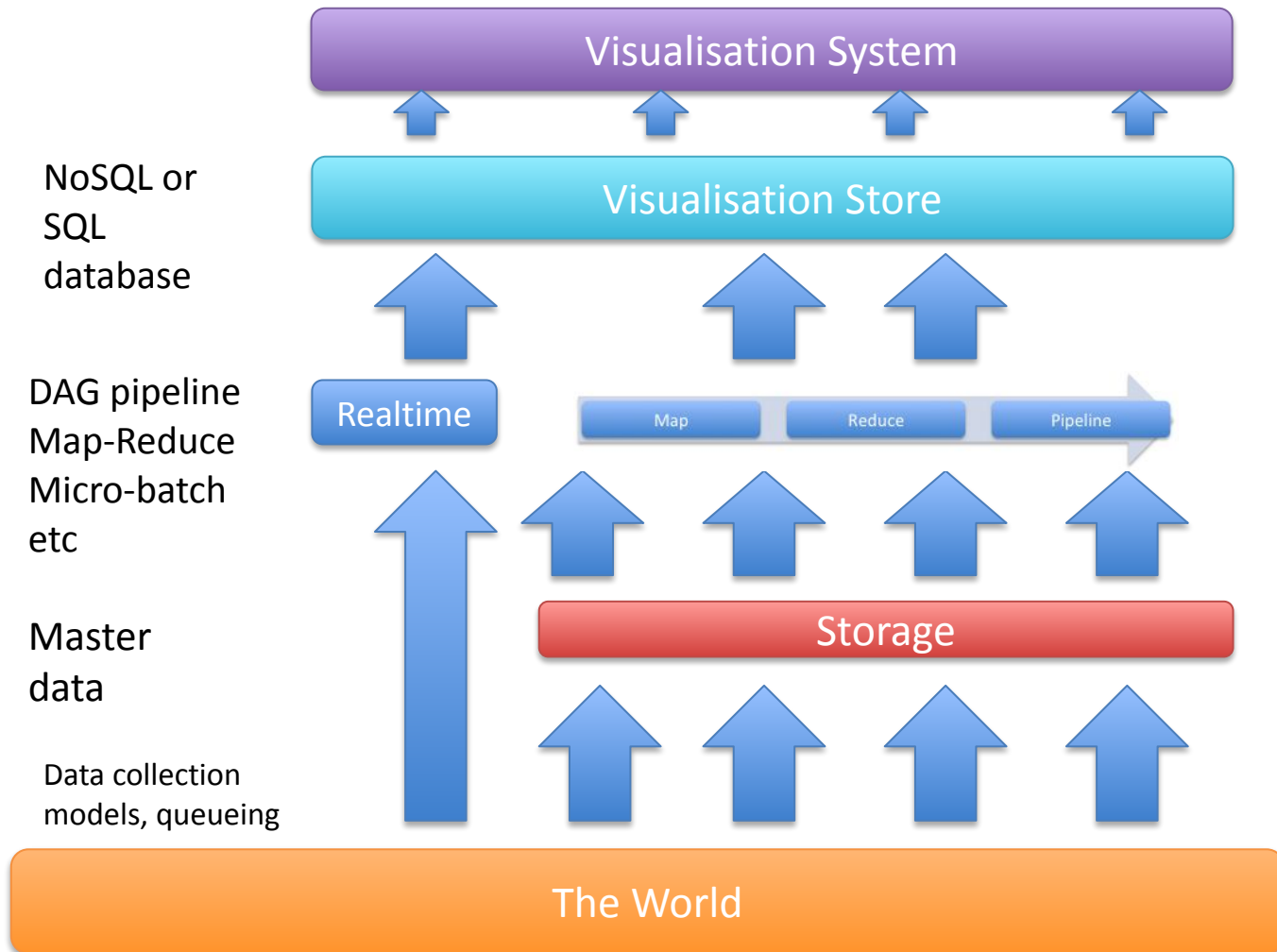


Contents

- Understanding the bigger picture
- What are the different components
- Message queueing and collection systems
- Map-Reduce and DAG systems
- Realtime Systems
- Theory recap



The big picture

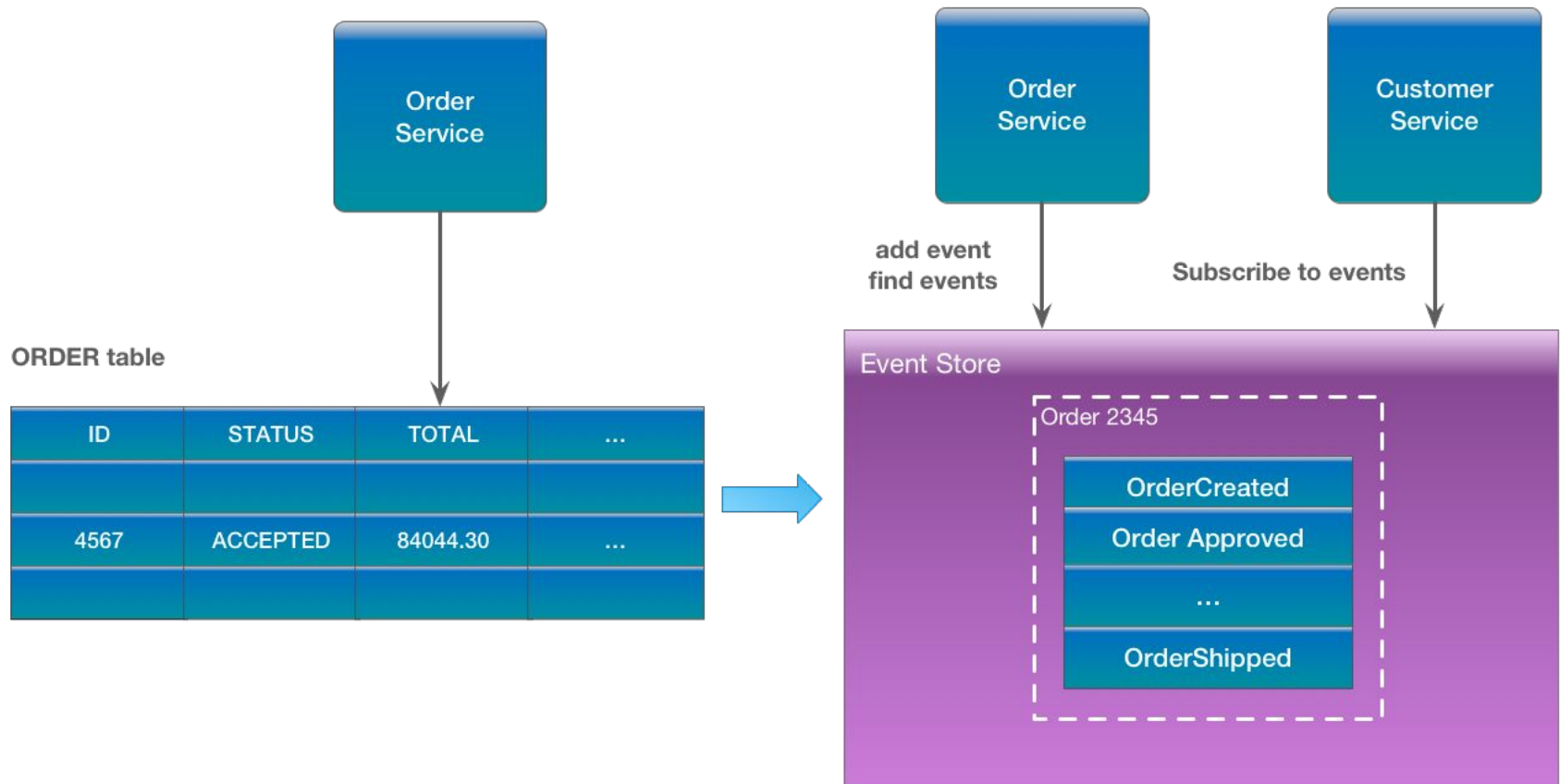


The big picture

- You have *immutable* master data
- You create a set of processes to:
 - Collect that data
 - Store master data
 - Process data
 - Store aggregates
 - Visualise and present
- Some of those processes act on batch and others on real-time data

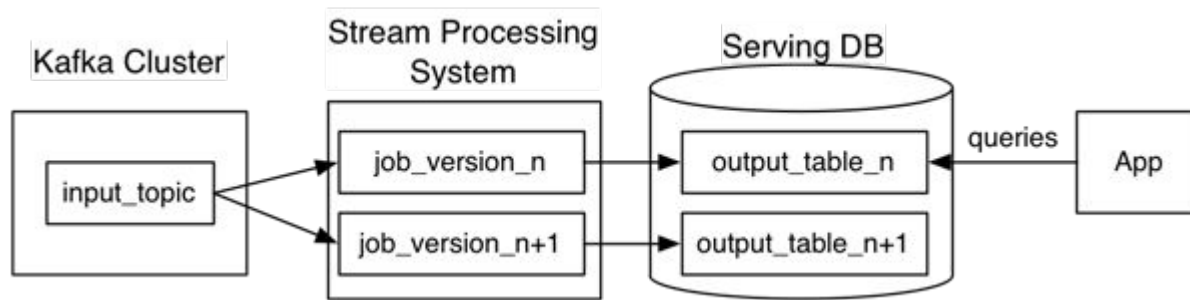
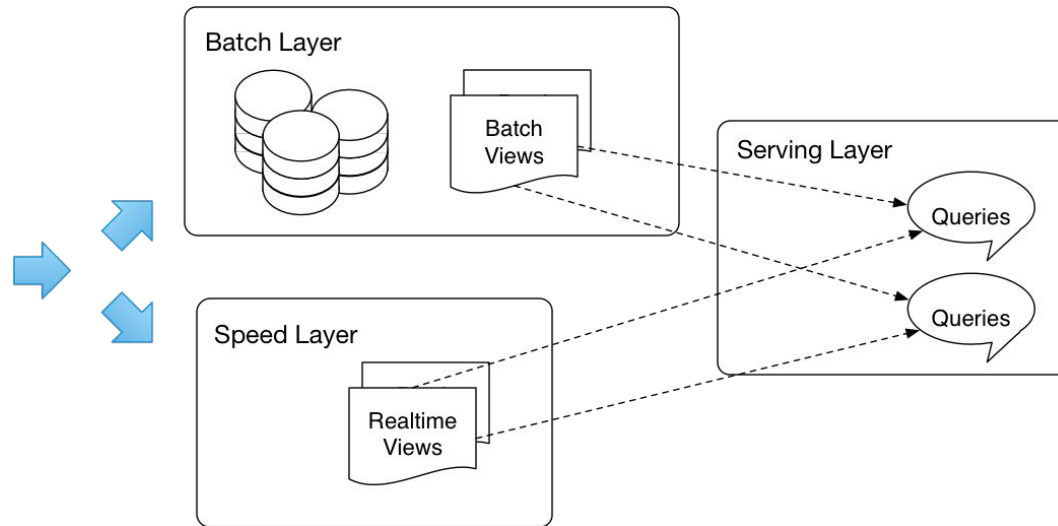


Event Sourcing



<https://eventuate.io/whyeventsourcing.html>

Lambda vs Kappa



How to choose the components?

- Two main approaches:
 - Best of breed
 - Choose the best available component in each space
 - Stack
 - Choose a curated stack that a team or organization is providing/selling/supporting



Approach

- Minimise the pain
 - Choose what you need when you need it
 - Don't over engineer



What Cloud Platform?

2019 Magic Quadrant



Market Overview

The market for cloud IaaS is maturing, but revenue is growing unabated. Gartner projects revenue in the cloud IaaS market to increase to \$81.5 billion by 2022, up from \$41.4 billion in 2019. But most of the enterprise interest and revenue are currently directed toward two providers: AWS and Microsoft. The market views both AWS and Microsoft as being general-purpose providers capable of supporting a broad range of workloads. Google is making steady progress in terms of enterprise adoption, but it remains in a distant third place in terms of overall annual revenue and interest among Gartner's enterprise clients. All other vendors in this market are forced to focus on regional dominance or niche workloads given the momentum of AWS and Microsoft, and the scale at which they operate. Examples of regional and niche-focused vendors are Alibaba and Oracle. Alibaba dominates the market for cloud IaaS in China, and Oracle is, naturally, mostly focused on Oracle workloads as it attempts to scale in the process of rebooting its cloud endeavors. Lastly, IBM remains in a precarious position due to being slow to improve its cloud IaaS offerings, which are ultimately not competitive with the market leaders.



MACRO PERSPECTIVE

MEGACLOUDS ARE FIGHTING TO BE #1 PLUMBING FOR DIGITAL BUSINESS

Besides a few serious regional players like Alibaba, global enterprises have 3 main marketplace bazaars to choose from to power their digital transformation



PLAYER #1 (CATEGORY LEADER): MOMENTUM AND BRAND NAME

\$17.1 Billion (2017 Revenue Est.)
40% YoY Growth

PRODUCT STRATEGY

The monocloud that's good enough for most things, not amazing for anything. Heading down proprietary path as most services are integrally tied to their public cloud architecture.

GTM STRATEGY

Aggressive enterprise sales: lock-in, land-and-expand.

BIG EXISTENTIAL QUESTION

Amazon can't allocate 30 top PhDs to solve a single problem. Who will hit Amazon in the achilles heel?



PLAYER #2 (FOR NOW): ENTERPRISE HERITAGE

\$6.1 Billion (2017 Revenue Est.)
81% YoY Growth

PRODUCT STRATEGY

Play to internal strengths: Underserved enterprise workloads like legacy Microsoft products, platform and application services for modern enterprise apps.

GTM STRATEGY

Strong enterprise support model.

BIG EXISTENTIAL QUESTION

Will enterprise chops trump Amazon's scale and scope?



Google Cloud Platform

PLAYER #3 (KILLER PRODUCTS): BUT WHERE'S THE ENTERPRISE LOVE?

\$950 Million (2017 Revenue Est.)
75% YoY Growth

PRODUCT STRATEGY

Google shines strength in machine learning, developer tools, and container orchestration (Kubernetes).

GTM STRATEGY

Historically Google hasn't catered to the enterprise with sales & support. They're apparently trying to change this though.

BIG EXISTENTIAL QUESTION

Can Diane Green, Sam Ramji, and the first-class GTM team from Apigee bring Google from enterprise 0 to hero?

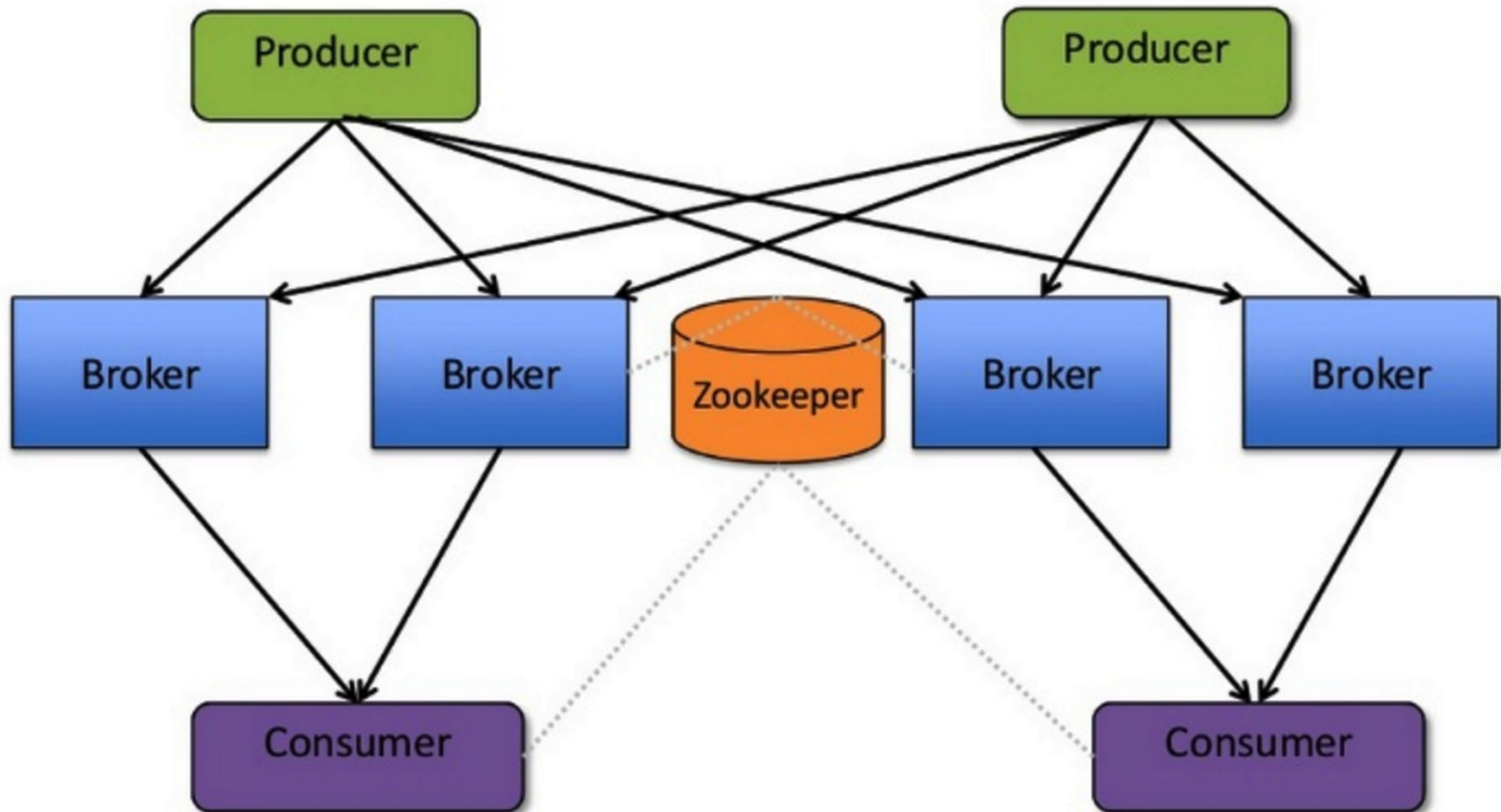
Source: Estimates from Bank of America Merrill Lynch's "Server & Enterprise Software: Cloud Wars 9: AI : From faster to smarter powered by ABC." May 8, 2017. Revenue includes PaaS & IaaS.

How do I ingest data?

- File transfer
- Live stream
 - Sockets
 - Syslog
 - Messaging system
- From existing databases



Apache Kafka



How do I store data?

- HDFS
- Cassandra File System
- NoSQL database only
 - Mongo / HBase / Cassandra
- Kafka for Kappa Architecture
- zFS / GlusterFS / NFS etc



How do I process data?

- Simple Map Reduce (Hadoop)
- DAG
 - e.g Spark, SparkR, SQL
 - Realtime only (Flink, Kafka Streams, Siddhi)
- Pipeline
- etc

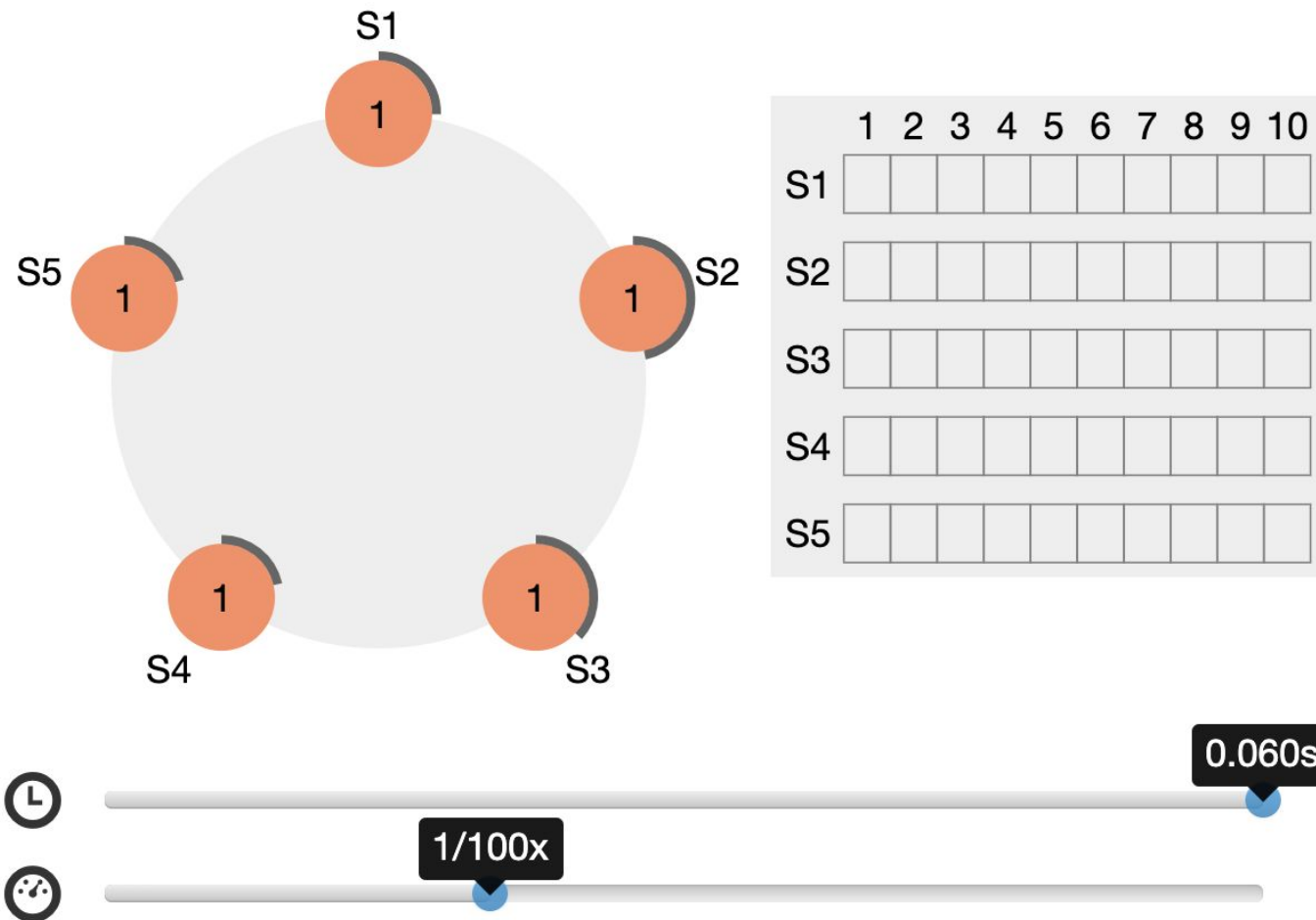


Cluster management systems for Big Data

- YARN
- Mesos
- Spark Master
- Kubernetes
 - Is becoming the defacto standard

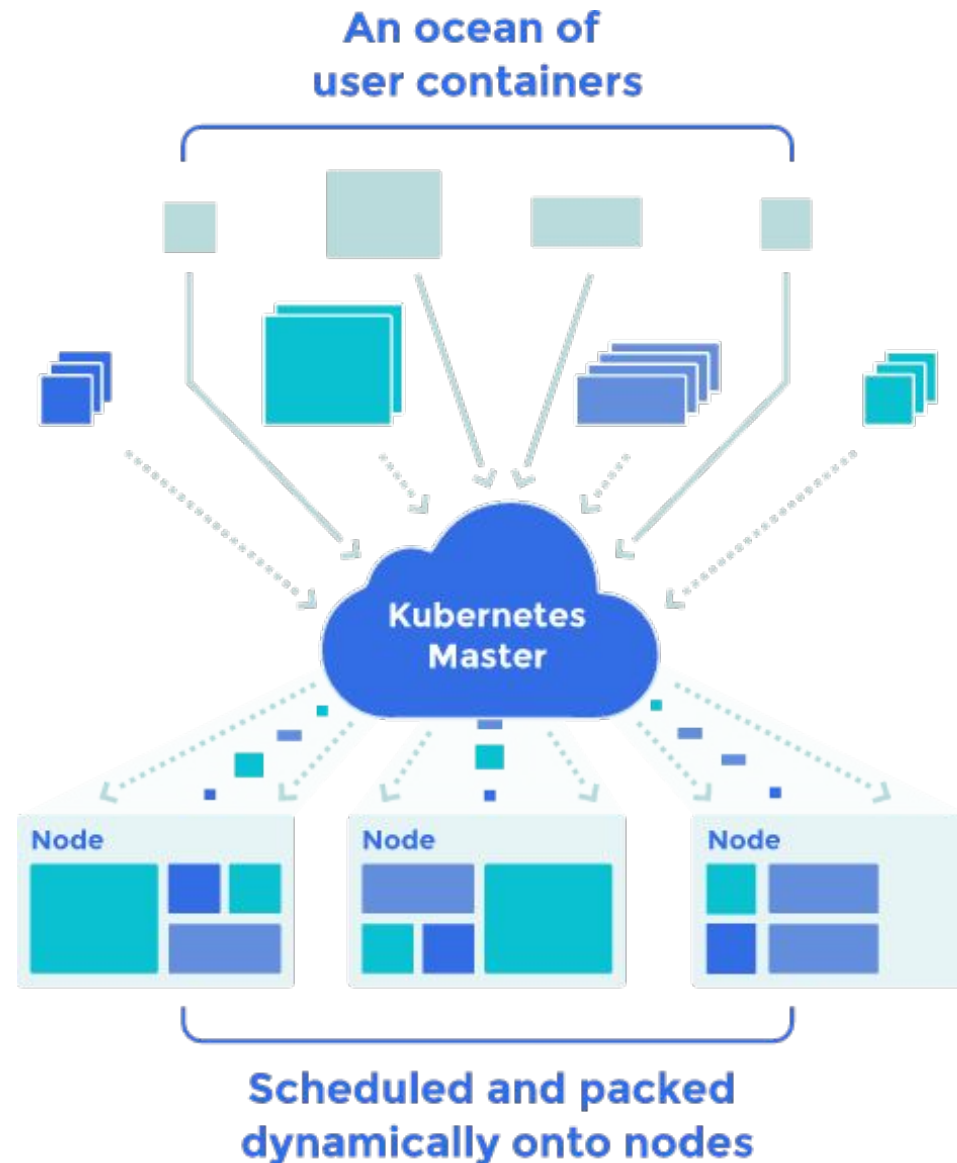


How do I scale up: Consensus



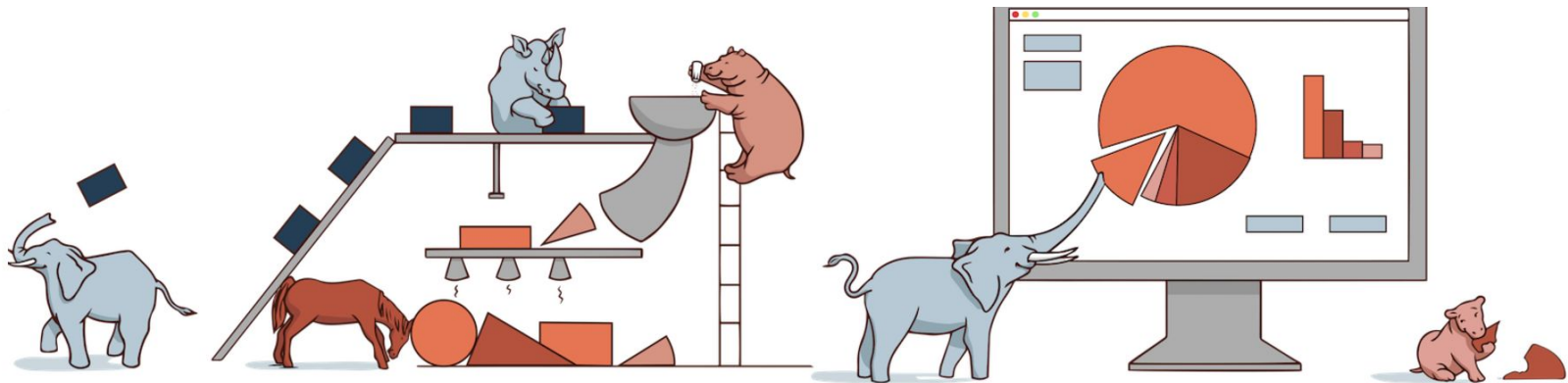
Kubernetes

- An operating system for a datacentre
- “Processes” are high-available scaled containers running in “Pods”



Pachyderm

<https://github.com/pachyderm/pachyderm>



release **v1.5.0** license **apache** godoc reference go report **A+** [Slack Status](#)

Pachyderm: A Containerized, Version-Controlled Data Lake

Pachyderm is:

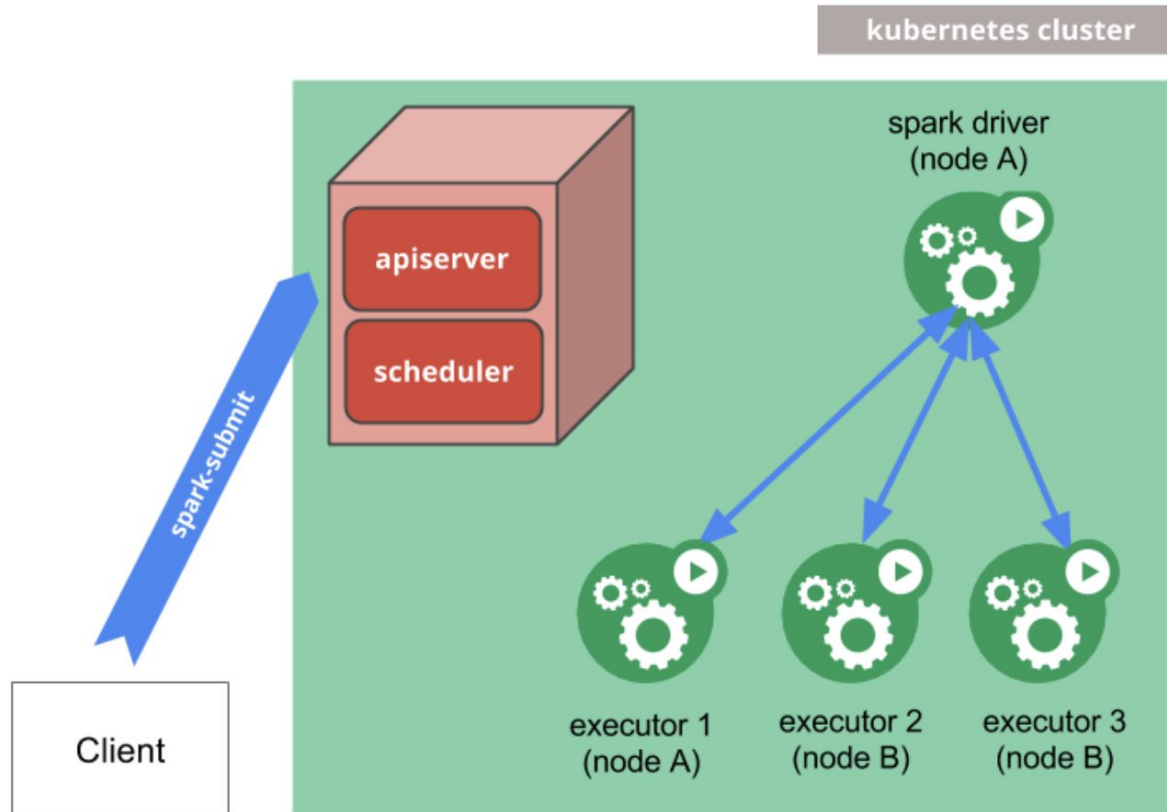
- **Git for Data Science:** Pachyderm offers complete version control for even the largest data sets.
- **Containerized:** Pachyderm is built on Docker and Kubernetes. Since everything in Pachyderm is a container, data scientists can use any languages or libraries they want (e.g. R, Python, OpenCV, etc).
- **Ideal for building machine learning pipelines and ETL workflows:** Pachyderm versions and tracks every output directly to the raw input datasets that created it (aka: **Provenance**).



© Paul Fremantle 2015. This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License
See <http://creativecommons.org/licenses/by-nc-sa/4.0/>

Spark on Kubernetes

How it works



`spark-submit` can be directly used to submit a Spark application to a Kubernetes cluster. The submission mechanism works as follows:

- Spark creates a Spark driver running within a [Kubernetes pod](#).
- The driver creates executors which are also running within Kubernetes pods and connects to them, and executes application code.
- When the application completes, the executor pods terminate and are cleaned up, but the driver pod persists logs and remains in “completed” state in the Kubernetes API until it’s eventually garbage collected or manually cleaned up.

Realtime

- Apache Storm
 - Highly flexible model
 - Supports pure streaming and micro-batch
 - Lots of plugins
- Apache Spark
 - Micro-batch only
 - Integrates cleanly into Spark (fewer components)
 - Some plugins and more being developed



Siddhi on Kubernetes

<https://siddhi.io/en/v5.1/docs/siddhi-as-a-kubernetes-microservice/>



Siddhi

v5.1 ▾

🔍 Search

Siddhi
1.1k Stars · 431 Forks 



Download

Quick Start

Documentation

Community

Development

License

Documentation

Introduction

Features

Quick Start

Examples ▾

Use case Guides ▾

Tooling

Query Guide

Siddhi APIs ▾

REST API Guides ▾

Extensions

Siddhi Java Library

Siddhi Local Microservice

Siddhi Docker Microservice

[Siddhi Kubernetes Microservice](#)

Siddhi Python Library

Configuration Guide

Siddhi 5.1 as a Kubernetes Microservice

This section provides information on running [Siddhi Apps](#) natively in Kubernetes via Siddhi Kubernetes Operator.

Siddhi can be configured using `SiddhiProcess` kind and passed to the Siddhi operator for deployment. Here, the Siddhi applications containing stream processing logic can be written inline in `SiddhiProcess` yaml or passed as `.siddhi` files via config maps. `SiddhiProcess` yaml can also be configured with the necessary system configurations. For more details about how to configure `SiddhiProcess` YAML, refer to [this configuration guide](#) which describe the usage of all the YAML specifications.

Prerequisites

- A Kubernetes cluster v1.10.11 or higher.
 - a. [Minikube](#)
 - b. [Google Kubernetes Engine\(GKE\) Cluster](#)
 - c. [Docker for Mac](#)

On this page

Prerequisites

Install Siddhi Operator

Deploy and run Siddhi App

Get Siddhi process status

List Siddhi processes

View Siddhi process configs

View Siddhi process logs

Change the Default
Configurations of Siddhi Runner

Using a custom-built Siddhi
runner image

Deploy and run Siddhi App
using config maps

Deploy Siddhi Apps without
Ingress creation

Deploy and run Siddhi App with
HTTPS

Externally publish data to NATS
from Siddhi



© Paul Fremantle 2015. This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License
See <http://creativecommons.org/licenses/by-nc-sa/4.0/>

A quick recap on theory

- CAP Theorem
 - PACELC as the “solution”
- FLP
 - Raft and Paxos use random timers as the solution
- Scalability at what COST?
- Amdahl's and Gustafson's
- Karp-Flatt Metric



Karp-Flatt Metric

e is the Karp-Flatt Metric

ψ is the speedup

p is the number of processors

$$e = \frac{\frac{1}{\psi} - \frac{1}{p}}{1 - \frac{1}{p}}$$

$e = 0$ is the best

$e = 1$ indicates no speedup

$e > 1$ indicates adding processors

slows down the system!!!

Fortune top 10 big data companies

fortune.com/2014/06/13/these-big-data-companies-are-ones-to-watch/

- MapR – Apache Hadoop
- MemSQL
- Databricks – Apache Spark
- Platfora – Apache Hadoop
- Splunk
- Teradata – Apache Hadoop
- Palantir – Hadoop, Cassandra, Lucene
- Premise
- Datameer – Apache Hadoop
- Cloudera – Apache Hadoop
- Hortonworks – Apache Hadoop
- MongoDB – MongoDB
- Trifacta – Apache Hadoop



Cloudera and Hortonworks finalize their merger



Frederic Lardinois @fredericl / 6 months ago

 Comment



\$720m revenue - 2019

Market Capitalization 2021 - ~\$4.6bn



© Paul Fremantle 2015. This work is licensed under a Creative Commons
Attribution-NonCommercial-ShareAlike 4.0 International License
See <http://creativecommons.org/licenses/by-nc-sa/4.0/>

Next steps

[Students](#)[Teachers](#)[Schools](#)[Events](#)[Get benefits](#)

[Home](#) / [Students](#) / GitHub Student Developer Pack



Learn to ship software like a pro.

There's no substitute for hands-on experience. But for most students, real world tools can be cost-prohibitive. That's why we created the GitHub Student Developer Pack with some of our partners and friends: to give students free access to the best developer tools in one place so they can learn by doing.



Free stuff



Affordable registration, hosting, and domain management

Benefit 1 year SSL certificate.

Benefit 1 year domain name registration on the .me TLD.



Domain names, web hosting, and websites. Unicorns and rainbows come standard with our customer support.

Benefit One free domain name and free Advanced Security (SSL, privacy protection, and more).



Access to the AWS cloud, free training, and collaboration resources

Benefit Free AWS Educate Starter Account for GitHub Students, worth \$100.



With Canva, anyone can create professional looking graphics and designs. Featuring thousands of templates and an easy to use editor.

Benefit Free 12 month subscription of Canva's Pro tier.



Access to Microsoft Azure cloud services and learning resources – no credit card required

Benefit Free access to 25+ Microsoft Azure cloud services plus \$100 in Azure credit.



Accomplish your creative goals using the world's leading real-time development platform, used to create half of the world's games.

Benefit Unity Student Plan free while you are a student.



System availability beyond this week

- Please sign up with **Github Education**
 - See Ex14a
 - Ex14a and b are done using free DigitalOcean credit
 - **You can use free AWS, Azure or DO credit for the assignment**
- What will be running and not!
 - **AWS** will be removed in the next hour
 - **Kafka TFL** until next Friday (Ex13)
 - **Slack** running until Monday - please grab anything you need
- All the materials for the course are always in Github:
 - <https://github.com/pzfreo/ox-clo>



Thanks!

- I really appreciate everyone's hard work and commitment even when remote!
- Please fill in the feedback forms
- Feel free to add me on LinkedIn
<https://www.linkedin.com/in/paulfremantle/>

But don't message me until you've submitted your assignment!



Questions?



© Paul Fremantle 2015. This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License
See <http://creativecommons.org/licenses/by-nc-sa/4.0/>