Data mgmt. & Analytics

April, 2019

Agenda

Introduction

What is the problem with data?

Data management

A typical pipeline

A word about disaster recovery

Data hygiene

Analytics

Overview of time series analysis

Visualization demo

Exercises

Introduction

What is the problem with data?

Data has value

Because it can **answer questions**

Keep all data. Don’t lose it.

Protect data from prying eyes.

Data needs:

Space, bandwidth, processing power

Tools to manage and **make sense of it**

And there are laws too (GDPR – 25 May 2018)

Give me my personal data

Forget about me

Let me know about breaches within 72 hours

Control disclosure to third parties

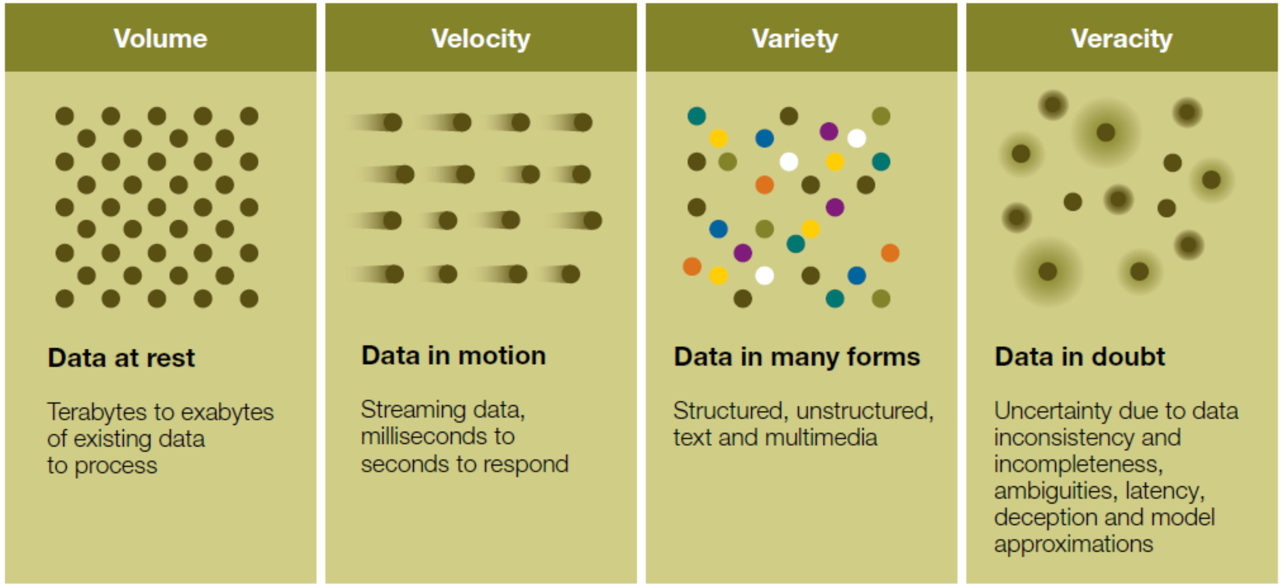

Volume
Data at rest
Terabytes to exabytes of existing data to process
Velocity
Data in motion
Streaming data, milliseconds to seconds to respond
Variety
Data in many forms
Structured, unstructured, text and multimedia
Veracity
Data in doubt
Uncertainty due to data inconsistency and incompleteness, ambiguities, latency, deception and model approximations

Image: http://www.ibmbigdatahub.com/sites/default/files/public_images/pdf/insurance-post-2-1.png

Data management

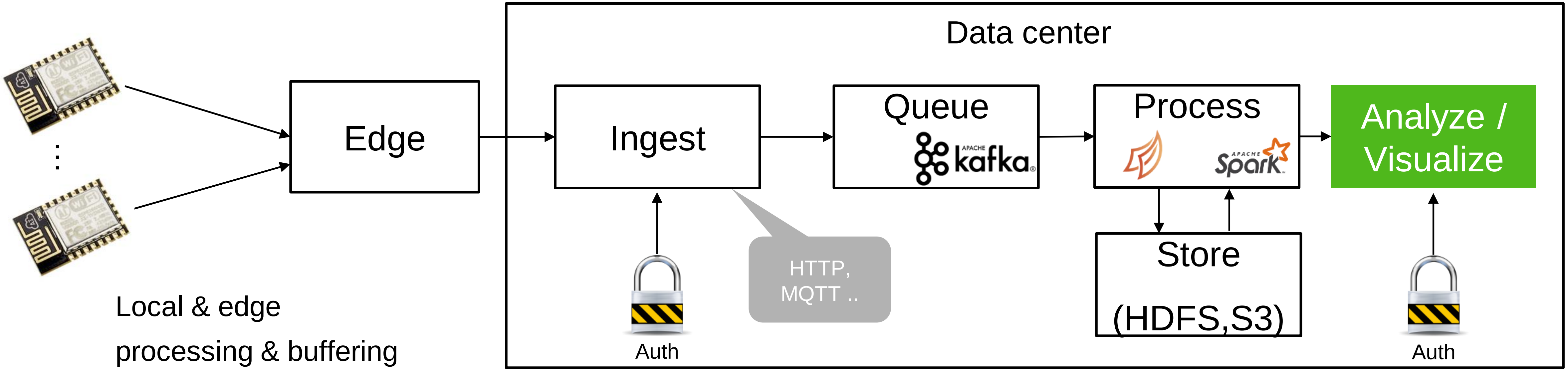
Typical data pipeline

Goals

Reliability & HA -> no data loss, tolerate server crashes

Scalability -> data volume & throughput can be increased

Speed: Low latency, fast and convenient analysis



Ingestion

Desired properties

Standard protocols (MQTT, HTTP)

Authentication (e.g. OAUTH2)

Fast, reliable buffering

Possible solution: Kafka

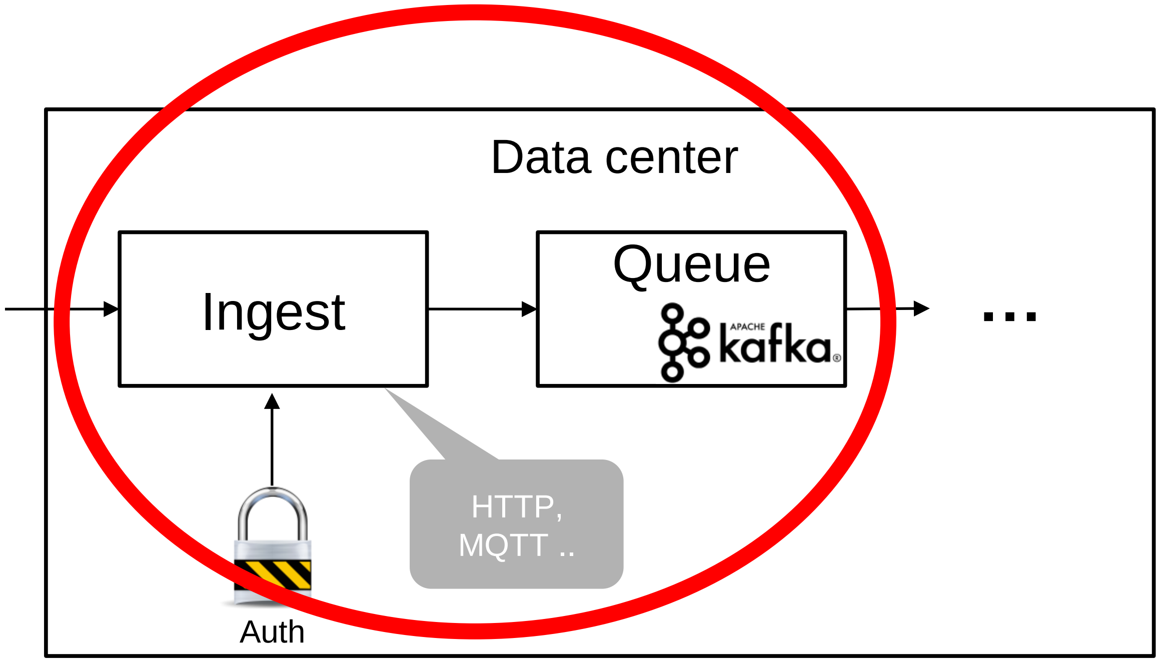
Scalable, reliable, persistent message queue

Accumulate buffers

Process larger chunks of data

Kafka streams

Kafka connect



Storage

Desired properties

Storage efficiency

Query performance

Interoperability

Possible solution: Apache Parquet

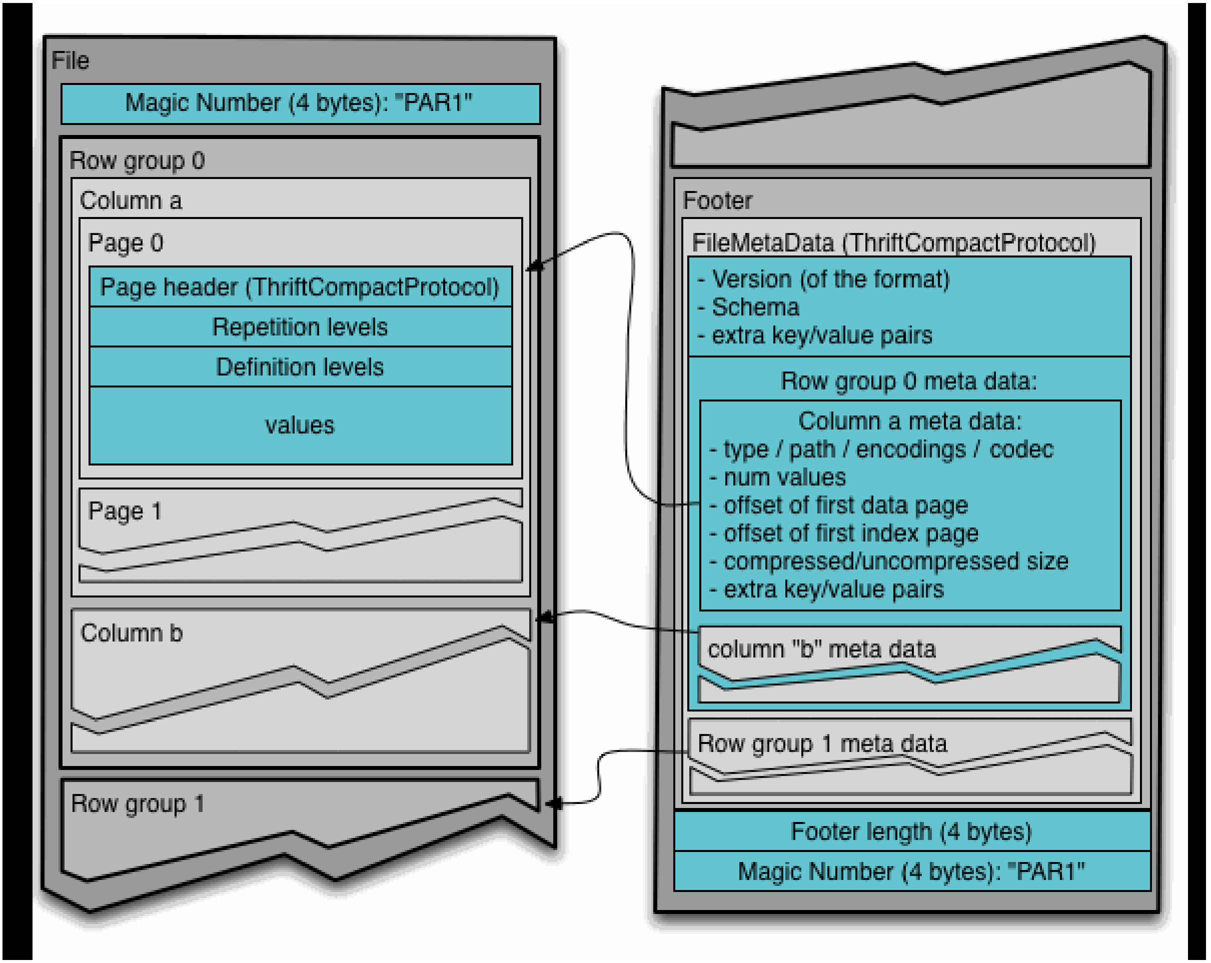
Column store

- contiguous column chunks in a row group
- Multiple pages in a row group. Same encoding/compre
- Column index

Compression

- Types: snappy, gzip, dictionary, delta, null
- Can be specified for individual columns

Interoperable


File
Magic Number (4 bytes): "PAR1"
Row group 0
Column a
Page 0
Page header (ThriftCompactProtocol)
Repetition levels
Definition levels
values
Page 1
Column b
Row group 1
Footer
FileMetaData (ThriftCompactProtocol)
- Version (of the format)
- Schema
- extra key/value pairs
Row group 0 meta data:
Column a meta data:
- type / path / encodings / codec
- num values
- offset of first data page
- offset of first index page
- compressed/uncompressed size
- extra key/value pairs
column "b" meta data
Row group 1 meta data
Footer length (4 bytes)
Magic Number (4 bytes): "PAR1"

A word about disaster recovery

What to do when the s* happens?

How to reinstall the whole thing?

Where are my backups and how do I restore them?

How to tell the customers?

Key metrics (SLAs)

MTTR = mean time to recover

RPO = recovery point objective

Possible solution

Reserved/planned DR data center

Scripted installations (e.g. Bash, Ansible, Chef …)

Staff guidelines & regular drills

Image: https://distributedalgorithm.files.wordpress.com/2016/02/data-center-disaster-after-typhoon.jpg?w=600

Data hygiene

Valid reasons to delete data (retention policy)

Can’t cope with so much data (e.g. no space left on device)

Required by law (e.g. upon user request)

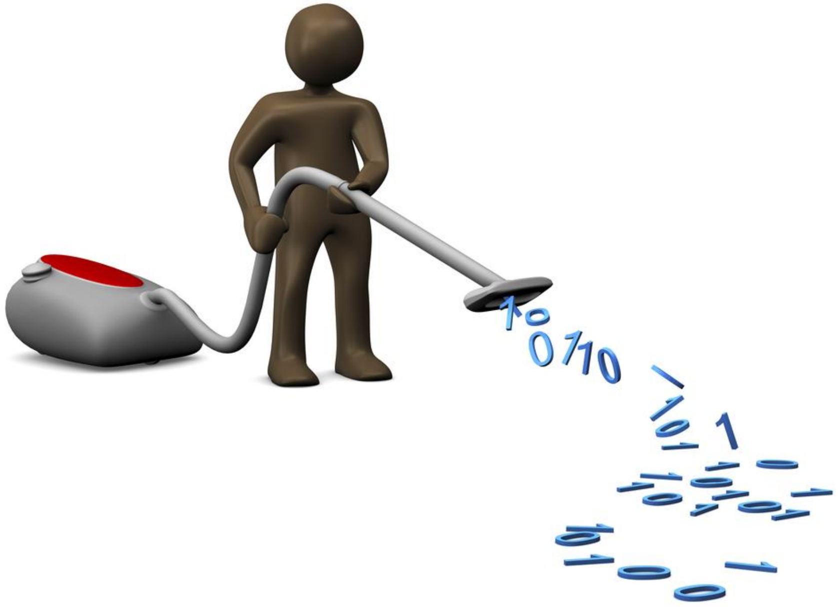
How to do it?

Delete less valuable data

Aggregation (e.g. discard details but keep stats)

Keep data of different legal entities easily separable

Rotation (e.g. log rotation)



https://api.ning.com/files/v4ZZJy3ZUOdMmC99izHFEMhzFEg6*jhTQYKGXo9TMnDE*9hFOSumxJevgFCA528y5EWZTslbVC8AQtCKxtyc6yVkPSi3VpKl/Datacleansingvmaintenance.jpg

Analytics

Time series

What is time series

A list of data points indexed in time

E.g. the readings of a sensor (or many sensors)

What to do with them?

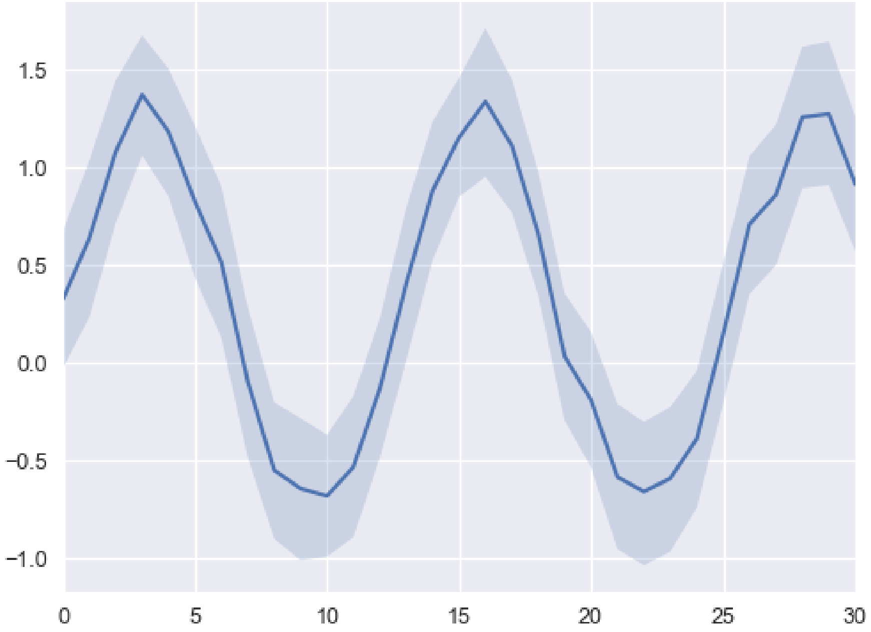
Extract high level features

- Summary: Min, Max, Med, Quantiles, Std.dev …
- Spectrum analysis and transformations (e.g. FFT, filters)
- Prediction, Classification, Anomaly detection, Clustering

ML models: ARMA/ARIMA, RNN/LSTM

Visualization

Demo with Jupyter & Seaborn



Exercises