Data Science and Engineering

Stijn Meijers
Data Engineer

ORTEC
OPTIMIZE YOUR WORLD

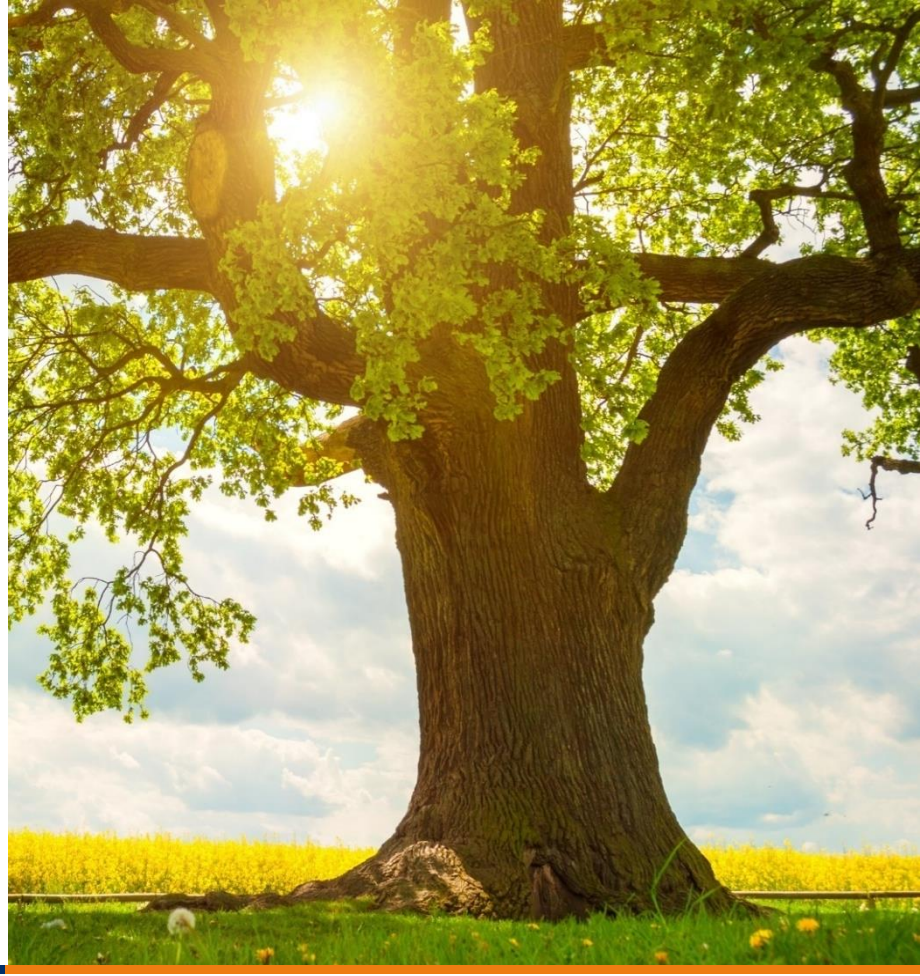
ORTEC Introduction

Data science & data engineering

VUmc collaboration: RNA Splicing

CRISP-DCW & Location based ad-serving

TOPICS



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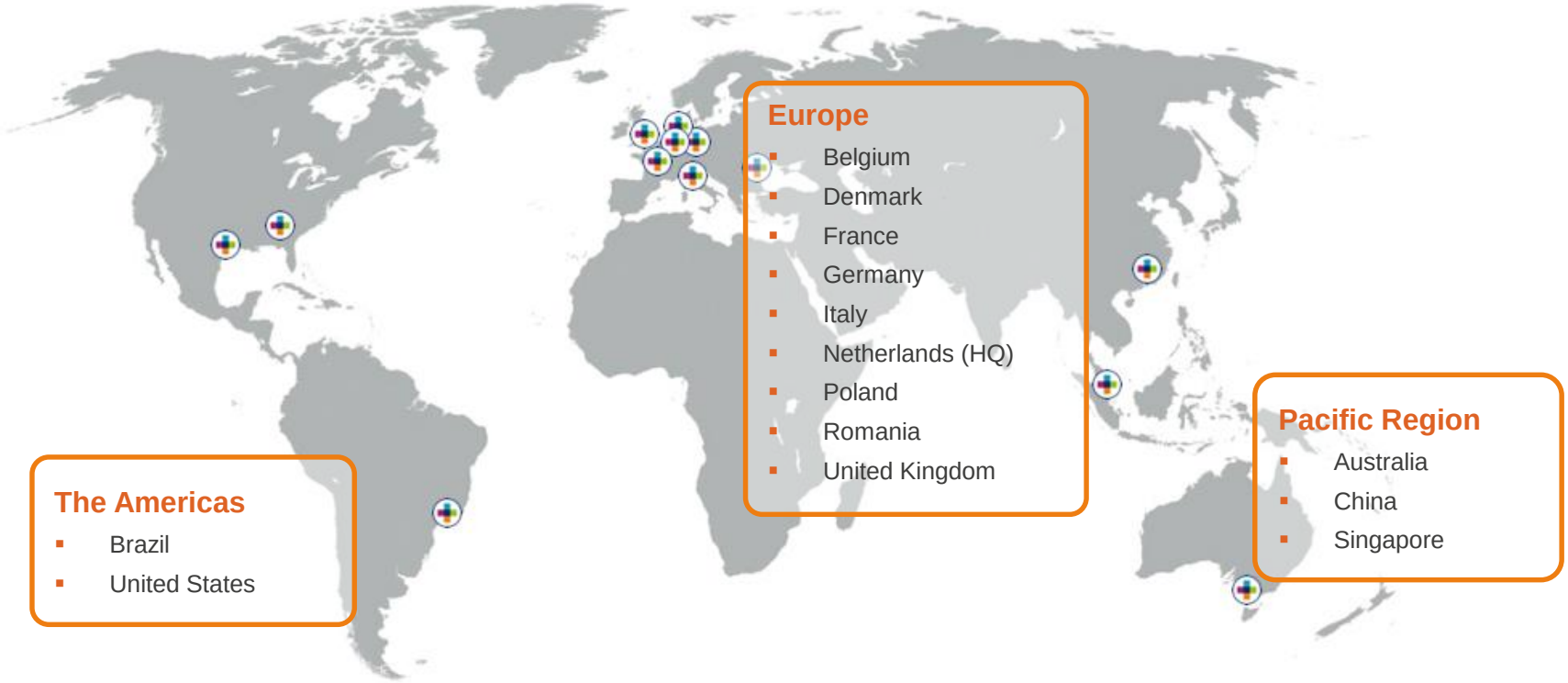
Who are we?

ORTEC

A Global Analytics & Optimization Company



Europe
- Belgium
- Denmark
- France
- Germany
- Italy
- Netherlands (HQ)
- Poland
- Romania
- United Kingdom

The Americas
- Brazil
- United States

Pacific Region
- Australia
- China
- Singapore

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Our Core Competences

Data driven program

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Empowering our Industry Leading Customers

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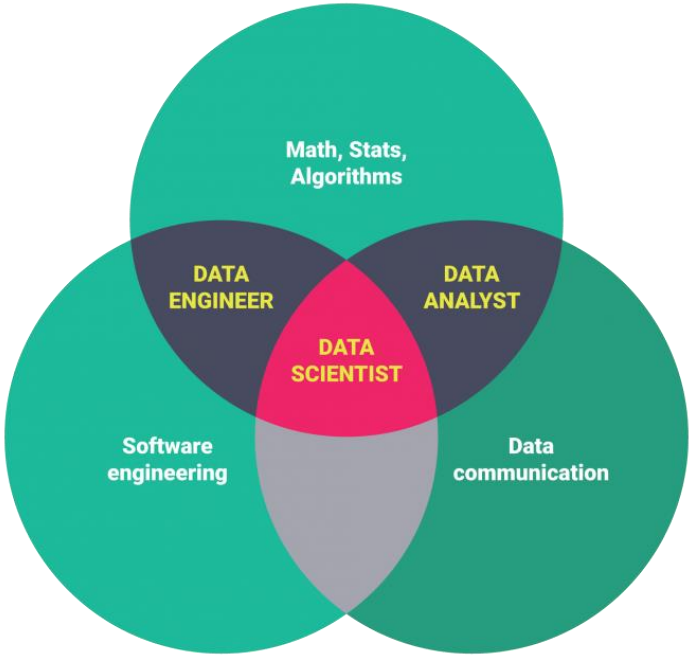
Data Science and Data Engineering

Differences in data science and data engineering

- Data scientists: create models and extracts business information using data

- Data engineers: Extract, transform and load (or; Extract, Load Transform) the data for analysis. Implements models for production.



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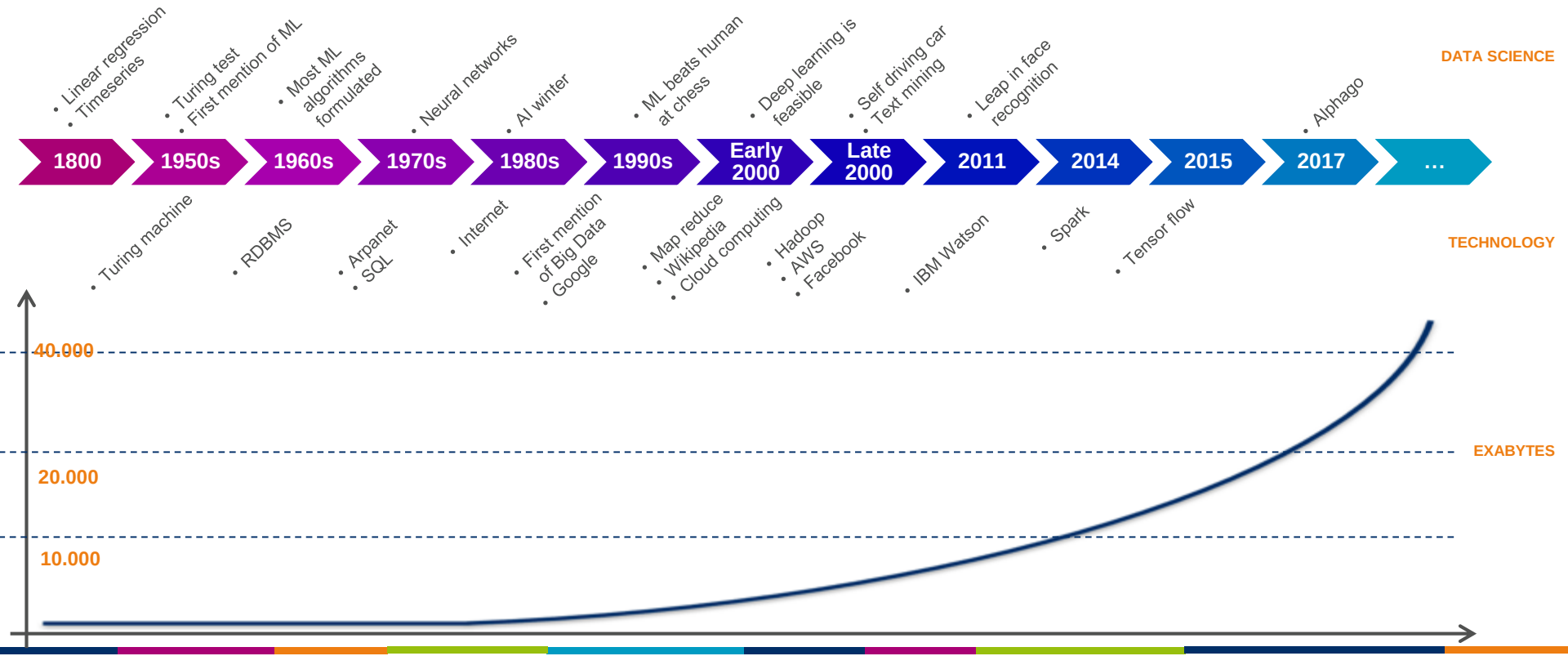
History of Big Data



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APACHE DRILL
Hortonworks
APACHE H BASE
hadoop YARN
aws
hadoop HDFS
Google Cloud Platform
APACHE GIRAPH
HIVE
Azure
APACHE Spark
mahout
FLUME
jupyter
kafka
hadoop Map Reduce
OOZIE
Ambari

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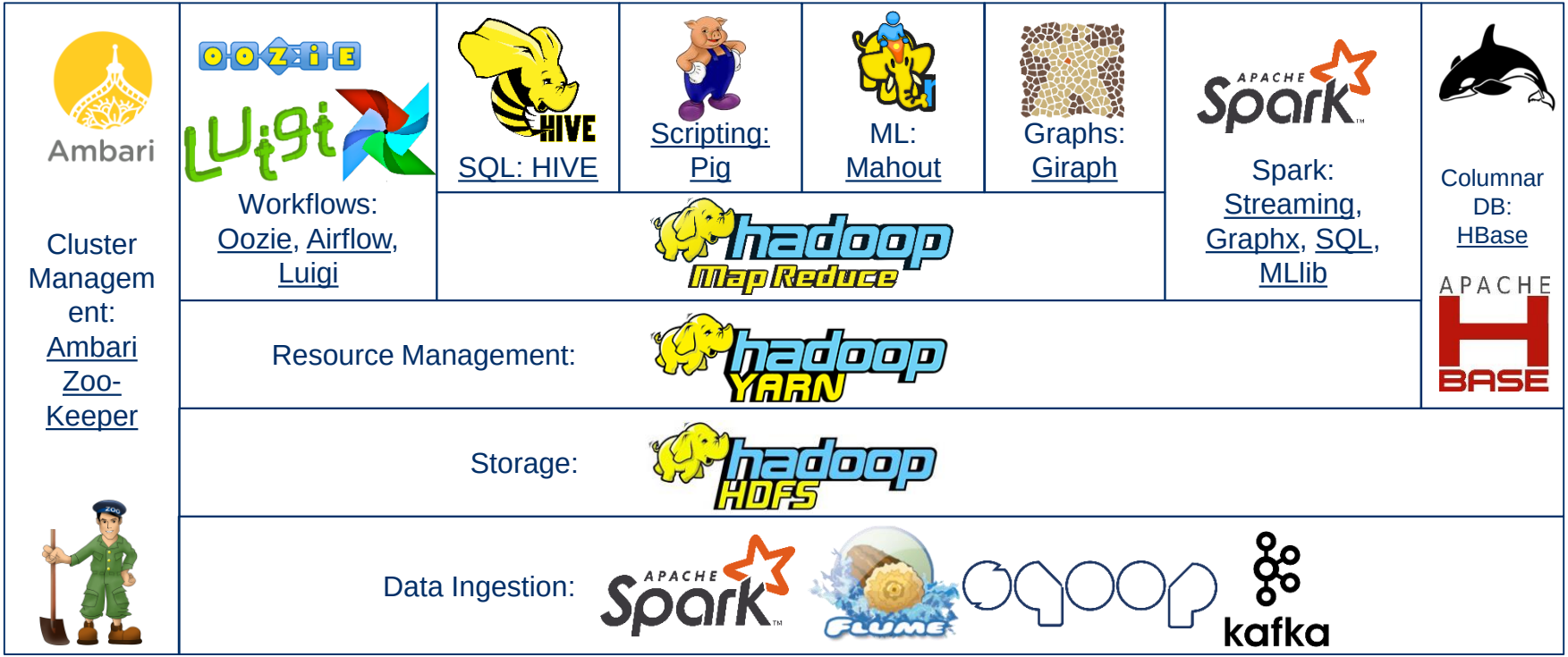
Hadoop Ecosystem



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Azure

aws

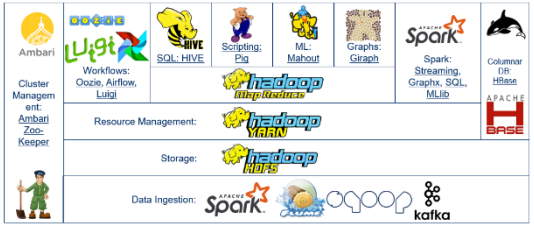
Cloud

Google Cloud Platform

cloudera

Hortonworks

Tech stacks



jupyter

UI / Notebook

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VU medical center: RNA splicing research project

RNA Splicing project

- Performance comparison of RNA splicing tool when using distributed computing
- Microsoft Azure
- Part of a larger research project where identifying certain RNA sequences will be identified that are more prevalent to rheumatism
- Final testing will take place on a very large data set provided by Vumc
- Currently building the architecture and distribution of the tools from the ground up

Distributed computing workflow creation

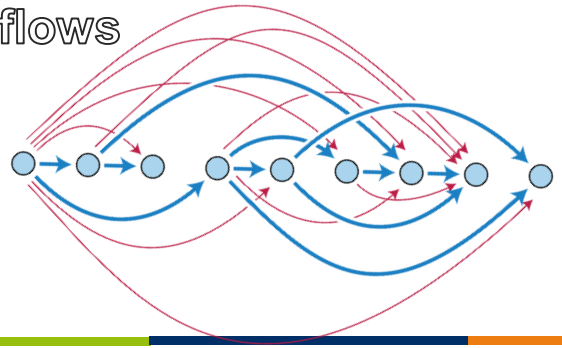
Big Data

Processing Platforms

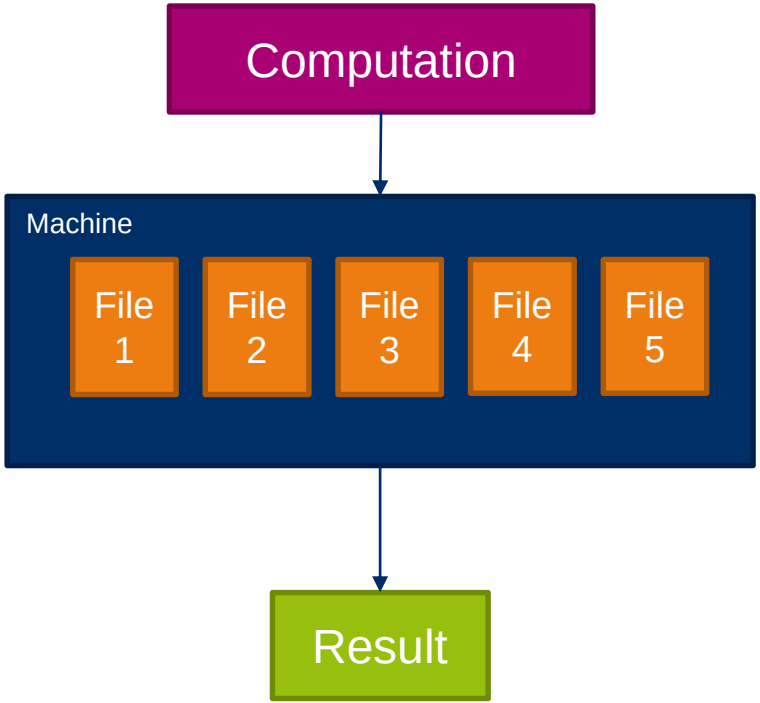
Introduction

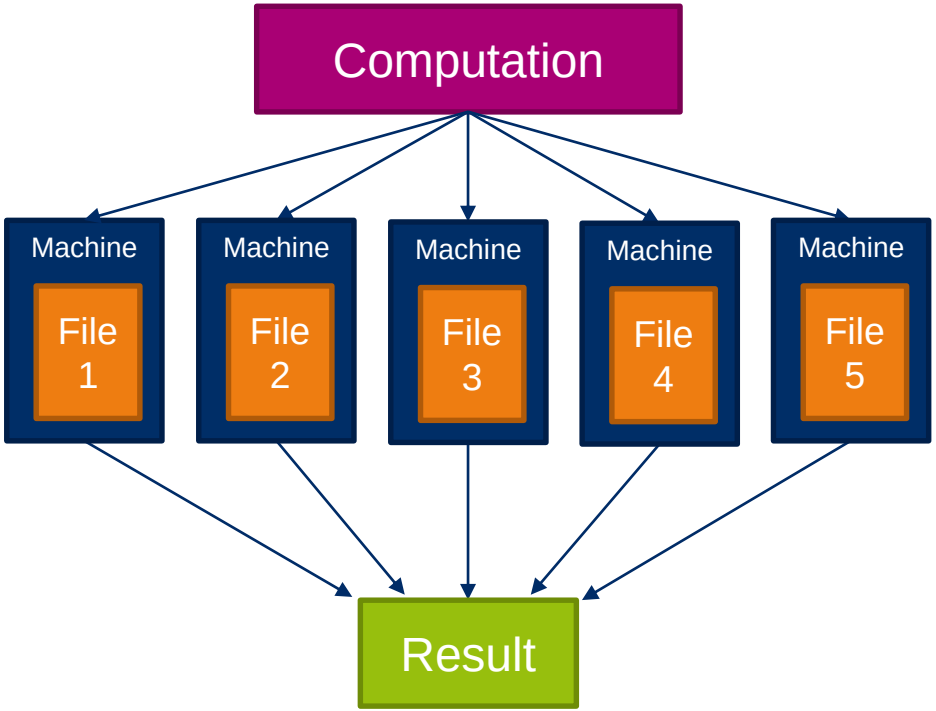
Cloud Computing

Scientific Workflows



Distributed Computing





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Artifact Design

Problem Context

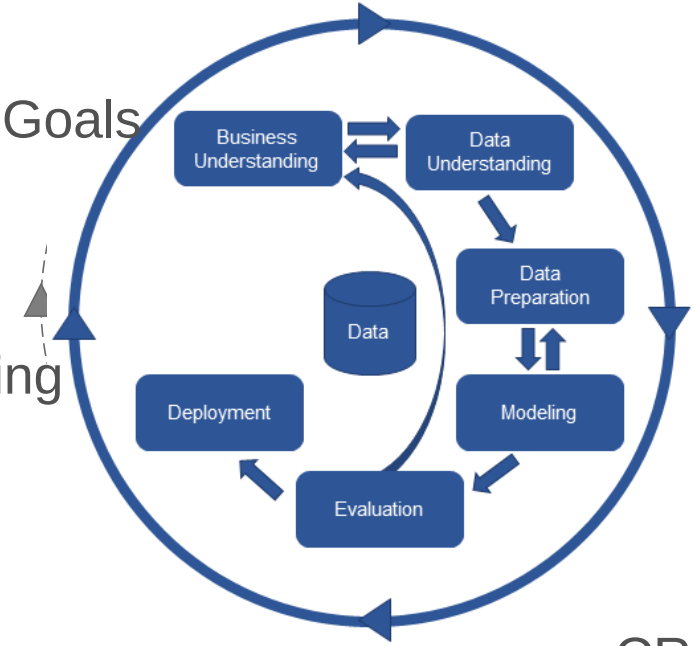
1. Define Context and Goals

Design

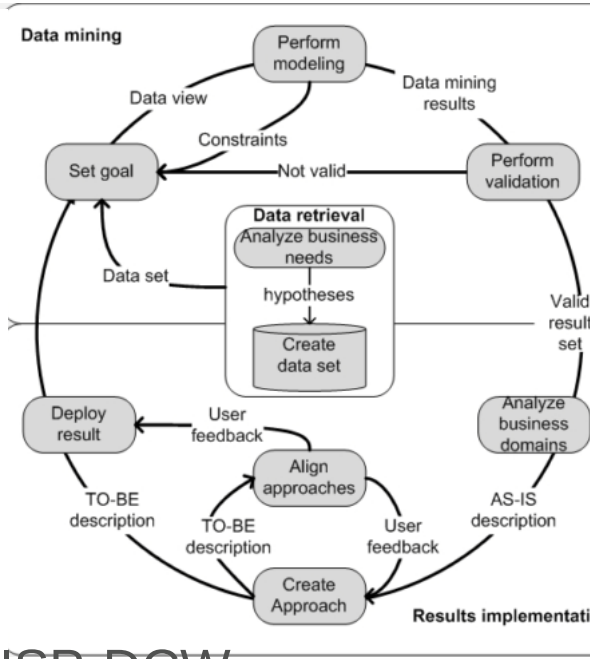
2. Determine Input
3. Estimate Output
4. Determine Processing

Implementation

5. Evaluate Results
6. Deploy Outcomes



CRISP-DM



CRISP-DCW
Three Phases Method

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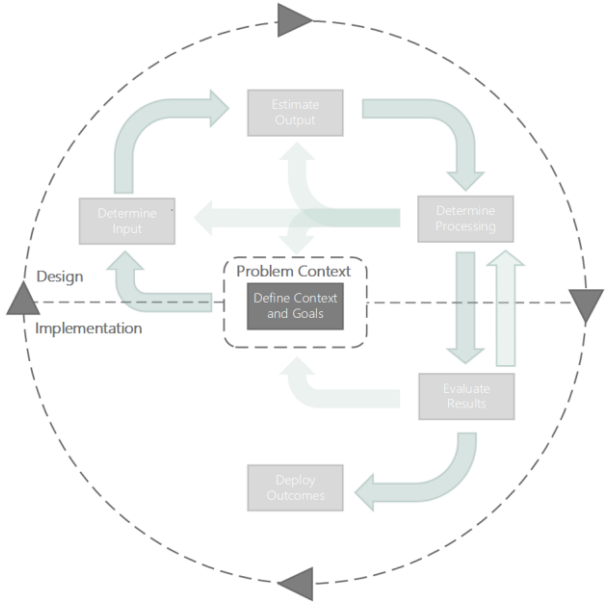
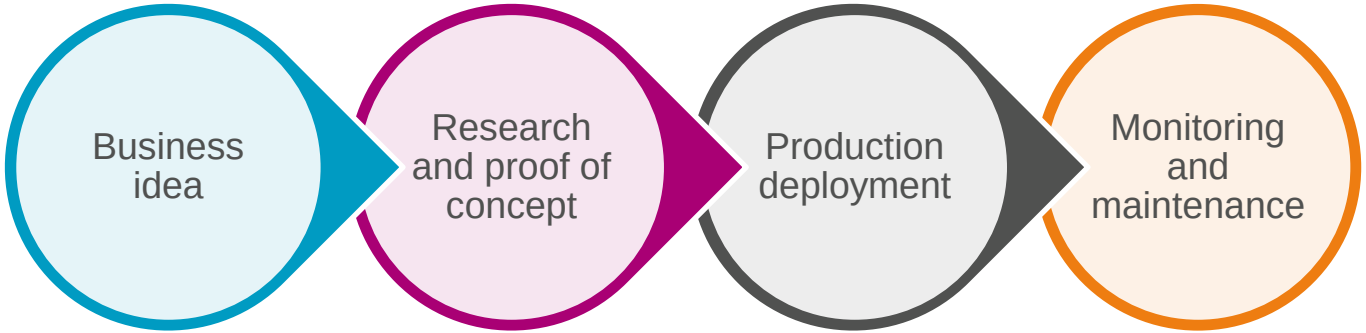
Artifact Design

- Define Context & Goals
  - Data Processing Objectives
  - Available Resources
  - Model Specifications



CRISP-DCW

Lifecycle of data science products



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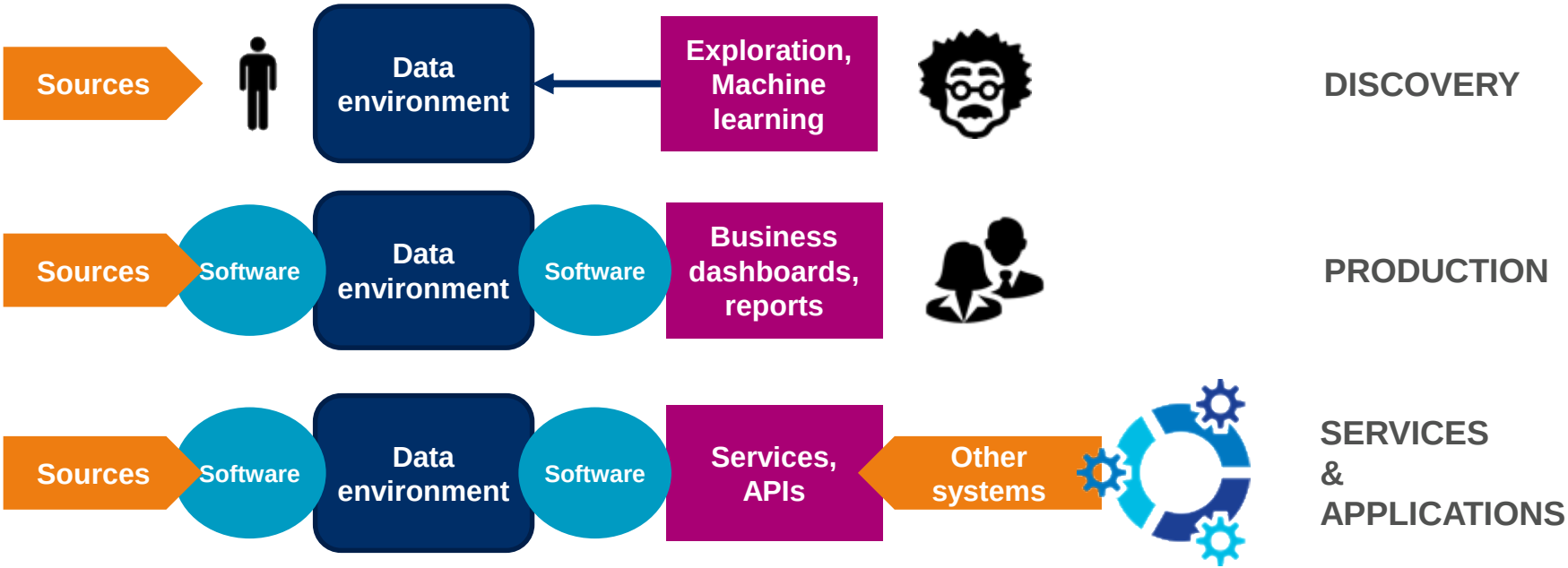
Type of application

Different flow, expectations, requirements



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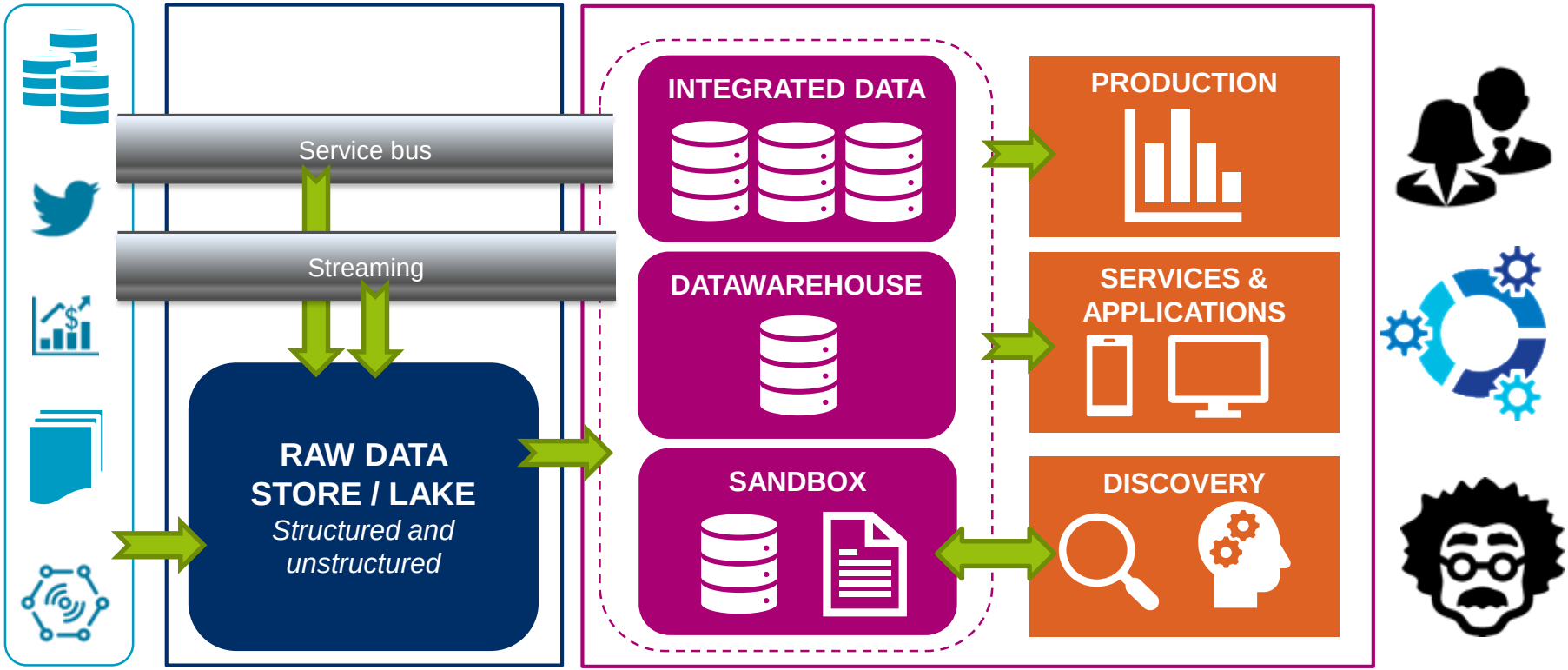
Data infrastructure blue print



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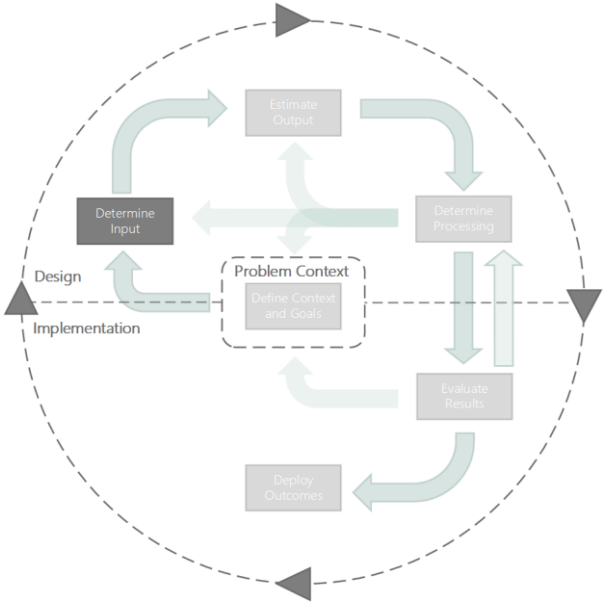
Artifact Design

- Determine Input
  - Volume: A lot of data!
  - Velocity: Fast or slow?
  - Variety: Different forms?
  - Variability: Does it change?
  - Veracity: Messy data?
  - Value: What is it worth?



CRISP-DCW

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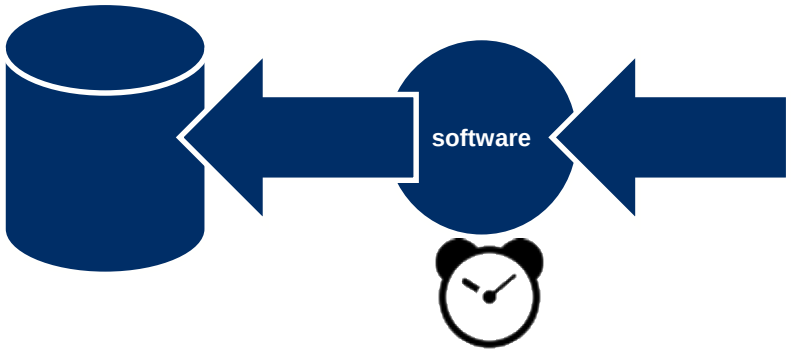
Getting the data - PULL

(automated)



Sources:

- Structured file (CSV, XLS, etc) → Download (FTP, HTTP, etc)
- Direct DB access (querying, synchronization/replication)
- API (XML/REST/SOAP/e.d.)
- Web scraping

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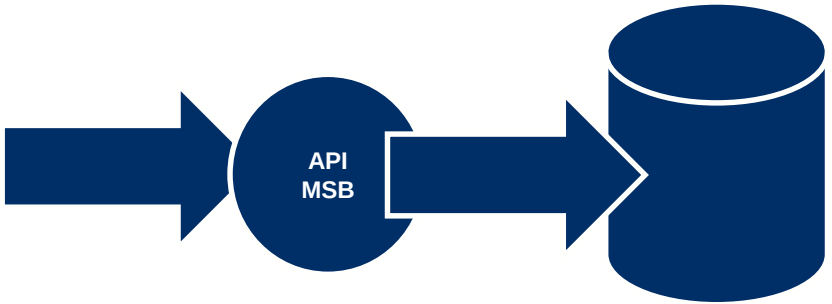
Getting the data - PUSH

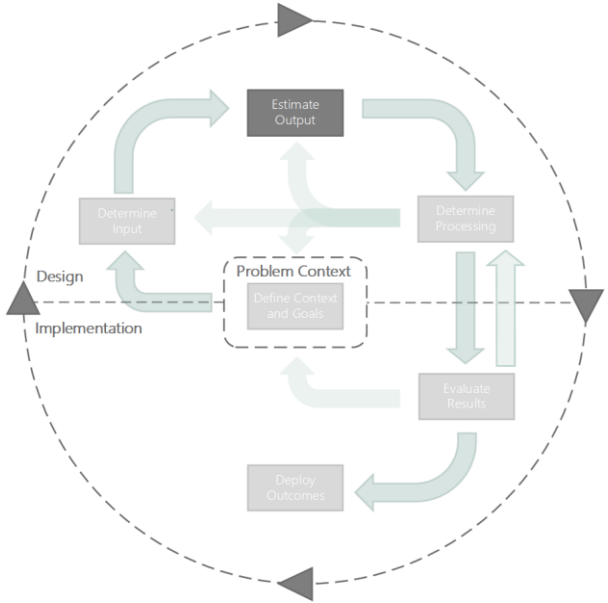
(automated)

- Streaming or message bus
- API (XML/REST/SOAP/e.d.)



Artifact Design

- Estimate Output
  - Volume: A lot of data!
  - Velocity: Fast or slow?
  - Variety: Different forms?
  - Variability: Does it change?
  - Veracity: Messy data?
  - Results & Visualizations



CRISP-DCW

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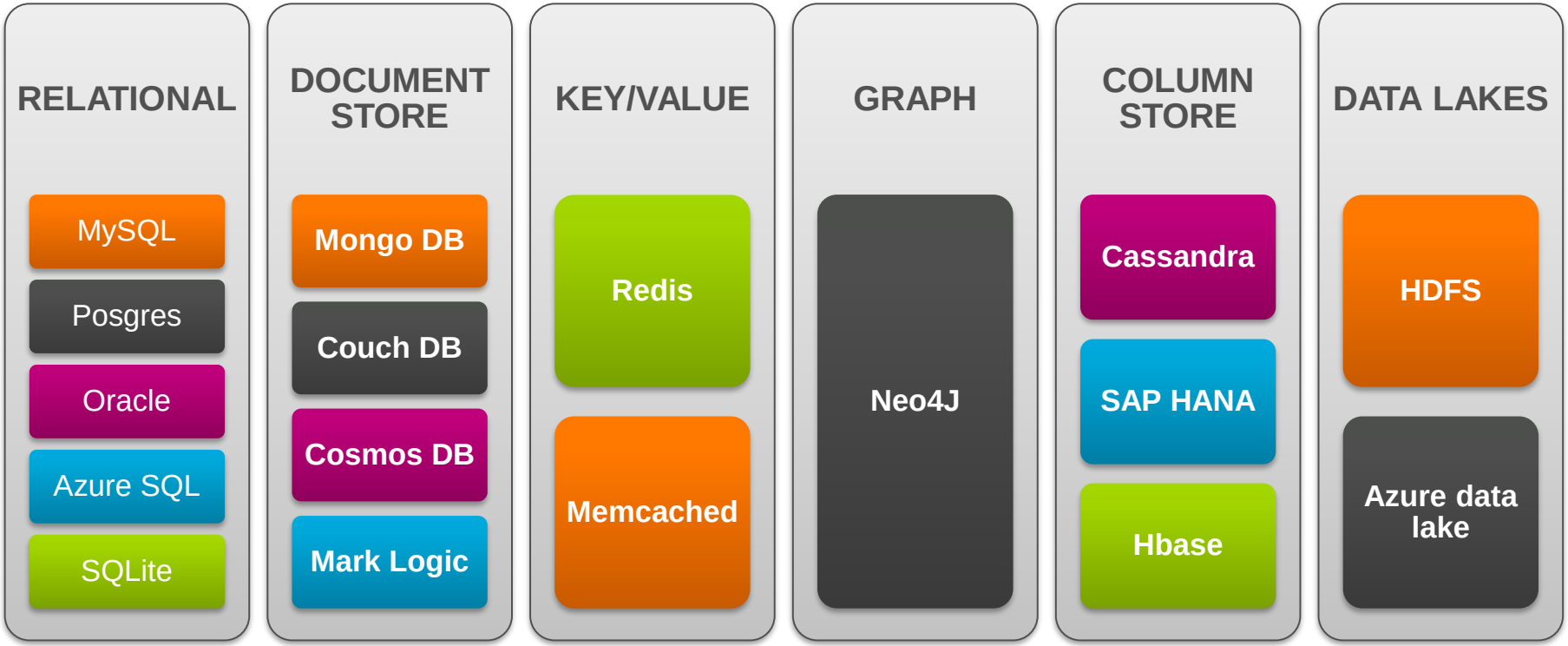
SQL and NoSQL databases categorization



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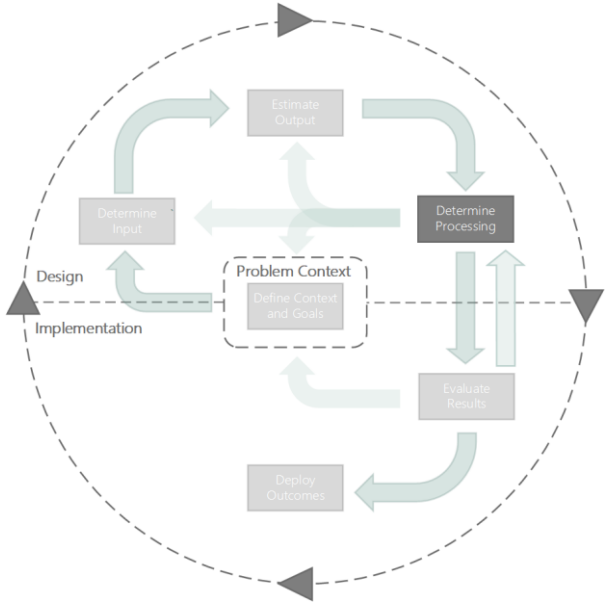
Artifact Design

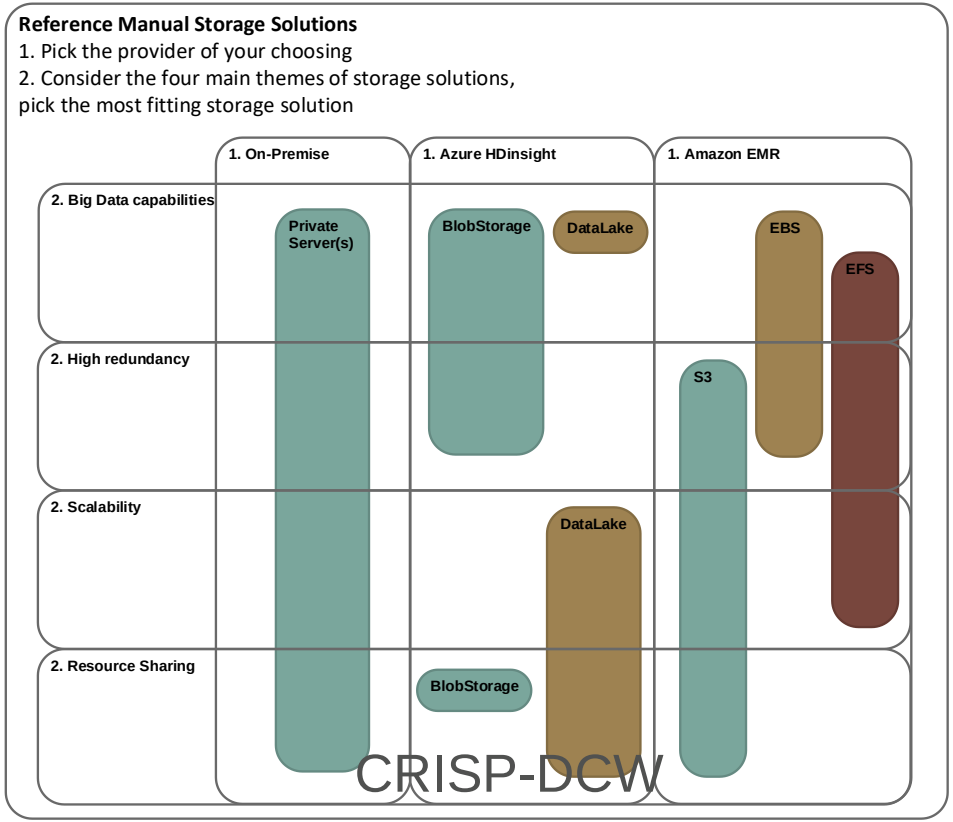
- Determine Processing
  - Input Processing
  - Data Transformations
  - Output Processing
  - Set up Workflow



CRISP-DCW

Artifact Design

- Determine Processing
  - **Input Processing**
  - Data Transformations
  - Output Processing
  - Set up Workflow



Artifact Design

- Determine Processing
  - **Input Processing**
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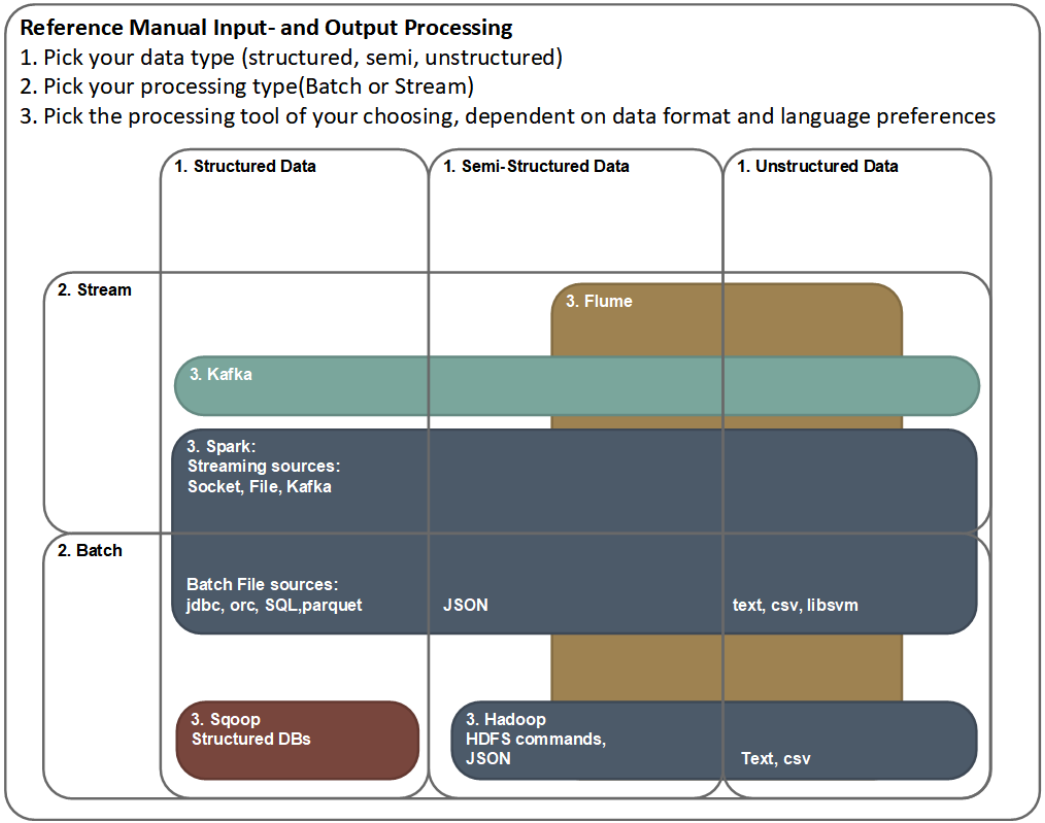
  - Set up Workflow



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Data Ingestion

- Sqoop
- Flume
- Kafka
- Spark

- Move data from different data sources to your cluster, for example relational DBs, or streaming sources

- **When to use:** Moving data from storage to HDFS, or the cluster.

kafka

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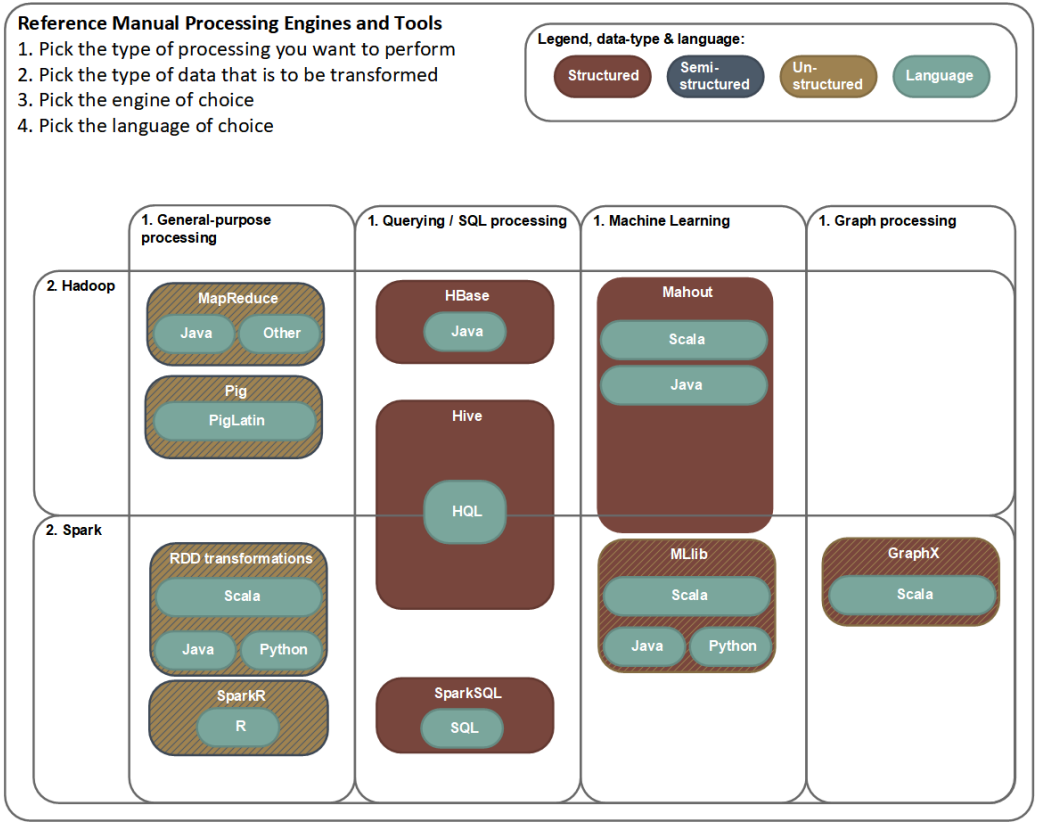
Artifact Design

- Determine Processing
  - Input Processing
  - **Data Transformations**
  - Output Processing
  - Set up Workflow



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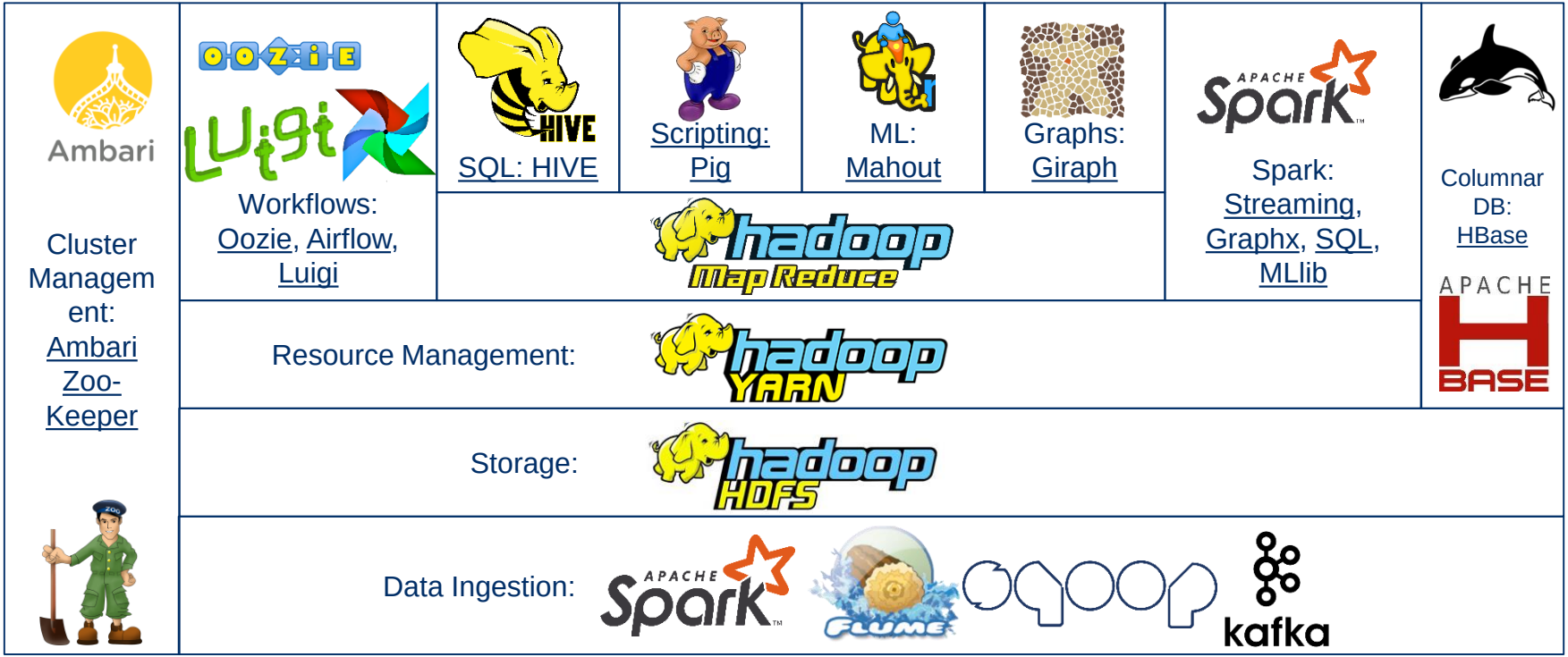
Hadoop Ecosystem



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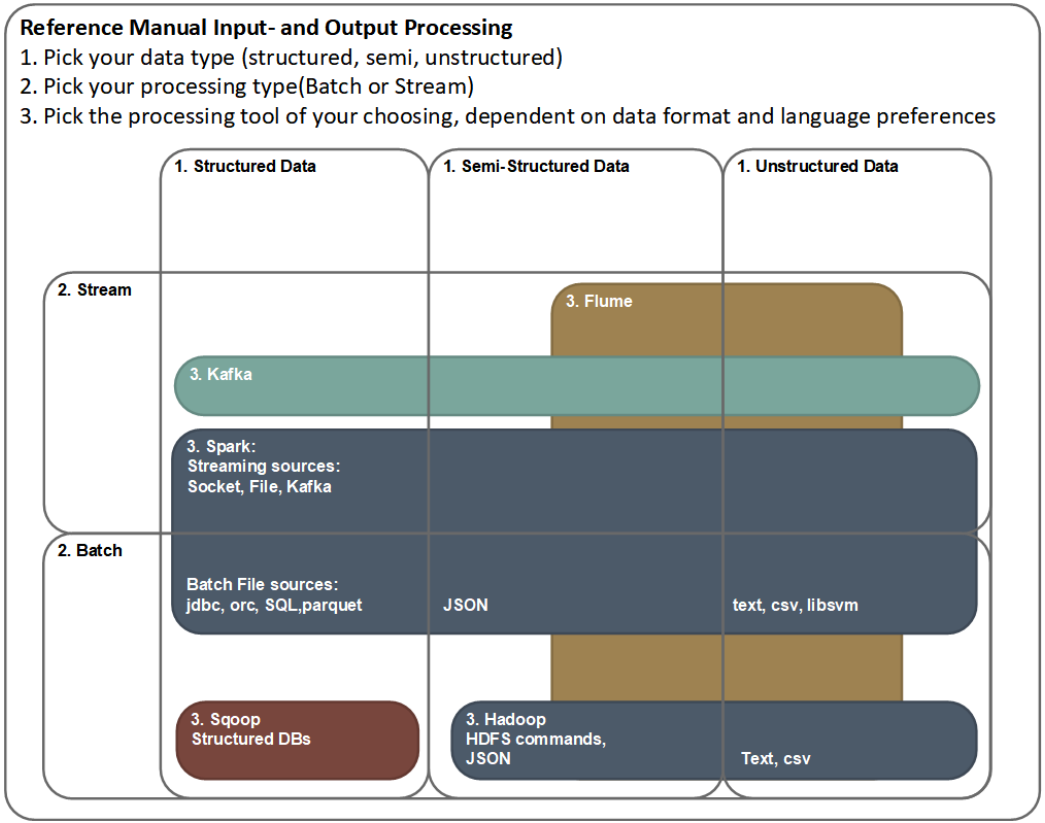
Artifact Design

- Determine Processing
  - Input Processing
  - Data Transformations
  - **Output Processing**
  - Set up Workflow



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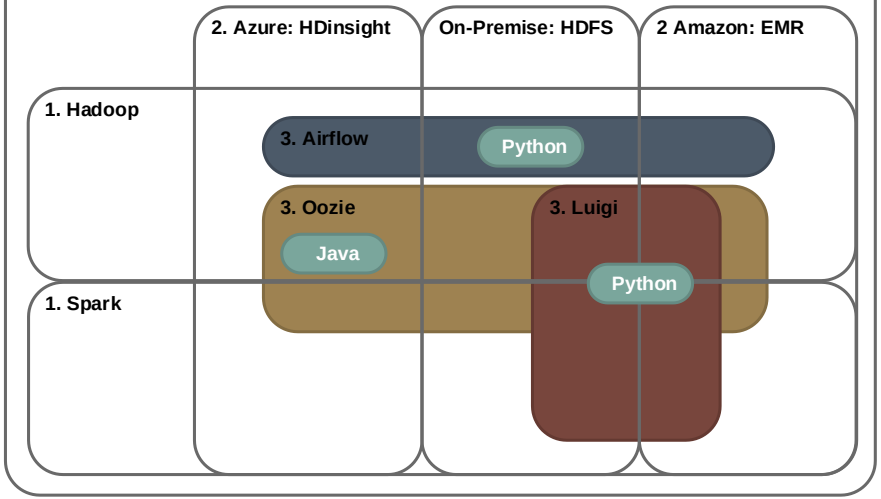
Artifact Design

- Determine Processing
  - Input Processing
  - Data Transformations
  - Output Processing
  - **Set up Workflow**

Reference Manual Workflows:

1. Pick your processing engine; What kind of jobs do you run(Hadoop, Spark, or both)?
2. Pick your storage; Do you use local machines, Azure, or Amazon?
3. Pick your workflow. Depended on the first two steps, and language preferences.



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Workflow Management

- Oozie, Airflow, Luigi
- What jobs need to be executed when?
- Set timers, or execute jobs based on arrival of data
- **When to use:** Many different concurrent jobs, with specific dependencies on each other

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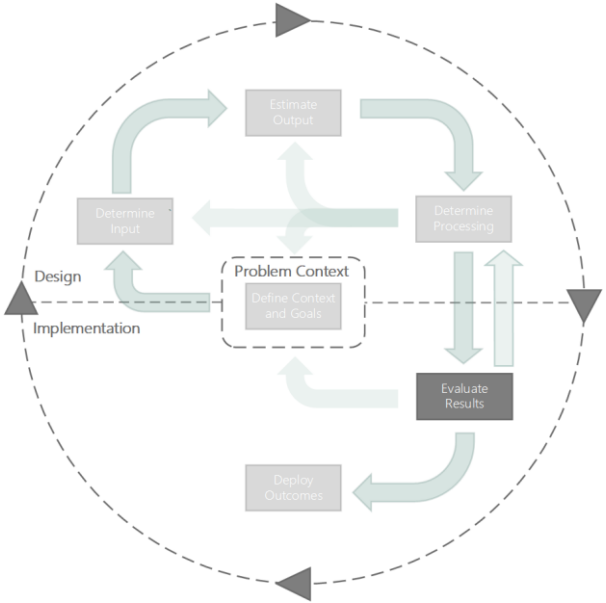
Artifact Design

- Evaluate Results
  - Performance:
    - Results
    - Timing & Latency
    - Costs
  - Distributed System
    - Scalability
    - Distribution Transparency
    - Resource Sharing



CRISP-DCW

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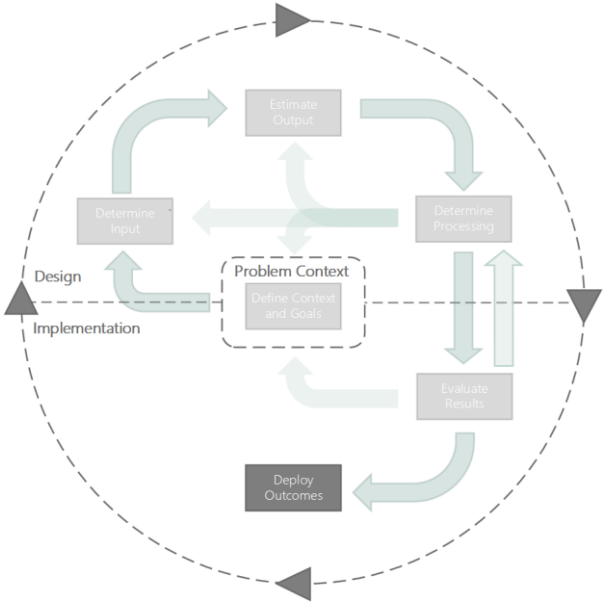
Artifact Design

- Deploy Outcomes
  - Deployment Plan
  - Conclusions & Lessons Learned



CRISP-DCW

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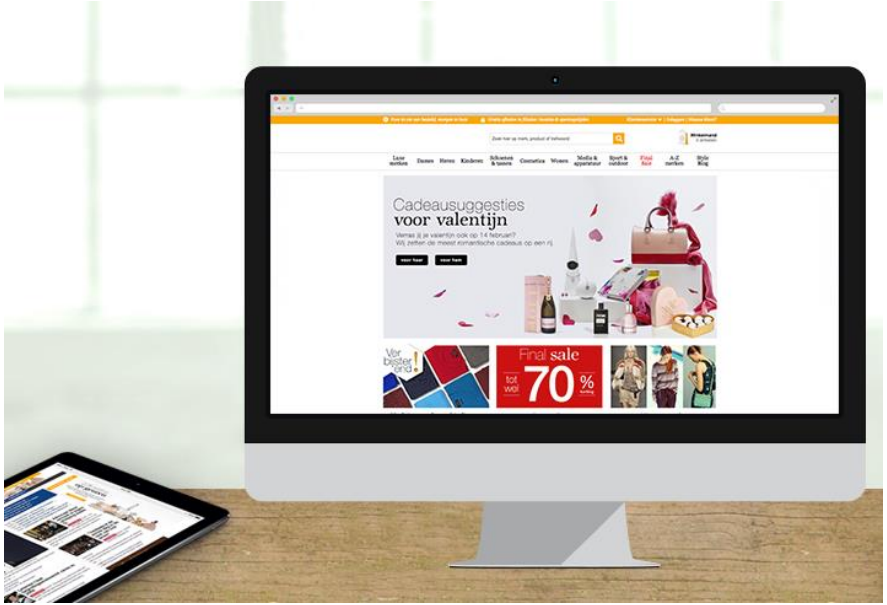
Real-Time Bidding (with AdScience)

Real-time bidding for performance display advertising



BUSINESS CHALLENGE

- Decide which add to publish on a website

ANALYTICS & OPTIMIZATION TECHNIQUES

- Naïve Bayes
- Scala, C++, MongoDB, Druid

BUSINESS VALUE

- Improved CTR (CPA) and conversions by showing more relevant banners
- Transparency, real-time insights
- Smart media buying decisions

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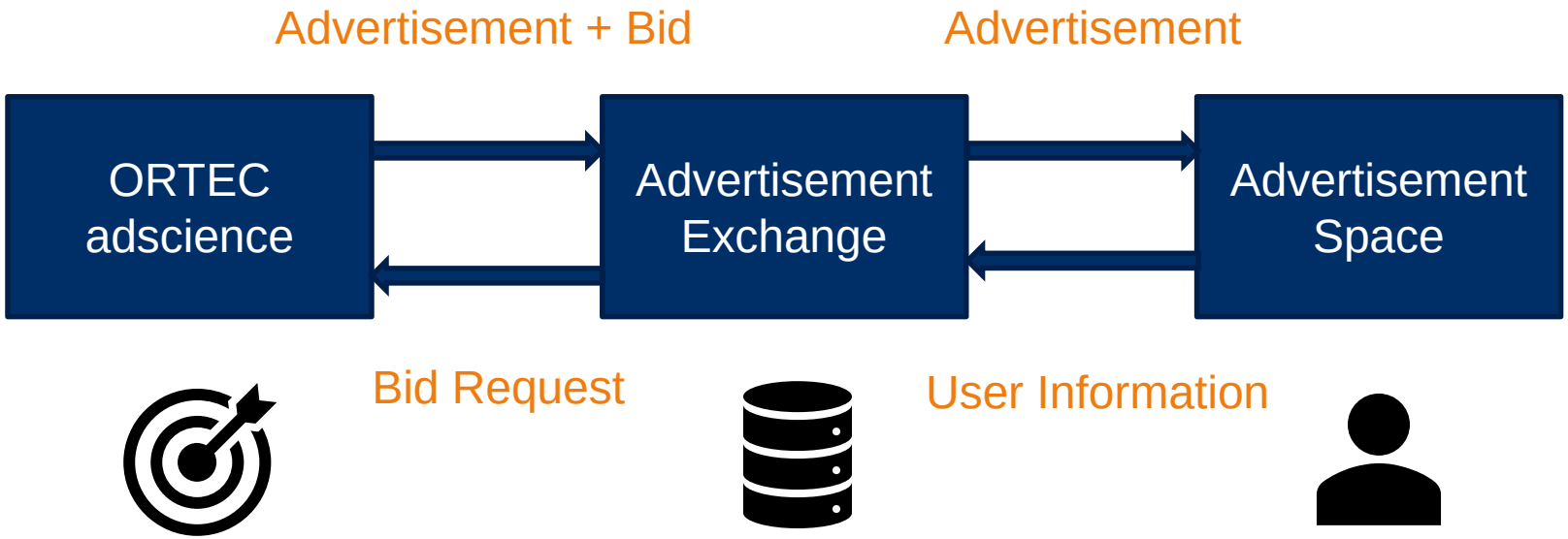
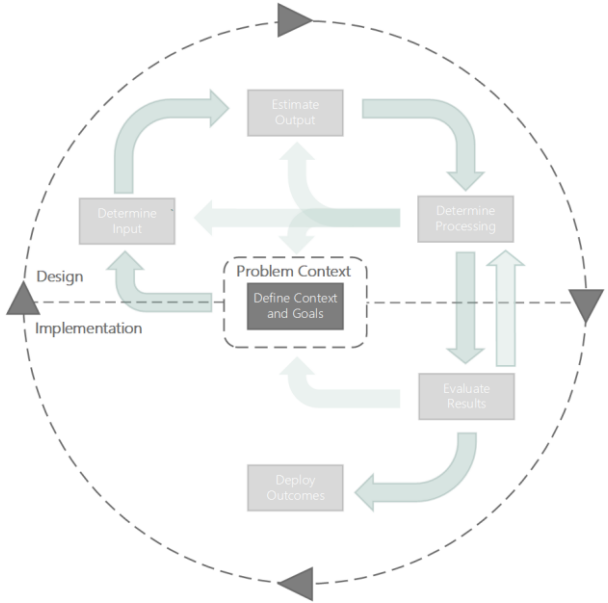
Putting the method into practice: Location Based Adserving

- ORTEC Adscience: Demand Side Platform



Design Validation: Define Context and Goals

- Geographical based targeting:
  Approximate locations of potential viewers, using data in Bid Requests
- Creation of dataset containing IP addresses and their approximate location
- Querying of dataset using unknown IP addresses
- Low budget, needs to be understandable, Azure has preference

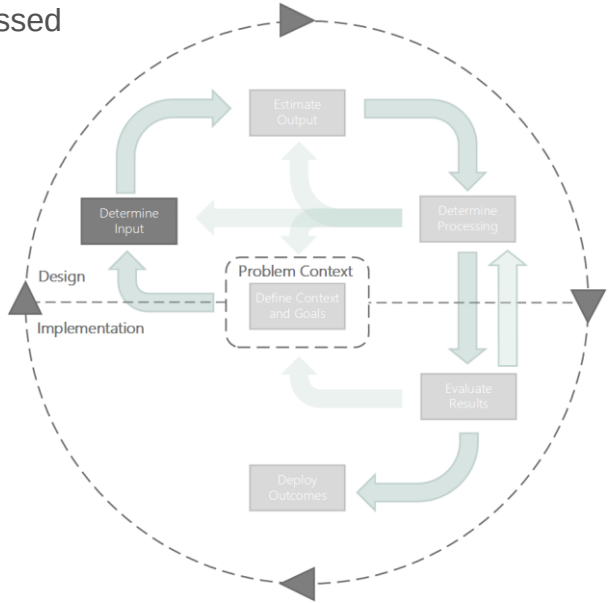


CRISP-DCW

Design Validation: Determine Input

- Volume: 500 GB compressed data per week, 5.5 TB uncompressed
  3000 files, 500 million rows
- Velocity: Batch analysis, completed every week,
  at the start of the week
- Variety: JSON files containing bid-request data, Gzip
  compressed, 66 variables
- Variability: Little change expected

- Value: Low current value, potential to create valuable insights



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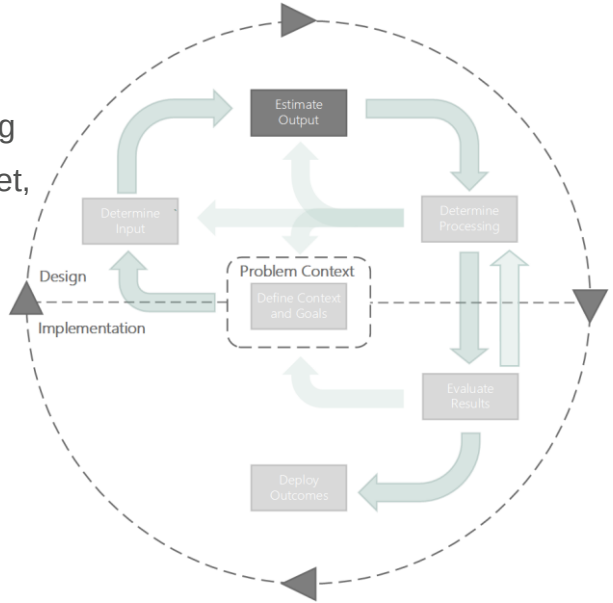
Design Validation: Estimate Output

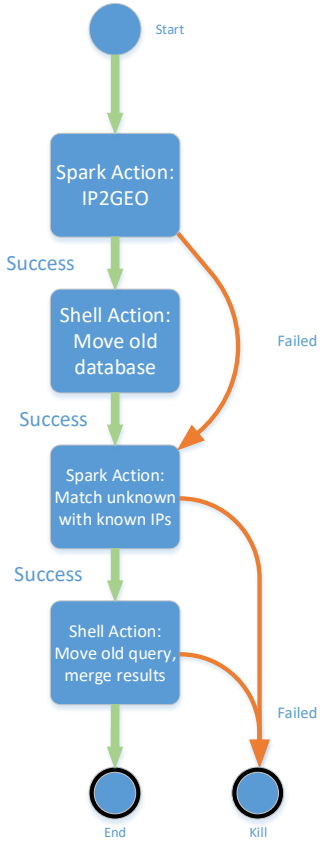
- Volume: Query results of about 10 MB & Dataset of about 10 GB
- Velocity: Set times for arrival of output data, batch processing
- Variety: Compressed files, preferably .parquet for the dataset, and JSON, CSV or TXT for the query results
- Variability: File size increases weekly, due to larger amount of raw data
- Results & Visualization: Human readable match results, further processing in Hadoop environment needed. Visualizations are nice-to-have.



CRISP-DCW

Design Validation: Determine Processing

- Cluster and Storage: Microsoft Azure Blob Storage & HDInsight
- Two Spark & two Hadoop jobs:
  1. Spark: Dataset creation of IPs and locations, using Cadaster data and bid-request data
  2. Hadoop: Moving old dataset
  3. Spark: Matching unknown IPs from a list, with IPs in the created dataset
  4. Hadoop: Merging files and removing old query
- Oozie workflow engine: Hadoop and Spark support, available on Azure



Apache Spark: Unified Big Data Processing

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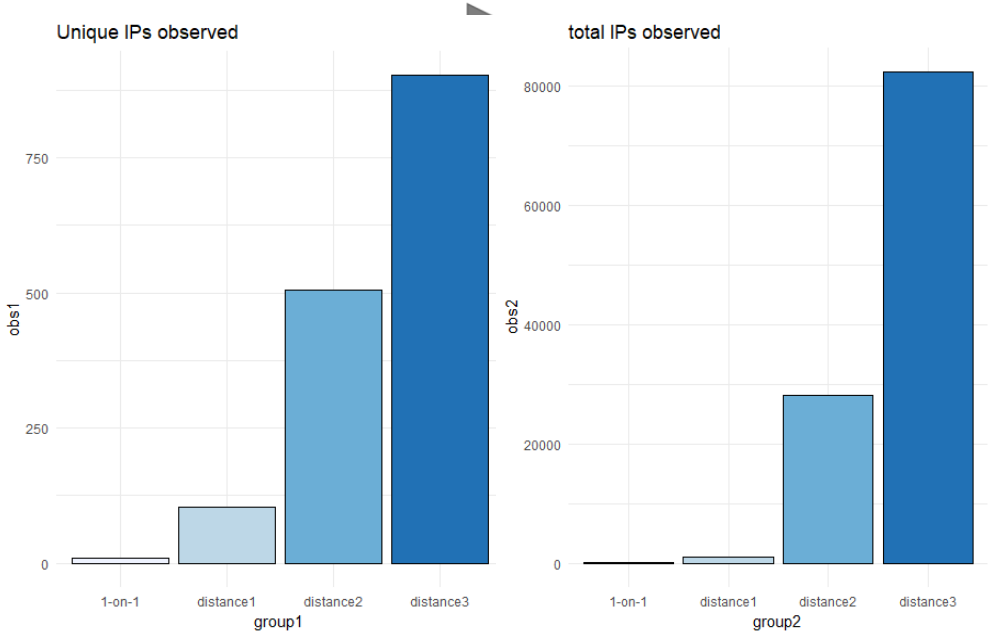
Design Validation: Evaluate Results

- **Performance: Results**

Result	Unique IPs observed	Total complete IPs
Geographical dataset	1785504	673220791
Query List	4141	
1-on-1 match	10	56
Distance 1	103	1051
Distance 2	506	28170
Distance 3	902	82326
Results total	902	108585



CRISP-DCW

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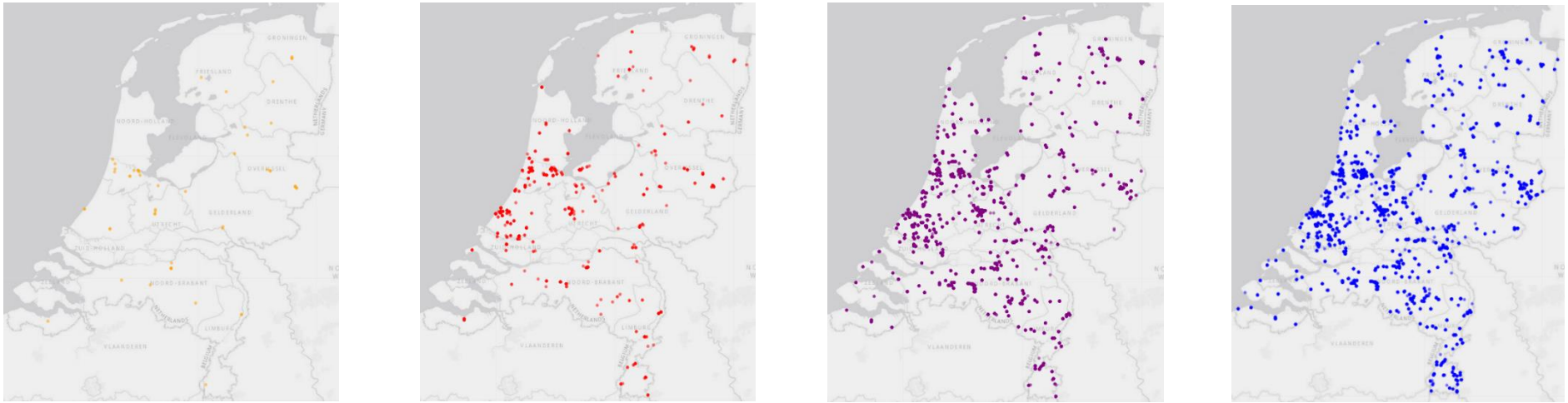
Design Validation: Evaluate Results

- **Performance: Results**



1-on-1 matches

10.000 addresses difference

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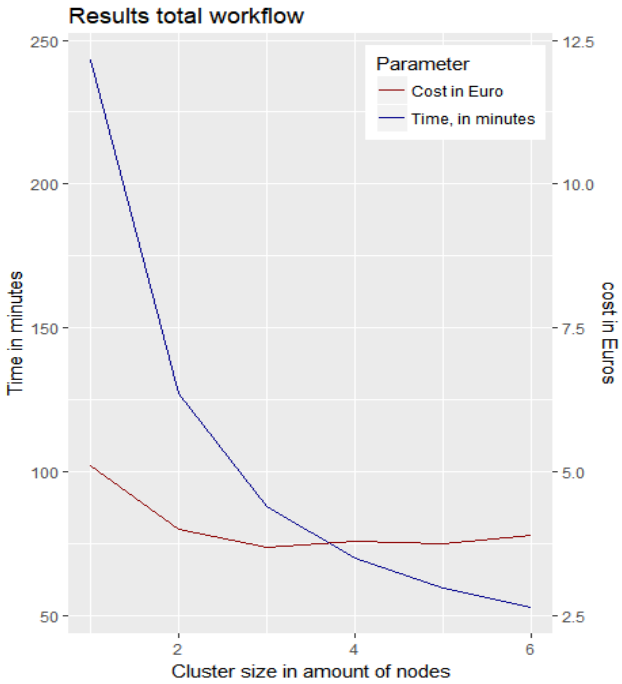
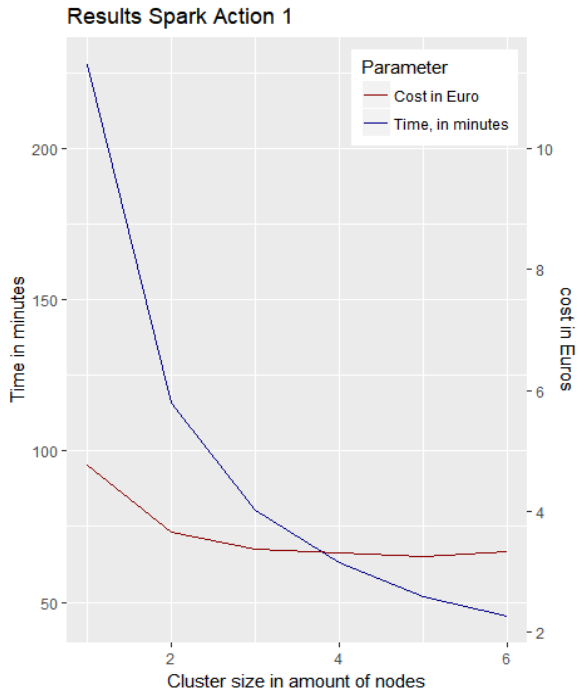
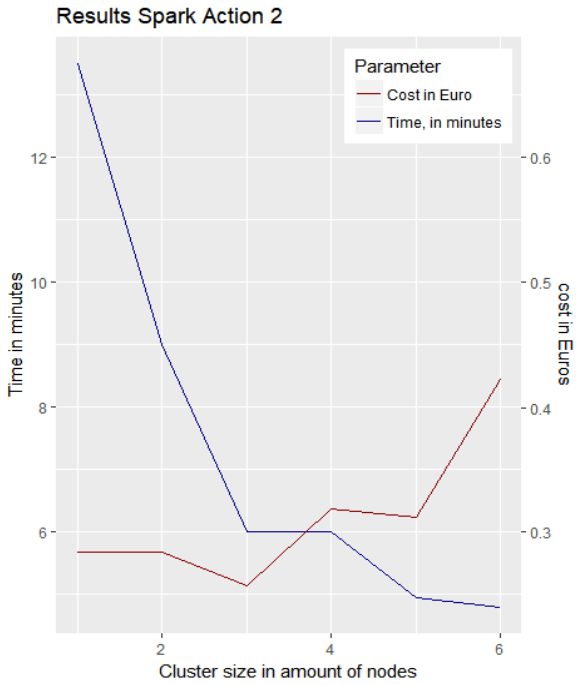
Design Validation: Evaluate Results

- **Performance: Timing and costs**

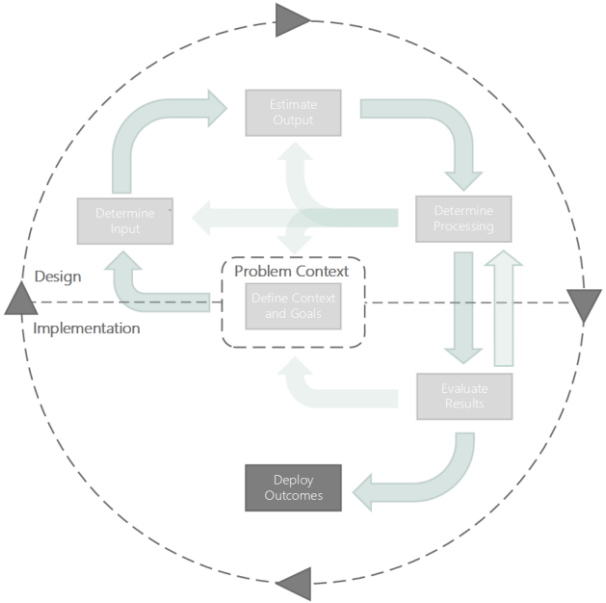






Design Validation: Deploy Outcomes

- Manual deployment during first month
- Upgrade to next versions of Spark, look into other workflow engines.
- Results deemed to be satisfactory by stakeholders, and final report is delivered to stakeholders



CRISP-DCW

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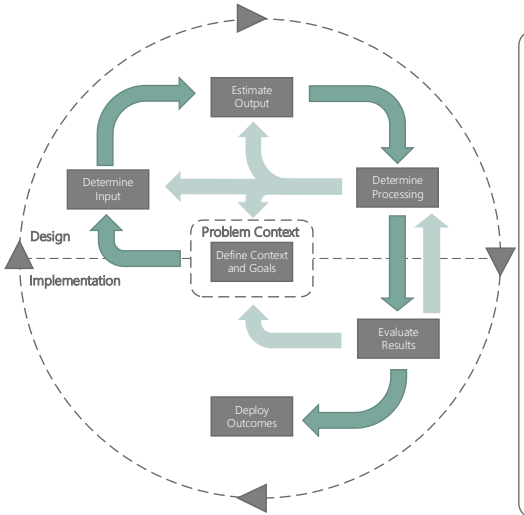
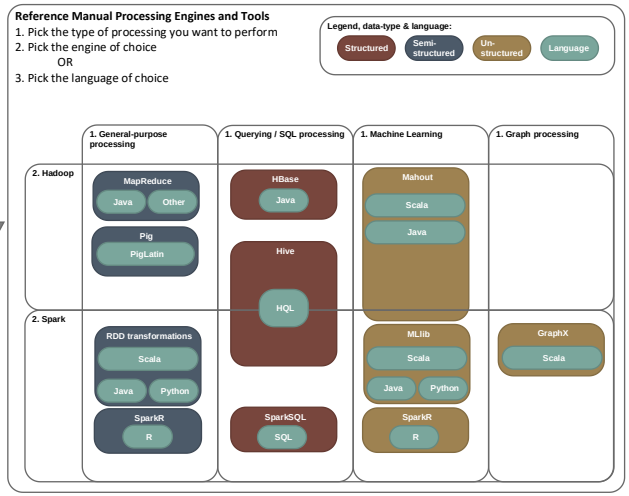
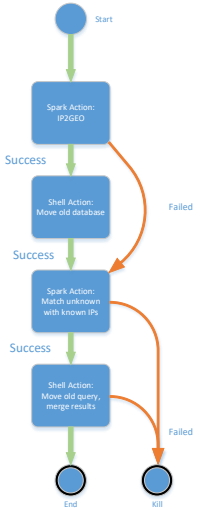
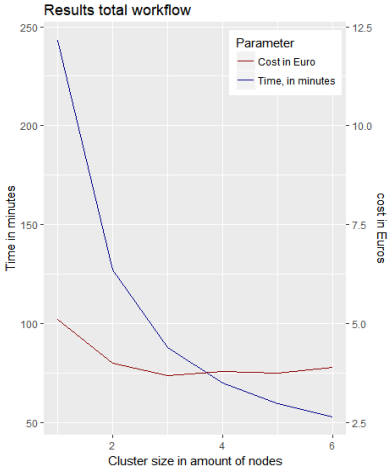
Conclusions









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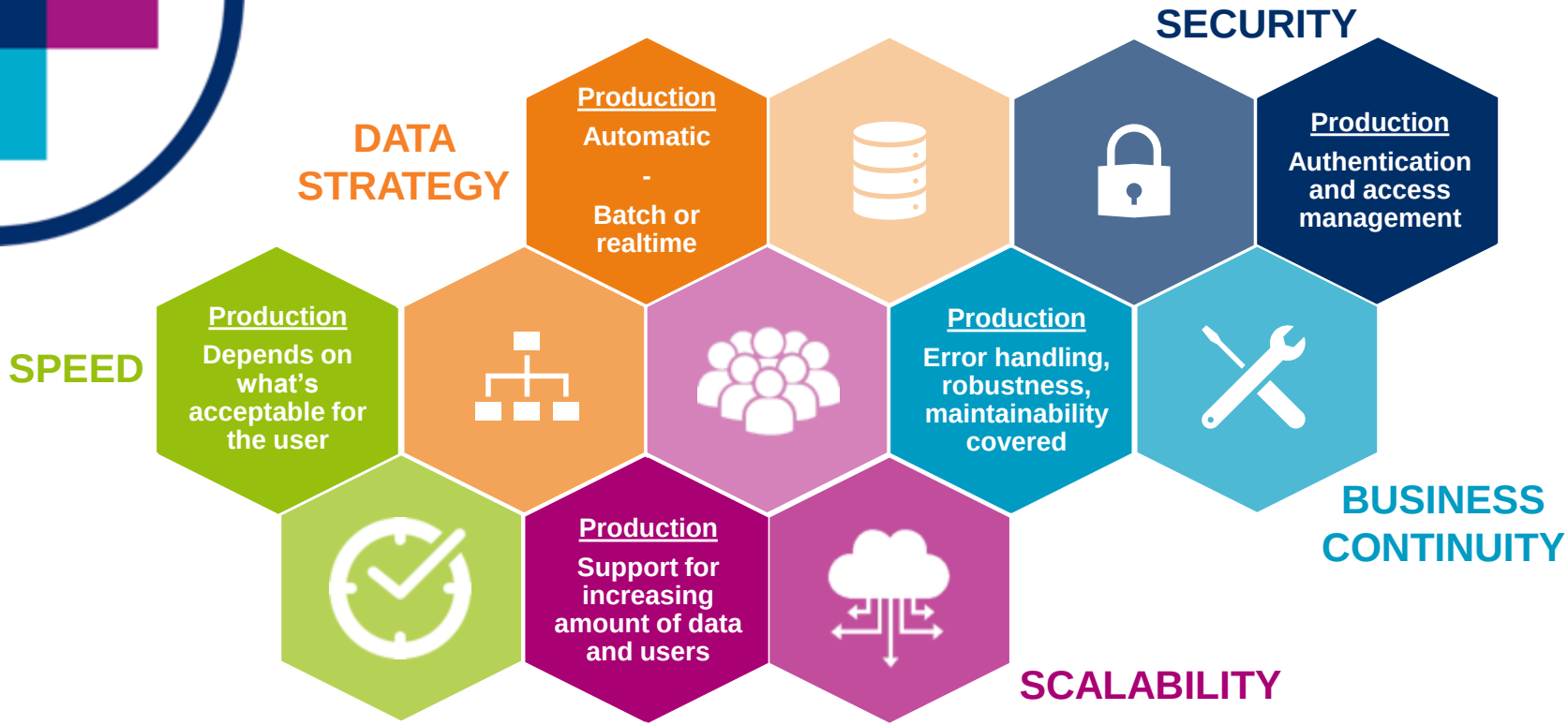
Proof of concept vs production



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Some final remarks…

Remember to…

- Always make sure you have a goal in mind, and document that goal: Too many data science projects never make it to production, because the project never got past the proof of concept phase. Making those is expensive!

- See data engineers and data scientists as a team, in the world of big data one cannot live without the other.

- Experiment and learn from the different tools and techniques available! There is a very high demand for well-rounded data scientists and engineers (Go beyond R)

- Most importantly, have some **fun**; there are many opportunities in the industry right now and find something you really like☺

Interested in collaboration / thesis subjects / a job?

Contact me!

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