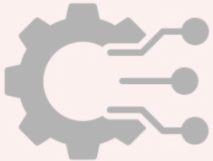
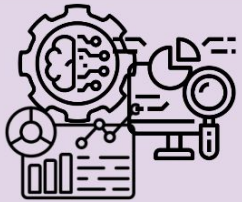
Big Data Management
Project P2

DTIM Research Group
Universitat Politècnica de Catalunya (UPC) - BarcelonaTech

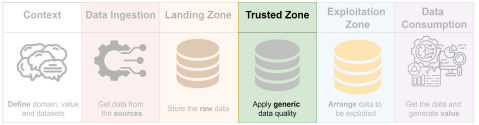
Contents

- Explaining the stages
  - Trusted Zone
  - Exploitation Zone
  - Downstream tasks
- Implementing the stages
  - Design
  - Databases
  - Transformations
- Data governance (additional criteria)
- Deliverables

Context	Data Ingestion	Landing Zone	Trusted Zone	Exploitation Zone	Data Consumption
					
Define domain, value and datasets	Get data from the **sources**	Store the **raw** data	Apply **generic** data quality	**Arrange** data to be exploited	Get the data and generate **value**

Stages Overview

Trusted Zone



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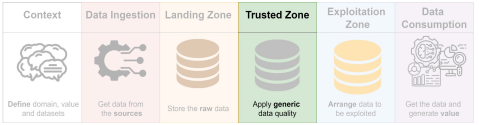

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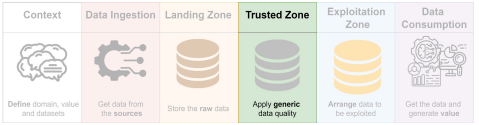

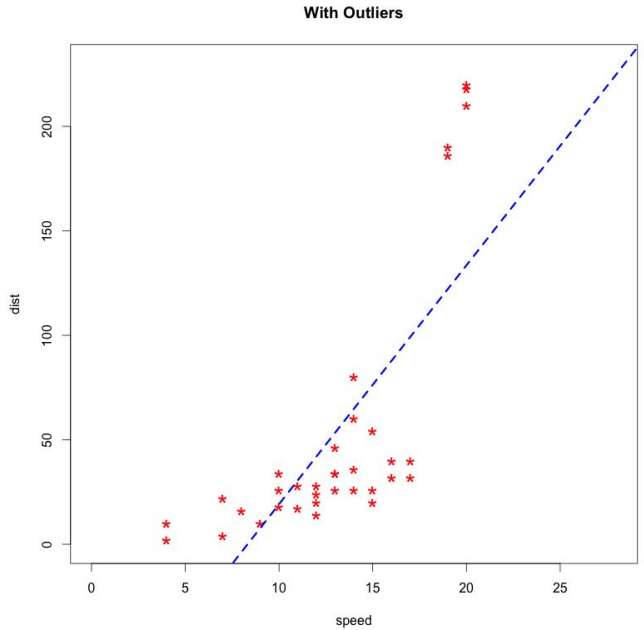

r-statistics: *Outlier Treatment With R*

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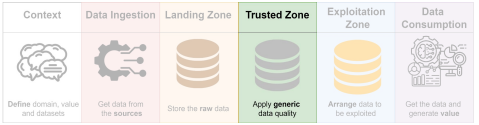

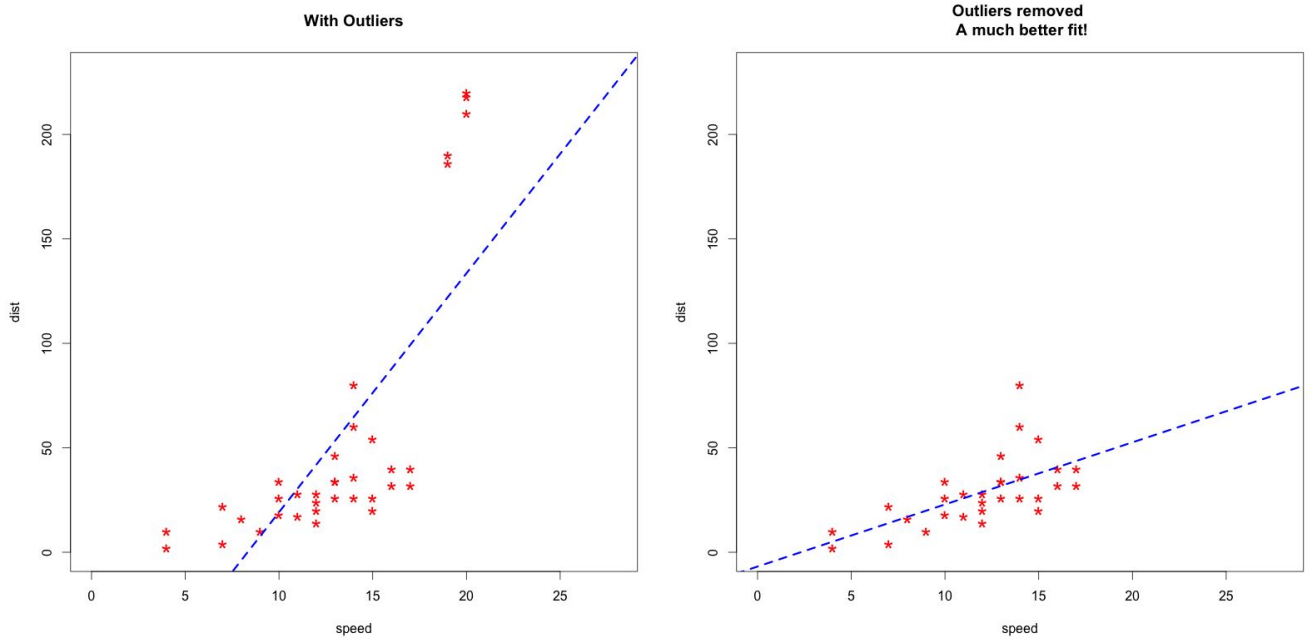

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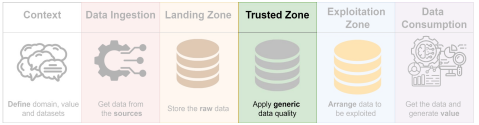

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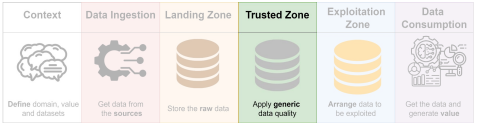

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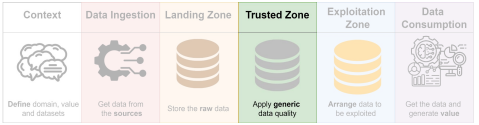
- What we have to apply are **generic** data quality tasks

Trusted Zone



- Examples of tasks (more are listed in the document):
  - **Deduplication**: removing repeated elements (e.g. based on primary key)
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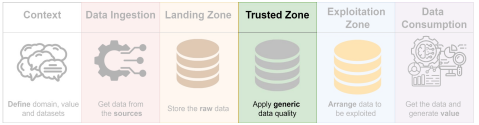

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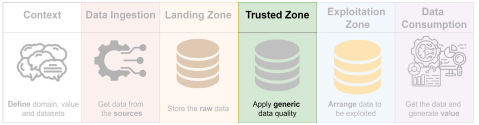

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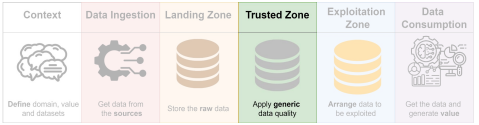
- Note that you can implement any task you want if it is adequately justified.

Trusted Zone - Tasks



You need to:

- Select the required data storage tools (i.e. databases, see section 2).
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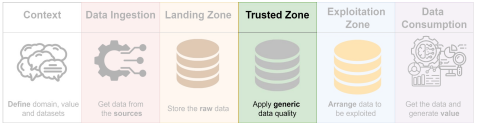

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Factors that will **positively contribute** towards the grade:

- Thoroughness and correctness of the cleaning tasks

Exploitation Zone

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- We are going to implement **two** separate processes to do so.

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Movie	Actor	A.Age	A.Birth	A...
Mx	a1	45	Madrid	...
My	a1	45	Madrid	...

Movie
Mx
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2	...	...	...

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2	B1	...	...
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- For semi-structured data this processing can be very complex

Exploitation Zone - New Data

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  - Summaries of textual data.
  - Classify into categories
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- For structured and semi-structured data, **KPI**s or other business-related **aggregates** can be obtained.
  - Total benefit per month.
  - Percentage of returning customers.
  - Average time from job posting to hire.

Exploitation Zone - New Data

You need to:

- Define the structure of the exploitation zone.
- Decide which additional data assets you are going to generate and how.
- Select the required data storage tools (i.e. databases, see section 2) and set them up
- Implement the pipelines that move the data from the trusted to the exploitation zone. Do so with appropriate technology (see section 2).

Factors that will **positively contribute** towards the grade:

- Effort in providing a coherent and nuanced organization to the data.
- Appropriate development of new data/artifacts.

Exploitation Zone - New Data

Important note: We acknowledge that the exploitation zone can be a bit confusing, and the data that you have might severely limit what you can do.

The goal of implementing this zone is, simply, that you play around with the problem of organizing the data in interesting ways to maximize its utility.

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- You can use **placeholders** and **synthetic data**.

Data Exploitation- Tasks

You need to:

- Define which **mechanisms** you are going to use to exploit the data.
- Select the **tools** you will use to implement such mechanisms.
- **Ship** the data from the exploitation zone onto selected systems.
- **Implement** the designed tasks.

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- Quality and complexity of the implemented processes.

Implementing the stages

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- We propose two main design alternatives

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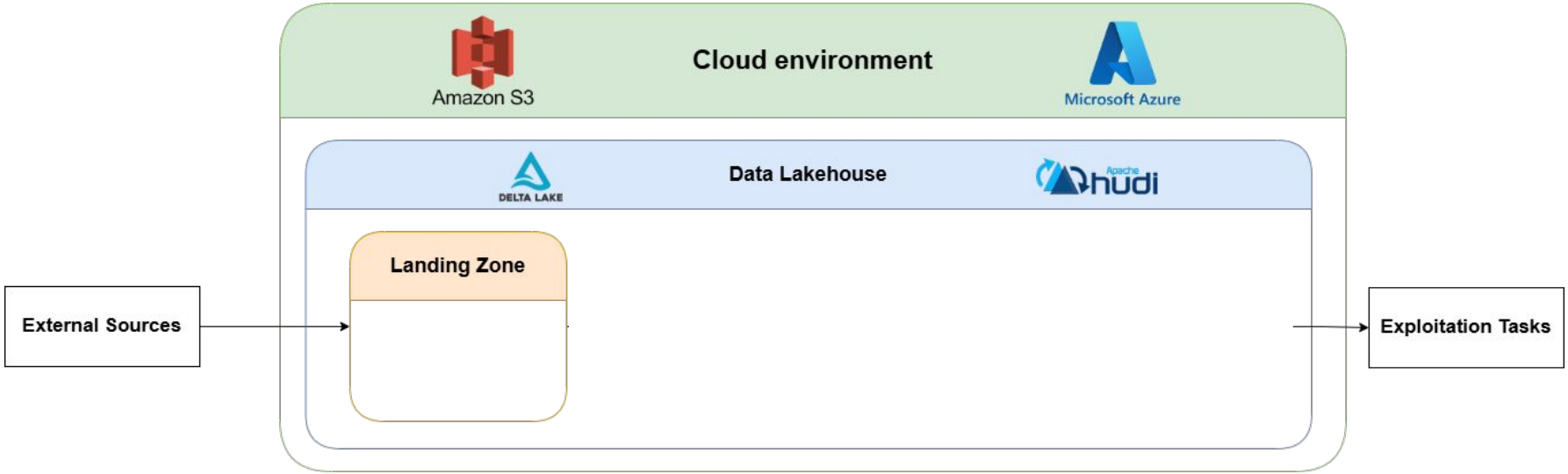

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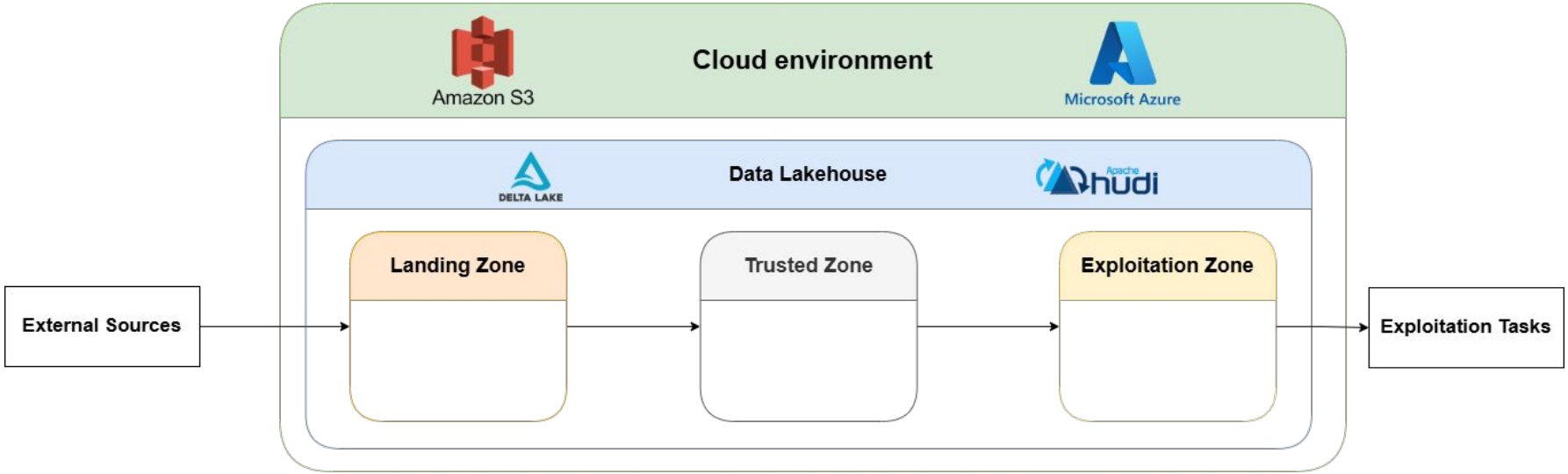
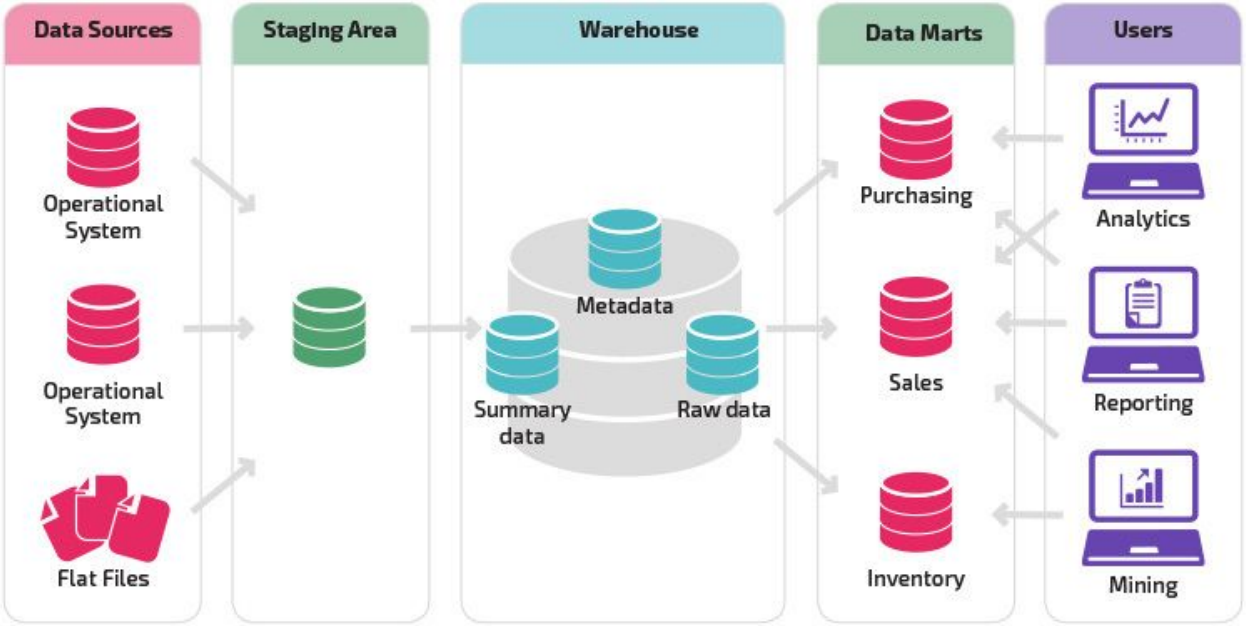


Design - Option 2: Moving the Data Out



Panoply: *Data Mart vs. Data Warehouse*

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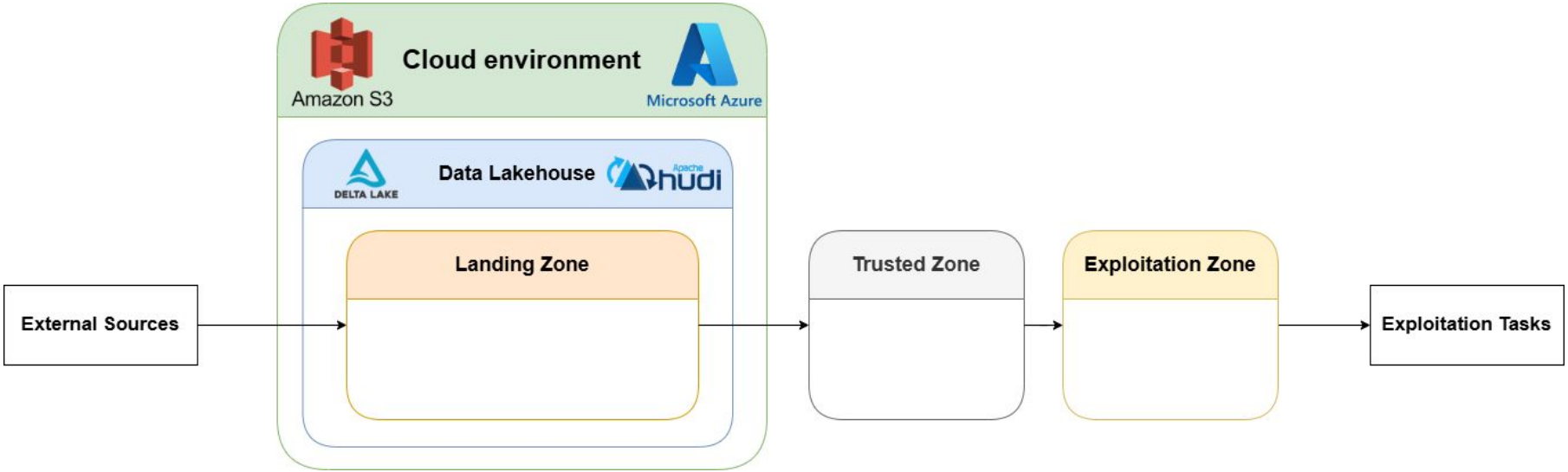

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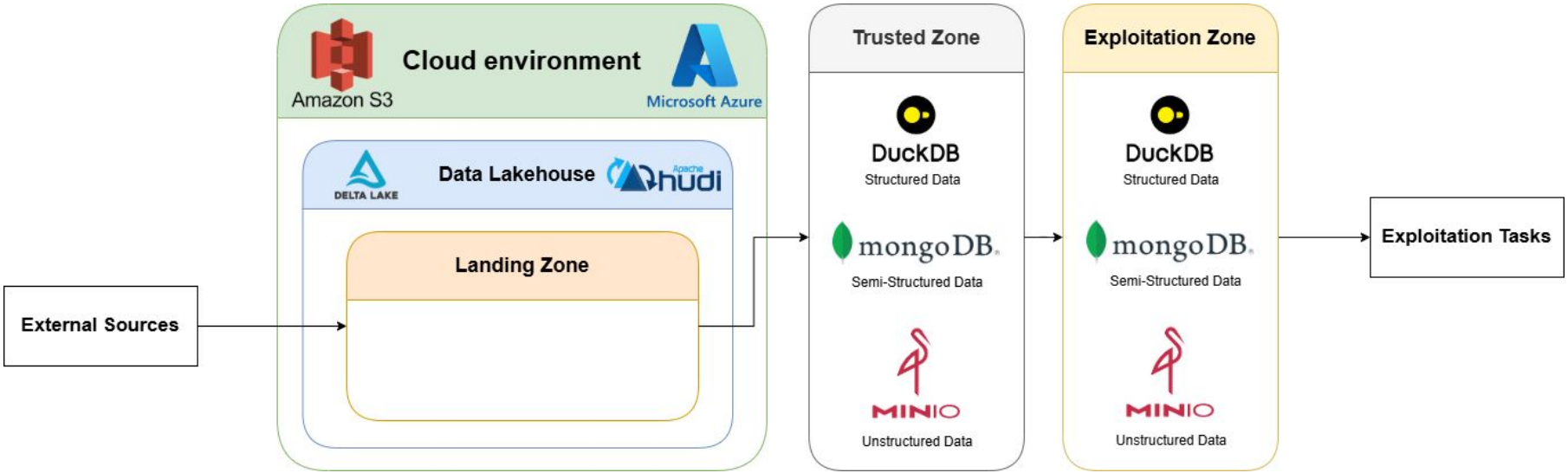

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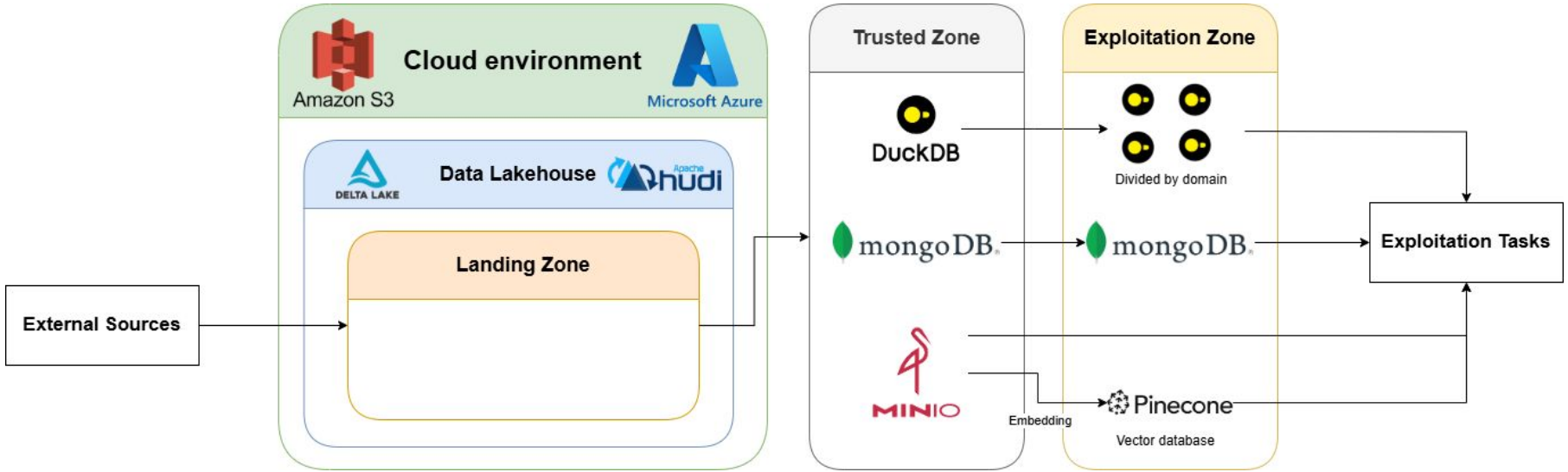

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Important: From an evaluation standpoint, both are perfectly acceptable. Nonetheless, a grade boost will be given to implementations that combine several technologies or define more interesting data management mechanisms.

Databases

Databases

- Relational Databases
  - Transactional (“traditional”): 
  - Analytical (“modern”): 

Databases

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Databases

- Graph Databases 

Databases

- Graph Databases 

- Time-Series Databases 

Databases

- Graph Databases 

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- Vector Databases 

Databases

- Graph Databases 

- Time-Series Databases 

- Vector Databases 

- Object Stores 

Transformations - Batch

Transformations - Batch

- Large-Scale Processing

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- Large-Scale Processing

- Small-Scale Processing

Transformations - Batch

- Large-Scale Processing

- Small-Scale Processing

- You need to **justify** what type of technology is appropriate to use depending on the **volume of data** you are working with.

Transformations - Streaming

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  - *Conceptually*, not in a hot path, as data has to be sent immediately.
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- Tools to process a stream:

(In Java)

Data Governance (Optional)

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- A good starting point is to reflect on your business domain and **define what you aim to achieve**.
  - For example: is securing sensitive customer data a concern? Or is it more important to ensure trust in ML outputs through robust data quality controls?

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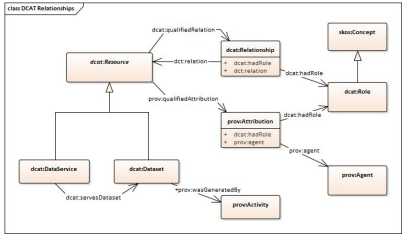
- A data product is a well-defined, reusable dataset or API that is treated with the **same care and discipline** as a software product.

- Rather than governing every table or pipeline independently, organizations can attach policies, ownership, quality checks, and access control rules at the **level of the data product**.

Data Governance - Tasks

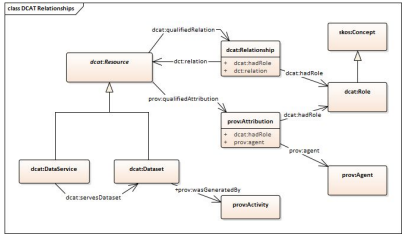
- Metadata Management



Apache Atlas

Data Governance - Tasks

- Metadata Management



Apache Atlas

- Data Quality

great expectations

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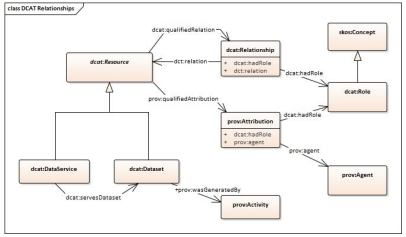

Apache Atlas

- Data Quality

great expectations

- Data Security

Apache Ranger

Data Governance - Tasks

Over your resulting data architecture, begin to **design your data governance strategy**. As previously discussed, data governance includes organizational, strategic, and business-aligned scopes.

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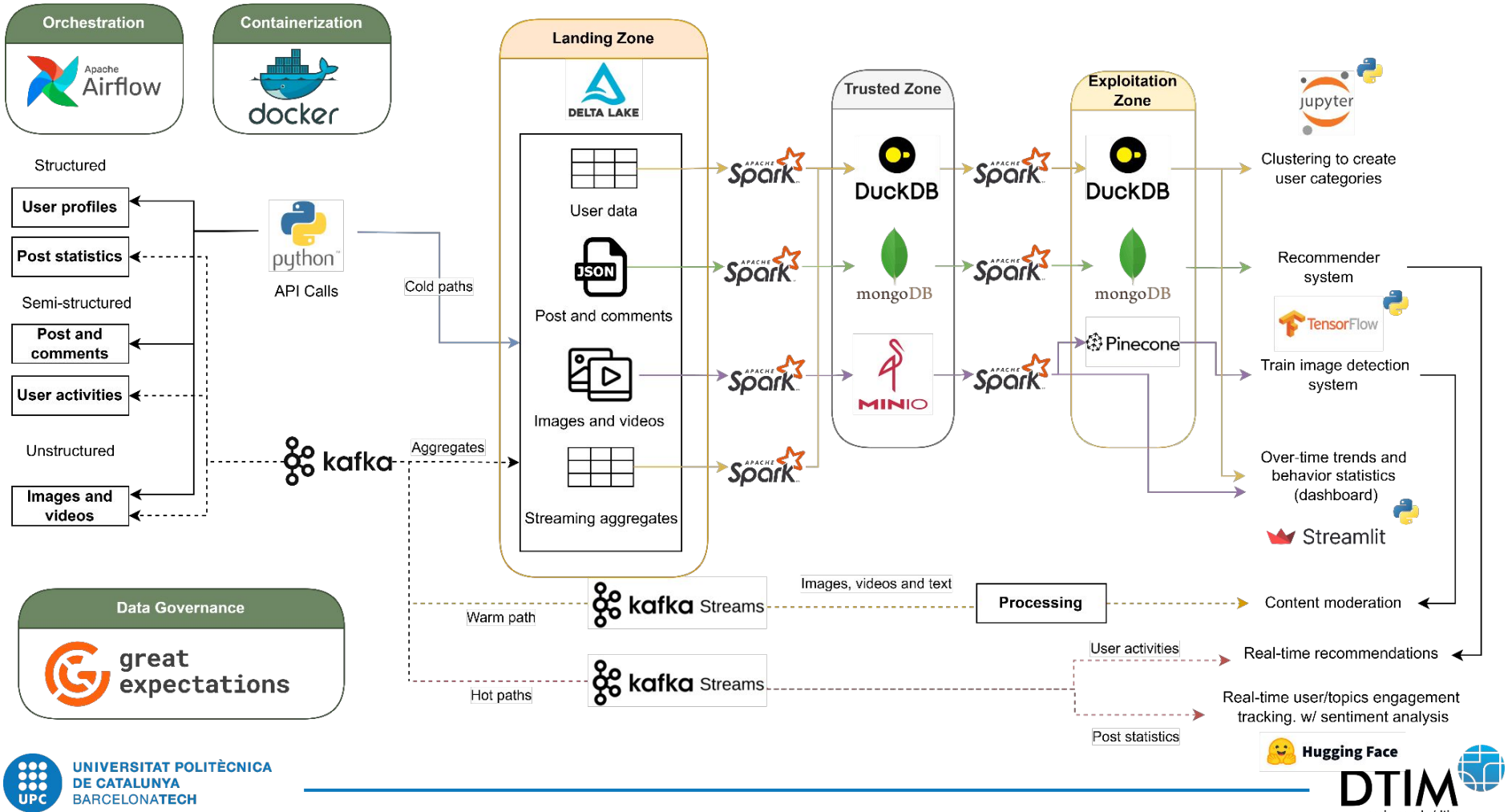
2. Provide at least **one detailed example** of a data product and the metadata you would associate with it to support governance.
3. Choose at least one **governance mechanism** (e.g., data quality validation, access control, lineage tracking, cataloging) and implement it over your architecture.

Deliverables

Main deliverable

- It has to implement:
  - Architecture design (updated version with the new zones, tools, processes, etc.)
  - Stage 3: trusted zone
  - Stage 4: exploitation zone
  - Stage 5: consumption tasks
  - Governance tasks (if applicable)


Orchestration
Apache Airflow
Containerization
docker
Landing Zone
DELTA LAKE
User data
Post and comments
Images and videos
Streaming aggregates
Trusted Zone
DuckDB
mongoDB
MINIO
Exploitation Zone
DuckDB
mongoDB
Pinecone
Structured
User profiles
Post statistics
Semi-structured
Post and comments
User activities
Unstructured
Images and videos
python
API Calls
Cold paths
kafka
Aggregates
Spark
jupyter
Clustering to create user categories
Recommender system
TensorFlow
Train image detection system
Over-time trends and behavior statistics (dashboard)
Streamlit
Data Governance
great expectations
Warm path
kafka Streams
Images, videos and text
Processing
Content moderation
Hot paths
kafka Streams
User activities
Real-time recommendations
Real-time user/topics engagement tracking. w/ sentiment analysis
Post statistics
Hugging Face

Follow-up deliverables

- First deliverable:
  - Architecture design (first version).

- Second deliverable:
  - Architecture design (updated).
  - Basic implementation of trusted zone, exploitation zone and consumption tasks.

- Remember the containerization and orchestration aspects