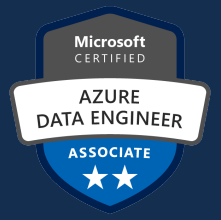
Learn Azure Data Factory From Scratch

About Me

Ramesh Retnasamy

Data Engineer/ Architect



LinkedIn

https://www.linkedin.com/in/ramesh-retnasamy/

About this course

Azure Data Factory (ADF)

Azure storage solutions

Azure SQL Database

Azure Blob Storage

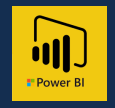
Azure Data Lake Storage Gen2

Other Bigdata Solutions

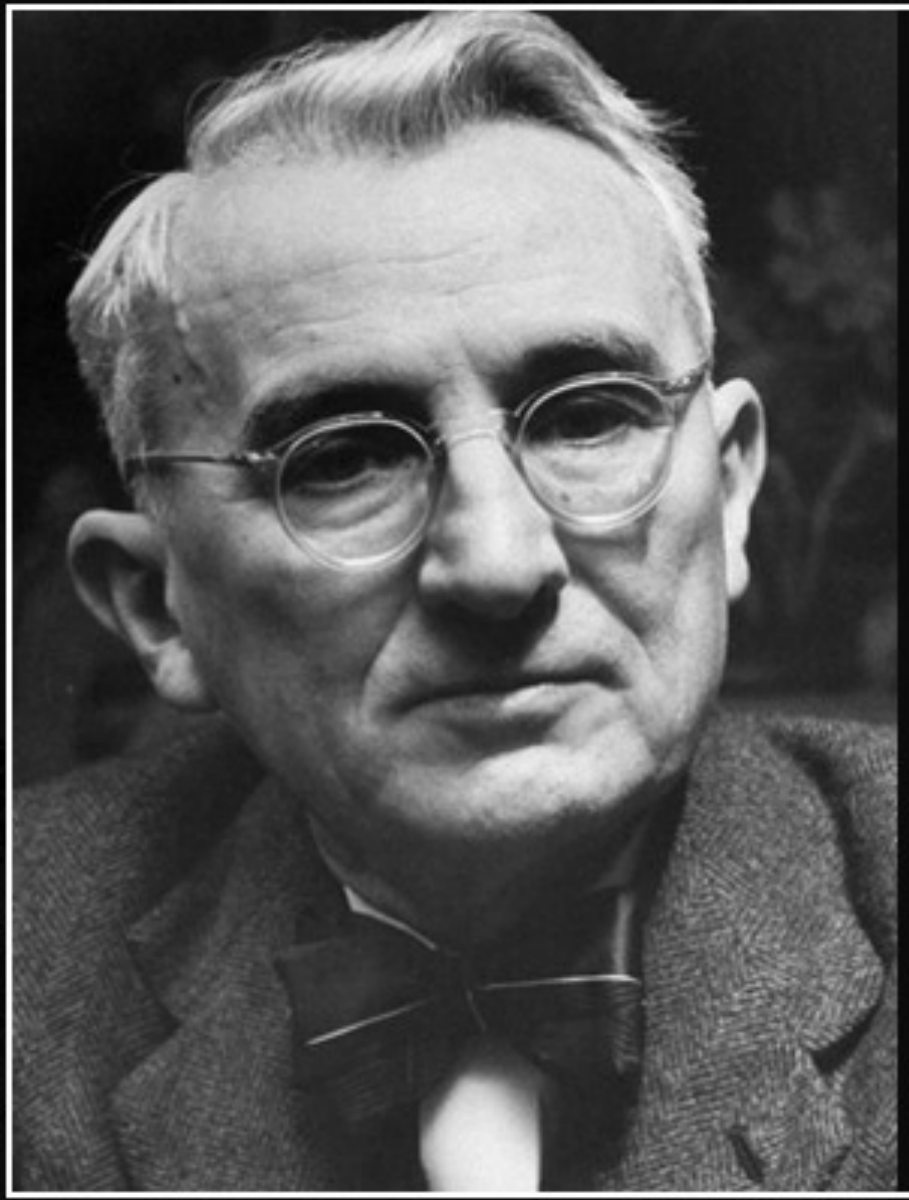
Azure Databricks

Azure HDInsight

Reporting Technologies



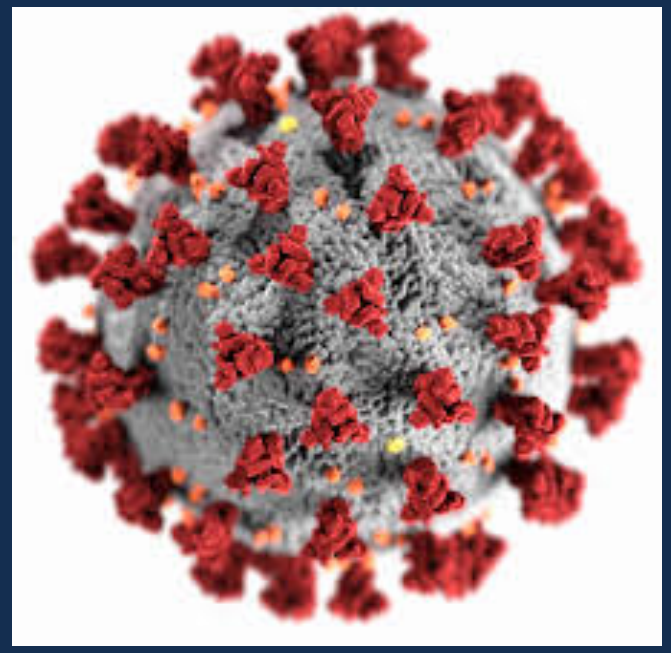
PowerBI



Learning is an active process. We learn by doing.. Only knowledge that is used sticks in your mind.

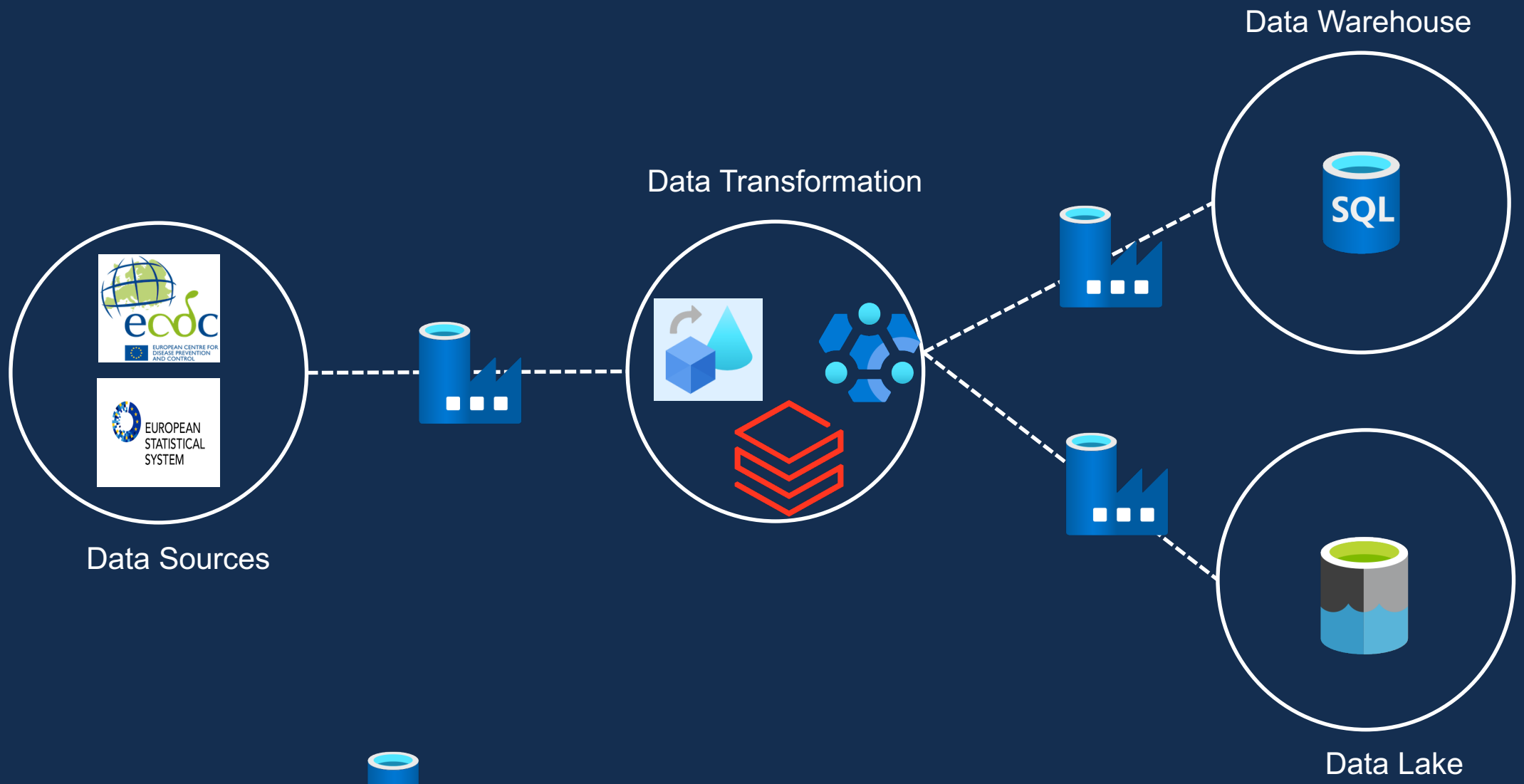
— Dale Carnegie —

AZ QUOTES

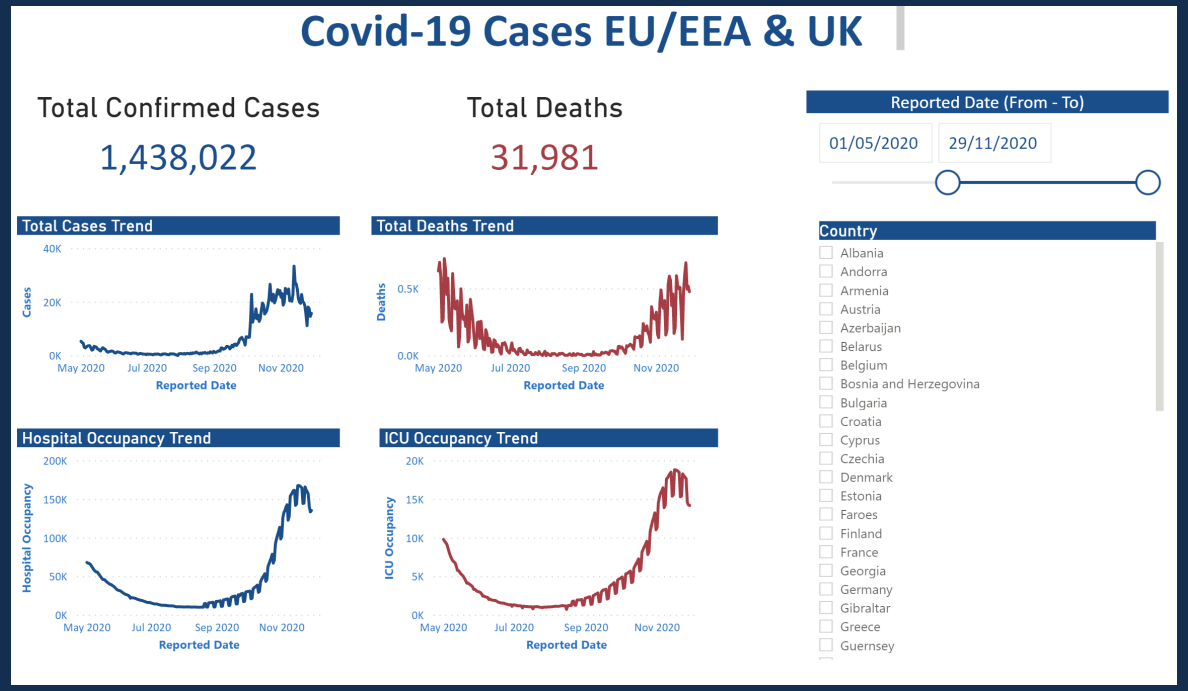


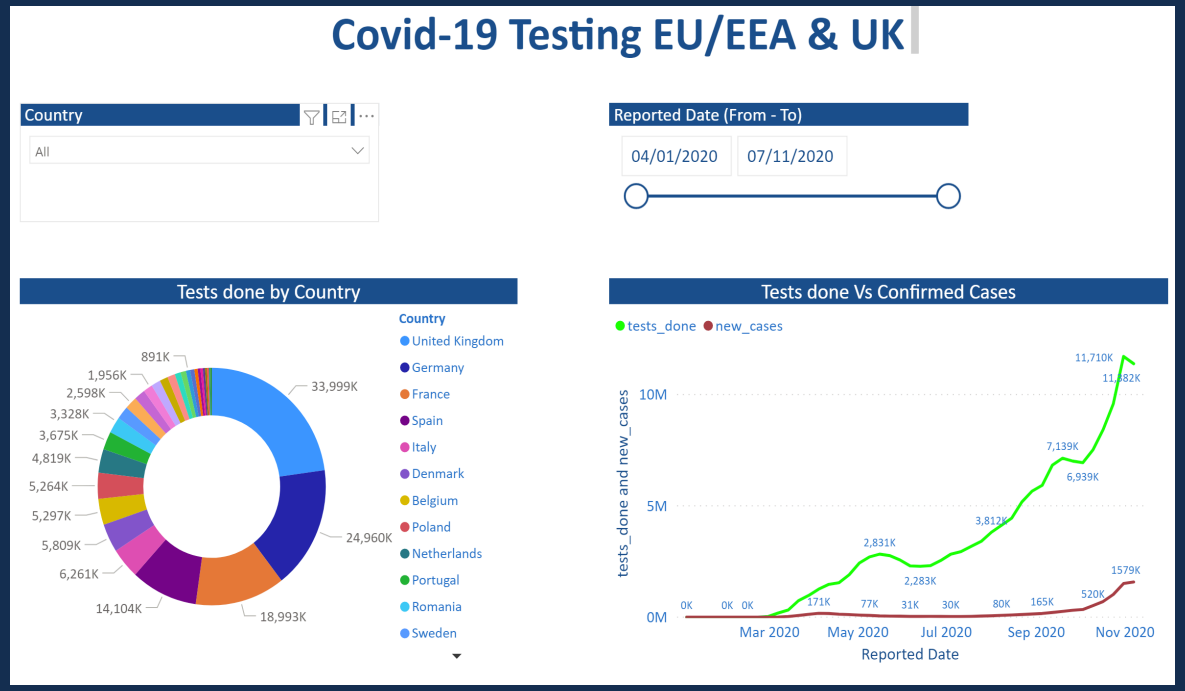
Covid-19 Prediction/ Reporting

Covid-19 Prediction/ Reporting

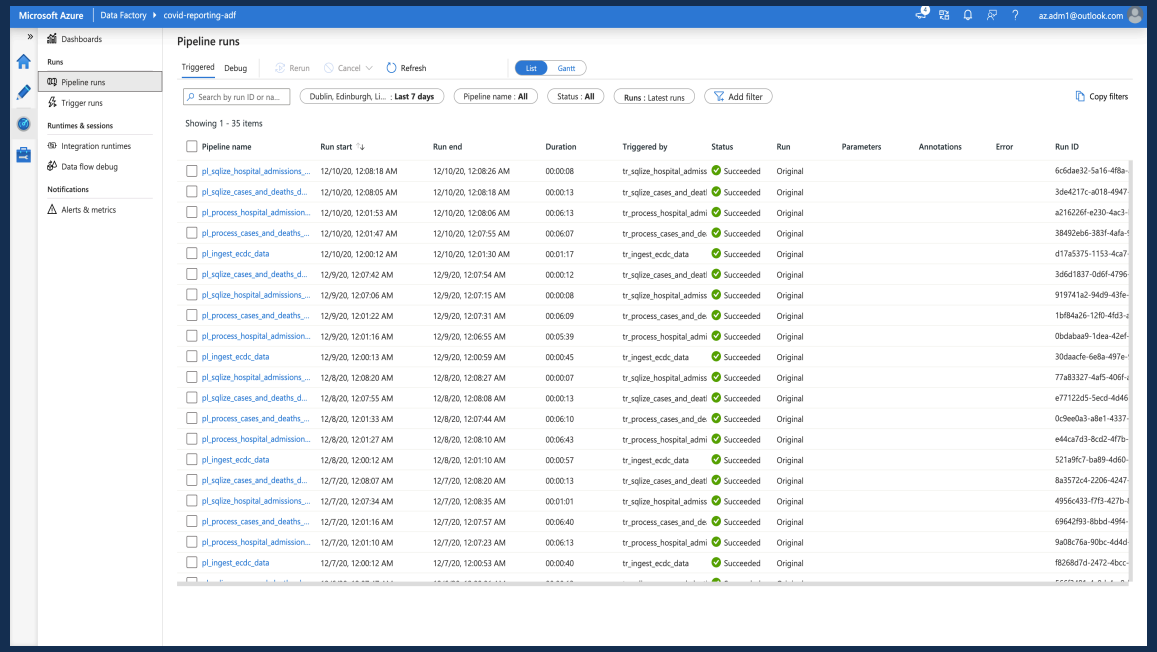


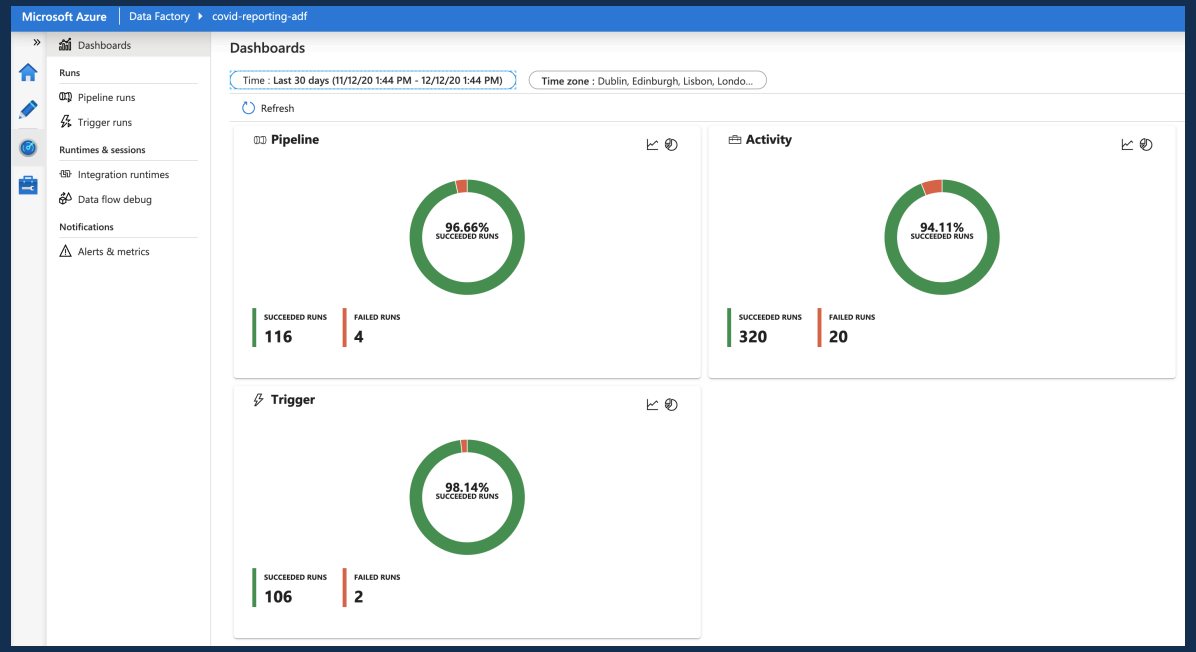
Covid-19 Prediction/ Reporting





Covid-19 Prediction/ Reporting





Who is this course for

- University students
- IT Developers from other disciplines
- AWS/ GCP/ On-prem Data Engineers
- Data Architects
- Data Scientists

Who is this course not for

- Your main focus is not learning Azure Data Factory
- You are not interested in hands-on learning approach
- Your only focus is Azure Data Engineering Certification

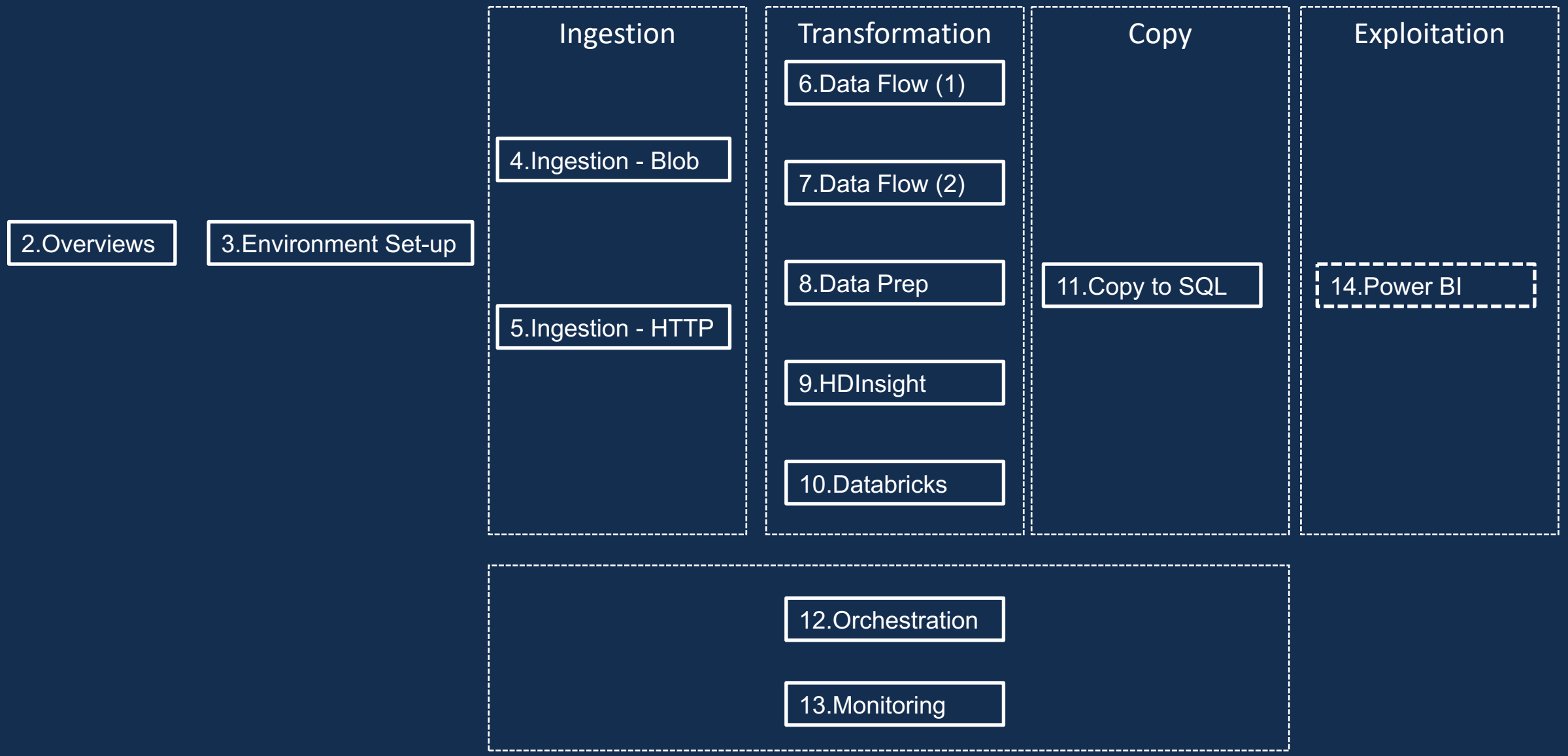
Pre-requisites

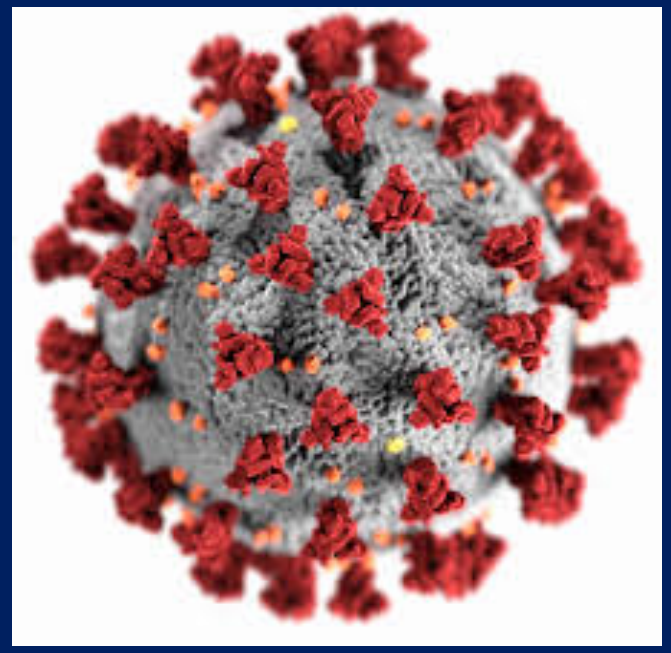
- No prior knowledge assumed
- cloud fundamentals would be beneficial, not necessary
- Basic knowledge on SQL would be beneficial, not necessary
- Azure Account

Our Commitments

- Ask Questions, I will answer ☺
- Keeping the course up to date
- Udemy life time access
- Udemy 30 day money back guarantee

Course Structure





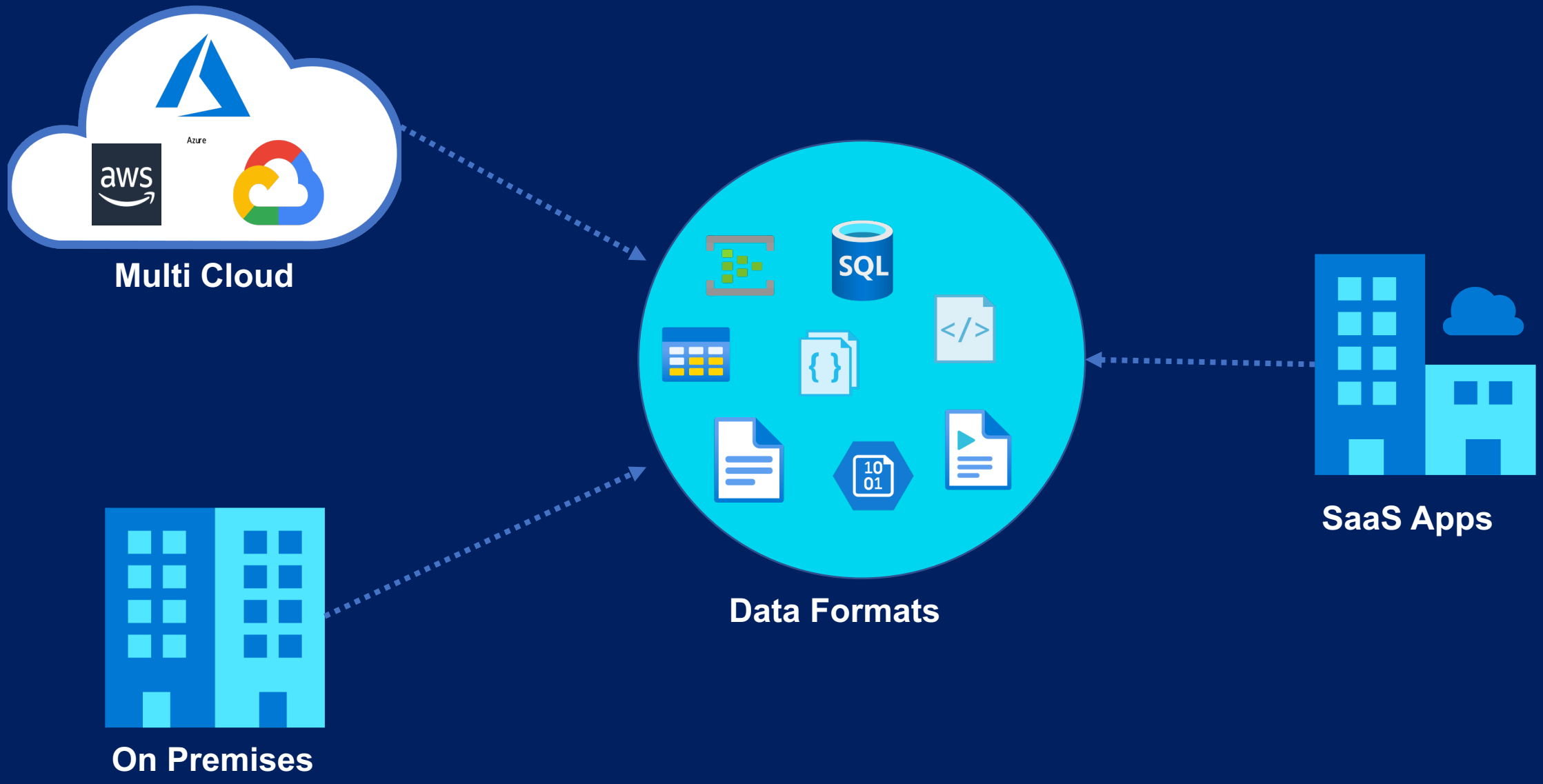
Covid-19 Prediction/ Reporting

Azure Data Factory Overview

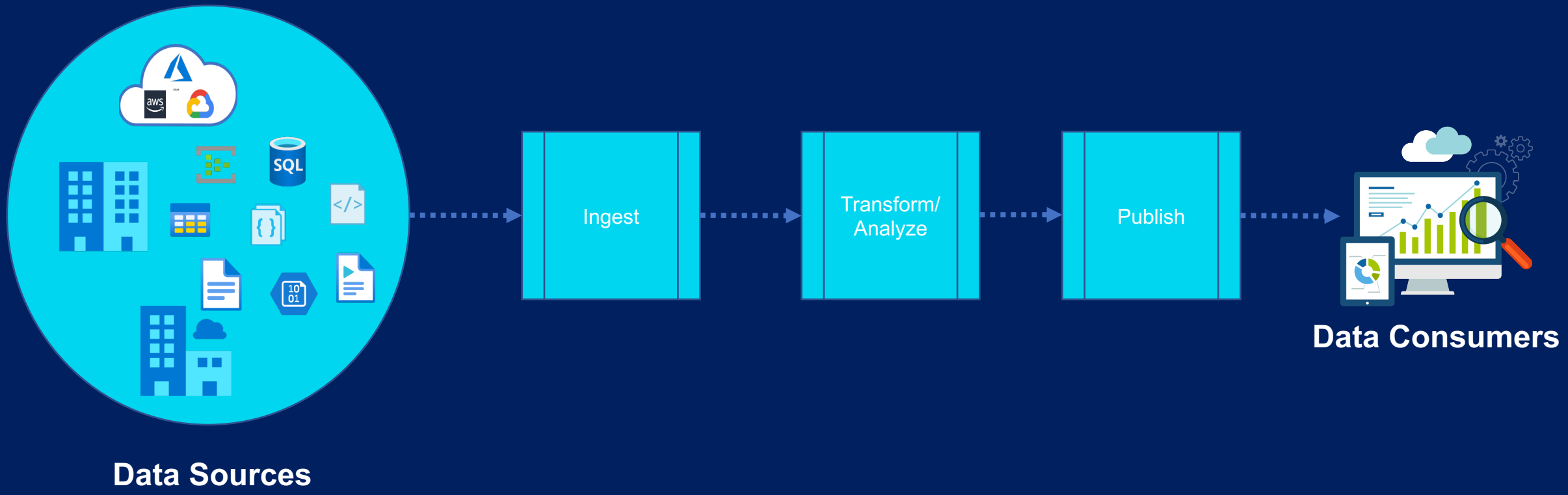
What is Azure Data Factory

A fully managed, serverless data integration solution for ingesting, preparing and transforming all of your data at scale.

The Data Problem



The Data Problem



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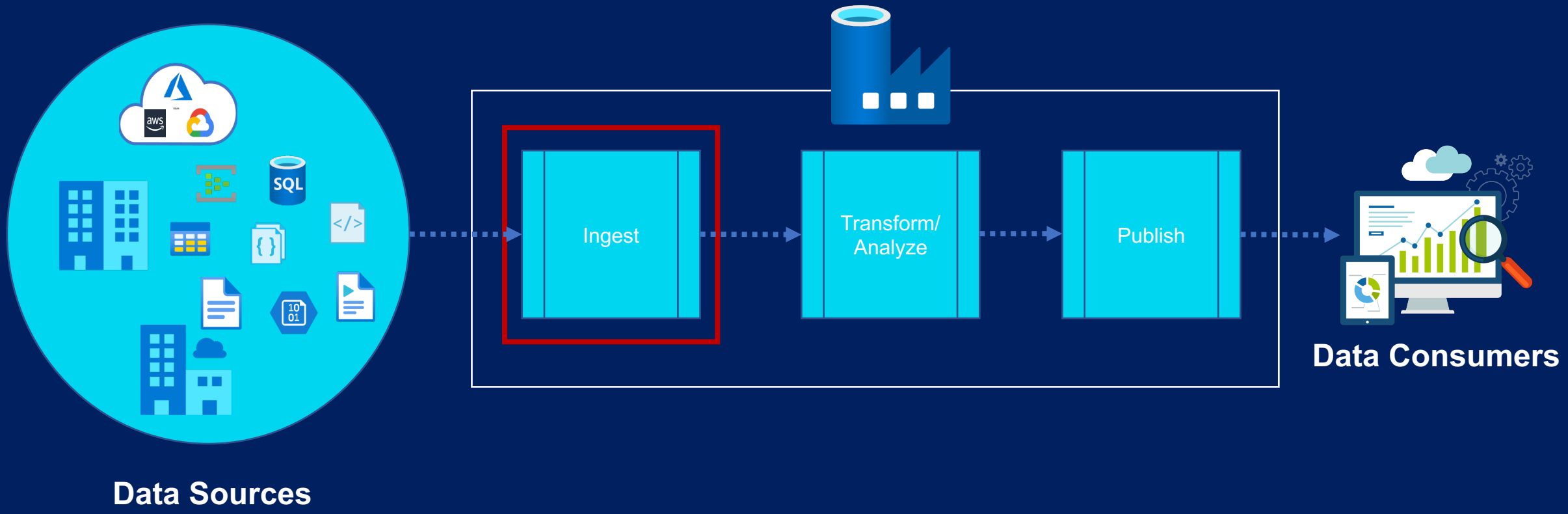
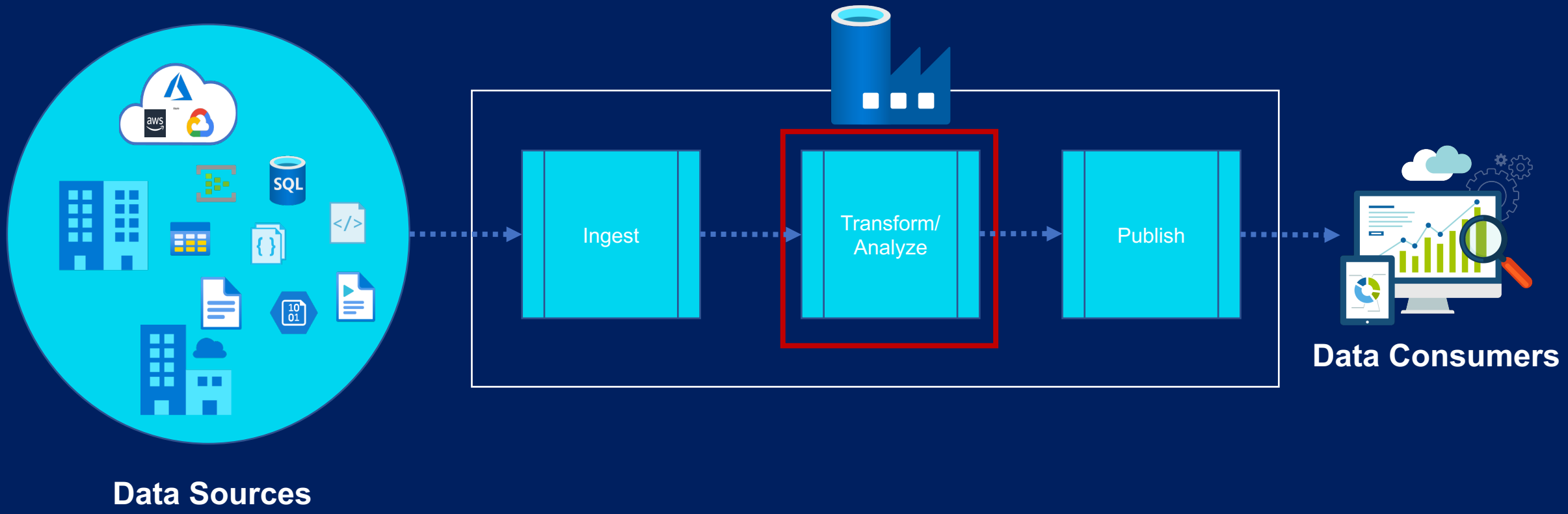
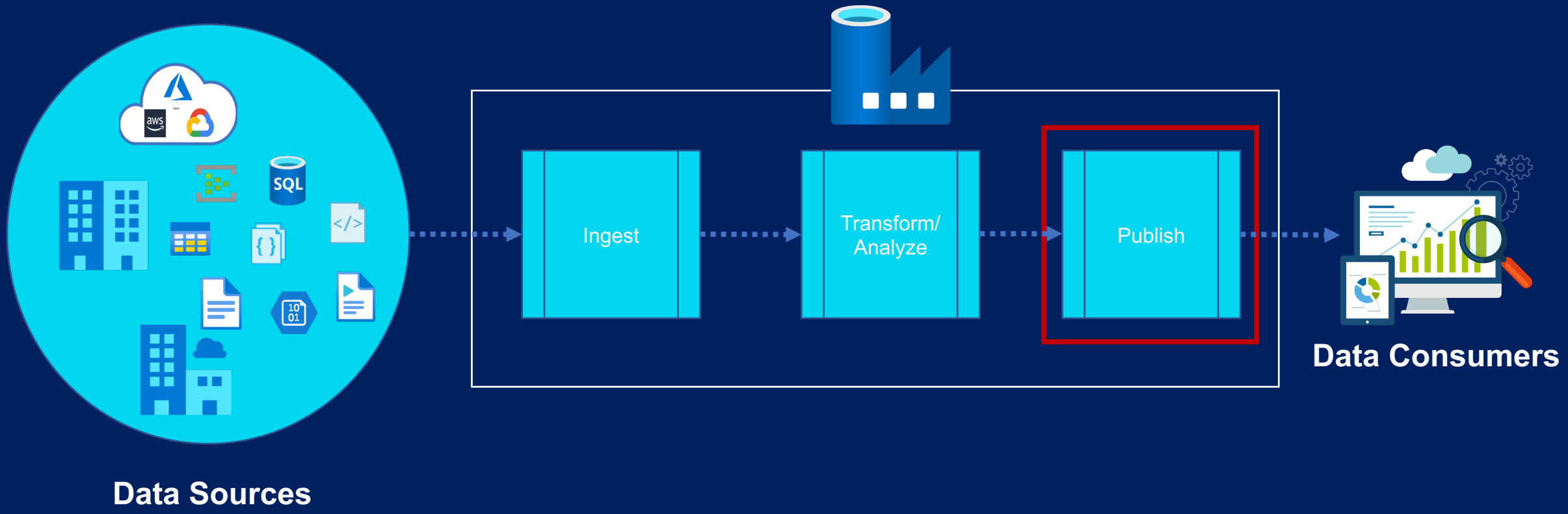


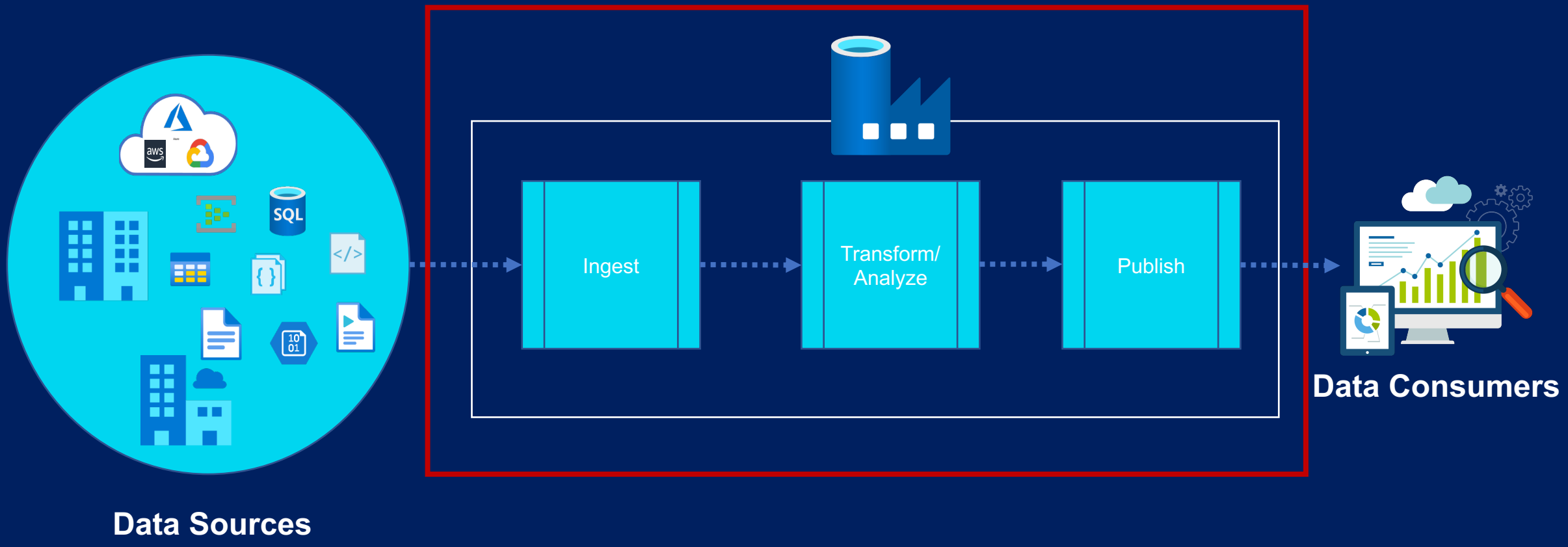
The Data Problem



The Data Problem



The Data Problem



What is Azure Data Factory

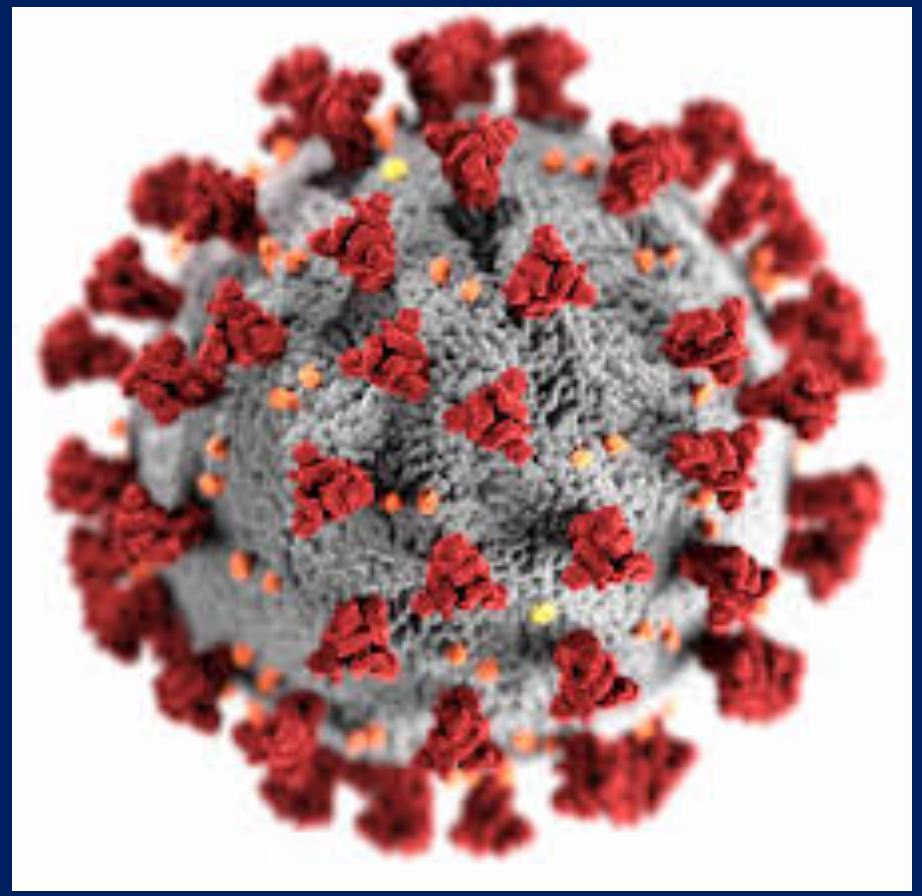
- Fully Managed Service
- Serverless
- Data Integration Service
- Data Transformation Service
- Data Orchestration Service

A fully managed, serverless data integration solution for ingesting, preparing and transforming all of your data at scale.

What Azure Data Factory Is Not

- Data Migration Tool
- Data Streaming Service
- Suitable for Complex Data Transformations
- Data Storage Service

Project Overview



Covid-19 Prediction/ Reporting

Data Lake

Data Lake to be built with the following data to aid Data Scientists to predict the spread of the virus/ mortality

- Confirmed cases
- Mortality
- Hospitalization/ ICU Cases
- Testing Numbers
- Country’s population by age group

Data Warehouse

Data Warehouse to be built with the following data to aid Reporting on Trends

- Confirmed cases
- Mortality
- Hospitalization/ ICU Cases
- Testing Numbers

Data Sources

ECDC Website

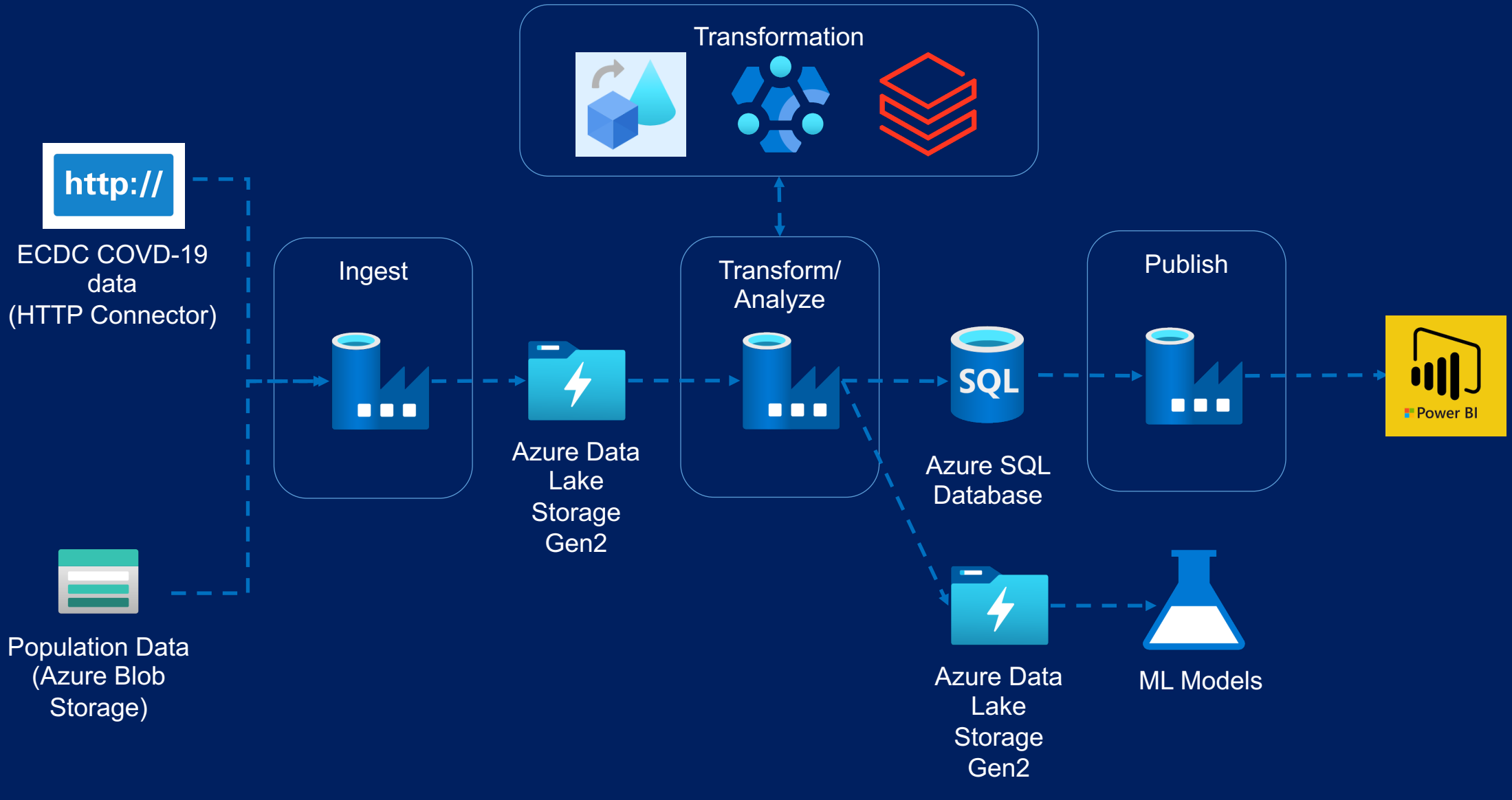
- Confirmed cases
- Mortality
- Hospitalization/ ICU Cases
- Testing Numbers

Eurostat Website

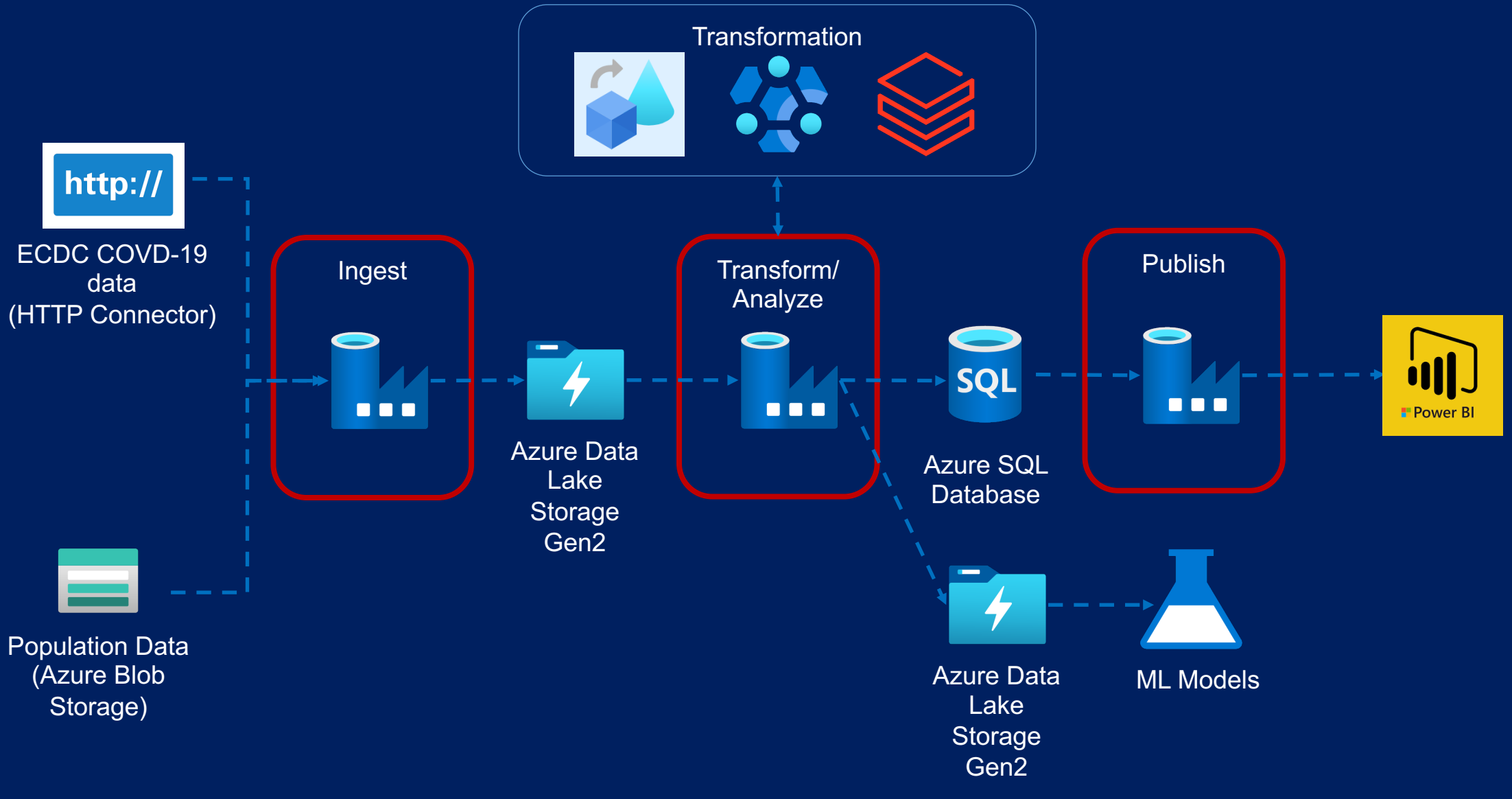
- Population by age

Solution Architecture

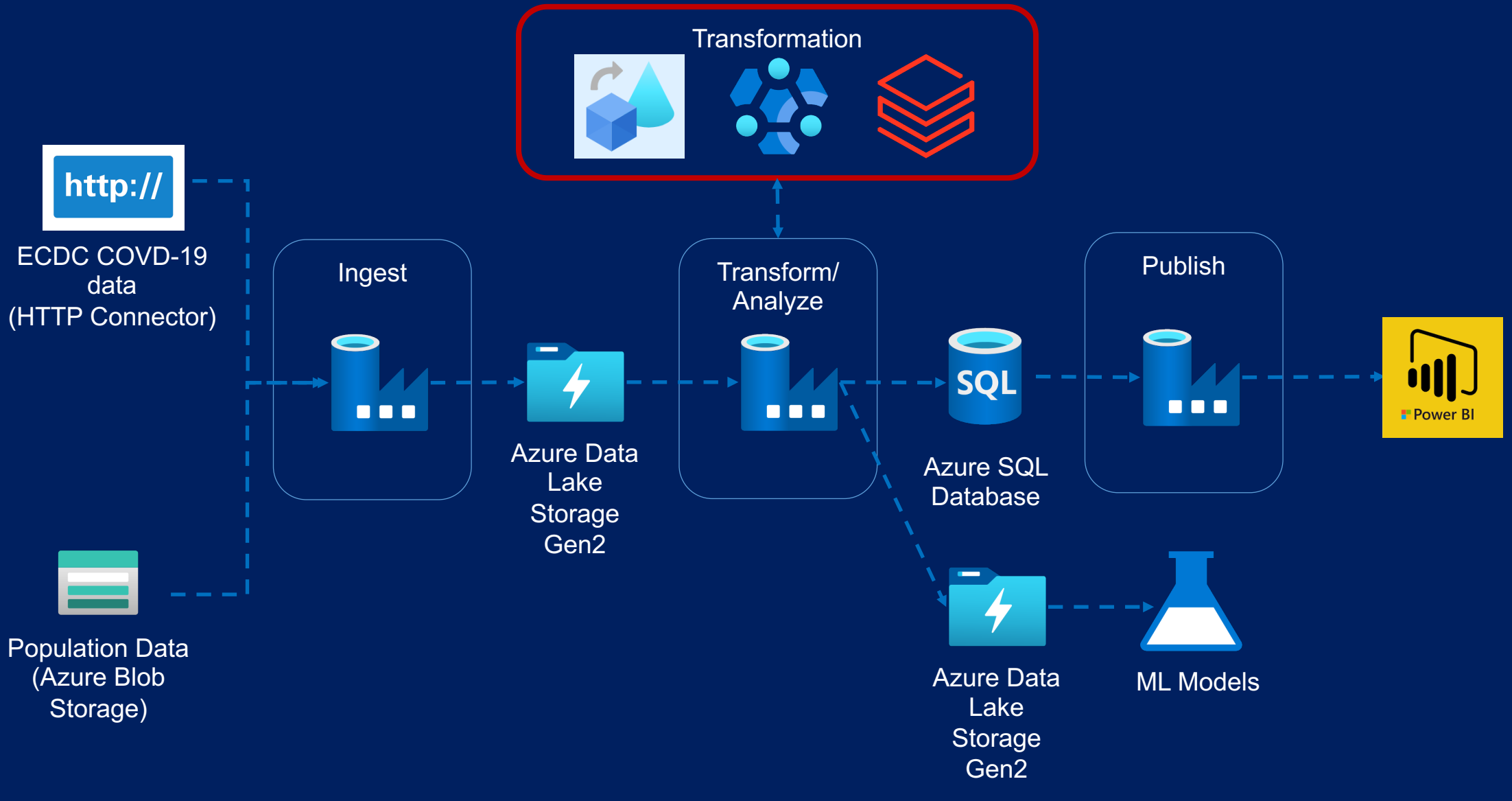
Solution Architecture



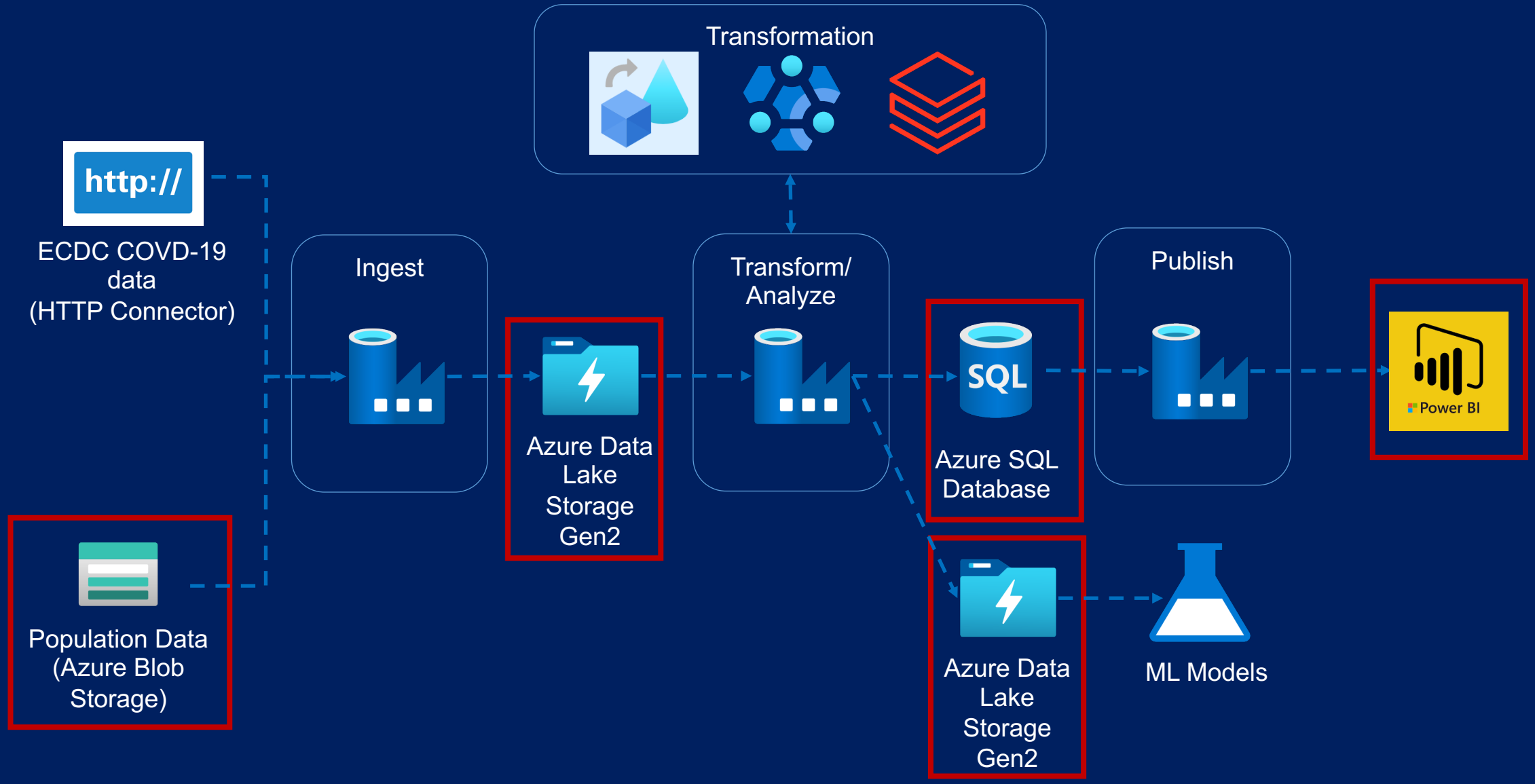
Solution Architecture



Solution Architecture



Solution Architecture



Storage Solutions

Key Factors to Consider

Structure of the data

- Structured
- Semi-Structured
- Unstructured

Operational needs

- How often is the data accessed?
- How quickly do we need to serve?
- Need to run simple queries?
- Need to run heavy analytical workload?
- Accessed from multiple regions?

Azure Databases

Azure SQL Database

Azure Database for MySQL

Azure Database for PostgreSQL

Azure Database for MariaDB

VM Images with Oracle, SQL Server etc.

Azure Storage Account

Blob Storage

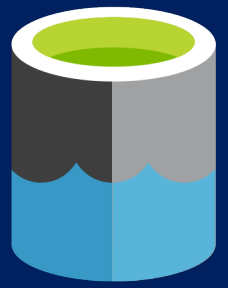
File Storage

Disk Storage

Table Storage

Queue Storage

Azure Data Lake



Azure Data Lake Storage Gen2

Enhance Performance

Better Security

Enhance Management

Azure Cosmos DB

Globally distributed

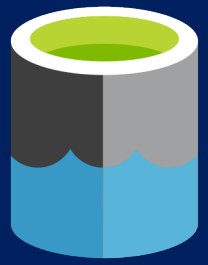
Multi Model

High Throughput

Storage solutions used in this course

Azure SQL Database

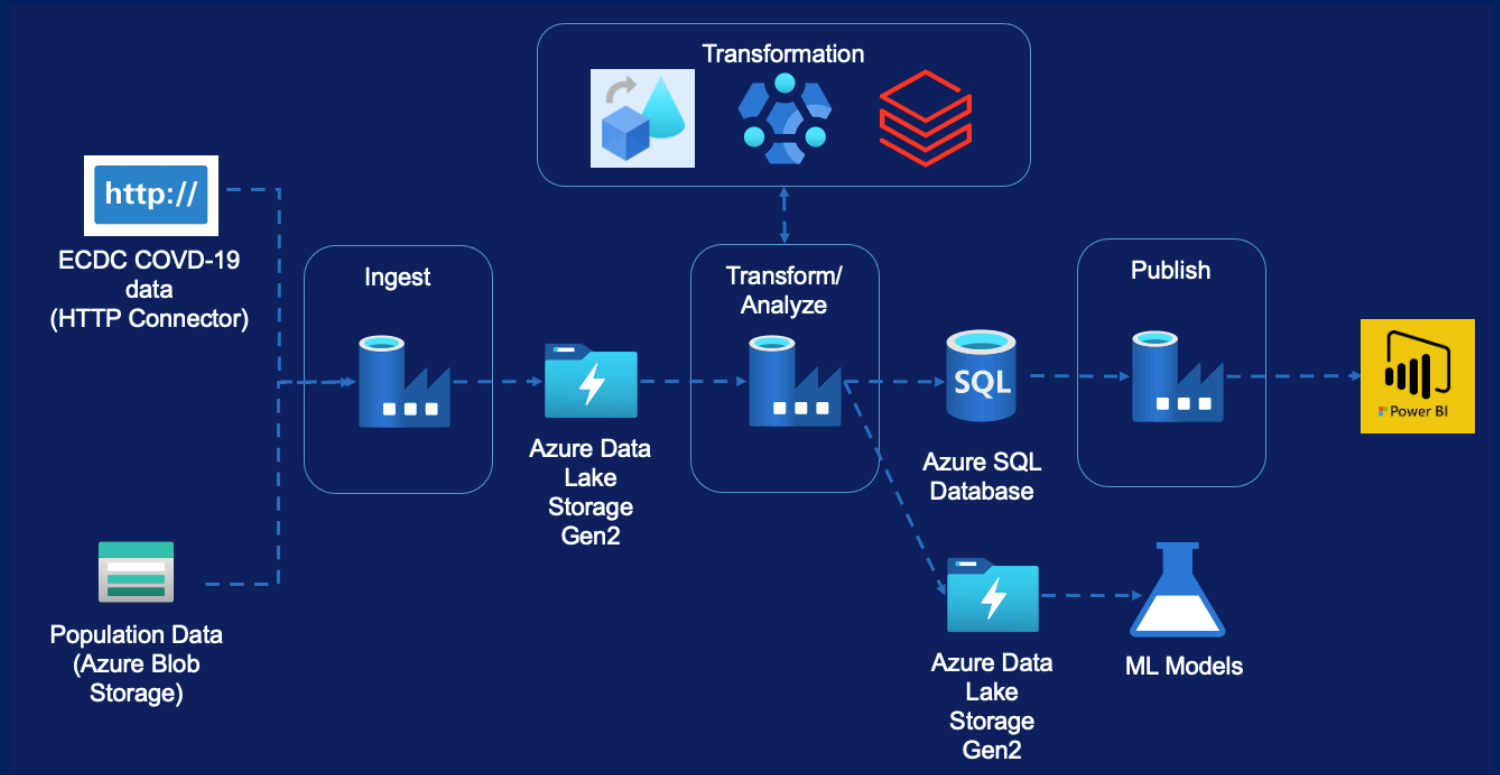
Azure Blob Storage



Azure Data Lake Storage Gen2

Environment set-up

Environment set-up



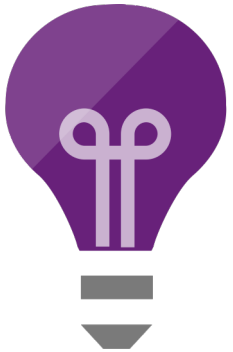
- Azure Subscription
- Data Factory
- Blob Storage Account
- Data Lake Storage Gen2
- Azure SQL Database

- Azure Databricks Cluster
- HD Insight Cluster

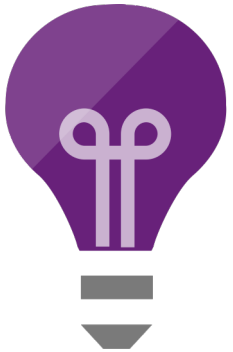
Creating Azure Free Account

Creating Azure Data Factory

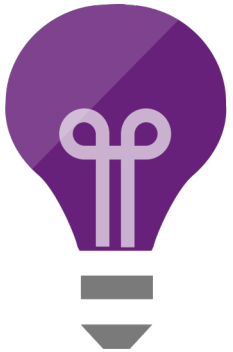
Creating Azure Storage Account



Creating Azure Data Lake Gen2



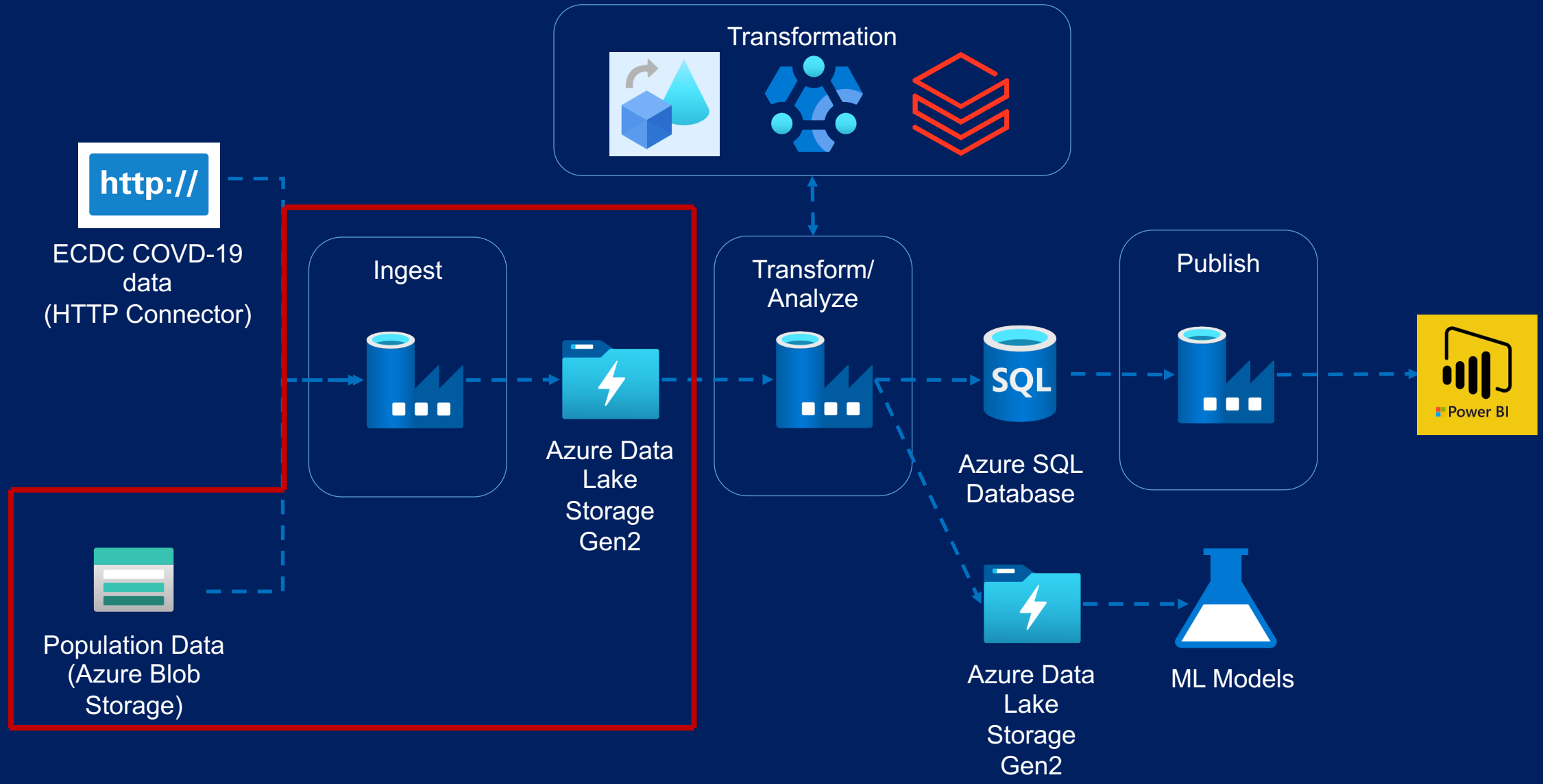
Creating Azure SQL Database



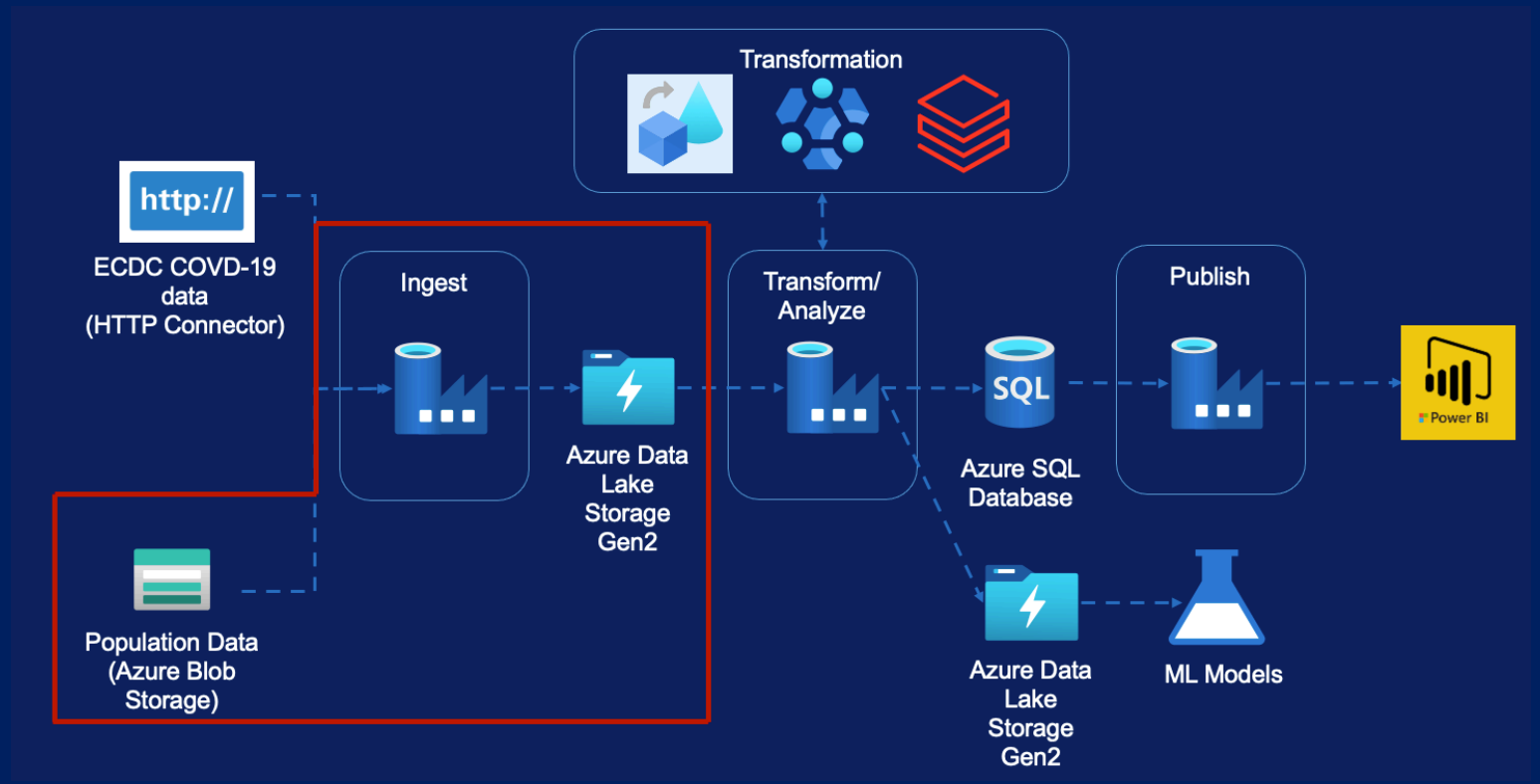
Data Ingestion

Data Ingestion - Module Overview (Population by Age)

Data Ingestion – Population Data



Data Ingestion – Population Data



- Copy Activity
- Linked Services
- Datasets
- Pipeline
- Validation Activity
- If Condition Activity
- Web Activity
- Get Metadata Activity
- Delete Activity
- Trigger

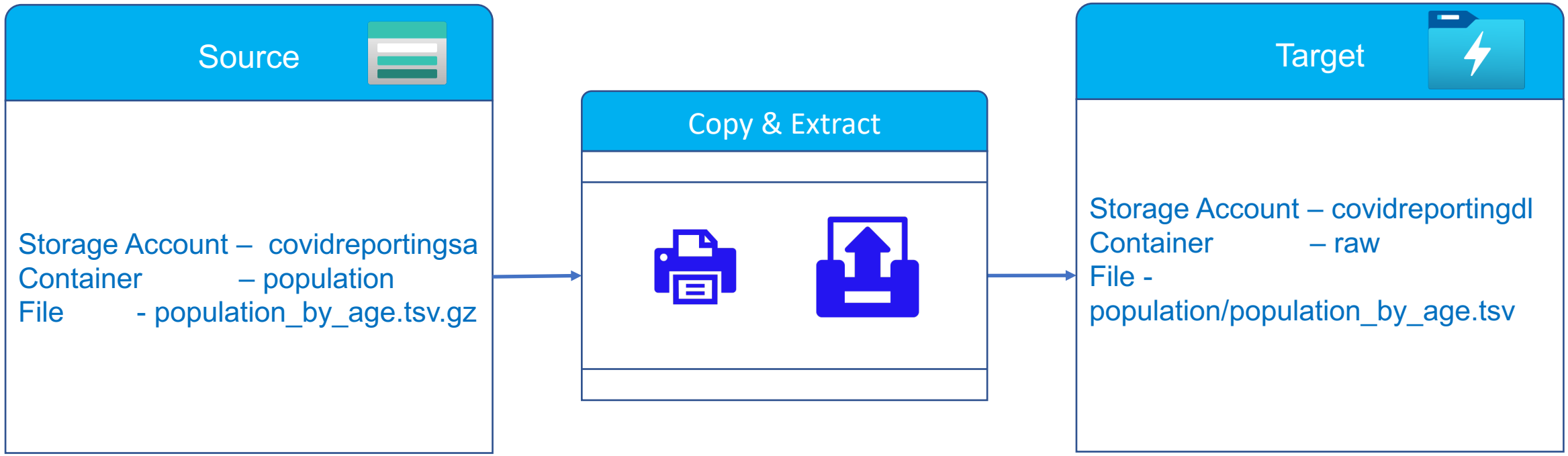
Copy Activity

Azure Blob Storage  Azure Data Lake

Copy Activity

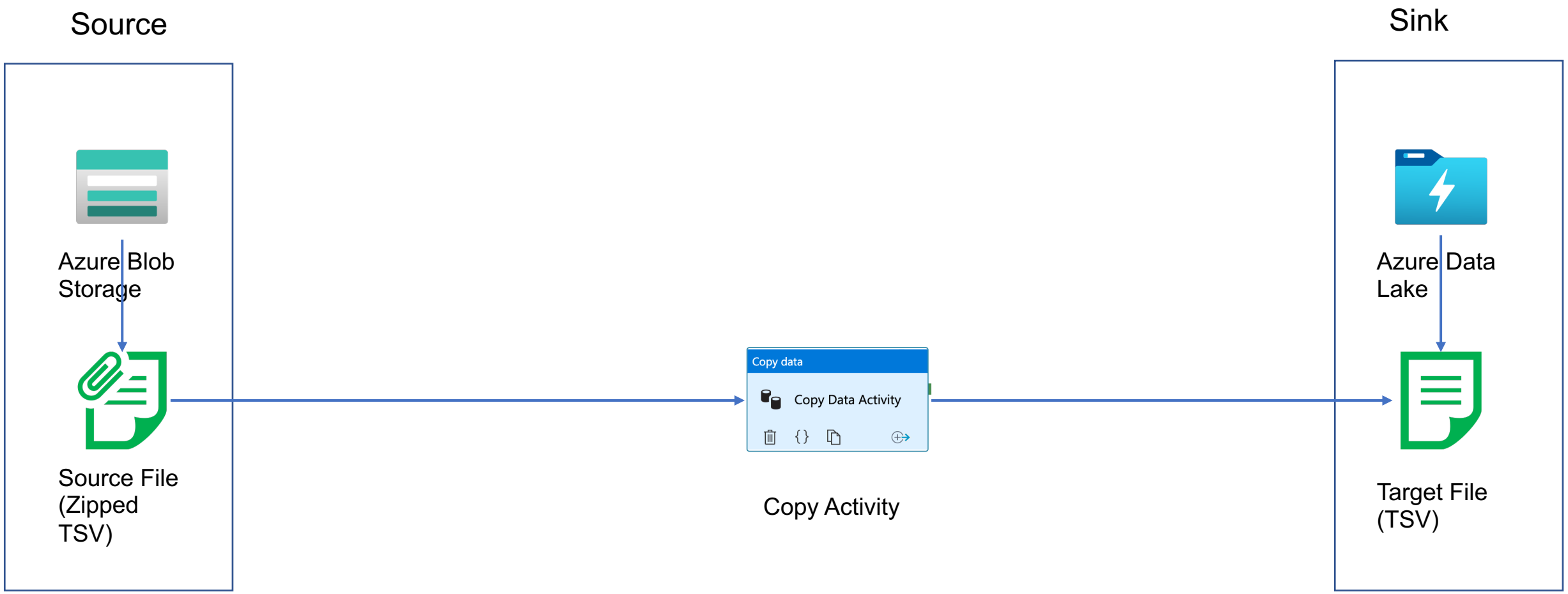
Ingest ”population by age” for all EU Countries into the Data Lake to support the machine learning models to predict increase in Covid-19 mortality rates

Copy Activity



Data Sourced from - https://ec.europa.eu/eurostat/tgm/table.do?tab=table&plugin=1&language=en&pcode=tps00010

Copy Activity



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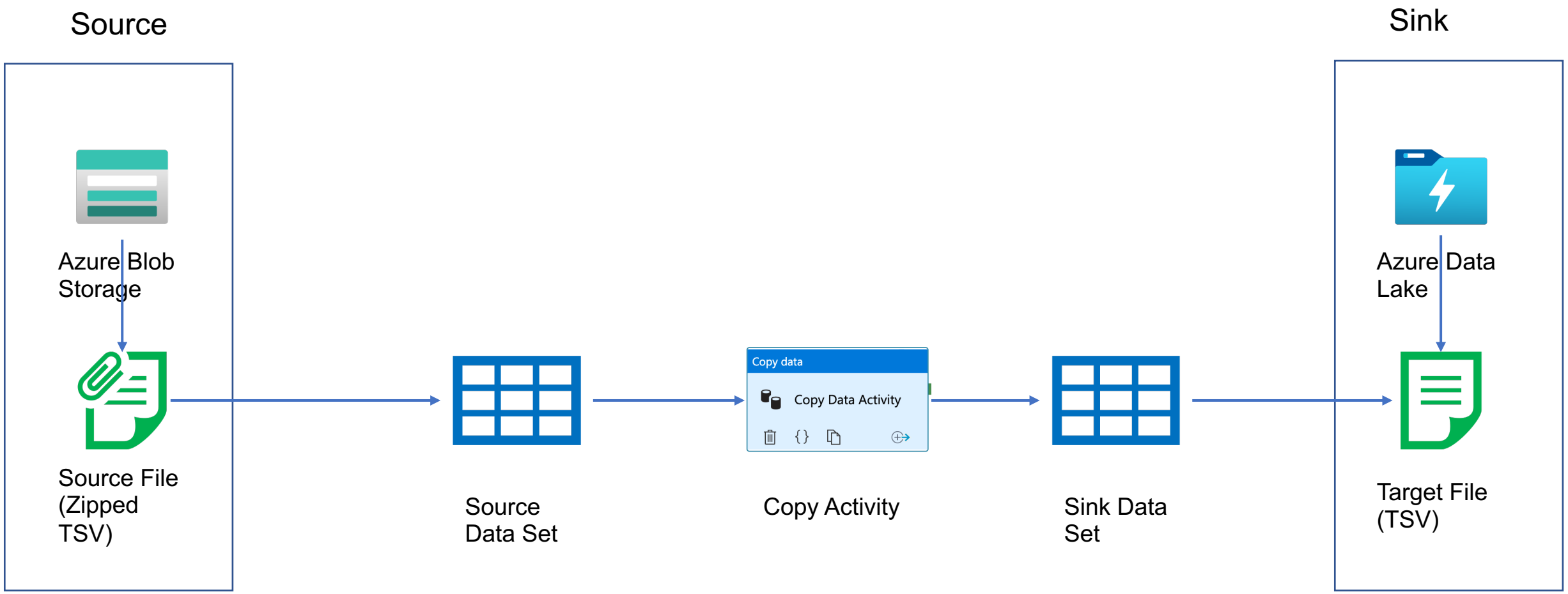

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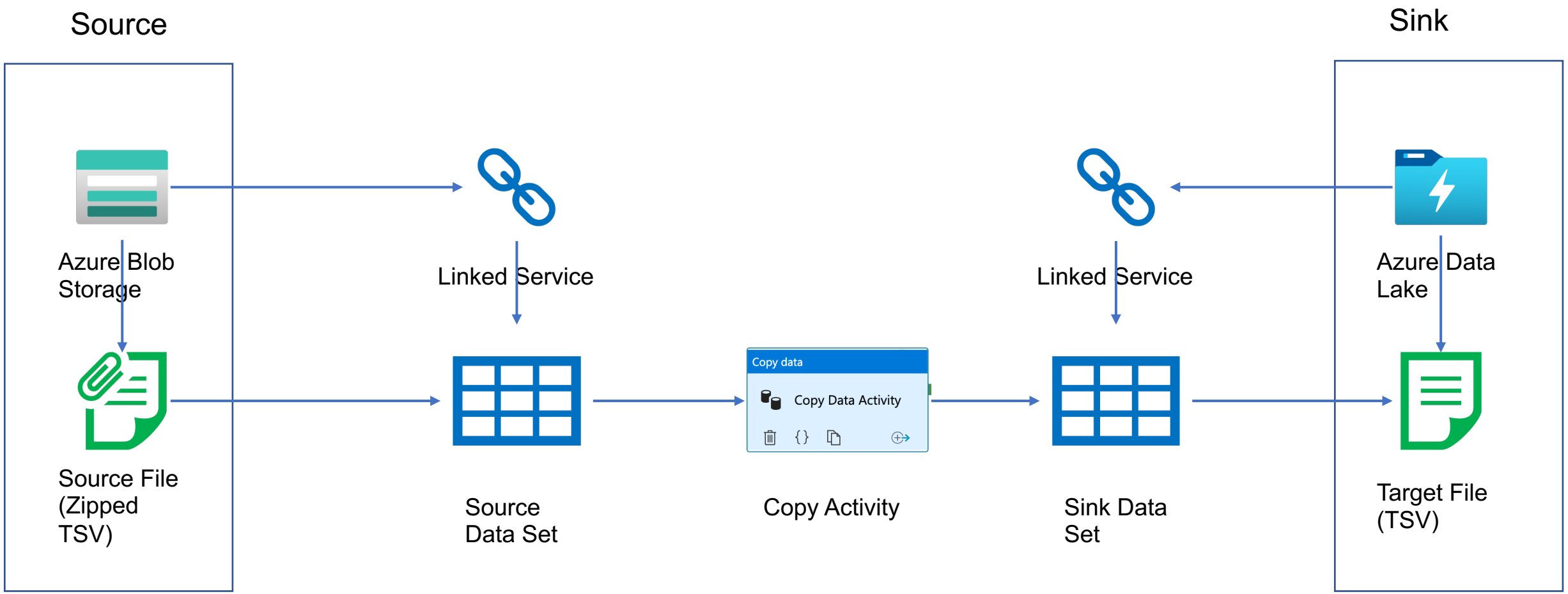

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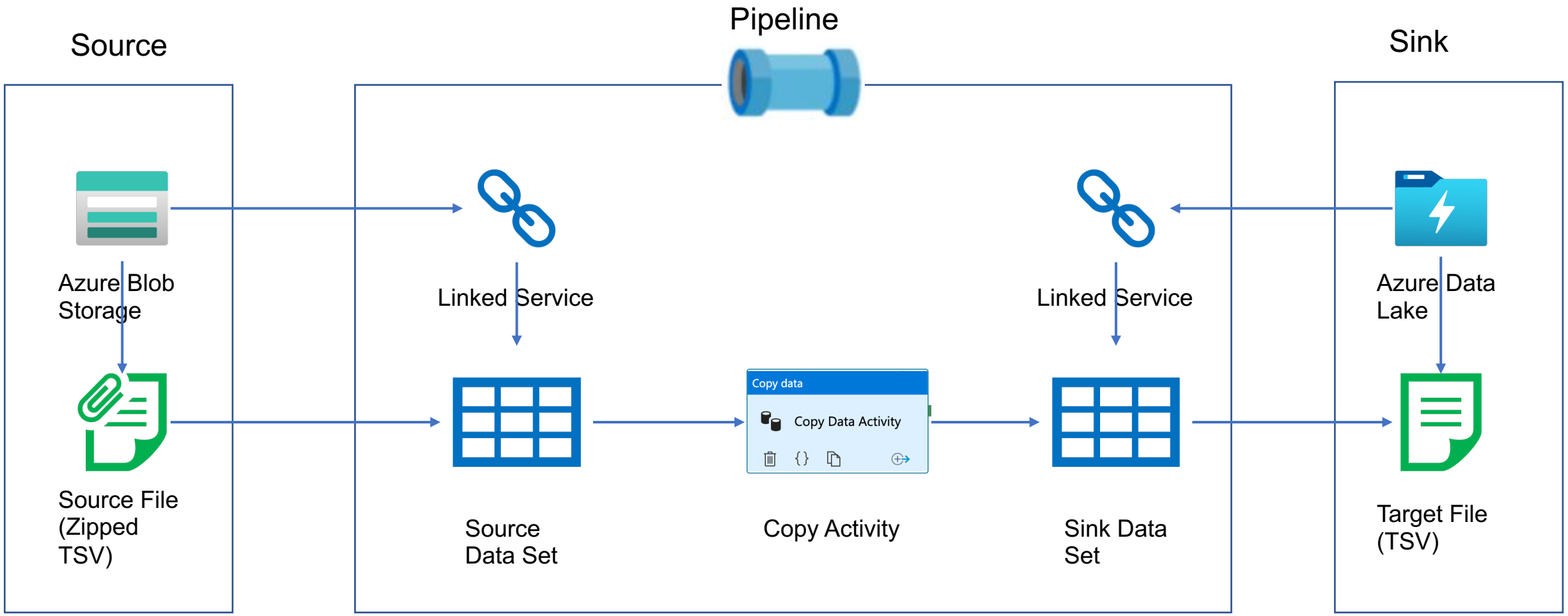
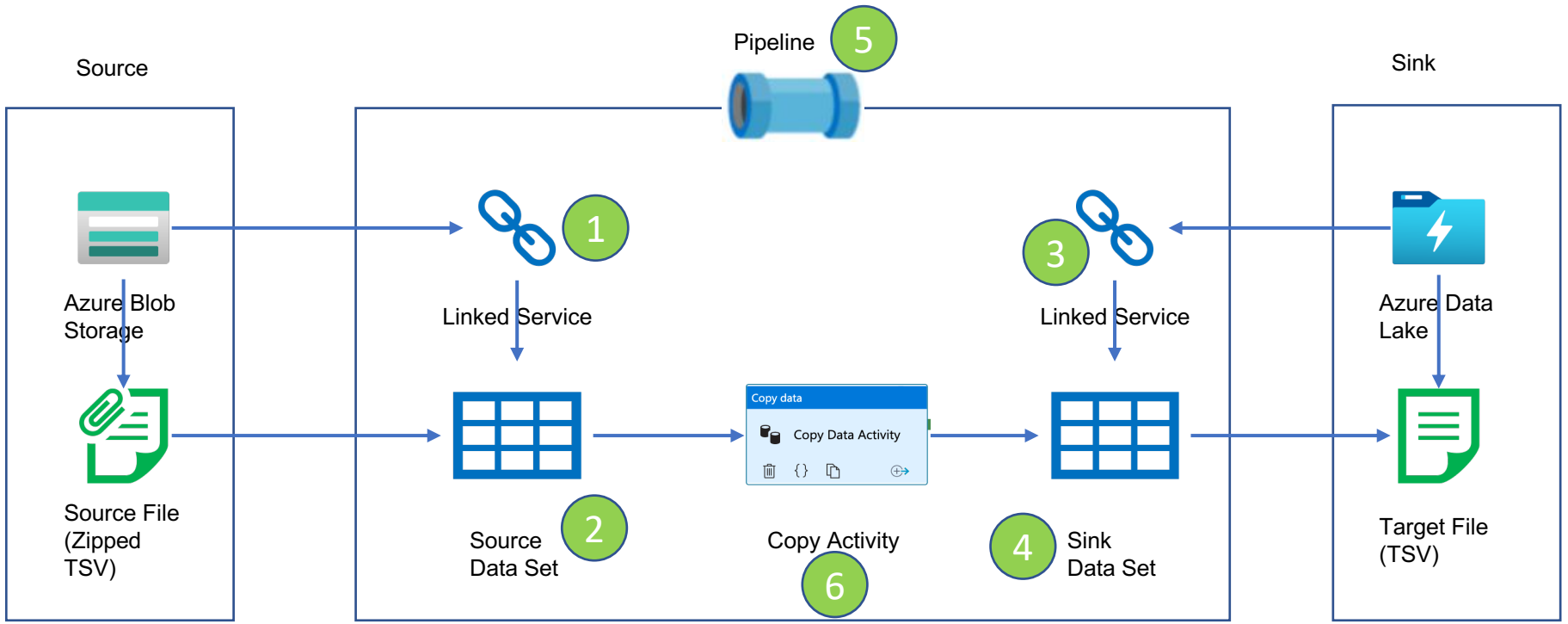


Copy Activity
From Azure Blob Storage

Copy Activity



Storage Account: covidreportingsa
Container: population
File: population_by_age.tsv.gz

Storage Account: covidreportingdl
Container: raw
File: population/population_by_age.tsv

1. ls_ablob_covidreportingsa
2. ds_population_raw_gz
3. ls_adls_covidreportingdl
4. ds_population_raw_tsv
5. pl_ingest_population_data
6. Copy Population Data

Handling Real World Scenarios

Scenario 1

Execute Copy Activity when the file becomes available

Scenario 2

Execute Copy Activity only if file contents are as expected

Scenario 3

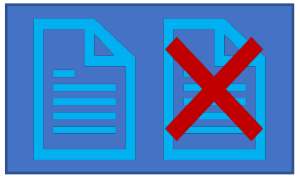
Delete the source file on successful copy

Scheduling Pipeline Execution

Triggers

Schedule Trigger

Tumbling Window Trigger



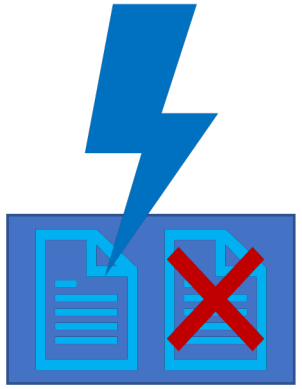
Event Trigger

Schedule Trigger

- Runs on a calendar/ Clock
- Supports periodic and specific times
- Trigger to Pipeline is Many to Many
- Can only be scheduled for a future time to start

Tumbling Window Trigger

- Runs at periodic intervals
- Windows are fixed sized, non-overlapping
- Can be scheduled for the past windows/ slices
- Trigger to Pipeline is one to one

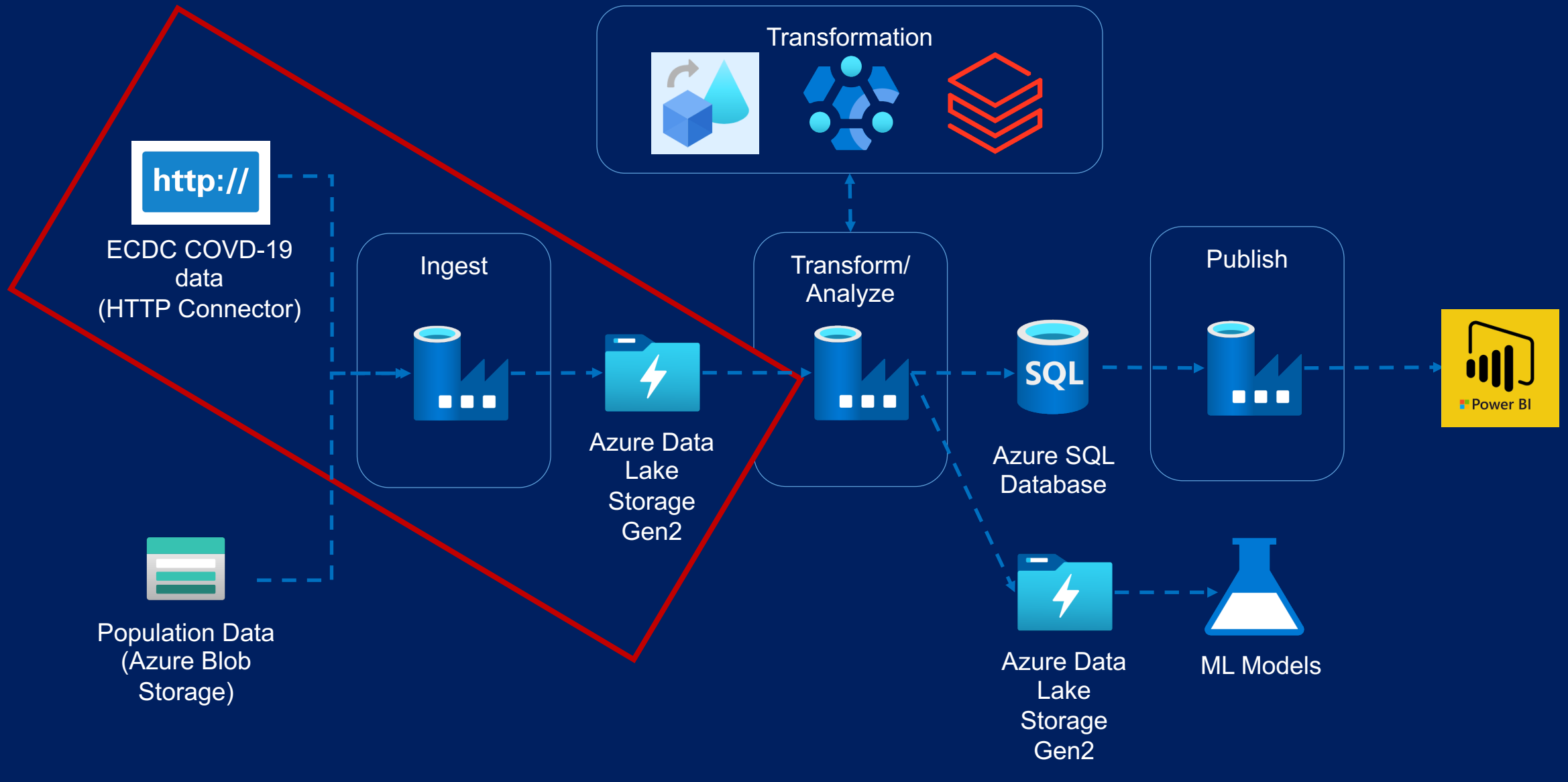


Event Trigger

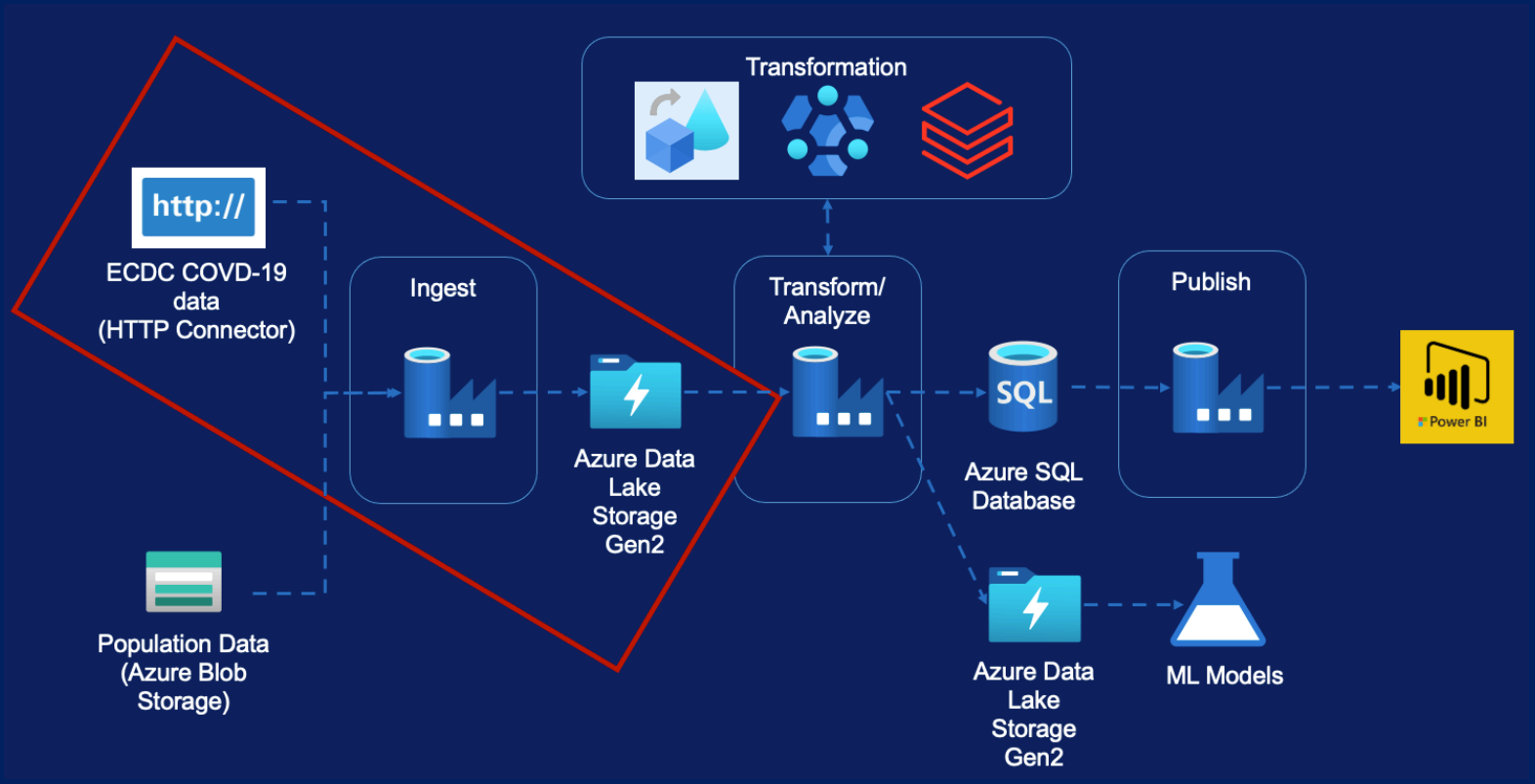
- Runs in response to events
- Events can be creation or deletion of Blobs/ Files
- Trigger to Pipeline is Many to Many

Data Ingestion - Module Overview (ECDC Data)

Data Ingestion – ECDC Data



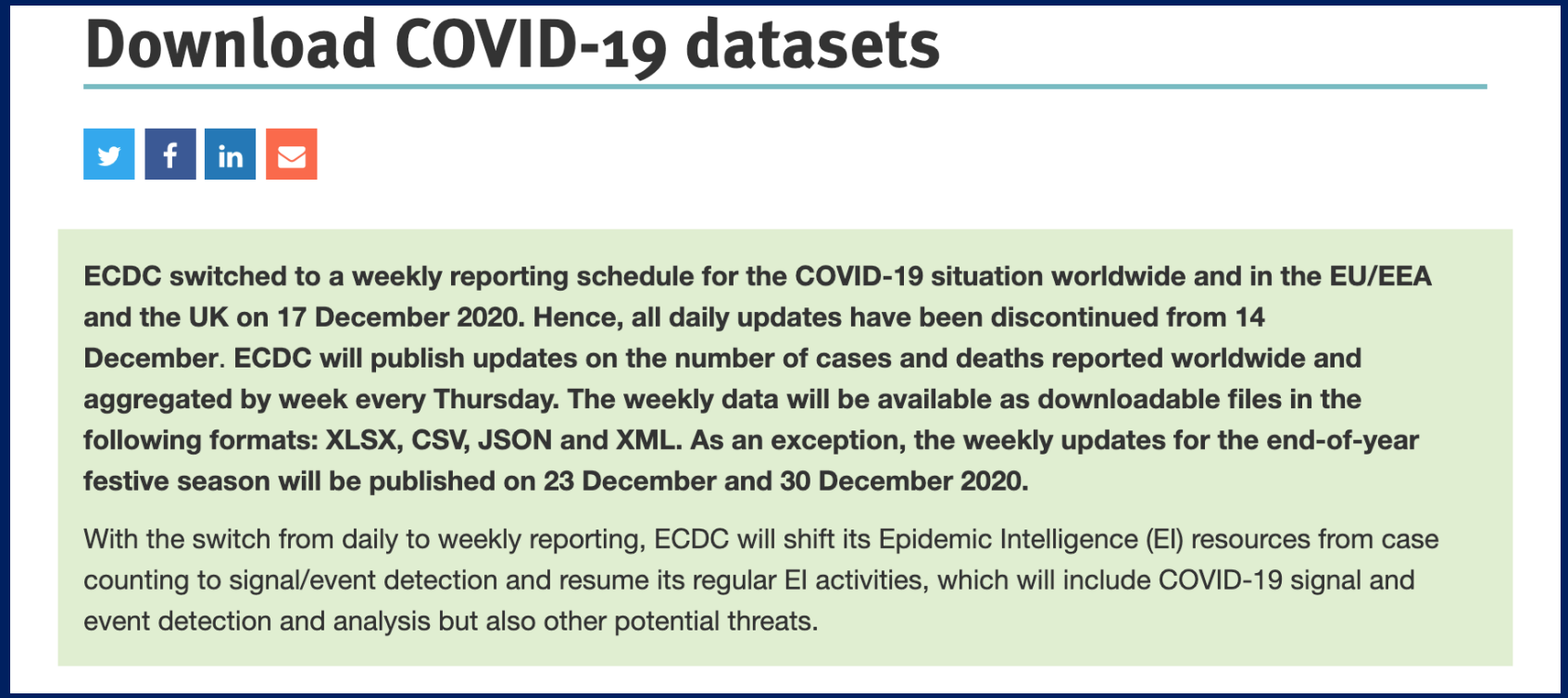
Data Ingestion – ECDC Data



- ECDC Data Overview
- Create Initial Pipeline
- Pipeline Variables
- Pipeline Parameters
- Lookup Activity
- For Each Activity
- Linked Service Parameters
- Metadata driven pipeline

Recent Changes to ECDC Data

Recent Changes to ECDC Data



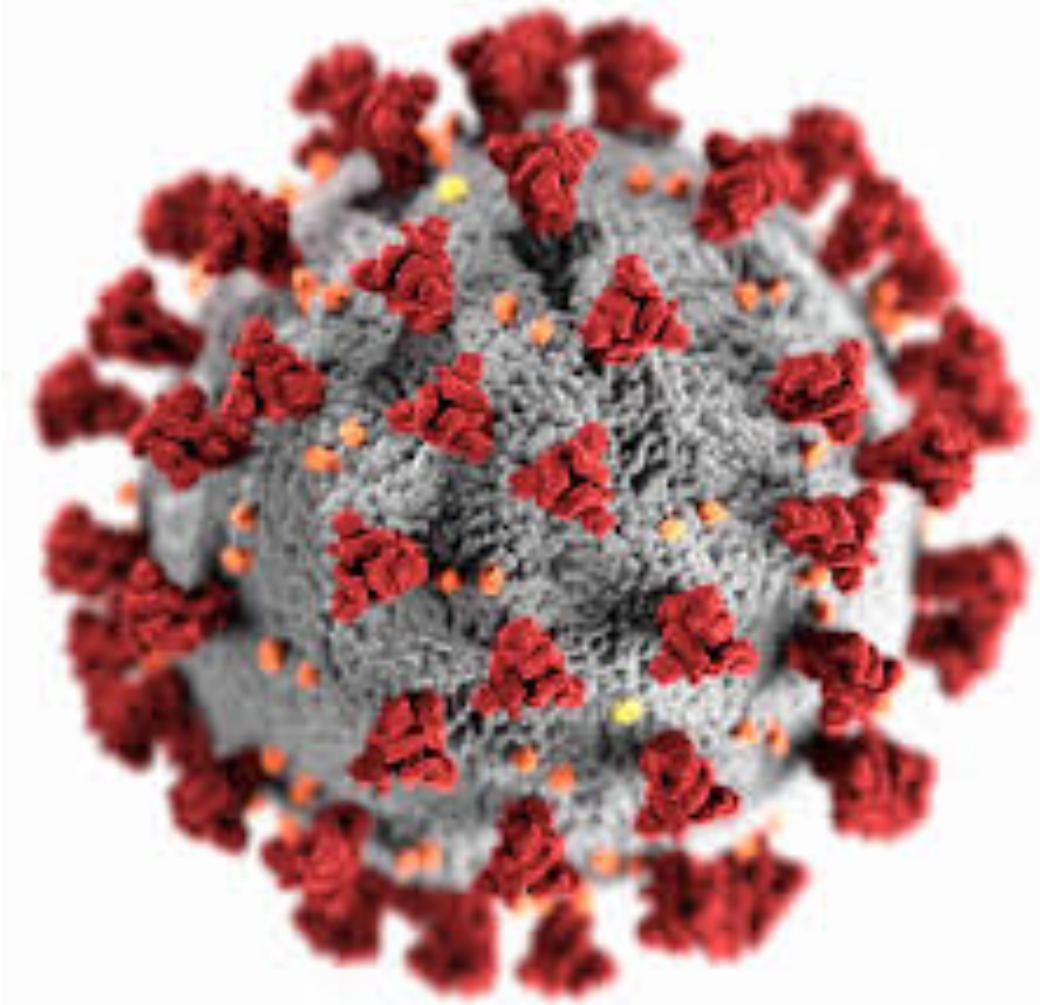
- Granularity of the data changed from daily to weekly
- File structure is also different as a result
- Use GIT Repo - https://github.com/cloudboxacademy/covid19

Data Ingestion

HTTP  Azure Data Lake

Data Ingestion Requirements

- Covid-19 new cases and deaths by Country
- Covid-19 Hospital admissions & ICU cases
- Covid-19 Testing Numbers
- Country Response to Covid-19



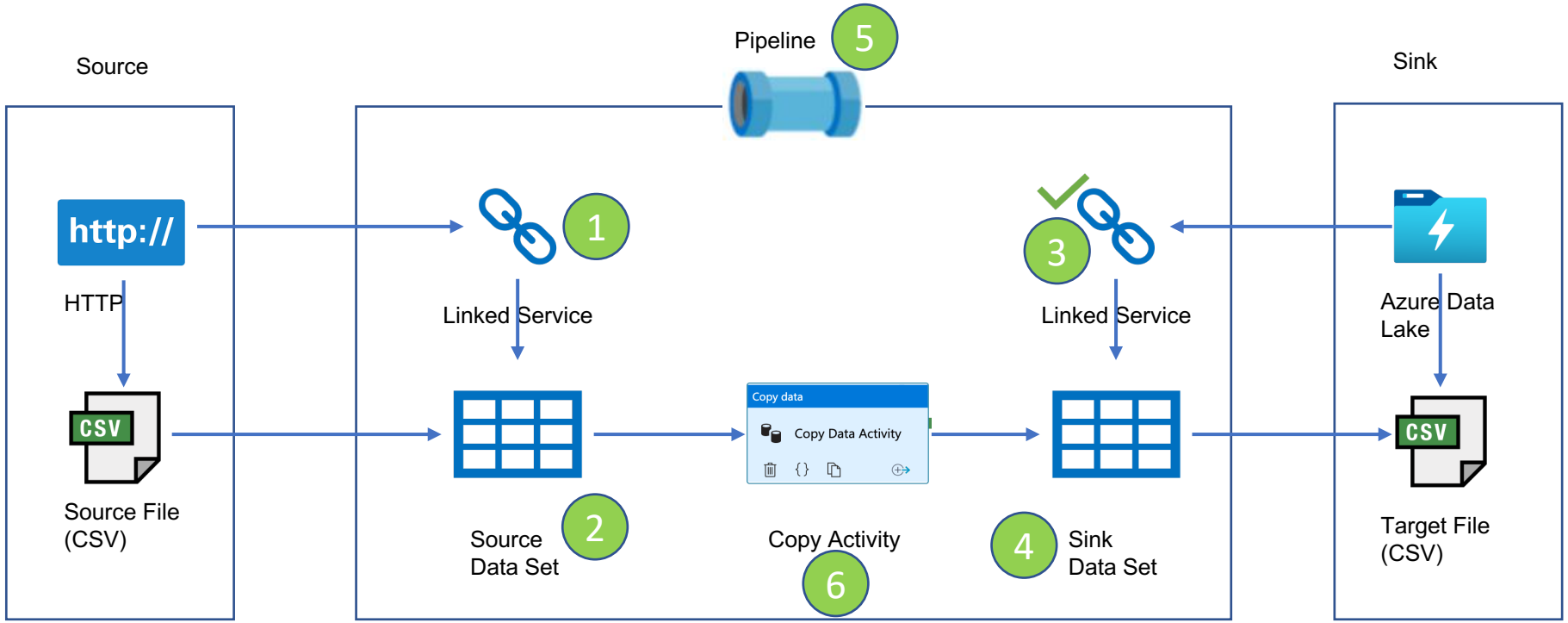
URL - https://www.ecdc.europa.eu/en/covid-19/data

Data Ingestion

Case & Deaths Data

URL - https://www.ecdc.europa.eu/en/publications-data/data-national-14-day-notification-rate-covid-19

Copy Activity – Case & Deaths Data

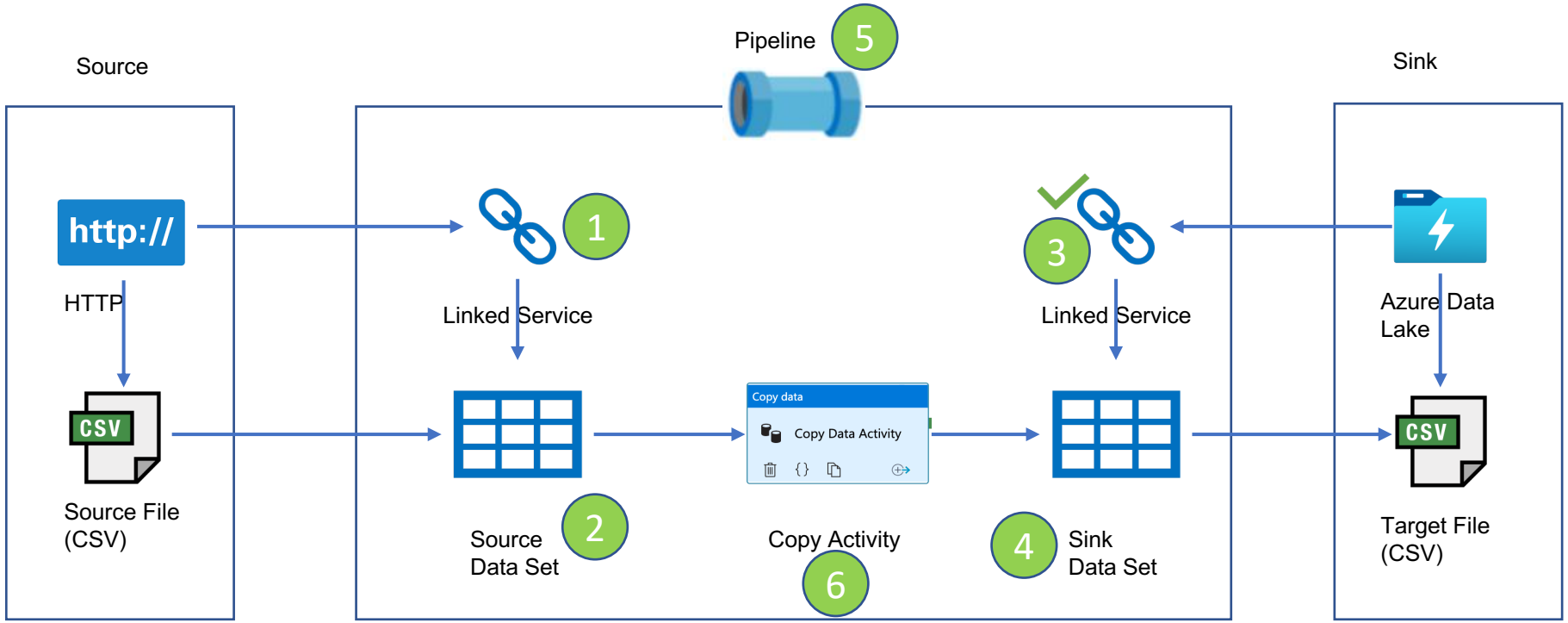


1. ls_http_opendata_ecdc_europa_eu
2. ds_cases_deaths_raw_csv_http
3. ls_adls_covidreportingdl ✓
4. ds_cases_deaths_raw_csv_dl
5. pl_ingest_cases_deaths_data
6. Copy Cases And Deaths Data

URL:
https://opendata.ecdc.europa.eu/covid19/nationalcasedeath/csv

Storage Account: covidreportingdl
Container: raw
File: ecdc/cases_deaths.csv

Copy Activity – Case & Deaths Data

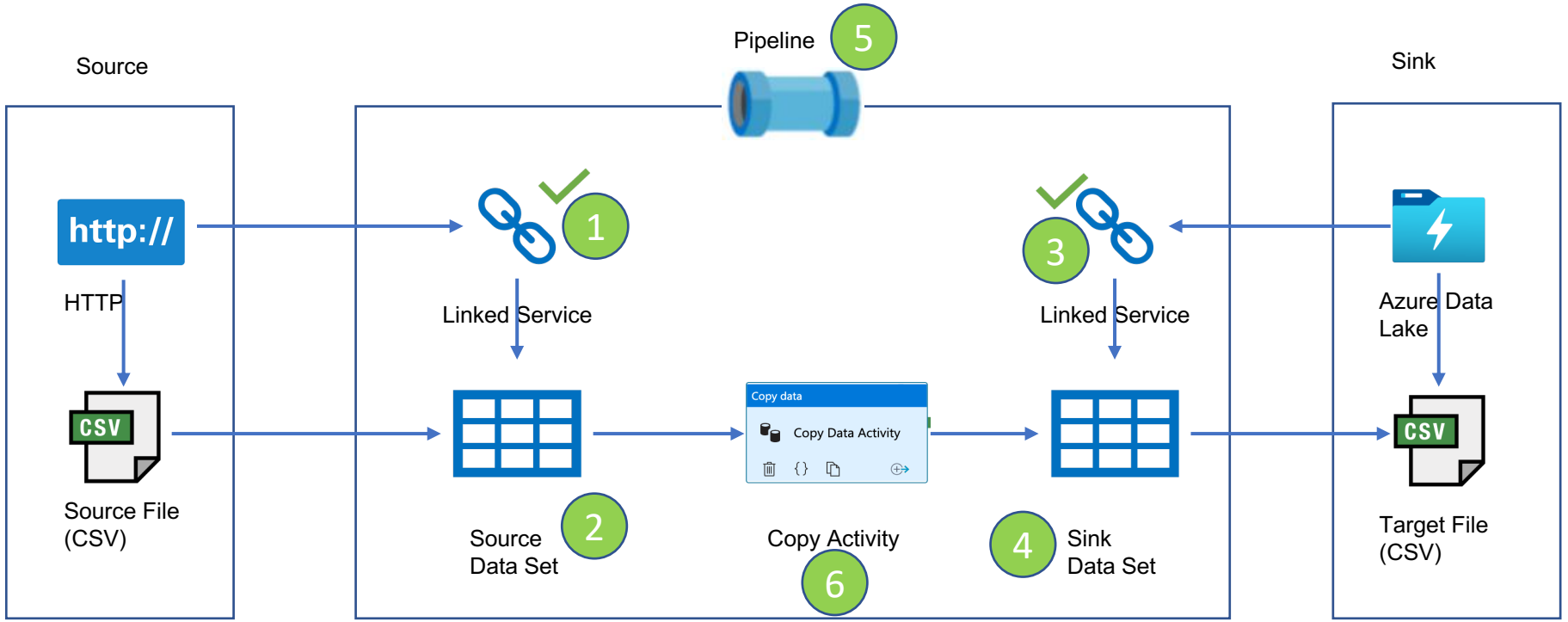


1. ls_http_opendata_ecdc_europa_eu
2. ds_cases_deaths_raw_csv_http
3. ls_adls_covidreportingdl ✓
4. ds_cases_deaths_raw_csv_dl
5. pl_ingest_cases_deaths_data
6. Copy Cases And Deaths Data

URL:
https://opendata.ecdc.europa.eu/covid19/nationalcasedeath/csv

Storage Account: covidreportingdl
Container: raw
File: ecdc/cases_deaths.csv

Copy Activity – Hospital Admission Data



1. ls_http_opendata_ecdc_europa_eu ✓
2. ds_hospital_admissions_raw_csv_http
3. ls_adls_covidreportingdl ✓
4. ds_hospital_admissions_raw_csv_dl
5. pl_ingest_hospital_admissions_data
6. Copy Hospital Admissions Data

URL:
https://opendata.ecdc.europa.eu/covid19/hospitalicuadmissionrates/csv/data.csv

Storage Account: covidreportingdl
Container: raw
File: ecdc/hospital_admissions.csv

Parameters & Variables

Parameters are external values passed into pipelines, datasets or linked services. The value cannot be changed inside a pipeline.

Variables are internal values set inside a pipeline. The value can be changed inside the pipeline using Set Variable or Append Variable Activity

Differences

Source

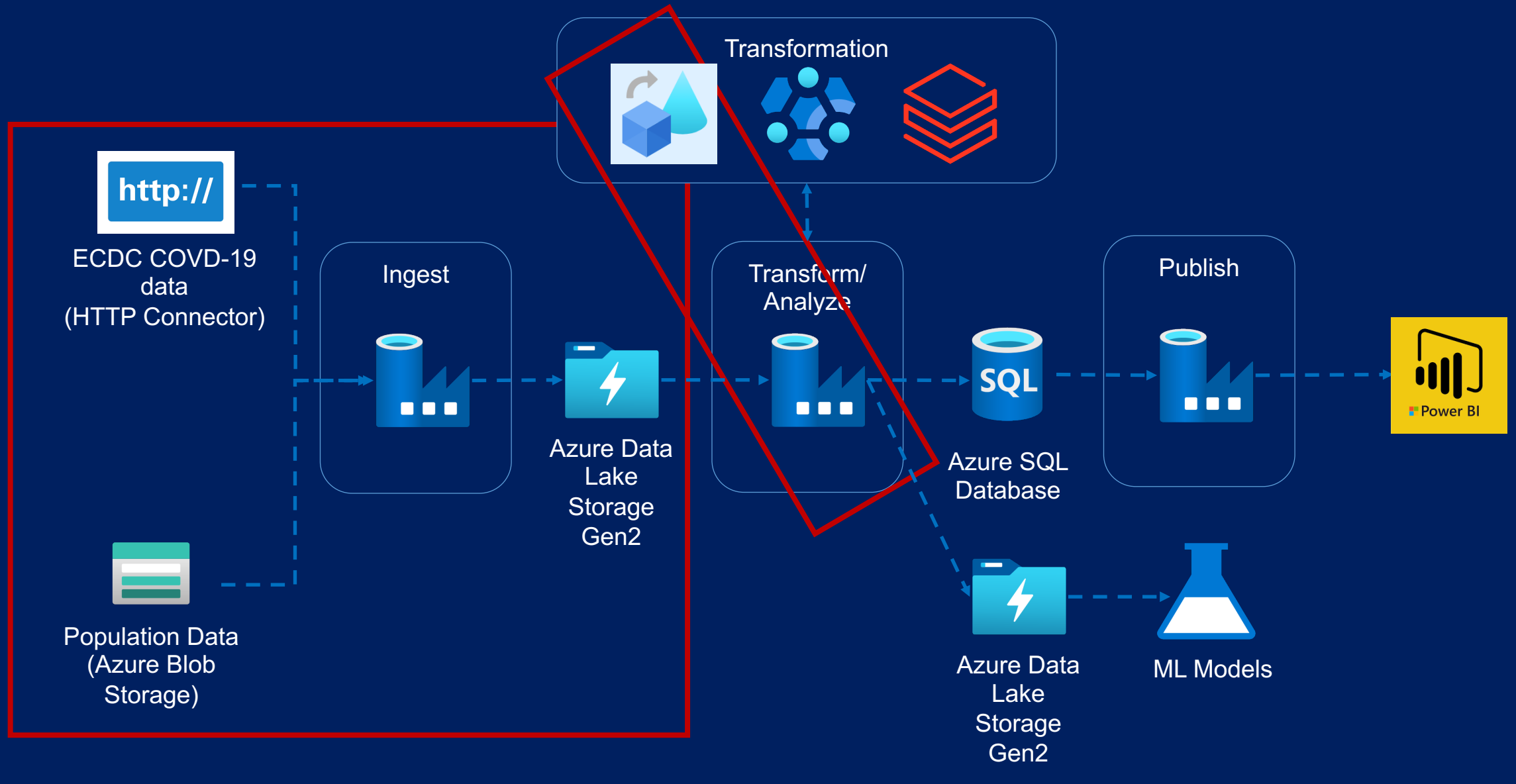
https://opendata.ecdc.europa.eu/covid19/nationalcasedeath/csv
https://opendata.ecdc.europa.eu/covid19/hospitalicuadmissionrates/csv/data.csv
https://opendata.ecdc.europa.eu/covid19/testing/csv
https://www.ecdc.europa.eu/sites/default/files/documents/data_response_graphs_0.csv

Sink

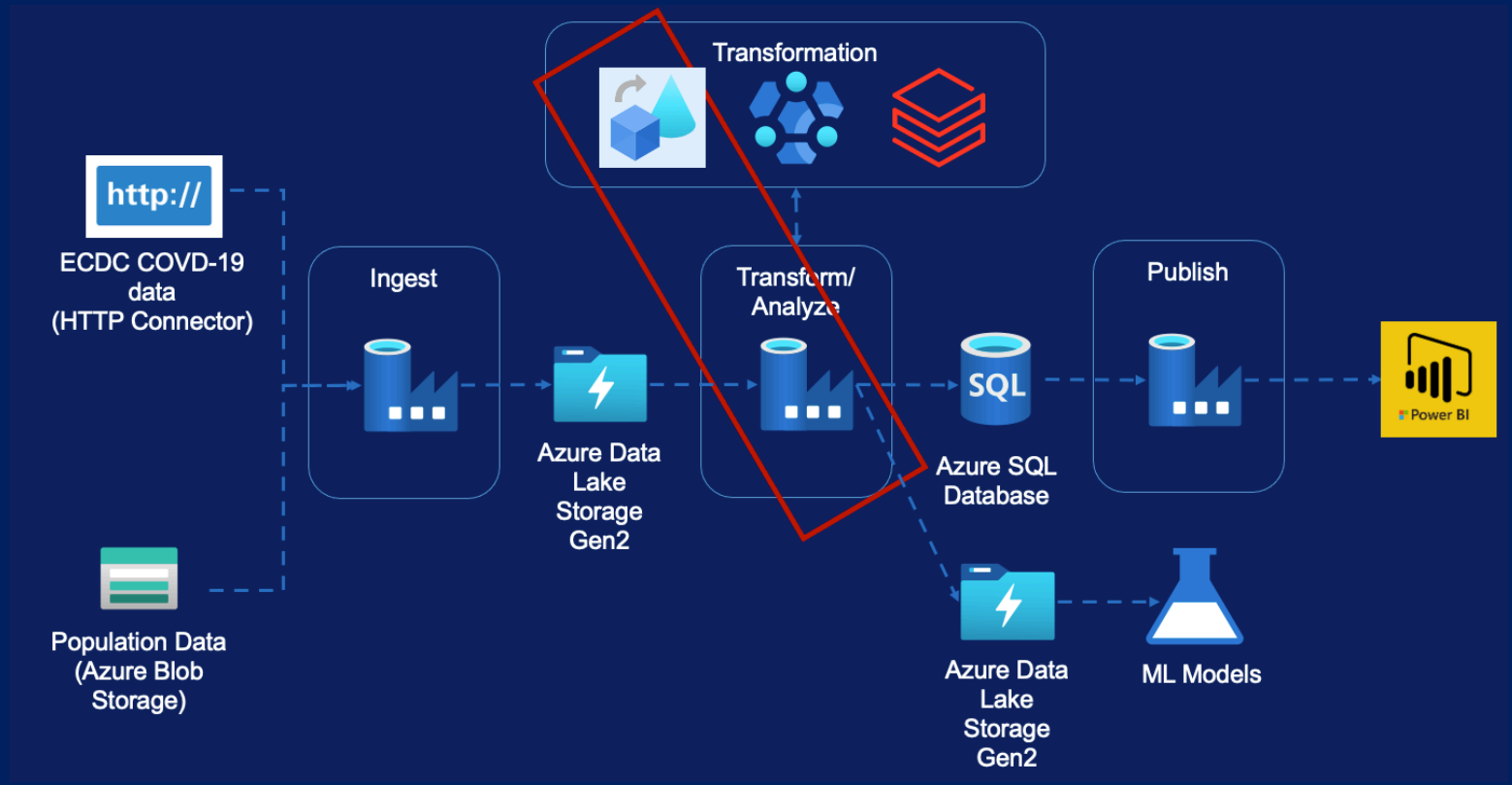
raw/ecdc/case_distribution.csv
raw/ecdc/hospital_admission.csv
raw/ecdc/testing.csv
raw/ecdc/country_response.csv

Data Flows (1) - Module Overview (Cases & Deaths File)

Data Flow – Cases & Deaths Data



Data Flow – Cases & Deaths Data



- Data Flow Overview
- Requirement
- Source Transformation
- Filter Transformation
- Select Transformation
- Pivot Transformation
- Lookup Transformation
- Sink Transformation
- Create Pipeline

Data Flows

Data Flows

Features

- Code free data transformations
- Executed on Data Factory managed Databricks Spark clusters
- Benefits from Data factory scheduling and monitoring capabilities.

Data Flows

Types

Data flow

Code free data transformation at scale

Wrangling Data Flow (Preview)

Code free data preparation at scale

Data Flows

Limitations

- Only available in some regions

  https://docs.microsoft.com/en-us/azure/data-factory/concepts-data-flow-overview#available-regions

- Limited set of connectors available

  https://docs.microsoft.com/en-us/azure/data-factory/data-flow-source#supported-sources

- Not suitable for very complex logic

Data Flows

Transform Cases & Deaths Data

Transform Cases & Deaths Data

Raw File from ECDC

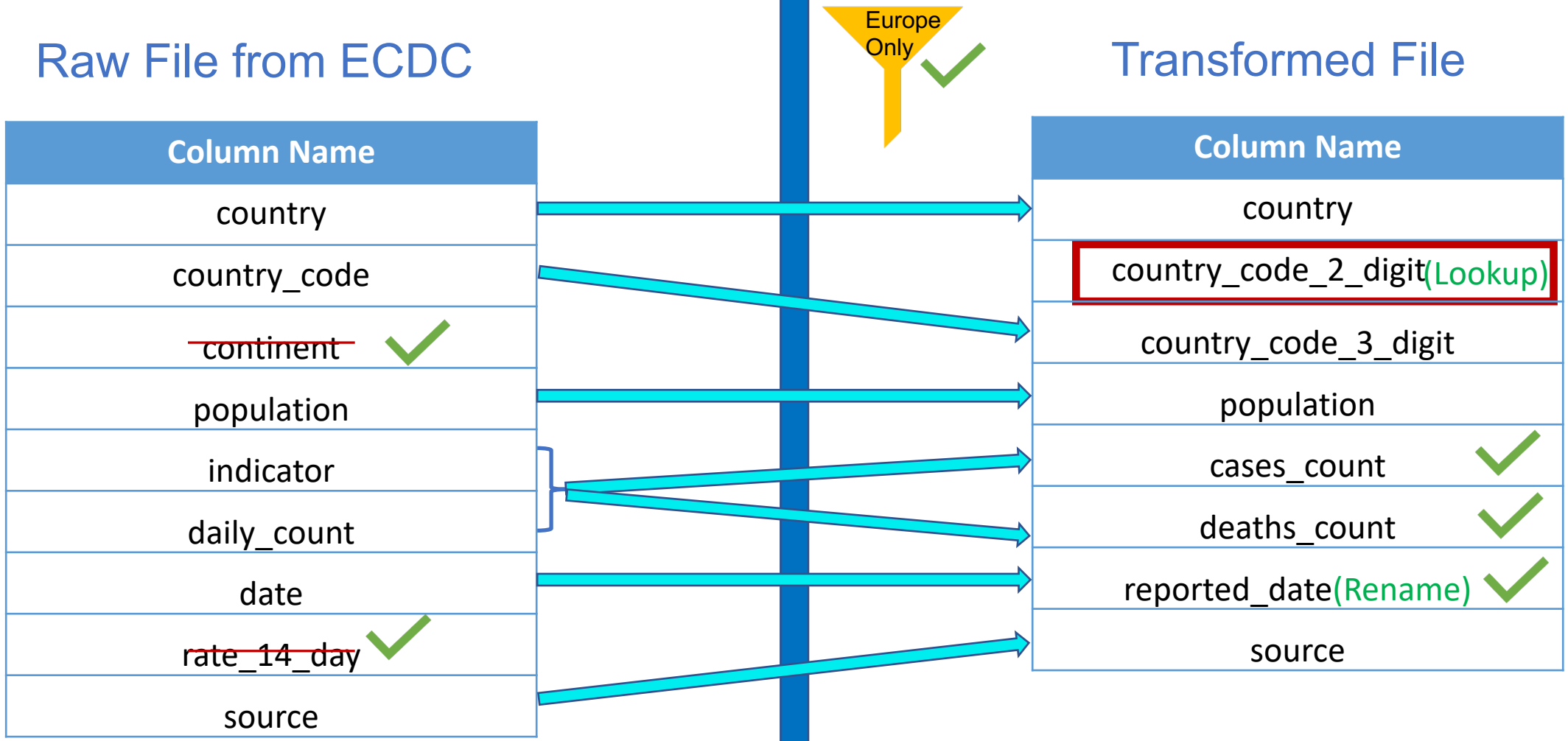
Column Name
country
country_code
~~continent~~
population
indicator
daily_count
date
~~rate_14_day~~
source

Europe Only

Transformed File

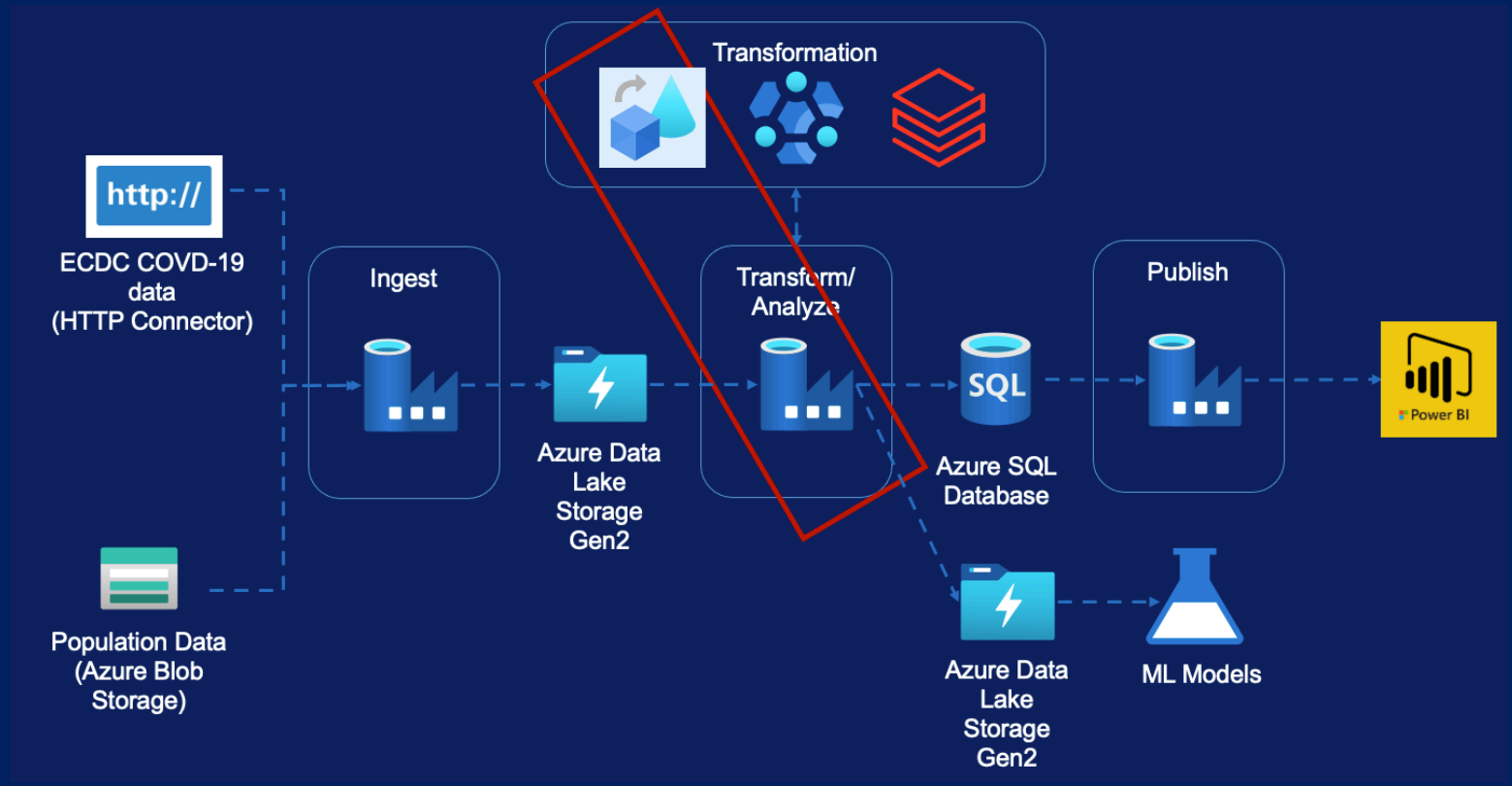
Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit
population
cases_count
deaths_count
reported_date
source

Transform Cases & Deaths Data



Data Flows (2) - Module Overview (Hospital Admissions File)

Data Flow – Cases & Deaths Data



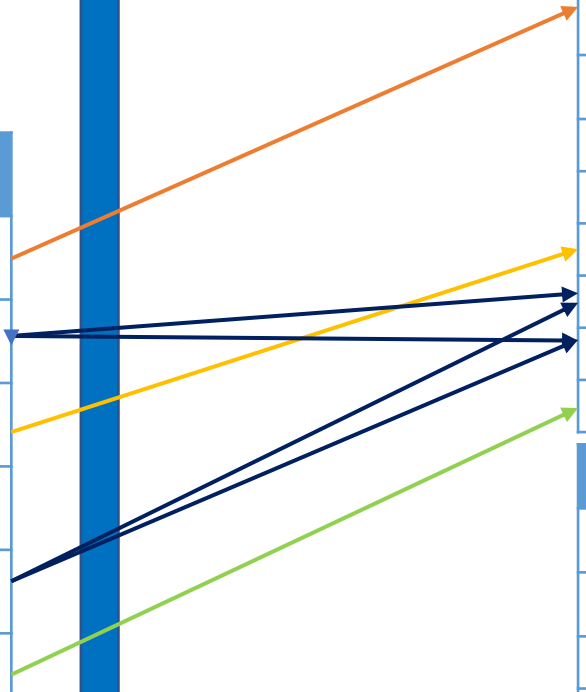
- Requirement
- Source Transformation
- Select Transformation
- Lookup Transformation
- Pivot Transformation
- Sink Transformation
- Conditional Split Transformation
- Derived Column Transformation
- Aggregate Transformation
- Sort Transformation
- Join Transformation
- Create Pipeline

Hospital Admissions Data

Hospital Admissions Data

Raw File from ECDC

Column Name
country
indicator
date
year_week
value
source
~~url~~



Transformed Daily File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
Population(Lookup)
reported_date
hospital_occupancy_count
icu_occupancy_count
source

Transformed Weekly File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
population(Lookup)
reported_year_week(transformed)
reported_week_start_date(Lookup)
reported_week_end_date(Lookup)
new_hospital_occupancy_count
new_icu_occupancy_count
Source

Hospital Admissions Data

Raw File from ECDC

Column Name
country
indicator
date
year_week
value
source
~~url~~

Transformed Daily File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
Population(Lookup)
reported_date
hospital_occupancy_count
icu_occupancy_count
source

Transformed Weekly File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
population(Lookup)
reported_year_week(transformed)
reported_week_start_date(Lookup)
reported_week_end_date(Lookup)
new_hospital_occupancy_count
new_icu_occupancy_count
Source

Source Transformation

Assignment

Select Transformation

Assignment

- Remove url
- Rename date to reported_date
- Rename year_week to reported_year_week

Lookup Transformation

Assignment

- Lookup country file
- Select only required fields (i.e. remove additional fields from lookup)

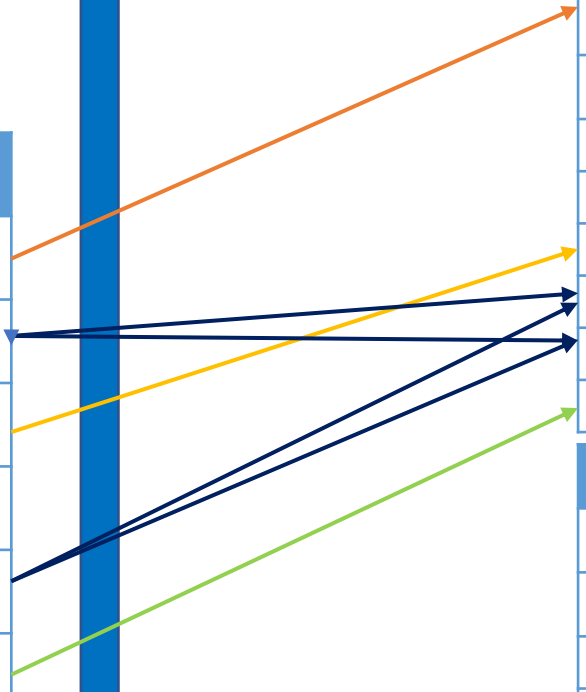
Pivot Transformation

Assignment

Hospital Admissions Data

Raw File from ECDC

Column Name
country
indicator
date
year_week
value
source
~~url~~



Transformed Daily File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
Population(Lookup)
reported_date
hospital_occupancy_count
icu_occupancy_count
source

Transformed Weekly File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
population(Lookup)
reported_year_week(transformed)
reported_week_start_date(Lookup)
reported_week_end_date(Lookup)
new_hospital_occupancy_count
new_icu_occupancy_count
Source

Hospital Admissions Data

Raw File from ECDC

Column Name
country
indicator
date
year_week
value
source
~~url~~

Transformed Daily File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
Population(Lookup)
reported_date
hospital_occupancy_count
icu_occupancy_count
source

Transformed Weekly File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
population(Lookup)
reported_year_week(transformed)
reported_week_start_date(Lookup)
reported_week_end_date(Lookup)
new_hospital_occupancy_count
new_icu_occupancy_count
Source

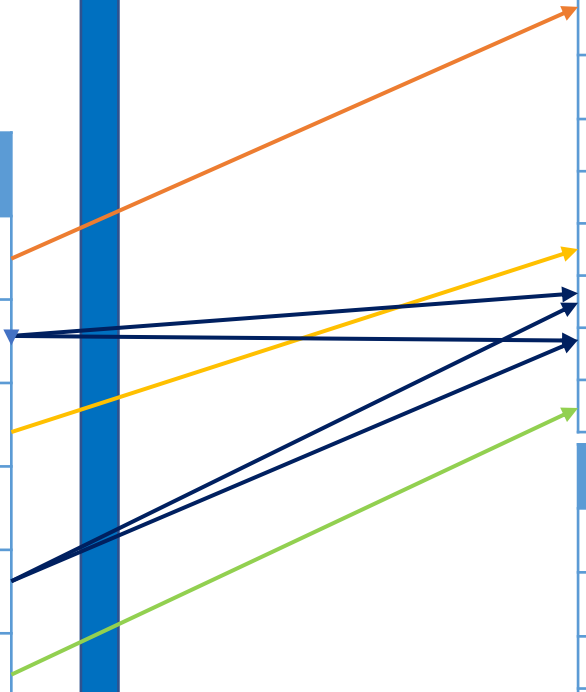
Select & Sink Transformation

Assignment

Hospital Admissions Data

Raw File from ECDC

Column Name
country
indicator
date
year_week
value
source
~~url~~



Transformed Daily File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
Population(Lookup)
reported_date
hospital_occupancy_count
icu_occupancy_count
source

Transformed Weekly File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
population(Lookup)
reported_year_week(transformed)
reported_week_start_date(Lookup)
reported_week_end_date(Lookup)
new_hospital_occupancy_count
new_icu_occupancy_count
Source

Hospital Admissions Data

Raw File from ECDC

Column Name
country
indicator
date
year_week
value
source
~~url~~

Transformed Daily File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
Population(Lookup)
reported_date
hospital_occupancy_count
icu_occupancy_count
source

Transformed Weekly File

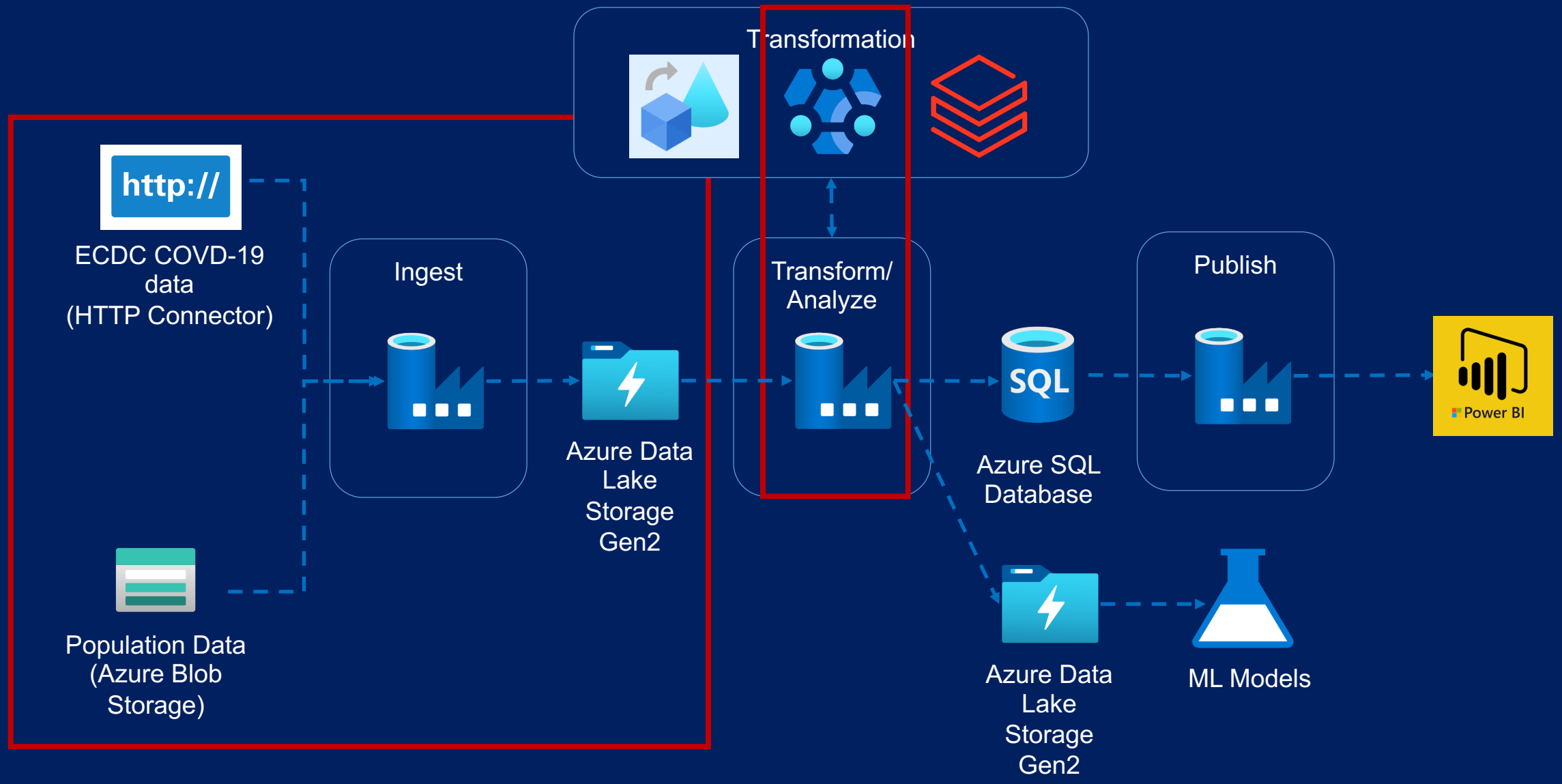
Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
population(Lookup)
reported_year_week(transformed)
reported_week_start_date(Lookup)
reported_week_end_date(Lookup)
new_hospital_occupancy_count
new_icu_occupancy_count
Source

Data Flow Execution

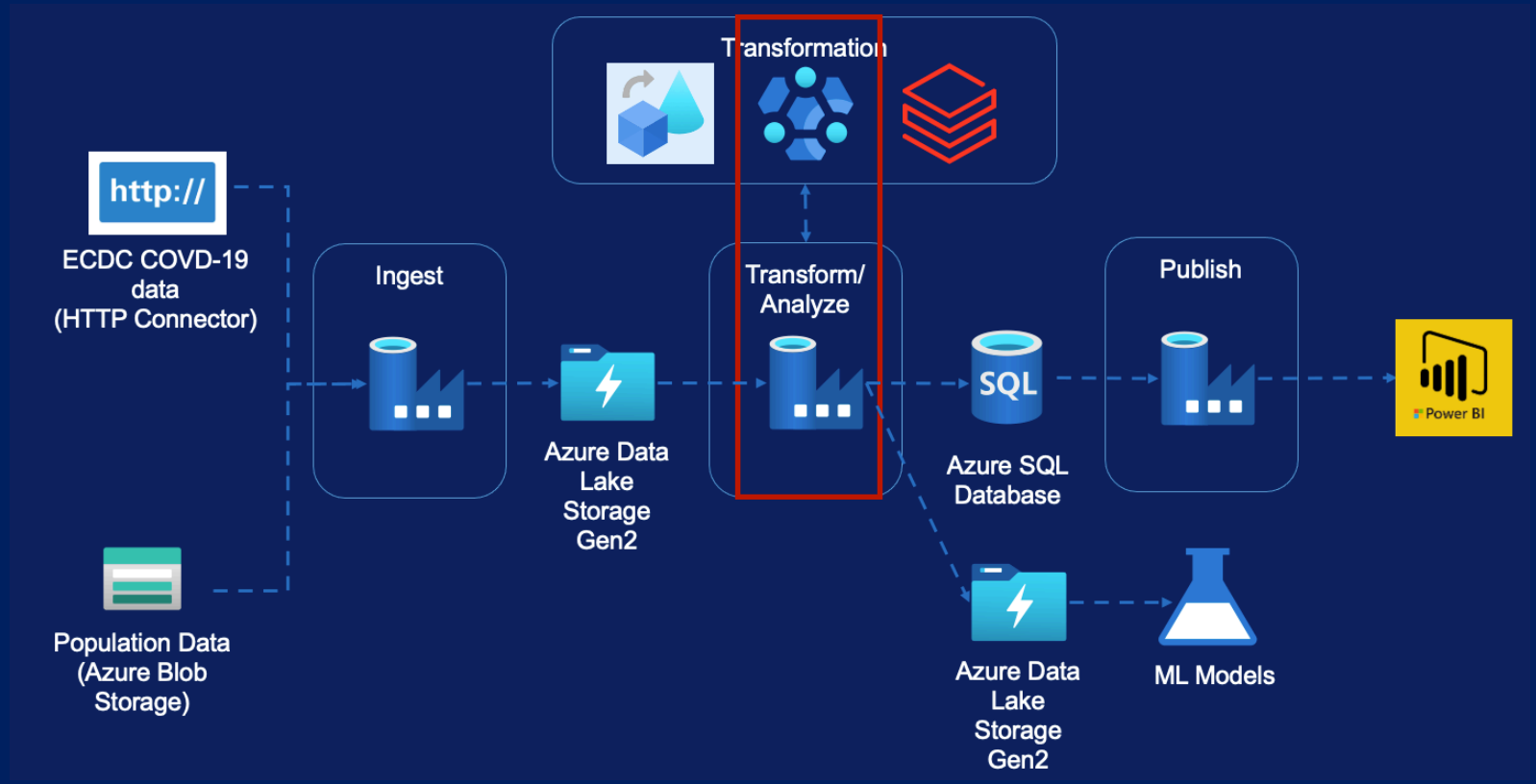
Assignment

HDInsight Activity - Module Overview (Testing File)

HDInsight Activity – Testing File

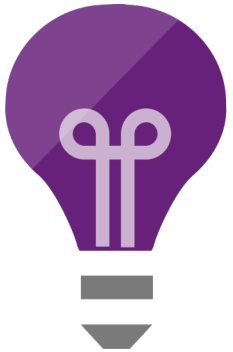


HDInsight Activity – Testing File



- Creating HDInsight Cluster
- HDInsight UI Overview
- Transformation Requirement
- Hive Script Walk-through
- Creating Pipeline
- Delete HDInsight Cluster

Creating HDInsight Cluster

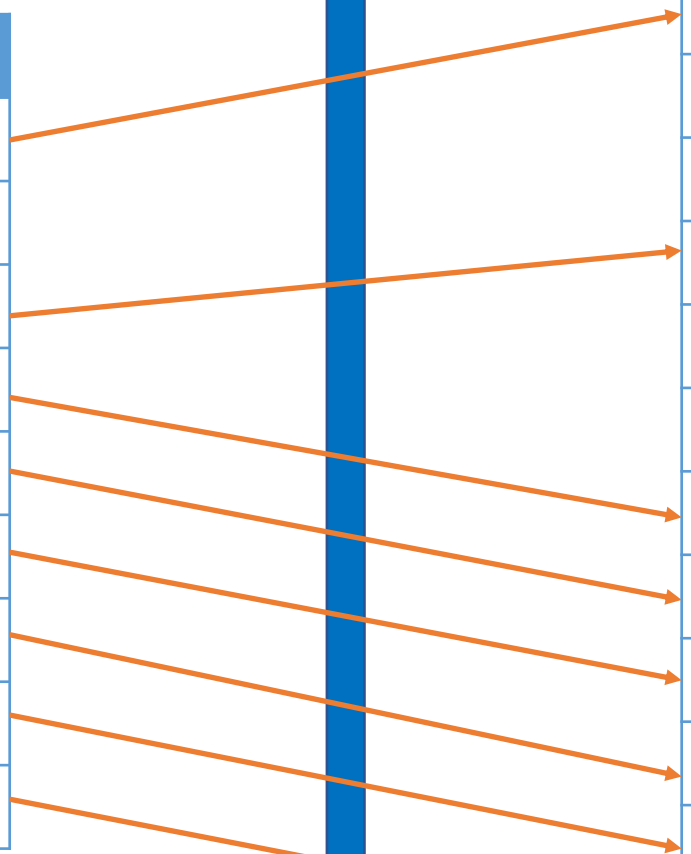


Testing Data

Testing Data

Raw File from ECDC

Column Name
country
country_code (Remove)
Year_week
new_cases
test_done
population
testing_rate
positivity_rate
testing_data_source

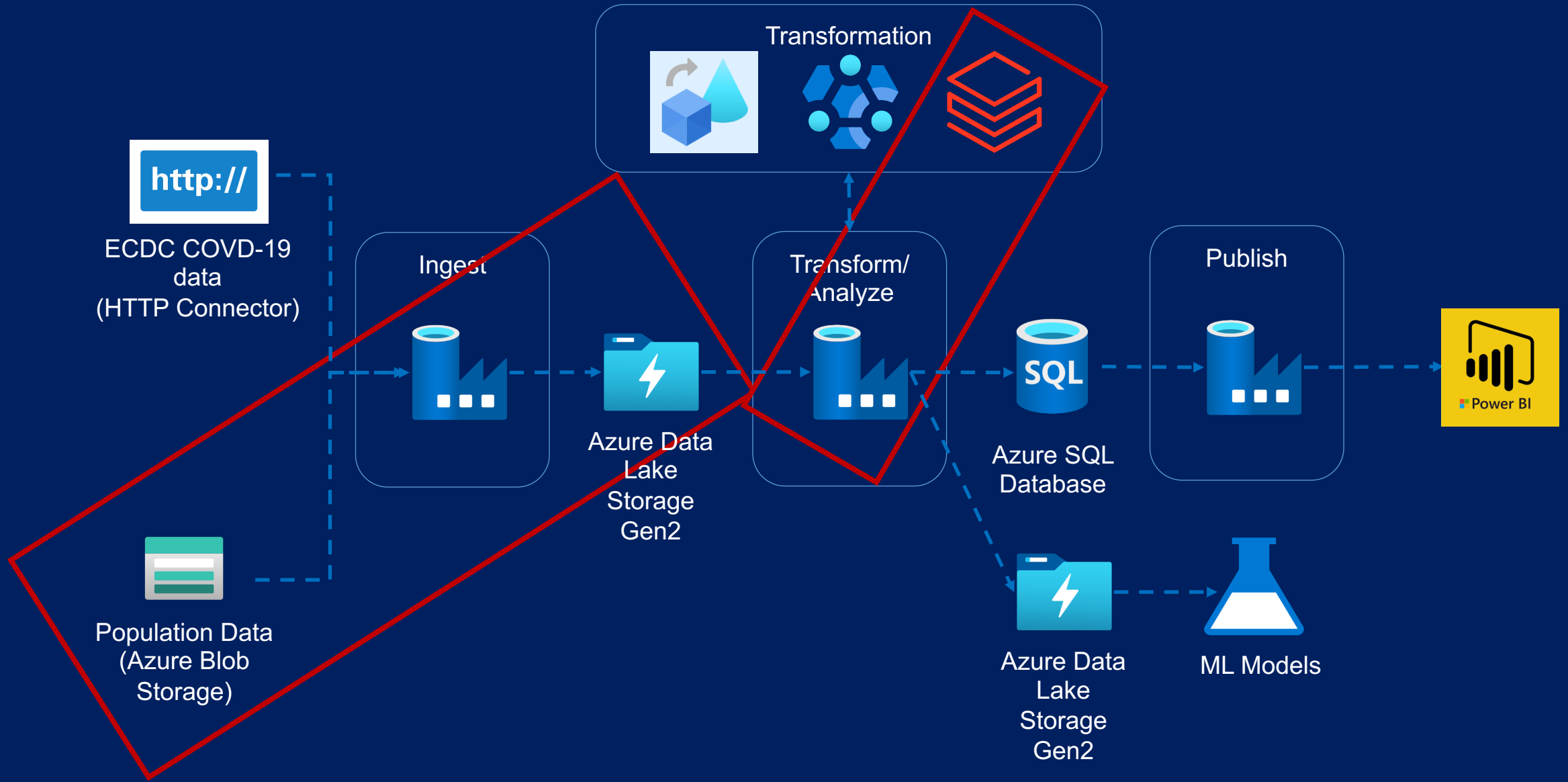


Transformed File

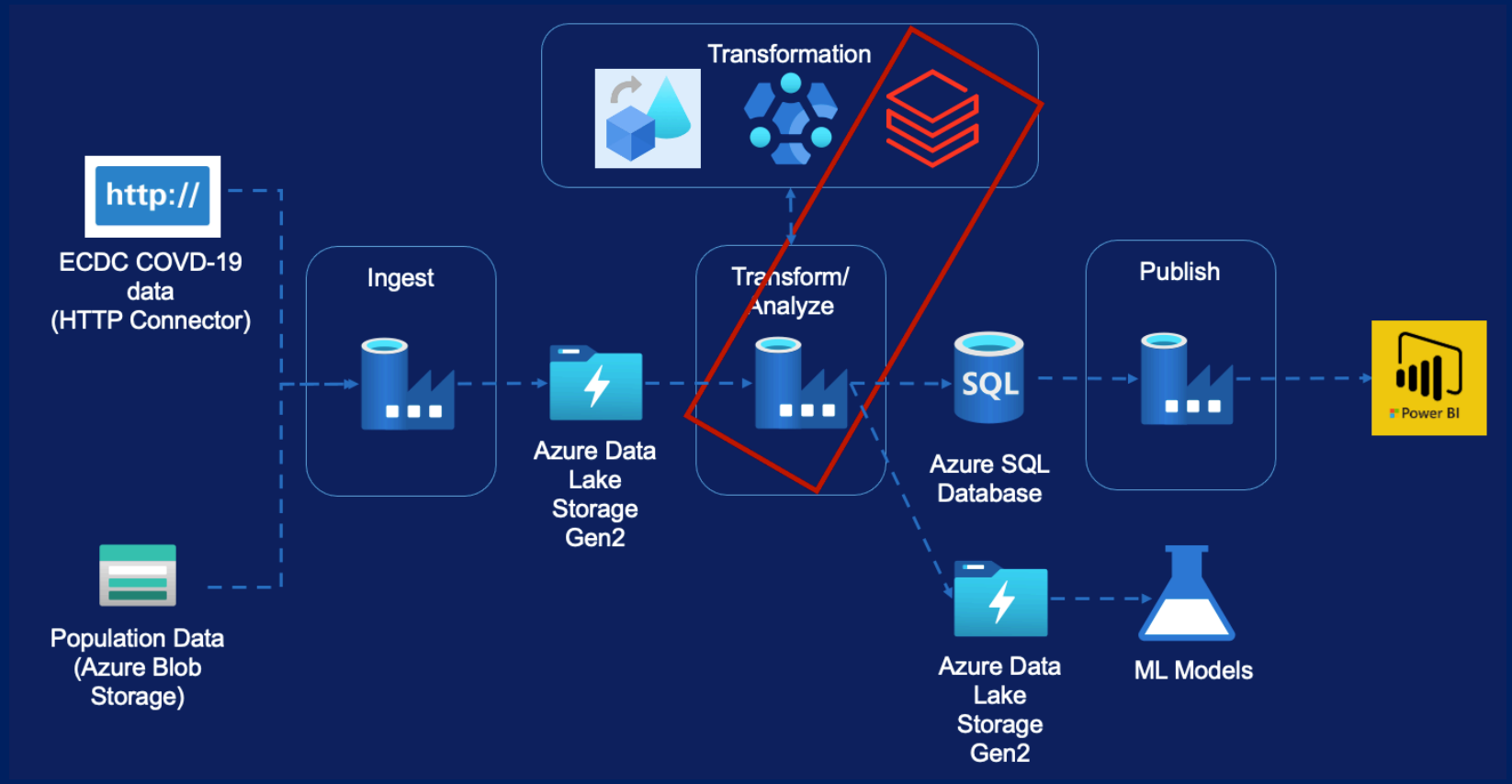
Column Name
country
country_code_2_digit (lookup)
country_code_3_digit(lookup)
reported_year_week
reported_week_start_date(lookup)
reported_week_end_date(lookup)
new_cases
test_done
population
testing_rate
positivity_rate
testing_data_source

Databricks Activity - Module Overview (Population File)

Databricks Activity – Population File



Databricks Activity – Population File



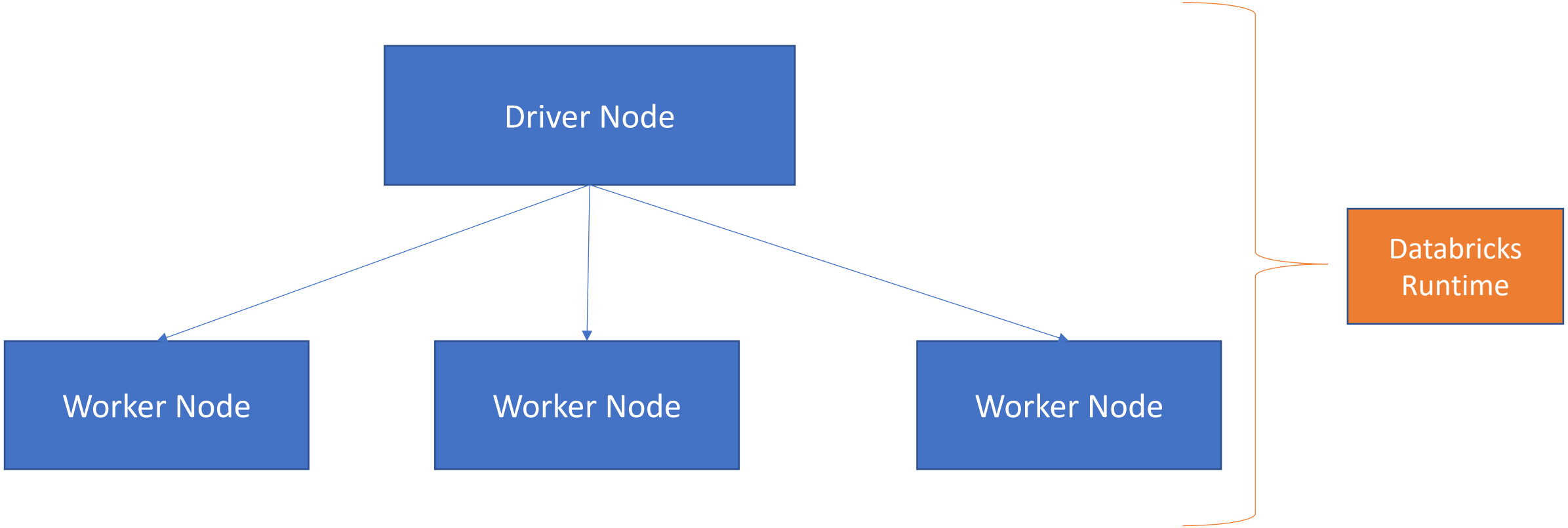
- Create Databricks Service
- Create Databricks Cluster
- Mount Storage Accounts
- Transformation Requirements
- Creating Pipeline

Databricks Environment Set-up

Creating Databricks Service

Creating Databricks Cluster

What is a cluster?



Cluster Types

All Purpose/ Interactive Clusters

Job Clusters

Mounting Data Lake Storage

Mounting Data Lake Storage

- Create Azure Service Principal
- Grant access for data lake to Azure Service Principal
- Create the mount in databricks using Service Principal

Transform Population By Age Data

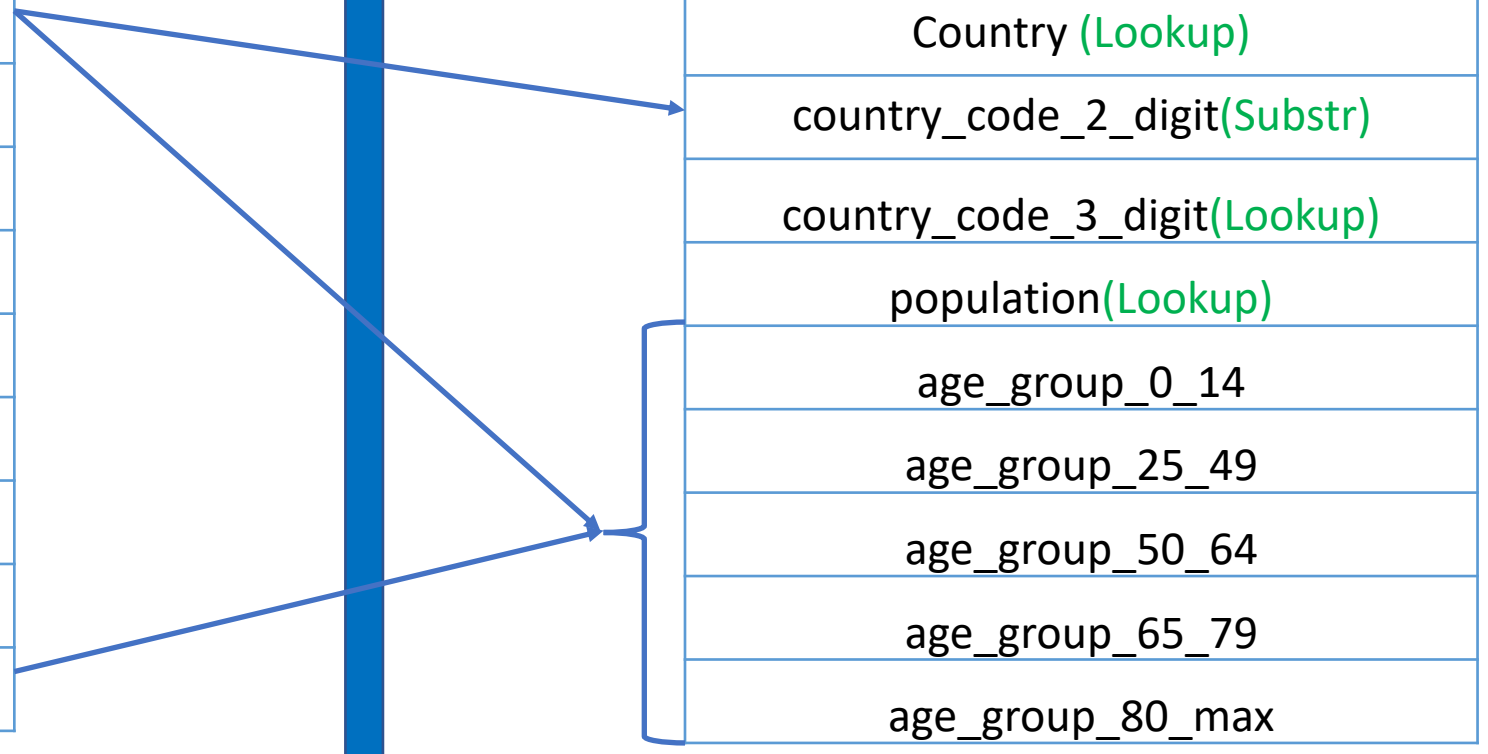
Transform Population By Age Data

Raw File

Column Name
indic_de,geo\time
~~2008~~
~~2009~~
~~2010~~
~~2011~~
…
….
~~2018~~
2019

Transformed File

Column Name
Country (Lookup)
country_code_2_digit(Substr)
country_code_3_digit(Lookup)
population(Lookup)
age_group_0_14
age_group_25_49
age_group_50_64
age_group_65_79
age_group_80_max

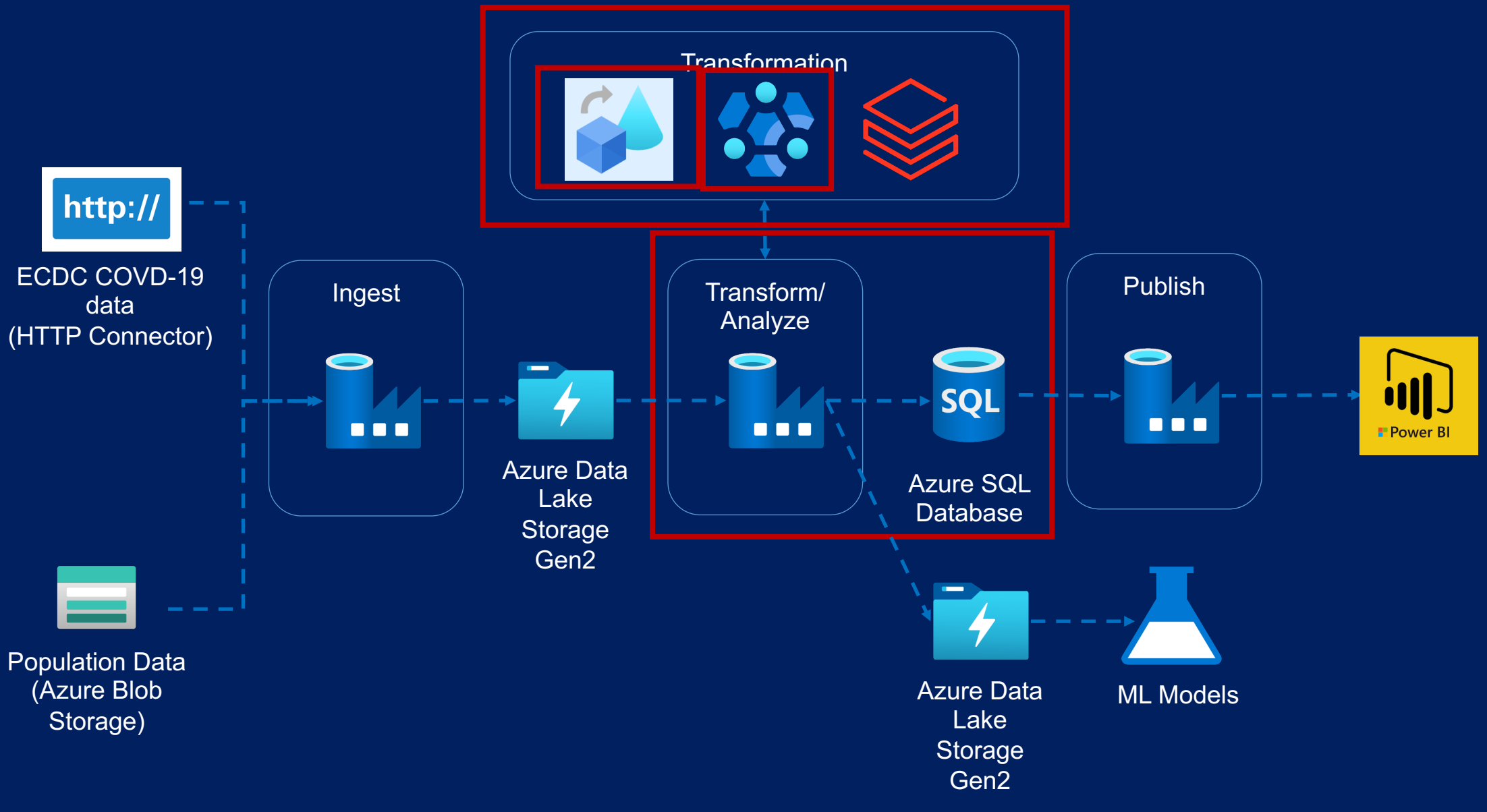


Transform Population By Age Data

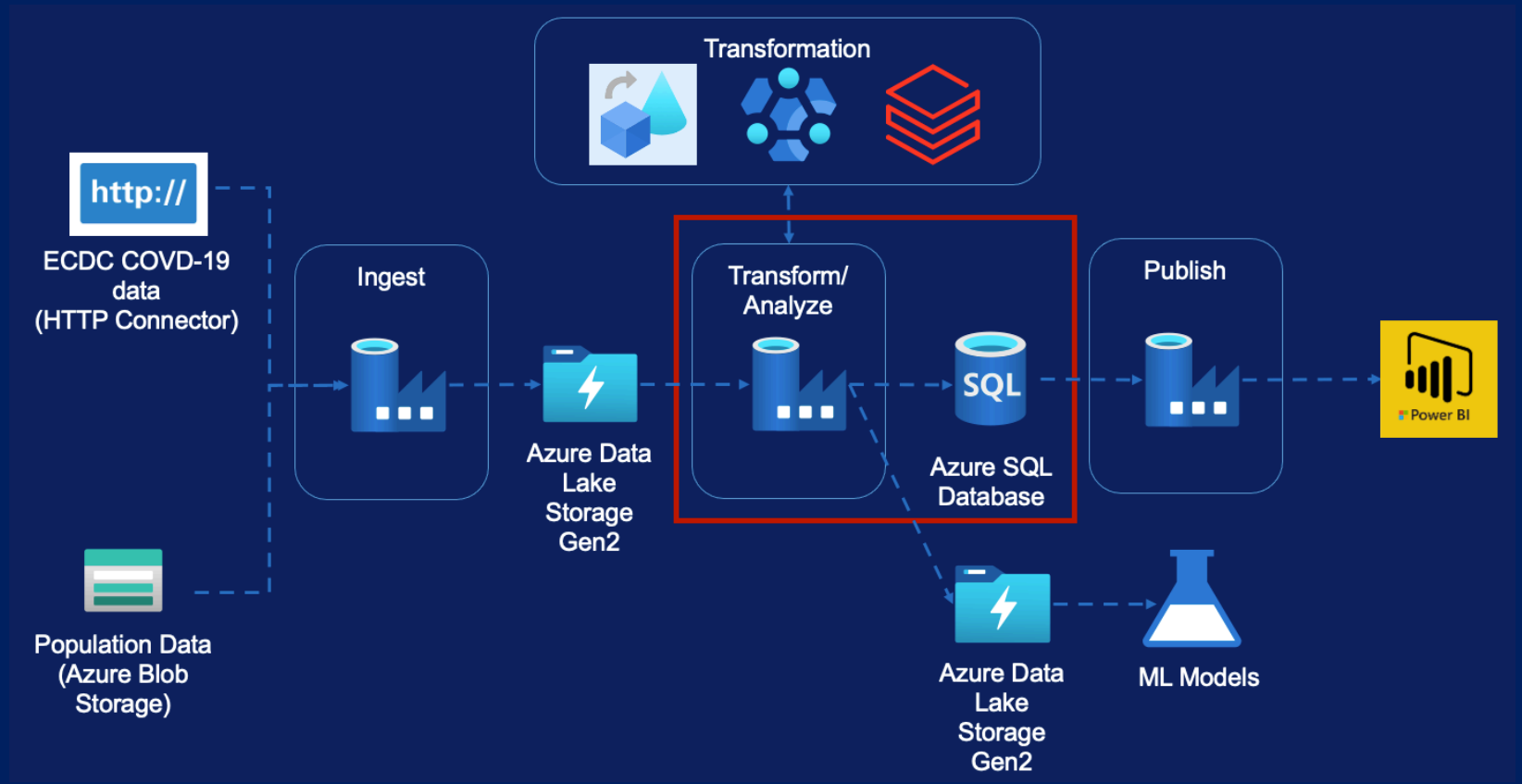
Data Factory Pipeline

Copy Data to Azure SQL

Copy Data to SQL



Copy Data to SQL



- Copy Cases & Deaths
- Copy Hospital Admissions
- Copy Testing

Copy Activity – Data Lake to SQL

Cases and Deaths Data

Copy Activity – Data Lake to SQL

Hospital Admissions Daily Data

Assignment

Copy Activity – Data Lake to SQL

Testing Data

Data Orchestration

Data Orchestration Requirements

- Pipeline executions are full automated
- Pipelines run at regular intervals or on an event occurring
- Activities only run once the upstream dependency has been satisfied
- Easier to monitor for execution progress and issues

Data Factory Capability

- Dependency between activities inside a pipeline
- Dependency between pipelines within a parent pipeline
- Dependency between triggers [Only tumbling window triggers]
- Custom-made Solution

Data Orchestration

Option 1 – Parent Pipeline

Data Orchestration

Option 2 – Trigger Dependency

Azure Data Factory - Monitoring

Azure Data Factory - Monitoring

- What to Monitor
- Data Factory Monitoring
- Creating Alerts
- Recovery From Failure
- Reporting on Metrics
- Azure Monitor Introduction
- Log Analytics
- Azure Data Factory Analytics

Monitoring

What do we want to monitor

- Azure Data Factory Resource
- Integration runtime
- Trigger runs
- Pipeline runs
- Activity runs

Data Factory Monitor

- Ability to monitor status of pipeline/ triggers
- Can be used to re-run failed pipelines/ triggers
- Ability to send alerts from base level metrics
- Provides base level metrics and logs
- Pipeline runs are stored only for 45 days

Azure Monitor

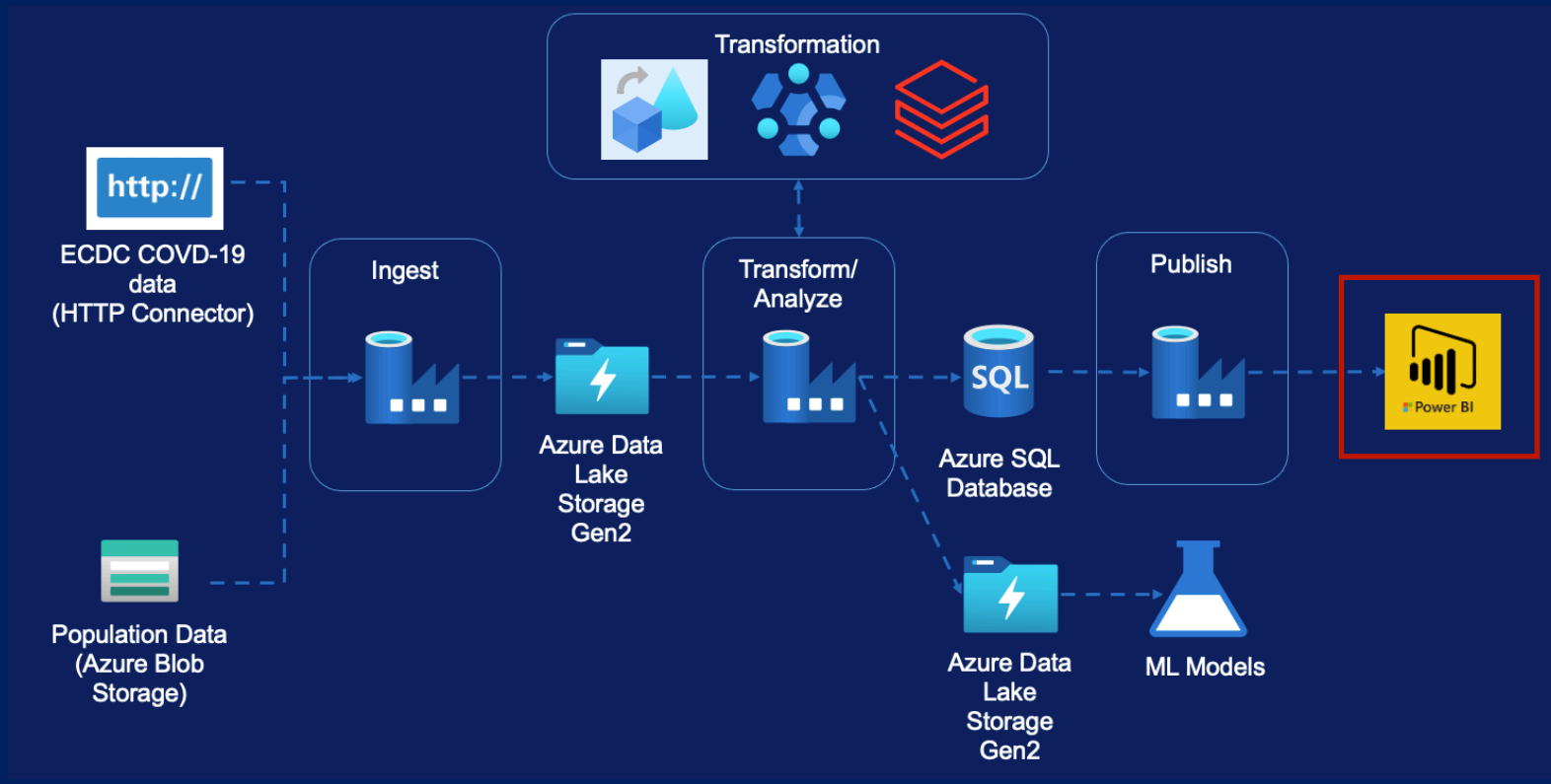
- Ability to route the diagnostic data to other storage solutions
- Provides richer diagnostic data
- Ability to write complex queries and custom reporting
- Ability to report across multiple data factories

Data Factory Monitor

Azure Monitor

Reporting via Power BI

Reporting via Power BI



- Introduction to Power BI Desktop
- Review the Covid-19 pre-built Report

Power BI Desktop Overview

Congratulations!
&
Thank you

Feedback

Ratings & Review

Thank you
&
Good Luck!