ODSC West 2024 WORKSHOP

Building Big Data Workflows: NiFi, Hive, Trino, & Zeppelin

Instructor: **Khaled Tannir PhD**

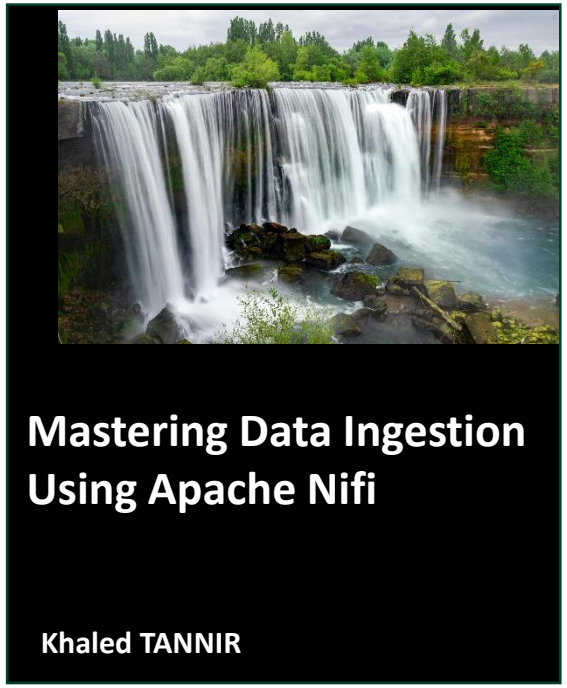
Your Instructor

Khaled TANNIR PhD

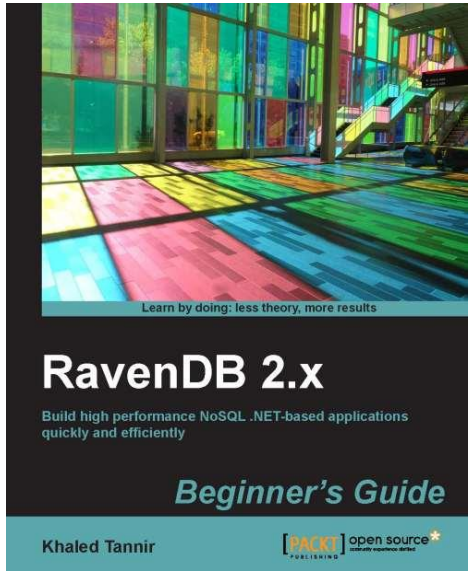
Doctorate in Artificial Intelligence
Senior Big Data Engineer & Course Lecturer
25+ years of experience

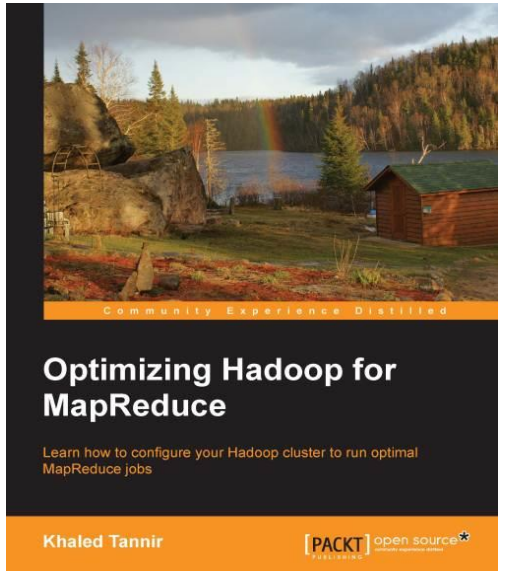
20+ Certificates

odscw24@dataxper.com



To Be Announced





Agenda

- *Workshop Overview*
  - *Overview of the Technical Environment*
- *Workshop Steps*
  - *Step 1 – Building The Nifi dataflow*
  - *Step 2 - Data Transformation & Storage*
  - *Step 3 – Data Exploration Using Hive and Trino / Zeppelin*
  - *Step 4 – Building the Superset Dashnoard*

Workshop Overview

Building Big Data Workflows: NiFi, Hive, Trino, & Zeppelin

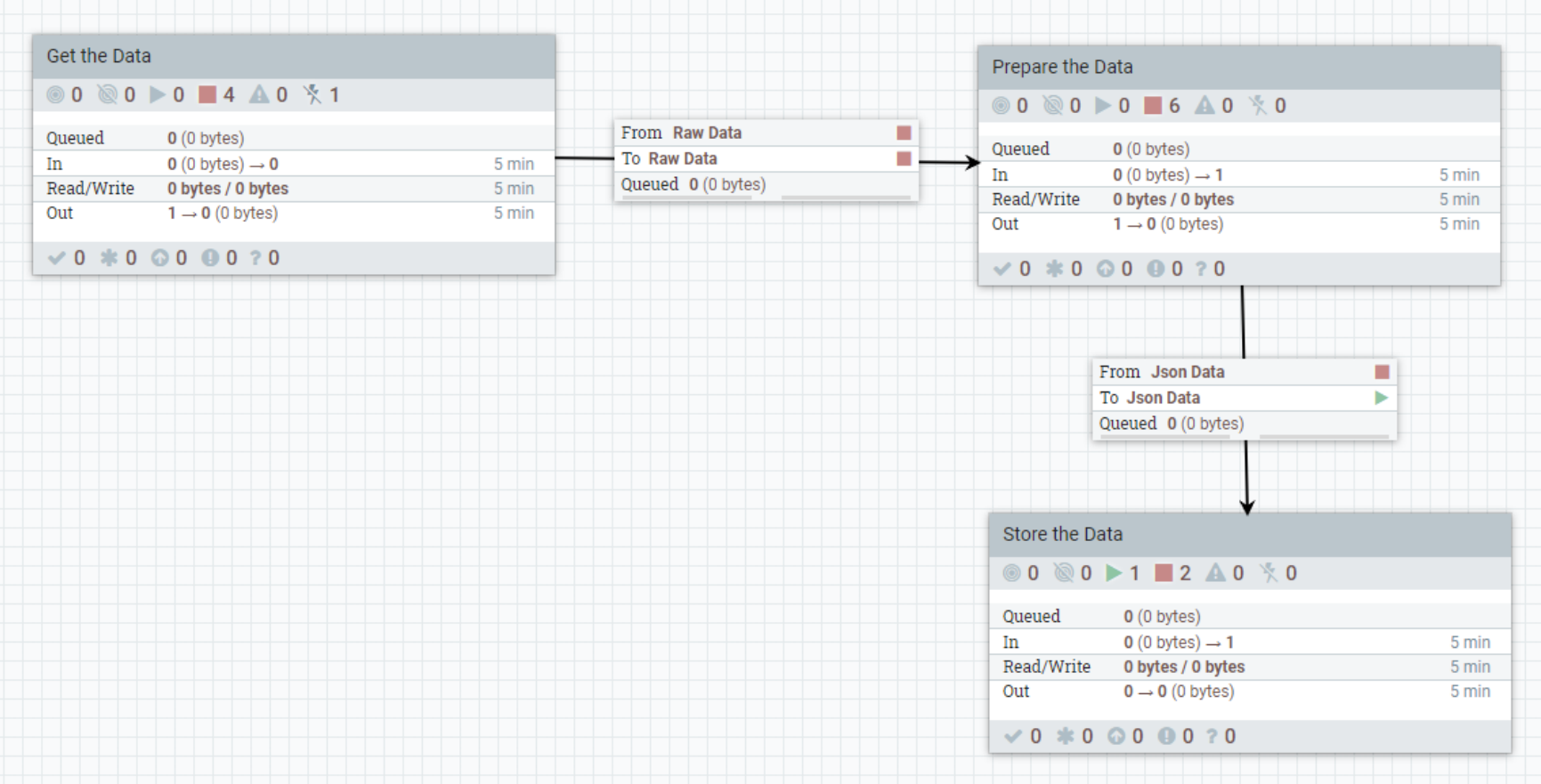
Create a data pipeline that:

Ingests, transforms and analyzes Nobel Prizes data using Apache NiFi, Jolt, Hive, Trino and Superset.

Total Duration: 1 hour

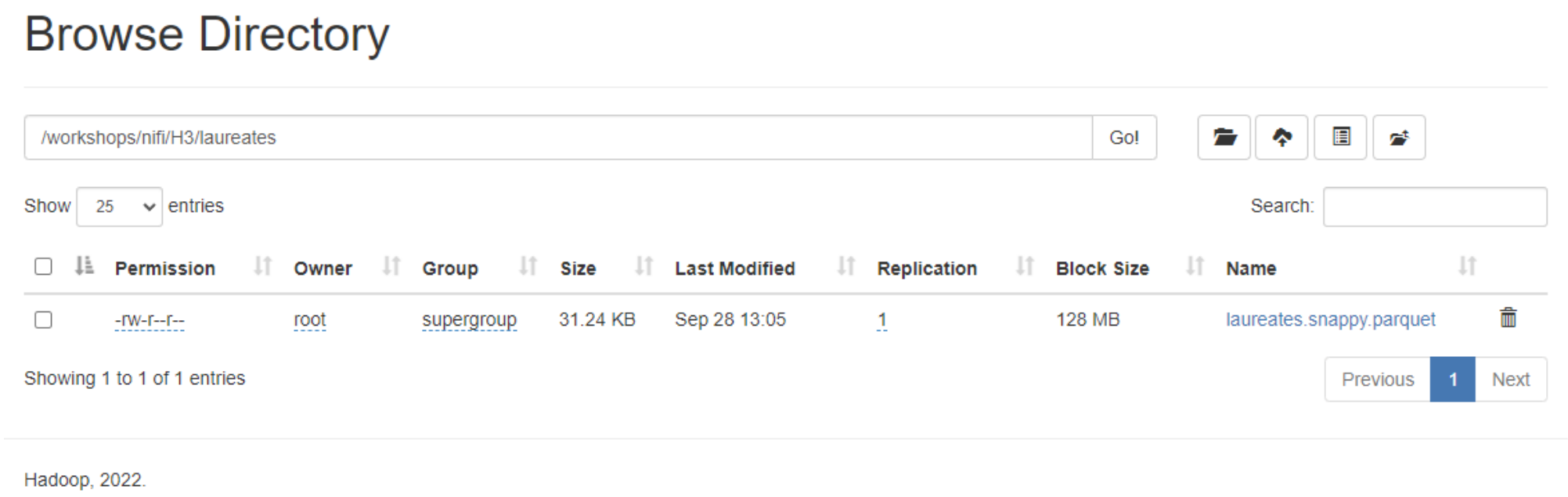
Workshop Step 1 – Data Ingestion

- Part 1
  - Connect to the Nobel Prizes REST API (data source) using Nifi



Workshop Step 2 – Data Storage

- Part 2
  - Transform and simplify the collected data and store it on HDFS



Workshop Step 3 – Explore the data

- Part 3
  - Access and load the data using Hive and use Trino to explore it using Zeppelin (5 queries)

```
%hive

select * from laureates.laureates limit 10;
```

FINISHED

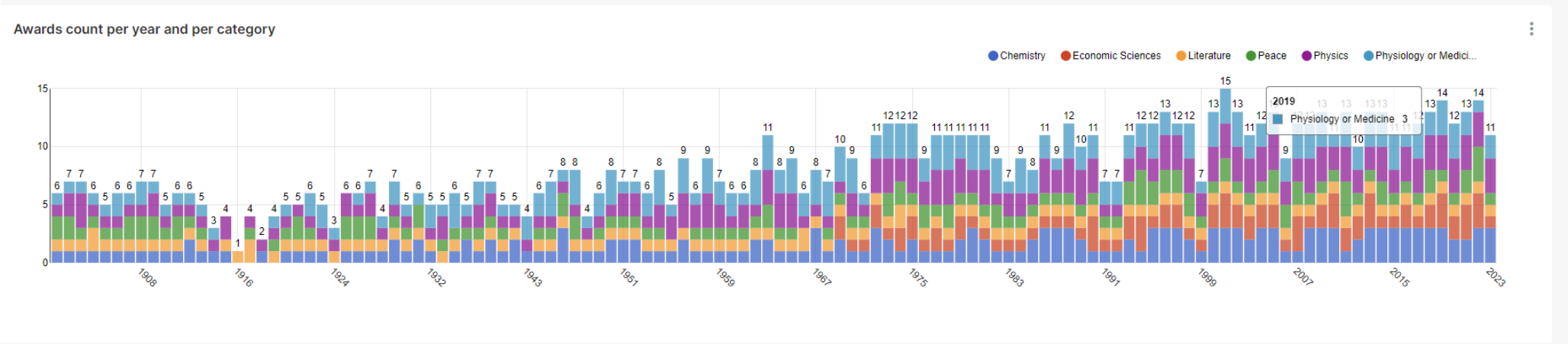
settings

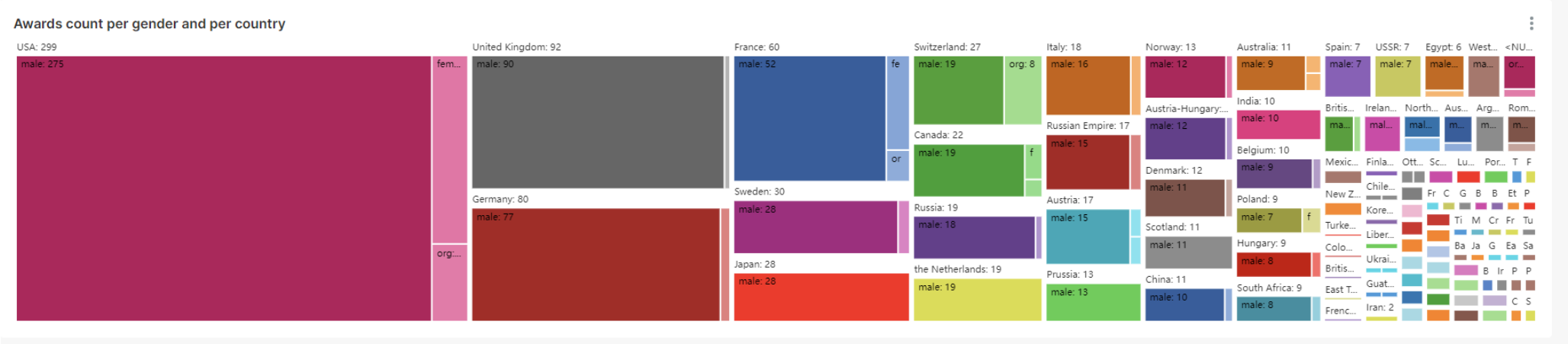
id	fullname	gender	date	country	awardyear	category
779	Aaron Ciechanover	male	1947-10-01	British Protectorate of Palestine	["2004"]	["Chemistry"]
259	Aaron Klug	male	1926-08-11	Lithuania	["1982"]	["Chemistry"]
1004	Abdulrazak Gurnah	male	1948-00-00	null	["2021"]	["Literature"]
114	Abdus Salam	male	1926-01-29	India	["1979"]	["Physics"]
982	Abhijit Banerjee	male	1961-02-21	India	["2019"]	["Economic Sciences"]
981	Abiy Ahmed Ali	male	1976-08-15	Ethiopia	["2019"]	["Peace"]
843	Ada E. Yonath	female	1939-06-22	British Mandate of Palestine	["2009"]	["Chemistry"]
866	Adam G. Riess	male	1969-12-16	USA	["2011"]	["Physics"]

Took 1 sec. Last updated by anonymous at September 28 2024, 1:05:40 PM.

Workshop Step 4 – Build The Dashboard

- Part 4
  - Connect Superset to Trino and build a dashboard to visualize the data (5 charts)





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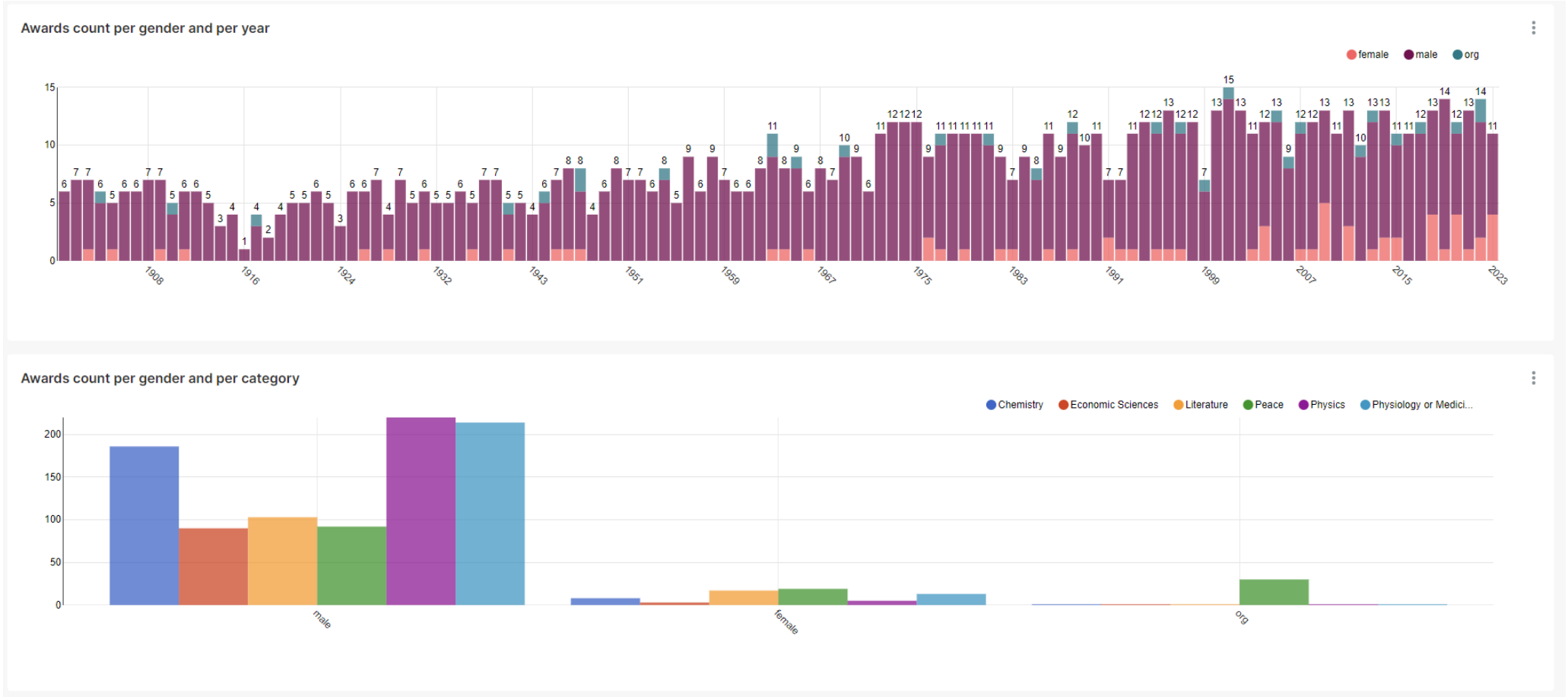

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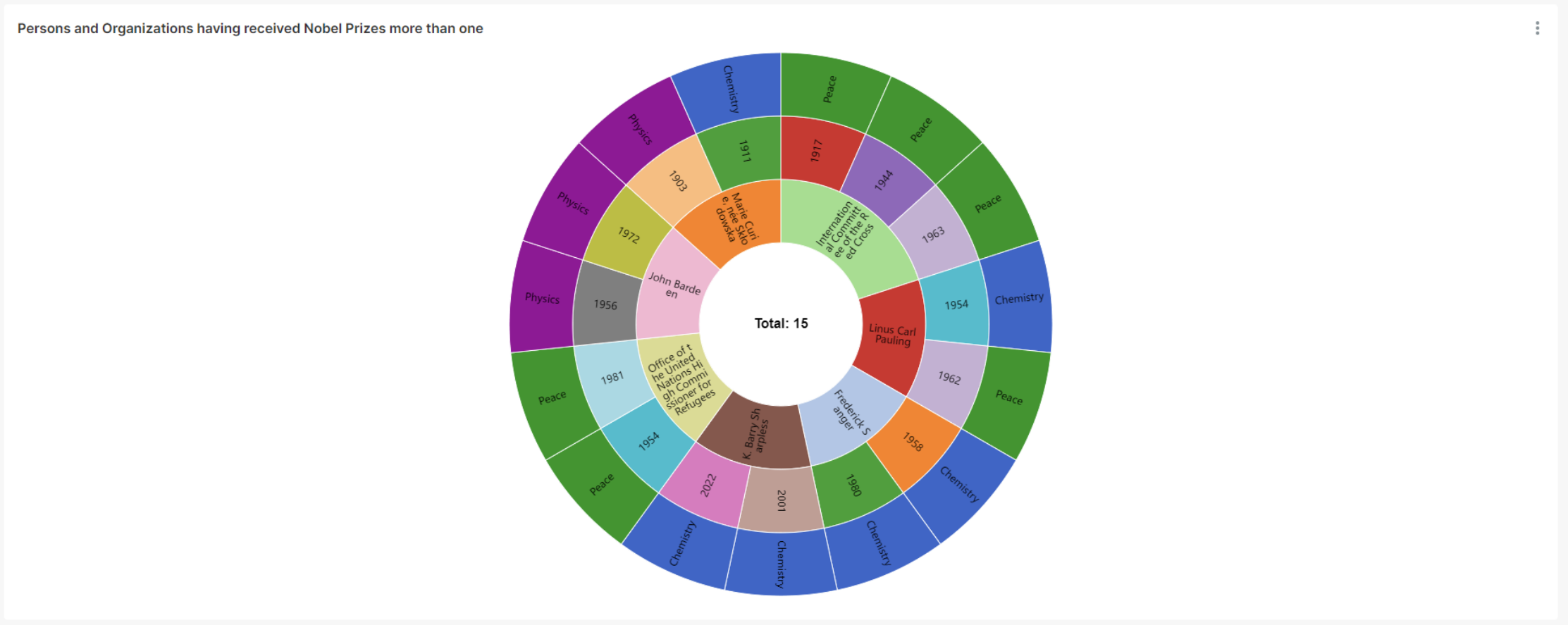
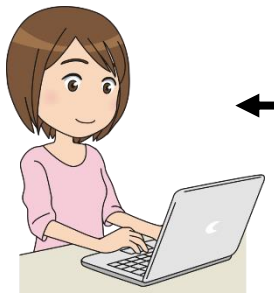


Materials Needed - Virtual Machine - Local

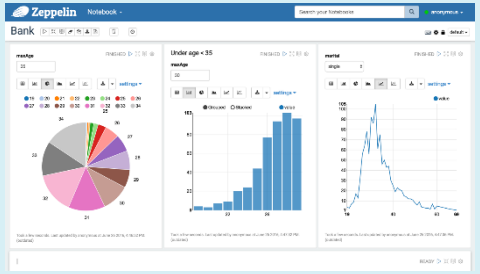


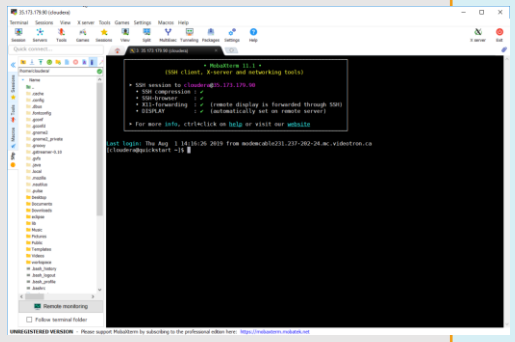
Requires

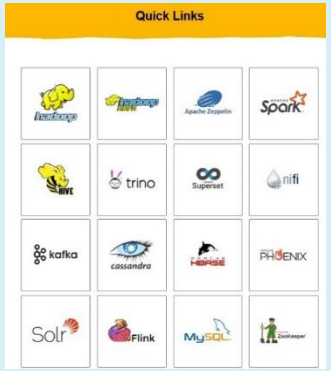
20 GB	
6 CPUS	

Mandatory

localhost







Local File System
/home/training
/Data

put

get

NameNode

DataNode

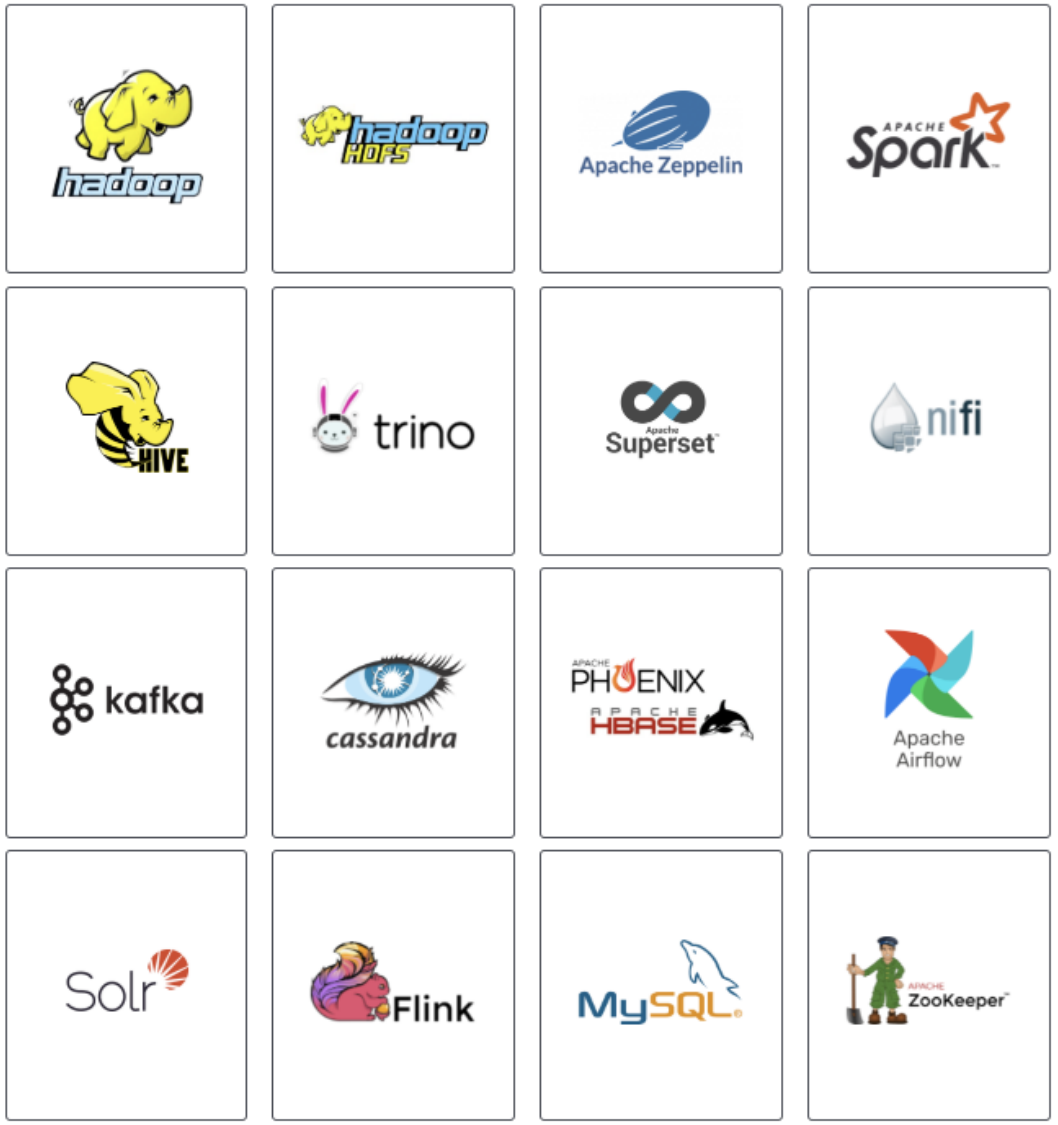
HDFS

DDP Sandbox VM – Linux Fedora based

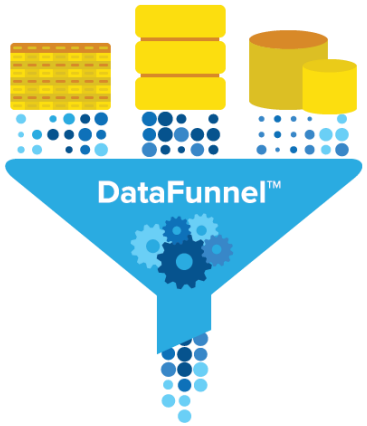
VirtualBox

About the Sandbox

- DataXper Data Platform (DDP) Sandbox
- Created The First Version in 2021
- Dedicated for Learning and Practicing
- **50+ Tutorials / Guides / Quizzes**
- **Full open-source**



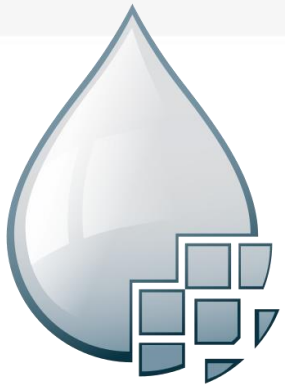
Workshop Dataflow – Step 1



1 **Collect**

Collect data from sources

Nobel Prizes Data

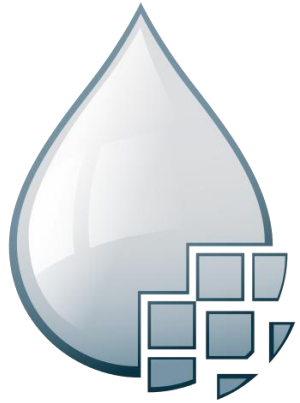


Apache NiFi Overview

Data Ingestion at Scale

Apache NiFi

- **What is NiFi ?**
  - **NiFi (short for "*Niagara Files*") is an Open-Source dataflow tool that can collect, route, enrich, transform and process data in a scalable manner.**
  - **It is a processing engine based on the concepts of *flow-based programming* (FBP), that was designed to manage the flow of information in an ecosystem**



Nifi Terminology

FlowFile

- Unit of data moving through the system
- Content + Attributes (key/value pairs)

Processor

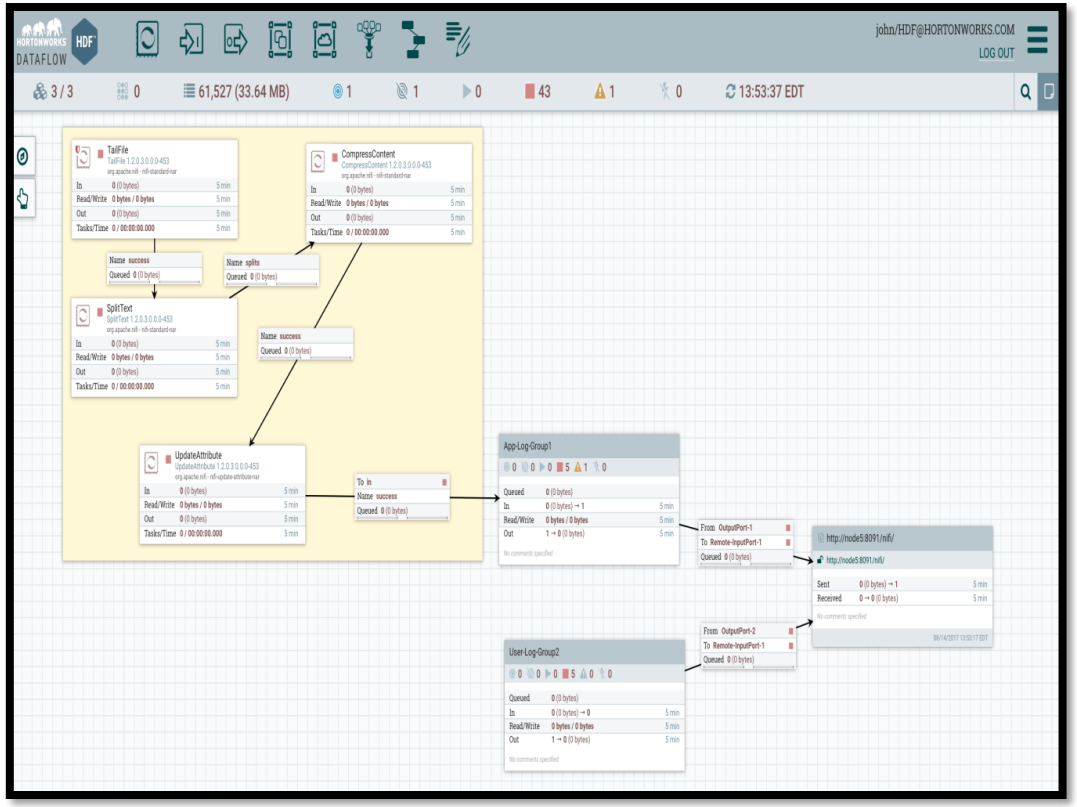
- Performs the work, can access FlowFiles

Connection

- Links between processors
- Queues that can be dynamically prioritized

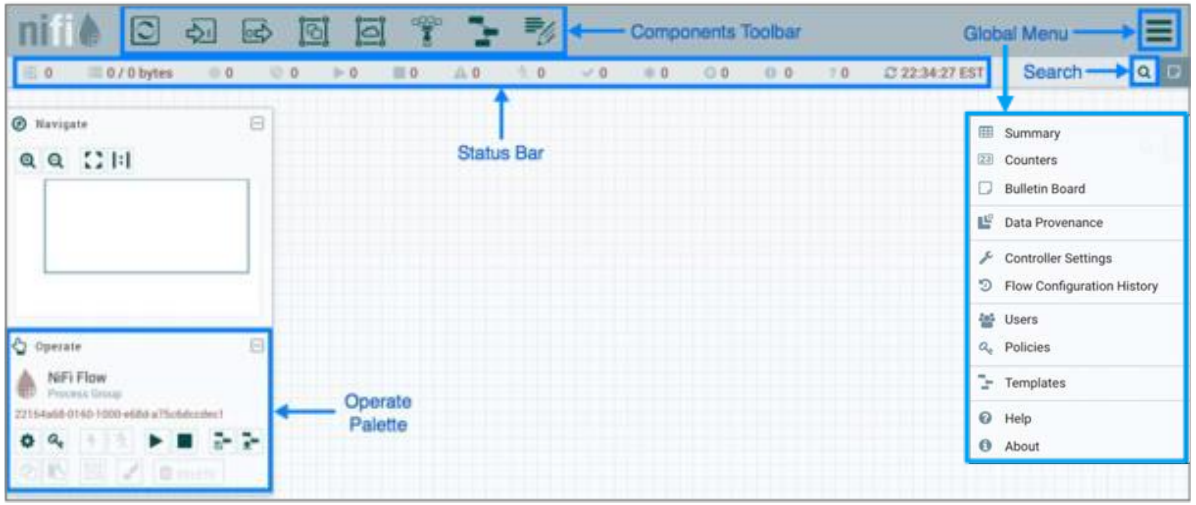
Process Group

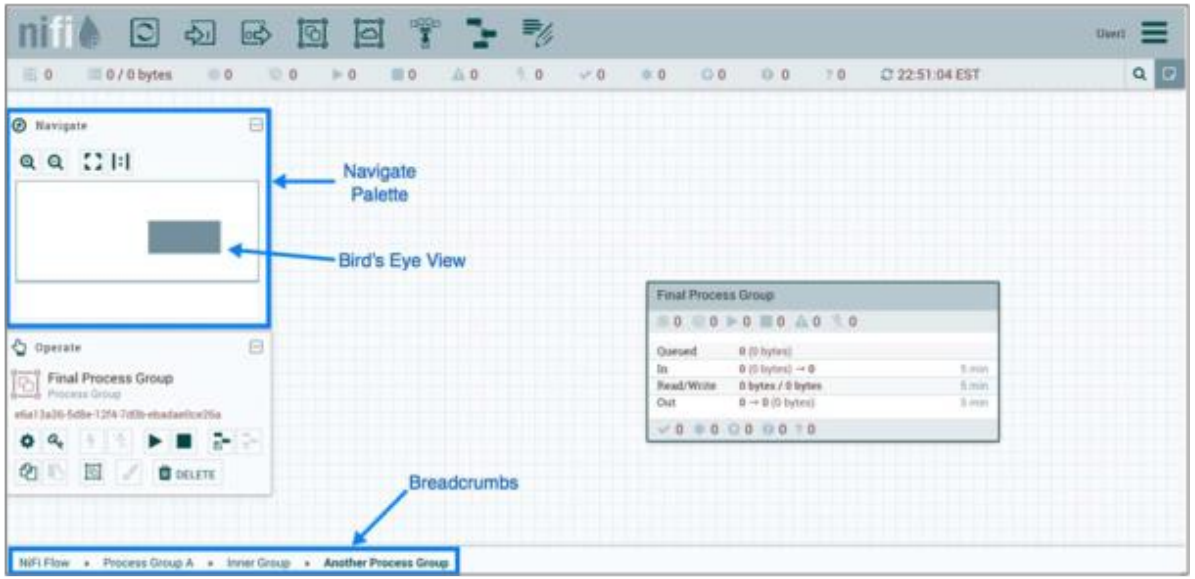
- Set of processors and their connections
- Receive data via input ports, send data via output ports



Visual Command & Control

- Drag and drop processors to build a flow
- Start, stop, and configure components in real time
- View errors and corresponding error messages
- View statistics and health of data flow
- Create templates of common processor &
- connections



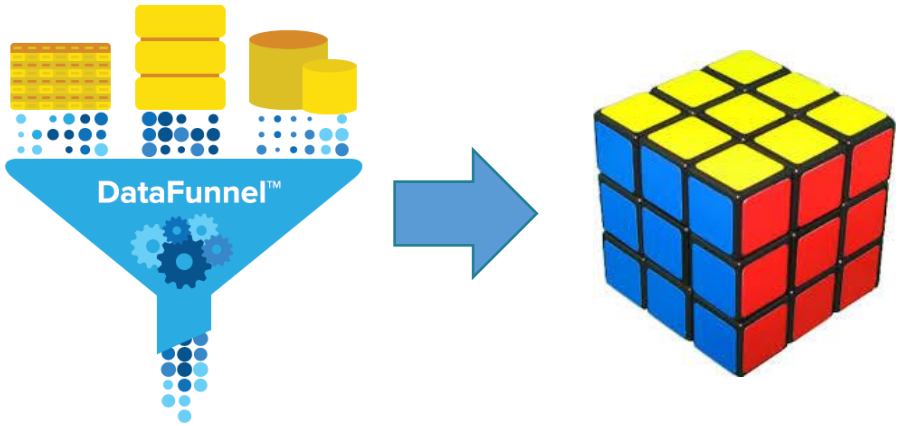


Workshop - Nifi

Workshop - NiFi Data Ingestion

- Add Process Group
  - Add GenerateFlowFile Processeur
  - Add InvokeHTTP Processeur
    - Requires StandardSSLContextService
  - UpdateAttribute
  - Output Port

Workshop Dataflow – Step 2



1 **Collect**

Collect data from sources

2 **Organize**

Prepare the data

APACHE nifi

JSON

JSON

JOLT

JSON

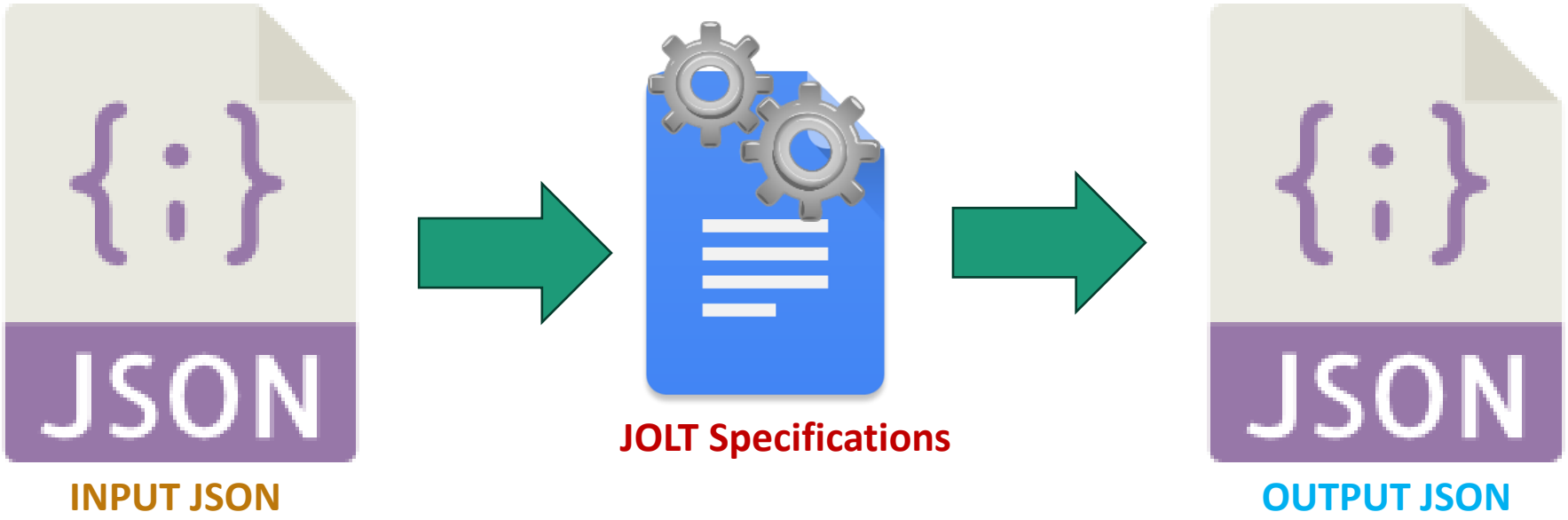
Parquet

JOLT

JsOn Language for Transformations

JOLT Transformations

- JsOn Language for Transformation
- Java library
- Transform one JSON structure to another



JOLT Specifications

JOLT Specifications Structure

Jolt Spec | JSON Validate

```
[
  {
    "operation": "shift",
    "spec": {
      //-- spec goes here
    }
  },
  {
    "operation": "remove",
    "spec": {
      //-- spec goes here
    }
  }
]
```

http://jolt-demo.appspot.com/#inception

JOLT Operations

- **shift:** Pic value from one node drop in another node.
- **default:** If null in input, put default in output.
- **remove:** Remove node from output.
- **cardinality:** Convert one to array, and, array to one.
- **sort** Sorts all arrays and maps from the input
- **modify-default-beta:** Modify if value is null or un-available.
- **modify-overwrite-beta:** Modify even if value is available.

JOLT – Shift Example

Json Input JSON Validate

```
{
  "country": "Canada",
  "population": "36624199",
  "sq_km_area": 9970610,
  "life_expectancy": "79.4",
  "elevation_in_meters": "487",
  "continent": "North America",
  "abbreviation": "CA",
  "location": "North America",
  "iso": "124",
  "capital_city": "Ottawa"
}
```

shift One to One Operation:

Take the value from one node and put it into another node

Jolt Spec JSON Validate

```
[
  {
    "operation": "shift",
    "spec": {
      "country": "pays.nom",
      "capital_city": "pays.capitale"
    }
  }
]
```

Output / Errors Transform ☐ **Sort Output?**

```
{
  "pays" : {
    "nom" : "Canada",
    "capitale" : "Ottawa"
  }
}
```

Special Chars in JOLT

- **'&'** **Ampersand special character.**
- **'*'** **Asterisk special character.**
- **'@'** **At special character.**
- **'#'** **Hash special character in LHS and in RHS** ***(Left- and Right-Hand Side)*****.**
- **'|'** **Pipe special character.**

- **Spec JSON content that is:**
  Before : (colon) will be LHS (or Input Side). LHS is node structure to pic to be transformed from input JSON
  After : colon will be RHS (or Output Side) . RHS is . (Dot) separated JSON path formatted structure

Special Chars in JOLT

Special Char	Used In	Operations	Use
&	Output	shift	Refer to current LHS node name &1 One level above current LHS node &(2) To level above current LHS …
*	Input	shift, remove, cardinality, modify-default-beta modify-overwrite-beta	Iterate over items.
@	Input Output	Shift(LHS and RHS) modify-default-beta (RHS) modify-overwrite-beta (RHS)	Lookup value in input json @ given node level.
$	Input	shift	Only field names.
#	Input Output	shift	In LHS Define a default value In RHS define the way object Array is created.
|	Input	shift	Input fields with uncertain name pointing to some output (OR Operator) .

Workshop –Data Prep.

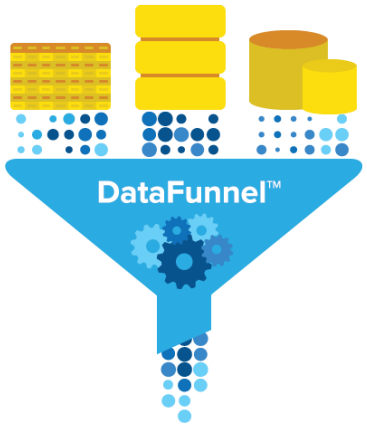
Workshop - NiFi Data Transformation

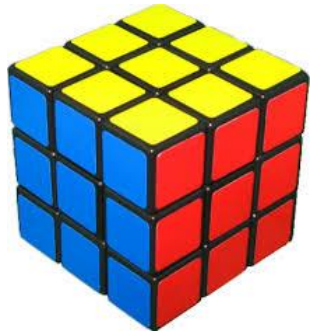
- Add Process Group
  - Add Input Port
  - Add JoltTransformJson Processor
  - Add MergeContent Processor
  - Add Output Port

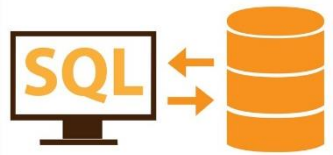
Workshop - NiFi Data Storage

- Add Process Group
  - Add Input Port
  - Add UpdateAttribute
  - Add PutParquet Processor

Workshop Dataflow – Step 3







1 **Collect**

Collect data from sources

2 **Organize**

Prepare the data

3 **Analysis**

Extract Knowledge from the data

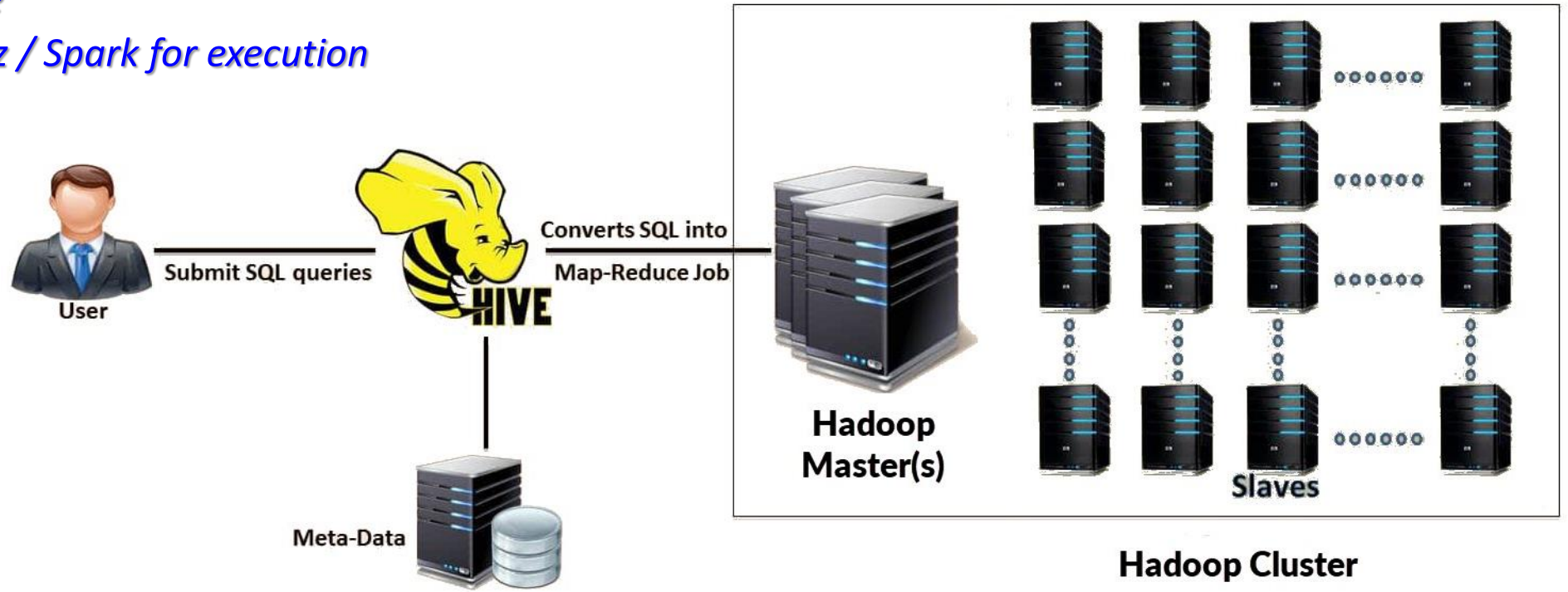
Data Warehouse on top of Hadoop

What is Apache Hive?

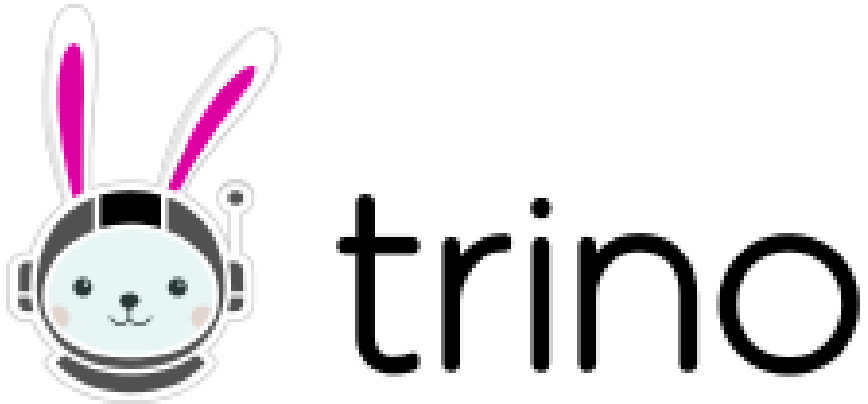
- A Data Warehouse on top of Hadoop (SQL on Hadoop).
- Can deal with different storage and file formats using *Input/Output* and *SerDes.*
- Summarize Big Data and makes querying and analyzing easy.
- Familiar, scalable, and extensible.
- Written in Java and open-source

How it Works?

- **Hive is built on top of Hadoop**
  - *Uses HDFS for storage*
  - *Uses MapReduce / Tez / Spark for execution*



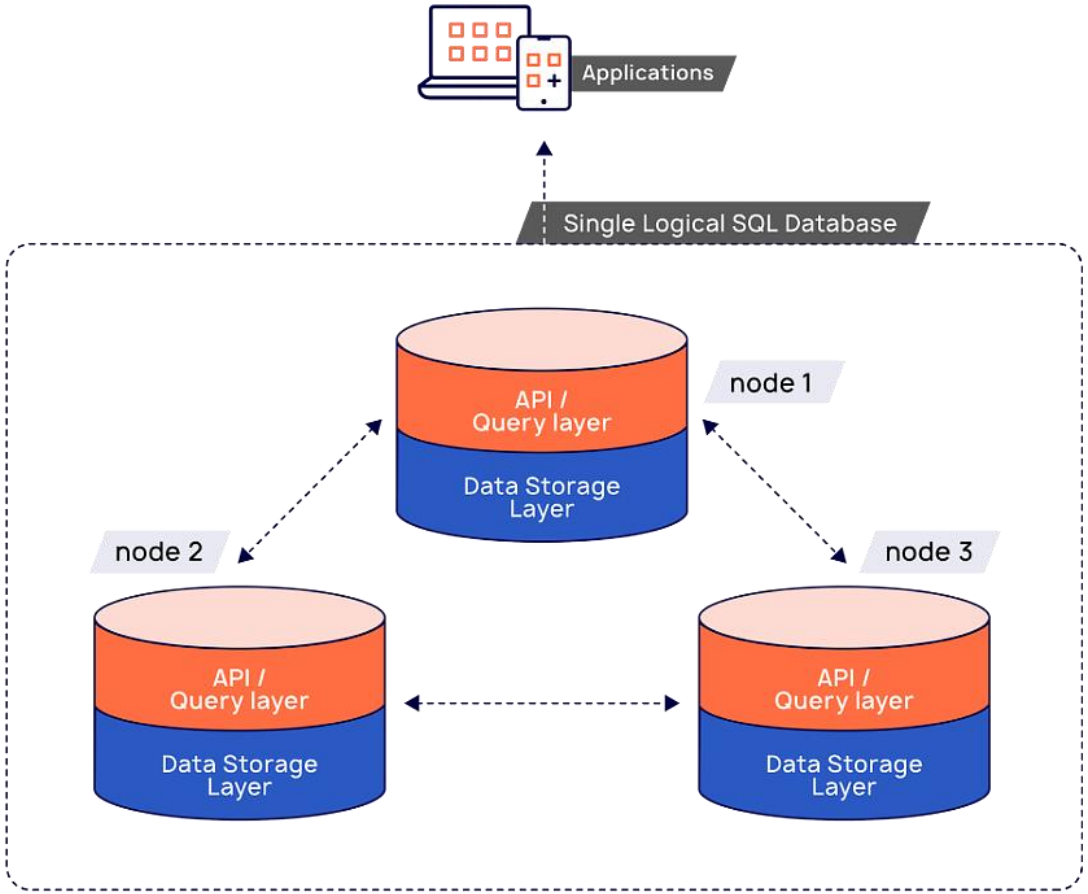
- **Hive compile HiveQL queries into MapReduce *Tez / Spark* jobs and run the jobs in the Hadoop cluster**



Querying Data at Scale Interactively

What is Apache Trino?

- Distributed SQL query engine
  - ANSI SQL on Databases, Data lakes
  - Designed to be interactive
  - Access to petabytes of data
- Open-source, Extensible
- Written in Java



Apache Trino is Different

- **Trino is not a database**

  You can't store data in Trino. It uses connectors to connect to an existing database.

- **Runs interactive queries on data in HDFS, and others.**

  Is complimentary to Hadoop, it does not have its own storage system. Can run over Yarn.

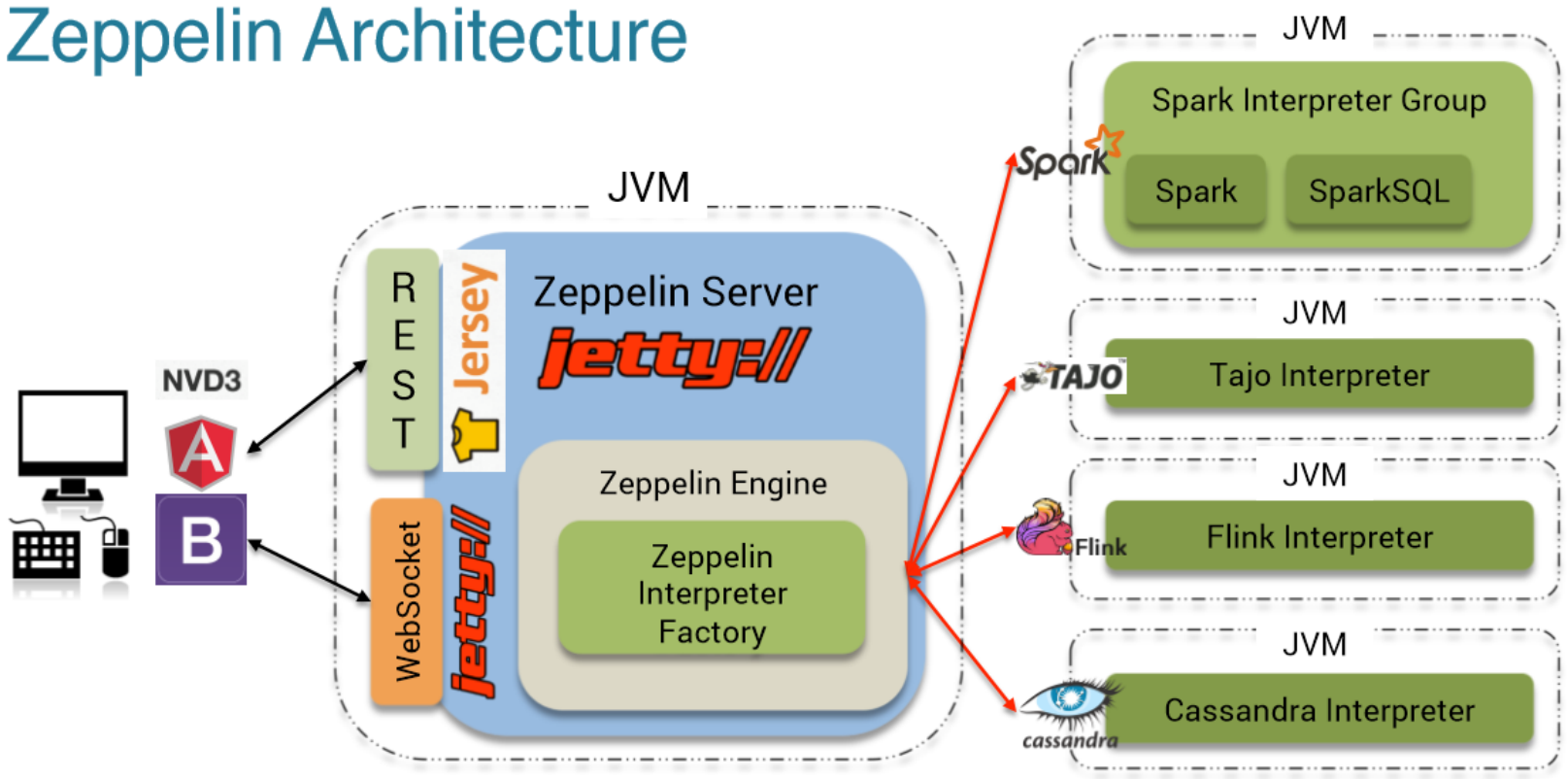
- **It is not a data warehouse**

  You can aggregate terabytes of data across multiple data sources and run efficient ETL queries.

A web-based notebook for interactive analytics

What is Apache Zeppelin?

- **A web-based notebook for interactive analytics**
- **Deeply integrated with Spark and Hadoop**
- **Supports multiple language backends**



What is a Zeppelin Note/Notebook?

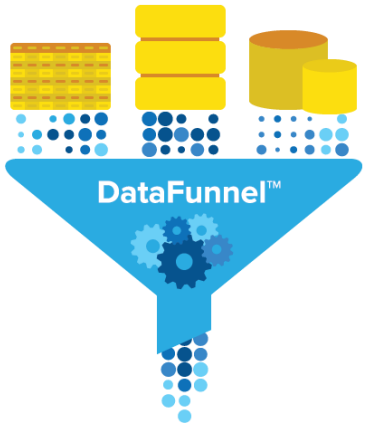
- A web based graphical user interface (GUI) for small pieces of code
- Write the code in a browser
- Zeppelin sends the code to the backend for execution and retrieves the resulting data
- Zeppelin visualizes the data
- Zeppelin Note = Set of (Paragraphs / Cells)
- Other Features - Sharing / Collaboration / Reports / Import / Export

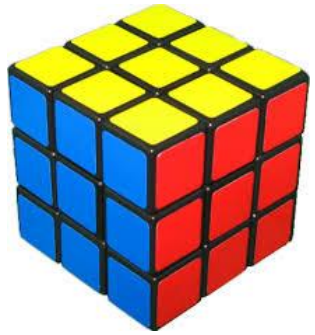
Workshop – Data Analysis

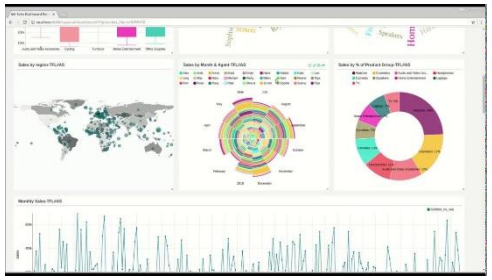
Workshop – Hive / Trino Data Analysis

- **Open Zeppelin and Create a new Note**
  - **Create Hive Database + Table**
  - **Prepare the final Parquet table**
  - **Use Trino to explore the Hive table (5 queries)**

Workshop Dataflow – Step 4







1 **Collect**

Collect data from sources

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Prepare the data

3 **Analysis**

Extract Knowledge from the data

4 **Visualization**

Create Dashboard

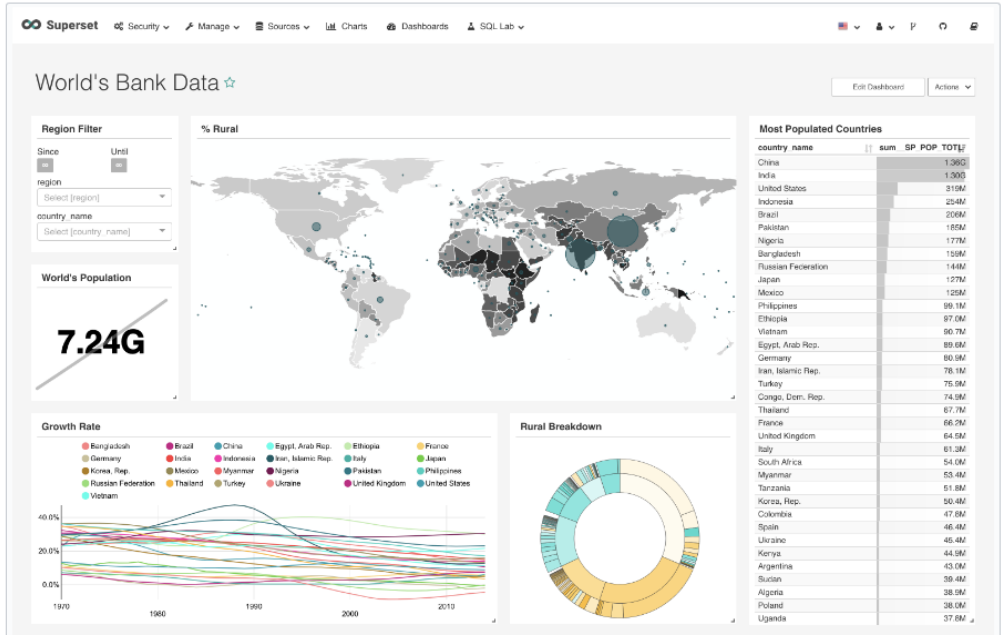
trino

Apache Superset™

Data Visualization and Exploration Platform

What is Apache Superset

- A data visualization and exploration platform
- Easy-to-use & fast “time-to-dashboard”
- Enterprise-ready & cloud-native
- Riche set of visualizations (50+)
- Lightweight semantic layer
- Works with a wide array of databases



Apache Superset Components

Apache Superset™ =

Visual Dashboard Building

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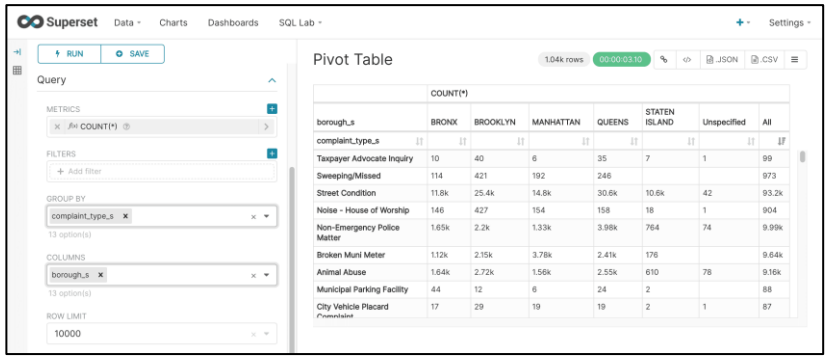

Data Exploration

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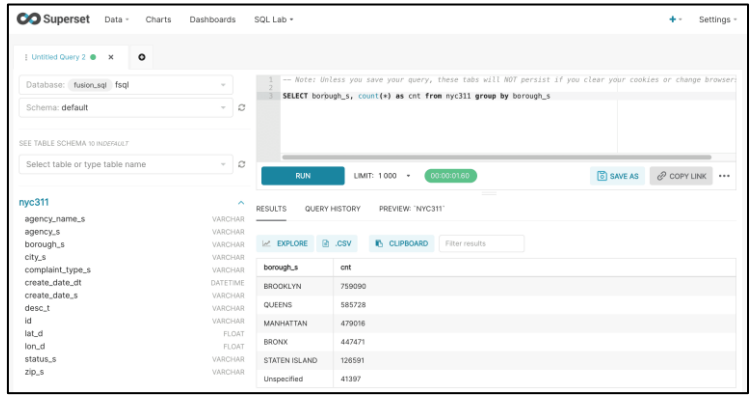

SQL Powerhouse

Workshop – Dashboard

Workshop – Superset Dashboard

- **Open Superset and Connect to Trino**
  - **Create Queries Hive Database + Table**
  - **Create Charts and add to the Dashboard**

End of the Workshop

Questions?

Merci!

Thank You!