DATA:Scotland 2024

Starting Soon

MEET - LEARN - SHARE

#DATAScotland

Kamil Nowinski

Microsoft® MVP Most Valuable Professional

Delta Lake Tables 101


DATA:Scotland
2024
bridgeall
Tabular Editor
MySQL
DATAmasterminds
Waterstons
ADVANCING
ANALYTICS
quorum
hippo
aim

Kamil Nowiński

Microsoft Data Platform **MVP, Databricks Champion**
Speaker, blogger, **YouTuber**, data enthusiast

Group Manager at Avanade UK&I
>20 years of experience in IT

Founder of blog AzurePlayer

GitHub: **#adftools**, SCD Merge Wizard and more…
Member of the Data Community PL
Former co-organiser of SQLDay (PL), Data Relay (UK), volunteer at SQLBits (UK)

SQL Server Certificates:
MCITP, MCP, MCTS, MCSA, MCSE Data Platform,
MCSE Data Management & Analytics, DevOps Expert

Moreover: Bicycle, Running, Digital photography
@NowinskiK, @Azure_Player

Blog

Azure Player

Play with data & have fun!

- Technical posts
- Various skill level
- Cheet sheets
- Recommended books
- Many useful other links
- Interviews (Podcast)
- YouTube Channel: www.AzurePlayer.net/YouTube

www.AzurePlayer.net

Scan me

Ingest data with Spark and Microsoft Fabric notebooks | Lab 10

Kamil Data Geek - Azure explained • 256 views • 3 weeks ago

Use real time eventstreams in Microsoft Fabric | Lab 09

Kamil Data Geek - Azure explained • 172 views • 1 month ago

Get started with data science in Microsoft Fabric | Lab 08

Kamil Data Geek - Azure explained • 251 views • 2 months ago

Get started with Real-Time Intelligence in Microsoft Fabric

Kamil Data Geek - Azure explained • 286 views • 2 months ago

Ask SQL Family

▶ Play all

This set of videos promote episodes of "Ask SQL Family" podcast.

Mladen Prajdić - Convince your boss to upgrade SQL...

Kamil Data Geek - Azure explained
16 views • 4 days ago

Alex Whittles - Successful BI business without autopilot |...

Kamil Data Geek - Azure explained
31 views • 2 weeks ago

Chris Webb - future of SSAS On-Premise and a few more...

Kamil Data Geek - Azure explained
116 views • 1 month ago

Kalen Delaney - story about @sqlqueen twitter handle |...

Kamil Data Geek - Azure explained
17 views • 1 month ago

Itzik Ben-Gan - Window functions have no secrets t...

Kamil Data Geek - Azure explained
86 views • 2 months ago

James Rowland-Jones: How failure crafts your better...

Kamil Data Geek - Azure explained
30 views • 2 months ago

www.AzurePlayer.net/YouTube

DATA:Scotland

@DATAScotland · 477 subscribers · 44 videos

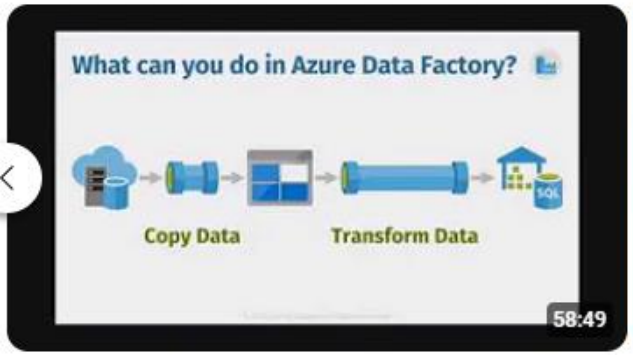
DATA:Scotland is Scotland's annual, free training conference, with sessions focused on al ...more

datascotland.org

Subscribed | View channel stats

Home | Videos | Shorts | Live | Playlists

For you



Pipelines and Packages: Introduction to Azure Data Factory - Cathrine Wilhelmsen

284 views • 3 years ago

DATA:Scotland Conference Livestream

312 views • Streamed 2 years ago

Gregor Suttie - Building an Azure Data Warehouse from Scratch

744 views • 3 years ago

Craig Porteous - Adventures in CI Synapse - Workspace deployment

5.9K views • 3 years ago >100x

youtube.com/@DATAScotland

Azure Player
Play with data & have fun!

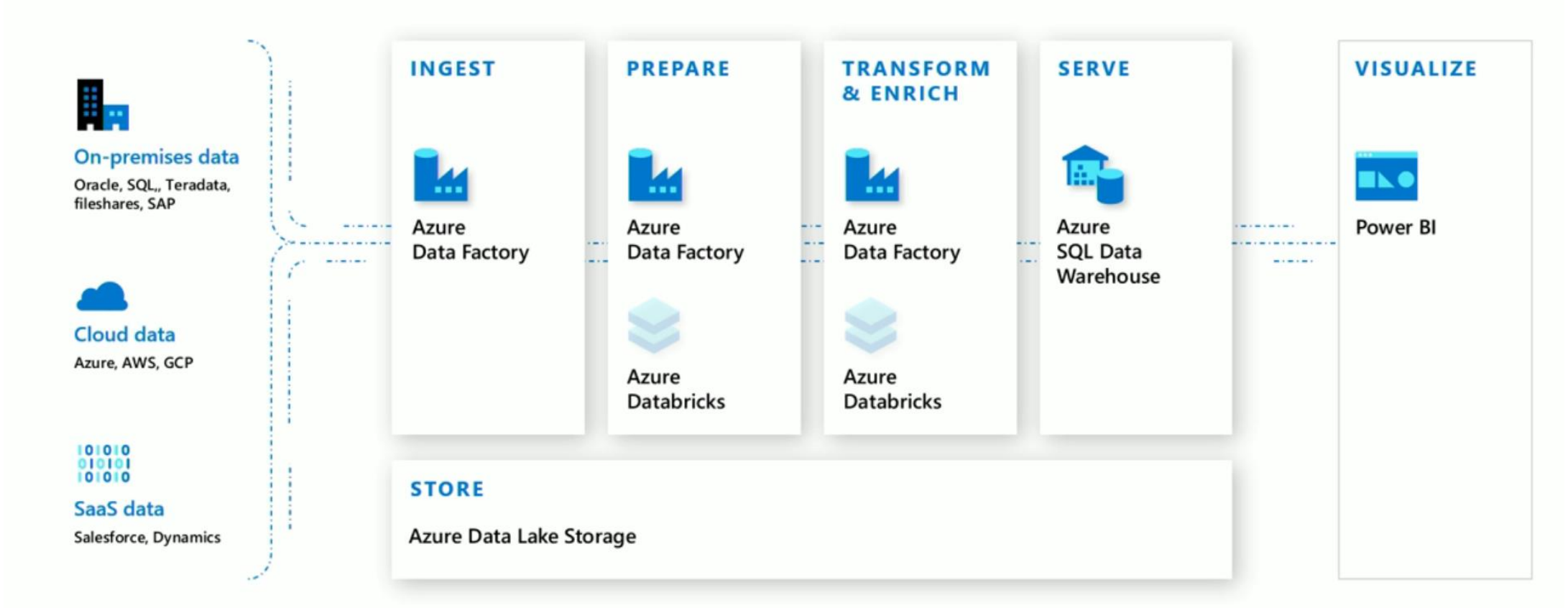
Slides available:

https://azureplayer.net/slides

AGENDA

- A bit of theory…
- … and history
- Key features of Delta Lake Tables
- Let's practice: DEMO time
    - Delta Lake Tables in Lake Databases (Databricks)
- Key takeaways

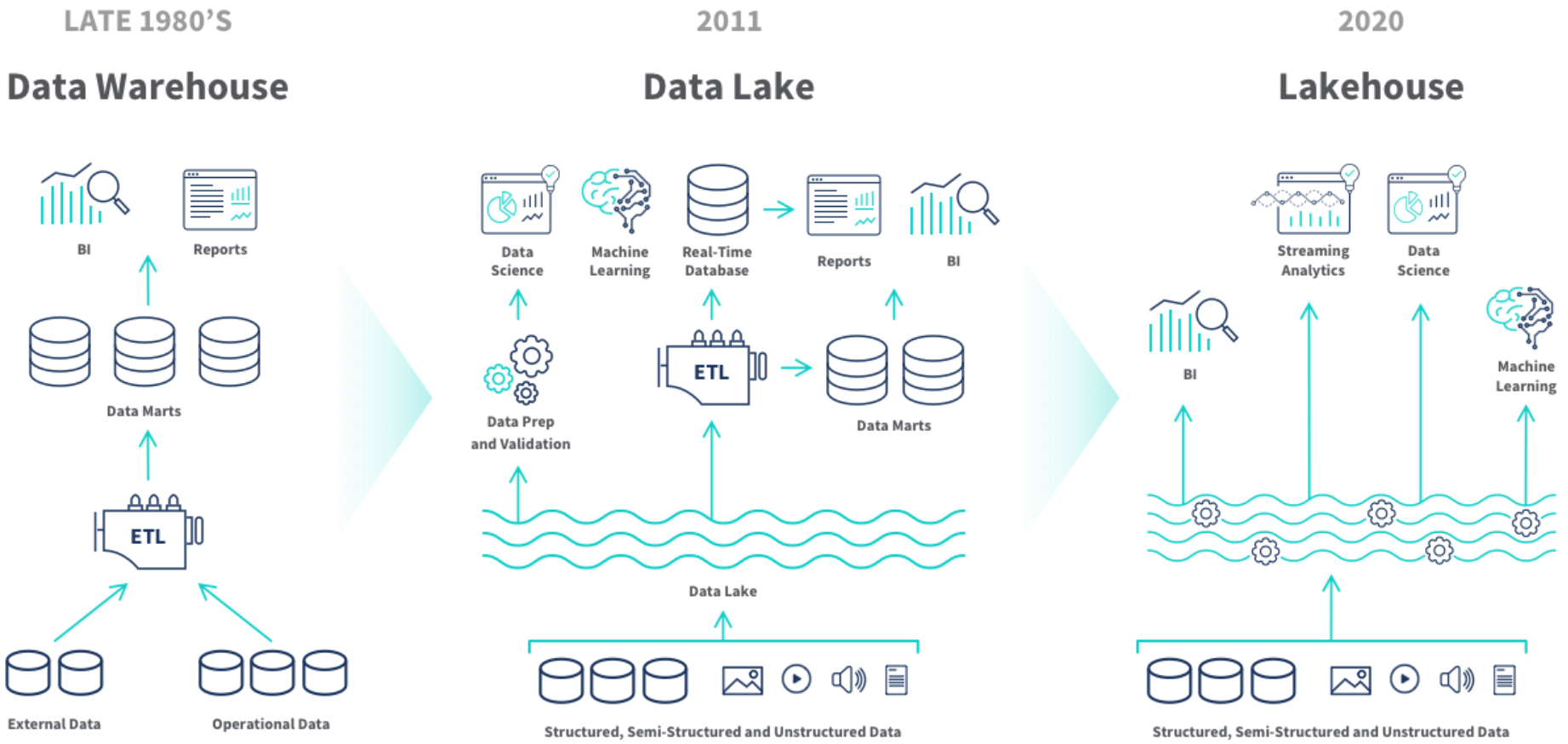
Modern Data Warehouse



Data Lake + Warehouse = Lakehouse

[> What Is a Lakehouse?]

Data Warehouse evolution



https://www.qlik.com/us/data-lake/data-lakehouse

Parquet format

Azure Player
Play with data & have fun!

What is Parquet?

Apache Parquet is an open source, column-oriented data file format designed for efficient data storage and retrieval. It provides efficient data compression and encoding schemes with enhanced performance to handle complex data in bulk. Apache Parquet is designed to be a common interchange format for both batch and interactive workloads.

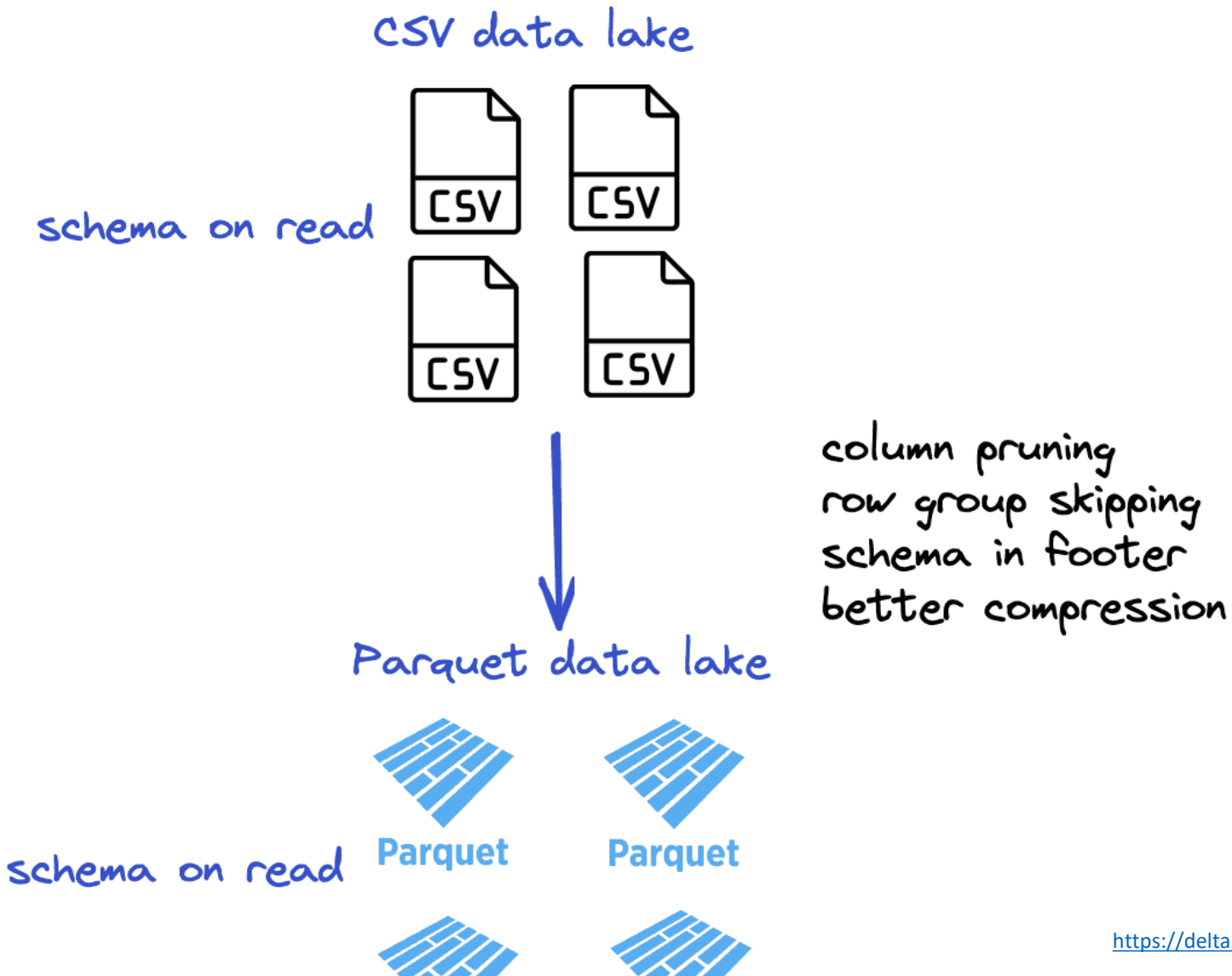
Characteristics of Parquet:

- **Free and open-source** file format
- Language **agnostic**
- Column-based format
- Used for analytics (**OLAP**) use cases
- **Highly efficient** data compression and decompression
- **Supports complex data types** and advanced nested data structures

Problems with Parquet format

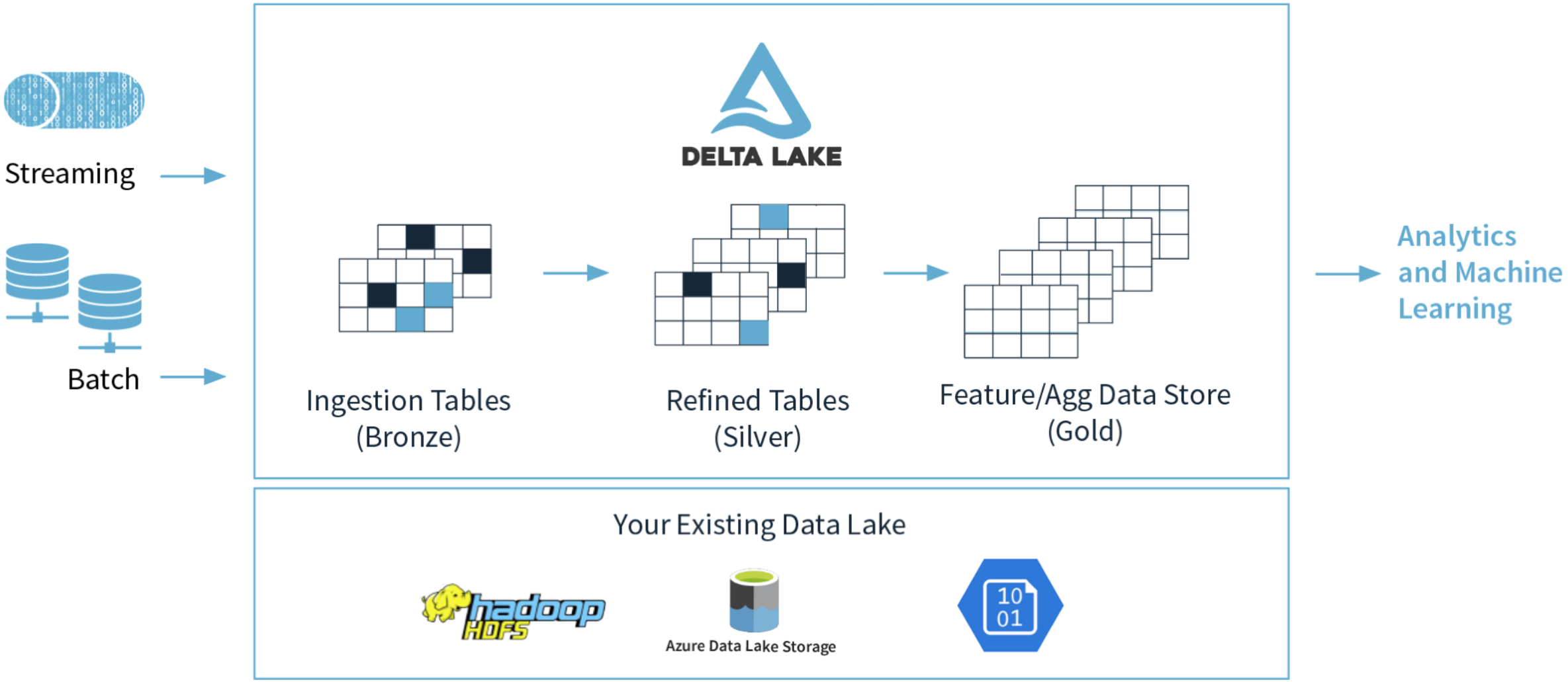
- No schema enforcement
- Updates – rewrite entire file/all files
- Transactions inconsistency
- No interoperability between batch & streaming workloads
- No versioning

Advantages of Delta Lake over CSV



https://delta.io/blog/2023-03-22-convert-csv-to-delta-lake/

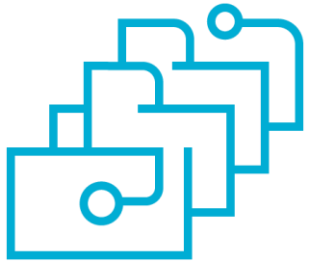
Medallion Architecture



Delta Lake – Key Features

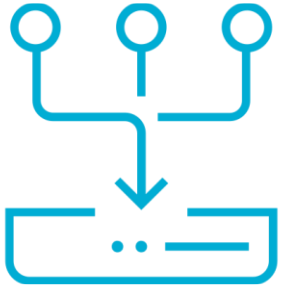
ACID Transactions

Scalable Metadata

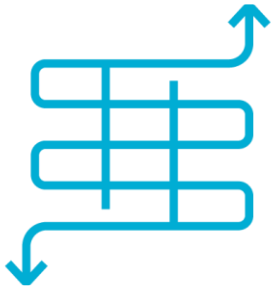


Time Travel

Open Source



Unified Batch/Streaming



Schema Evolution / Enforcement

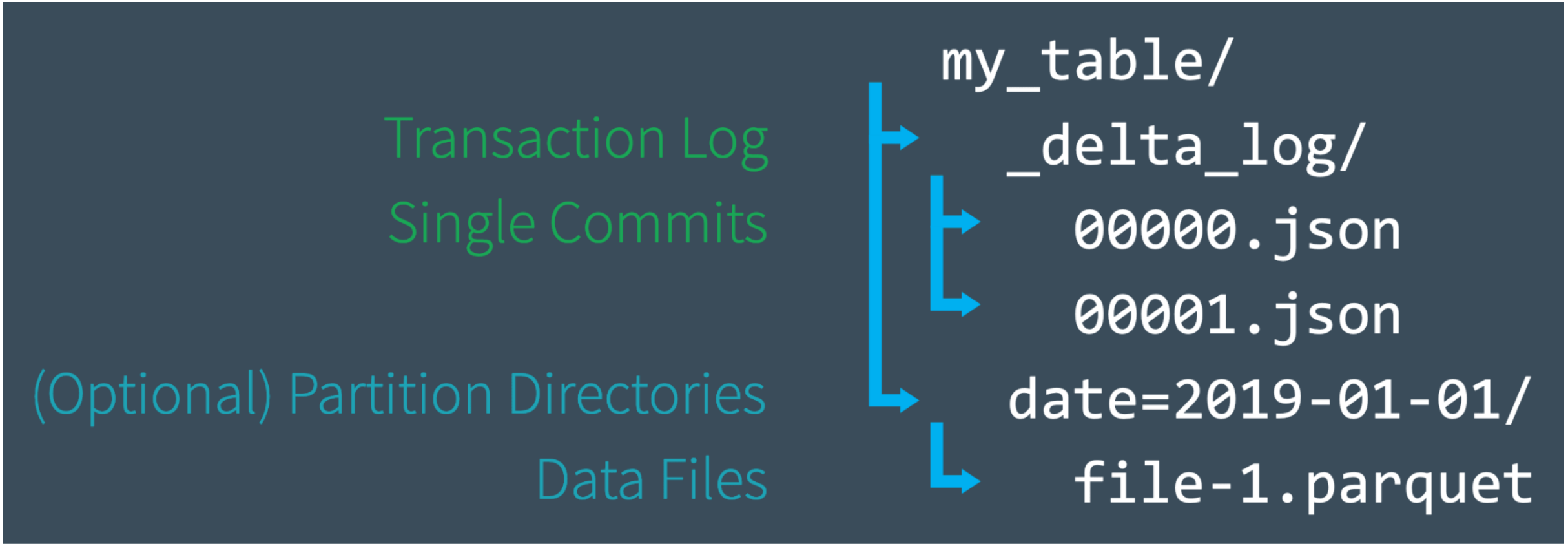
Audit History

DML Operations

CONVERT

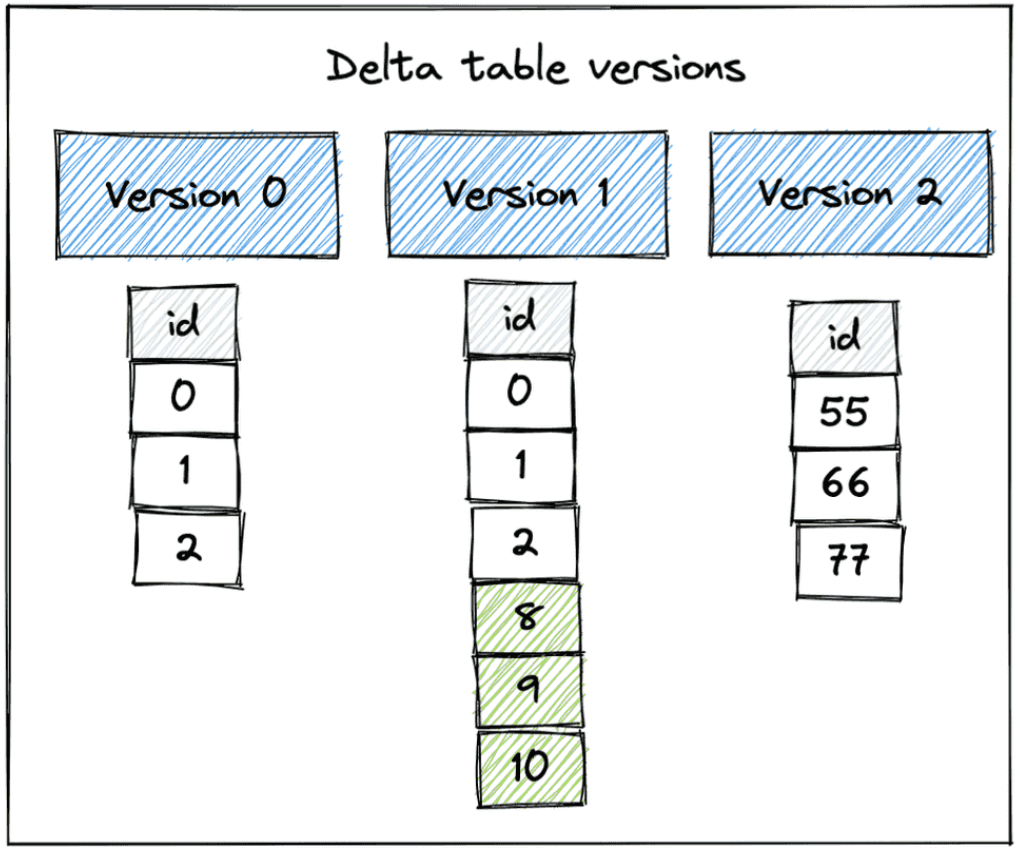

```
CONVERT TO DELTA database_name.table_name; -- only for Parquet tables

CONVERT TO DELTA parquet.`s3://my-bucket/path/to/table`
  PARTITIONED BY (date DATE); -- if the table is partitioned

-- Uses Iceberg manifest for metadata
CONVERT TO DELTA iceberg.`s3://my-bucket/path/to/table`;
```

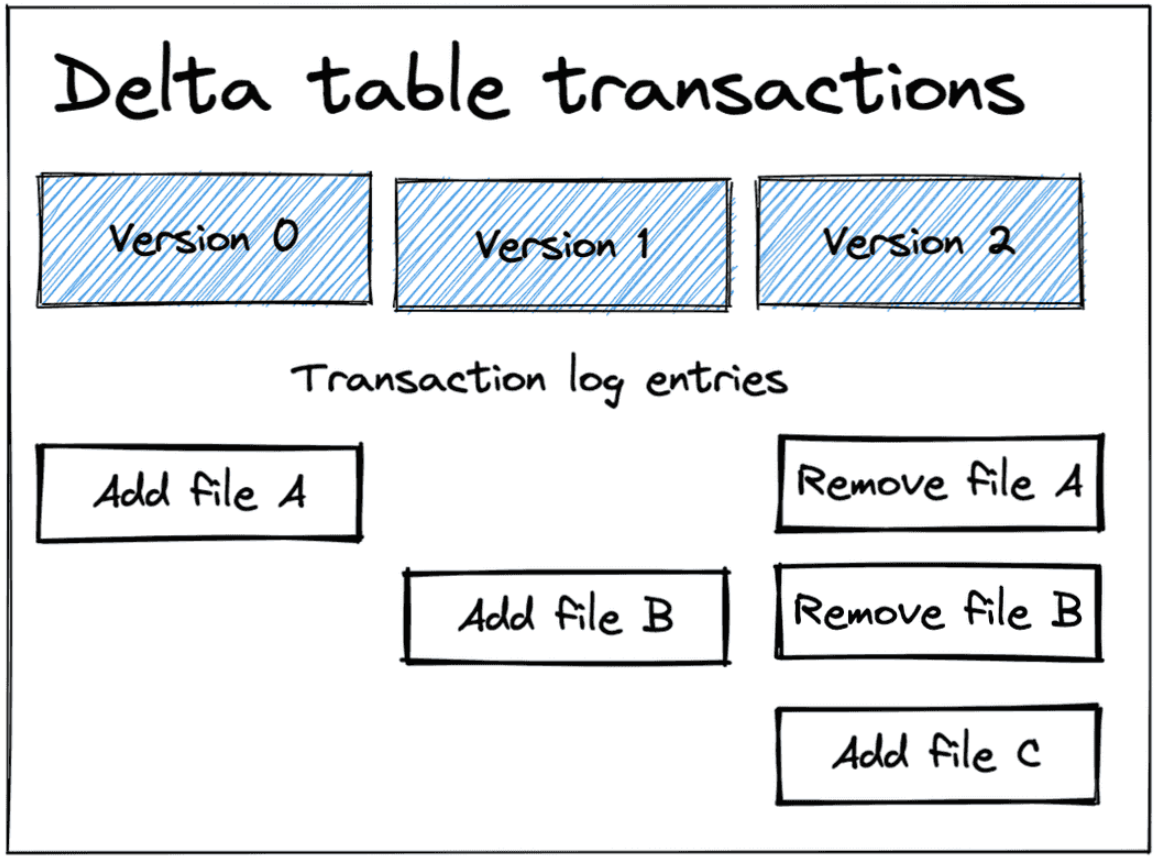
Transaction Log



Transaction Log

Time Travel





Metadata Tools

Command	Result
`DESCRIBE TABLE`	Schema of a table
`DESCRIBE EXTENDED`	Schema of a table + table details
`DESCRIBE HISTORY`	Table's changes & versions

DESCRIBE TABLE

- `DESCRIBE TABLE Lakedb.deltaUsers`

	col_name	data_type	comment
1	UserId	int	null
2	DisplayName	string	null
3	LastAccessDate	date	null
4	Reputation	int	null

DESCRIBE TABLE EXTENDED

- `DESCRIBE EXTENDED Lakedb.deltaUsers`

	col_name	data_type	comment
1	UserId	int	null
2	DisplayName	string	null
3	LastAccessDate	date	null
4	Reputation	int	null
5			
6	# Detailed Table Information		
7	Catalog	spark_catalog	
8	Database	Lakedb	
9	Table	deltaUsers	
10	Type	EXTERNAL	
11	Location	dbfs:/datarelay2023/delta/deltausers	
12	Provider	delta	
13	Owner	root	
14	Table Properties	[delta.minReaderVersion=1,delta.minWriterVersion=2]	

View Table Details

- `DESCRIBE DETAIL '/delta/deltausers/'`
- `DESCRIBE DETAIL Lakedb.deltaUsers`

Column	Type	Description
format	string	Format of the table, that is, `delta`.
id	string	Unique ID of the table.
name	string	Name of the table as defined in the metastore.
description	string	Description of the table.
location	string	Location of the table.
createdAt	timestamp	When the table was created.
lastModified	timestamp	When the table was last modified.
partitionColumns	array of strings	Names of the partition columns if the table is partitioned.
numFiles	long	Number of the files in the latest version of the table.
sizeInBytes	int	The size of the latest snapshot of the table in bytes.

format	id	name	description	location	createdAt	lastModified	partitionColumns
delta	4a67f614-32f2-465f-85fa-5e466983393c	spark_catalog.lakedb.deltausers	null	dbfs:/datarelay2023/delta/deltausers	2023-09-30T01:20:30.202+0000	2023-09-30T01:21:46.000+0000	[]

numFiles	sizeInBytes	properties	minReaderVersion	minWriterVersion	tableFeatures	statistics
2	2409	{}	1	2	["appendOnly",	{}

minReaderVersion	int
	Minimum version of readers (according to the log protocol) that can d the table.
	imum version of writers (according to the log protocol) that can te to the table.

History

- `DESCRIBE HISTORY Lakedb.deltaUsers`
- `DESCRIBE HISTORY delta.`/delta/users``

	version	timestamp	userId	userName	operation	operationParameters	job
1	2	2023-09-30T01:21:46.000+0000	4809069939003851	kamil@nowinski.net	MERGE	{"predicate": "[\"(UserId#14978 = UserId#14982)\"]", "matchedPredicates": "[{\"actionType\":\"update\"}]", "notMatchedPredicates": "[{\"actionType\":\"insert\"}]", "notMatchedBySourcePredicates": "[]"}	null
2	1	2023-09-30T01:21:10.000+0000	4809069939003851	kamil@nowinski.net	MERGE	{"predicate": "[\"(UserId#13638 = UserId#13646)\"]", "matchedPredicates": "[{\"actionType\":\"update\"}]", "notMatchedPredicates": "[{\"actionType\":\"insert\"}]", "notMatchedBySourcePredicates": "[]"}	null

notebook	clusterId	readVersion	isolationLevel	isBlindAppend	operationMetrics	userMetadata
{"notebookId": "2353687493752337"}	0926-221804-4448n59m	1	WriteSerializable	false	{"numTargetRowsCopied": "2", "numTargetRowsDeleted": "0", "numTargetFilesAdded": "2", "numTargetBytesAdded": "2409", "numTargetBytesRemoved": "1247", "numTargetDeletionVectorsAdded": "0", "numTargetRowsMatchedUpdated": "1", "executionTimeMs": "8325", "numTargetRowsInserted": "0", "numTargetRowsMatchedDeleted": "0", "scanTimeMs": "1742", "numTargetRowsUpdated": "1", "numOutputRows": "3", "numTargetDeletionVectorsRemoved": "0", "numTargetRowsNotMatchedBySourceUpdated": "0", "numTargetChangeFilesAdded": "0", "numSourceRows": "1", "numTargetFilesRemoved": "1", "numTargetRowsNotMatchedBySourceDeleted": "0", "rewriteTimeMs": "6485"}	null
{"notebookId": "2353687493752337"}	0926-221804-4448n59m	0	WriteSerializable	false	{"numTargetRowsCopied": "0", "numTargetRowsDeleted": "0", "numTargetFilesAdded": "1", "numTargetBytesAdded": "1247", "numTargetBytesRemoved": "0", "numTargetDeletionVectorsAdded": "0", "numTargetRowsMatchedUpdated": "0", "executionTimeMs": "3056", "numTargetRowsInserted": "3", "numTargetRowsMatchedDeleted": "0", "scanTimeMs": "1979", "numTargetRowsUpdated": "0", "numOutputRows": "3", "numTargetDeletionVectorsRemoved": "0", "numTargetRowsNotMatchedBySourceUpdated": "0", "numTargetChangeFilesAdded": "0", "numSourceRows": "3", "numTargetFilesRemoved": "0", "numTargetRowsNotMatchedBySourceDeleted": "0", "rewriteTimeMs": "970"}	null
{"notebookId": "2353687493752337"}	0926-221804-4448n59m	null	WriteSerializable	true	{}	null

Schema Validation

- All DataFrame **columns** must exist in the target table
- DataFrame column **data types** must match
- DataFrame **column names** cannot differ **only by case**

Schema Evolution

Azure Player
Play with data & have fun!

Delta Lake allows for schema evolution

1: Suppose you have this Delta table

```
+----------+---+
|first_name|age|
+----------+---+
|       bob| 47|
|        li| 23|
|   leonard| 51|
+----------+---+
```

2: Data to append

```
+----------+---+-------+
|first_name|age|country|
+----------+---+-------+
|     frank| 68|    usa|
|   jordana| 26| brasil|
+----------+---+-------+
```

Extra column of data

3: Schema enforcement will prevent the mismatched append

```
df.write.format("delta").mode("append").save("tmp/fun_people")
```

👮🛑 Exception: no data appended!

4: Use mergeSchema to enable schema evolution 🥰

```
df.write.option("mergeSchema", "true").mode("append").format("delta").save(
    "tmp/fun_people"
)
```

```
spark.read.format("delta").load("tmp/fun_people").show()
```

```
+----------+---+-------+
|first_name|age|country|
+----------+---+-------+
|   jordana| 26| brasil|
|     frank| 68|    usa|
|   leonard| 51|   null|
|       bob| 47|   null|
|        li| 23|   null|
+----------+---+-------+
```

So amazingly cool!

Schema Evolution - Automatic

Columns that are present in the DataFrame but missing from the table are automatically added as part of a write transaction when:

- write or writeStream have .option("**mergeSchema**", "true")
- spark.databricks.delta.**schema.autoMerge.enabled** is true


Azure Player
Play with data & have fun!
DEMO
Feedback please

DEMO Agenda

Azure Player
Play with data & have fun!

- Convert CSV to Parquet and to Delta
- Read, insert & update data (DML)
- Transaction Log & DESCRIBE command
- Time Travel
- Schema validation & enforcement
- ~~Compact files / partition~~

Feedback please

Update Table Schema

Azure Player
Play with data & have fun!

Columns	Query (in SQL)	Behaviour without schema evolution (default)	Behaviour with schema evolution

Target columns: key, value
 	
Source columns: key, value, new_value
	`MERGE INTO target_table t`
	`USING source_table s`
	`ON t.key = s.key`
	`WHEN MATCHED`
	`THEN UPDATE SET *`
	`WHEN NOT MATCHED`
	`THEN INSERT *`
		The table schema remains unchanged; only columns key, value are updated/inserted.	The table schema is changed to (key, value, new_value). Existing records with matches are updated with the value and new_value in the source. New rows are inserted with the schema (key, value, new_value).

Target columns: key, old_value
 	
Source columns: key, new_value
	`MERGE INTO target_table t`
	`USING source_table s`
	`ON t.key = s.key`
	`WHEN MATCHED`
	`THEN UPDATE SET *`
	`WHEN NOT MATCHED`
	`THEN INSERT *`
		UPDATE and INSERT actions throw an error because the target column old_value is not in the source.	The table schema is changed to (key, old_value, new_value). Existing records with matches are updated with the new_value in the source leaving old_value unchanged. New records are inserted with the specified key, new_value, and NULL for the old_value.

Target columns: key, old_value
 	
Source columns: key, new_value
	`MERGE INTO target_table t`
	`USING source_table s`
	`ON t.key = s.key`
	`WHEN MATCHED`
	`THEN UPDATE`
	`  SET new_value = s.new_value`
		UPDATE throws an error because column new_value does not exist in the target table.	The table schema is changed to (key, old_value, new_value). Existing records with matches are updated with the new_value in the source leaving old_value unchanged, and unmatched records have NULL entered for new_value. See note (1).

Target columns: key, old_value
 	
Source columns: key, new_value
	`MERGE INTO target_table t`
	`USING source_table s`
	`ON t.key = s.key`
	`WHEN NOT MATCHED`
	`THEN INSERT (key, new_value)`
	`  VALUES (s.key, s.new_value)`
		INSERT throws an error because column new_value does not exist in the target table.	The table schema is changed to (key, old_value, new_value). New records are inserted with the specified key, new_value, and NULL for the old_value. Existing records have NULL entered for new_value leaving old_value unchanged. See note (1).

Release 3.2

- https://github.com/delta-io/delta/releases/tag/v3.2.0
- Support for Apache Spark 3.5.

Release 4.0 (preview)

- https://github.com/delta-io/delta/releases/
- Documentation: https://github.com/delta-io/delta/releases/tag/v4.0.0rc1
- Built on top of Apache Spark 4.0.0!

Databricks Runtimes

Standard

14.0	Scala 2.12, Spark 3.5.0
13.3 LTS	Scala 2.12, Spark 3.4.1
13.2	Scala 2.12, Spark 3.4.0
13.1	Scala 2.12, Spark 3.4.0
13.0	Scala 2.12, Spark 3.4.0
12.2 LTS	Scala 2.12, Spark 3.3.2
11.3 LTS	Scala 2.12, Spark 3.3.0
10.4 LTS	Scala 2.12, Spark 3.2.1
9.1 LTS	Scala 2.12, Spark 3.1.2
7.3 LTS	Scala 2.12, Spark 3.0.1

ML

14.0 ML	GPU, Scala 2.12, Spark 3.5.0
14.0 ML	Scala 2.12, Spark 3.5.0
13.3 LTS ML	GPU, Scala 2.12, Spark 3.4.1
13.3 LTS ML	Scala 2.12, Spark 3.4.1
13.2 ML	GPU, Scala 2.12, Spark 3.4.0
13.2 ML	Scala 2.12, Spark 3.4.0
13.1 ML	GPU, Scala 2.12, Spark 3.4.0
13.1 ML	Scala 2.12, Spark 3.4.0
13.0 ML	GPU, Scala 2.12, Spark 3.4.0
13.0 ML	Scala 2.12, Spark 3.4.0
12.2 LTS ML	GPU, Scala 2.12, Spark 3.3.2
12.2 LTS ML	Scala 2.12, Spark 3.3.2

Uncategorised

Runtime 10.2	Scala 2.12, Spark 3.2
Runtime 10.2	Scala 2.12, Spark 3.2
Runtime 3.0	Scala 2.10, Spark 2.2
Runtime 3.0	Scala 2.10, Spark 2.2
Spark 2.0	Scala 2.10, Spark 2.0
Spark 1.6.2	Scala 2.10, Spark 1.6.2
Spark 1.5.2	Scala 2.10, Spark 1.5.2

Synapse Runtimes

Component	Version
Apache Spark	3.2.1
Operating System	Ubuntu 18.04
Java	1.8.0_282
Scala	2.12.15
Hadoop	3.3.1
.NET Core	3.1
.NET	2.0.0
Delta Lake	1.2
Python	3.8
R (Preview)	4.2

Component	Version
Apache Spark	3.3.1
Operating System	Ubuntu 18.04
Java	1.8.0_282
Scala	2.12.15
Hadoop	3.3.3
Delta Lake	2.2.0
Python	3.10
R (Preview)	4.2.2

Component	Version
Apache Spark	3.4.1
Operating System	Mariner 2.0
Java	11
Scala	2.12.17
Delta Lake	2.4.0
Python	3.10
R	4.2.2


Azure Player
Play with data & have fun!
Summary

Summary

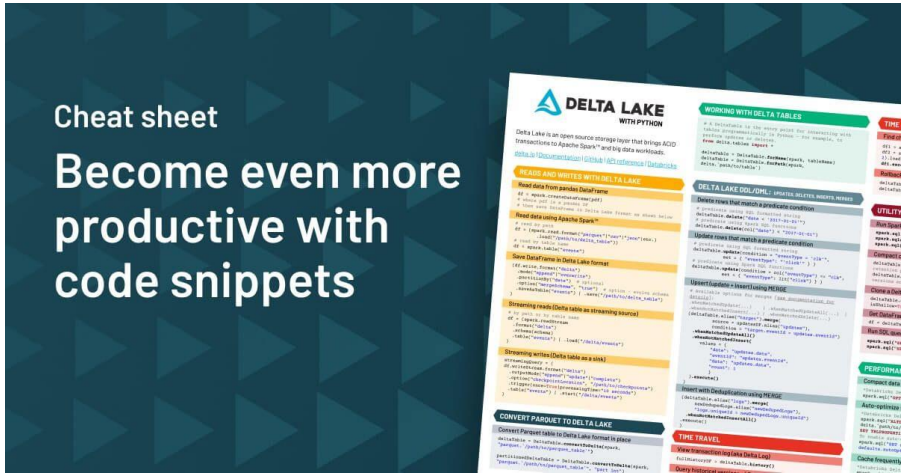
- Delta Lake is optimized storage layer
- Delta Lake operates on Parquet files underneath
- File-based transaction log for ACID transactions
- Open Source
- Supported by Azure Databricks, Synapse & ADF
- Default storage format for all operations on Azure Databricks

Resources

- https://delta.io/
  - https://docs.delta.io/latest/releases.html
  - https://github.com/delta-io/delta/
  - https://github.com/delta-io/delta/releases/
  - https://github.com/delta-io/delta-examples/
  - Table batch reads and writes
- Lambda Architecture
- Delta Lake Blogs
- What is Delta Lake? (Microsoft)
- Getting Started with Delta Lake (Databricks)
- Follow on LinkedIn: Delta Lake
- Unpacking The Transaction Log
- Cheat sheets on Learn with AzurePlayer (free)

Azure Player
Play with data & have fun!

Thank you for your feedback



Resources – cont.

Azure Player
Play with data & have fun!

How to engage?

DELTA LAKE

delta.io

delta-users
Slack

Delta Lake
YouTube channel

delta-users
Google Group

Delta Lake
GitHub Issues

Delta Lake RS
Bi-weekly meetings

data-ai-online

Thank you
for your feedback

Thank you!


kamil@azureplayer.net


@NowinskiK @Azure_Player


AzurePlayer.net


https://AzurePlayer.net/slides

Thank you for your feedback

Kamil Nowinski
Microsoft Data Platform MVP
Analytics Architect, Azure DevOps Engineer Expert

DATA:Scotland 2024

Session Feedback

Event Feedback