



Microsoft Ignite





AI on Legacy Machines: From Sparse Signals to Real Outcomes

Michael Plettner



Agenda

- Framing the challenge
- Practical paths to start with AI and Data fundamentals
- Demo
- Blueprint

Framing the Challenge in Manufacturing



Framing the Challenge in Manufacturing

AI Adoption Motivations

Executive leadership drives AI adoption to boost production efficiency, sales, and profitability in manufacturing.

Legacy Equipment Challenges

Existing machines are under depreciation, lack telemetry, and have limited data access and compute capabilities.

Non-Invasive AI Retrofits

Non-invasive AI retrofits enable AI deployment alongside current equipment without hardware replacement or downtime.

Operational Constraints

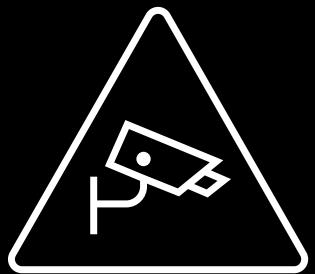
Challenges include data scarcity, hardware limits, and operational risk, requiring practical AI implementation strategies.



Practical paths to start with
AI and Data fundamentals

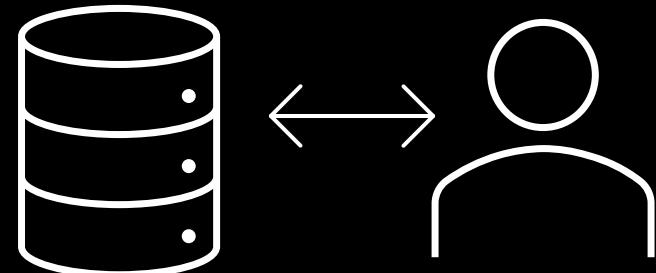
Practical paths to start with AI

Sensor-based



(e.g. gauge reading, defect detection)

Proxy data



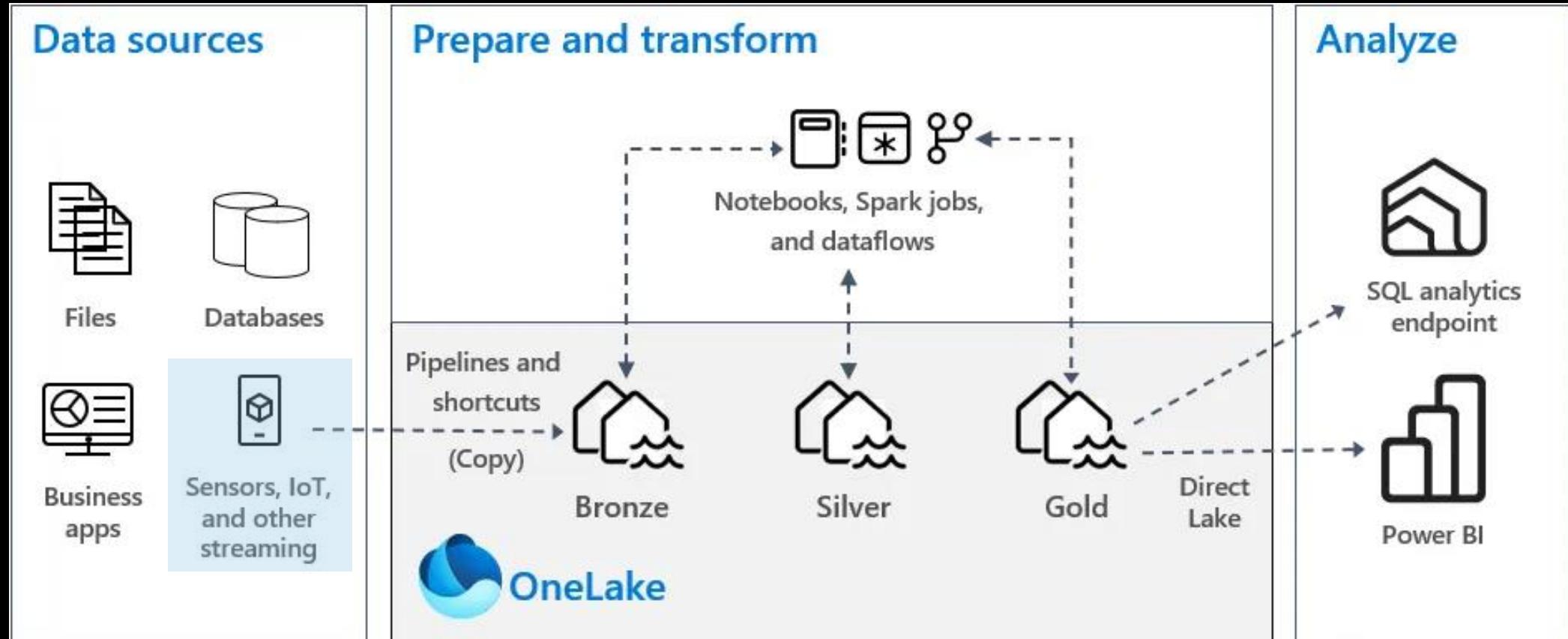
(e.g. downtime logs, operator input)

Edge gateway or hybrid cloud inference



(local pre/post-processing + cloud AI)

Demo Fundamental – Medallion Architecture

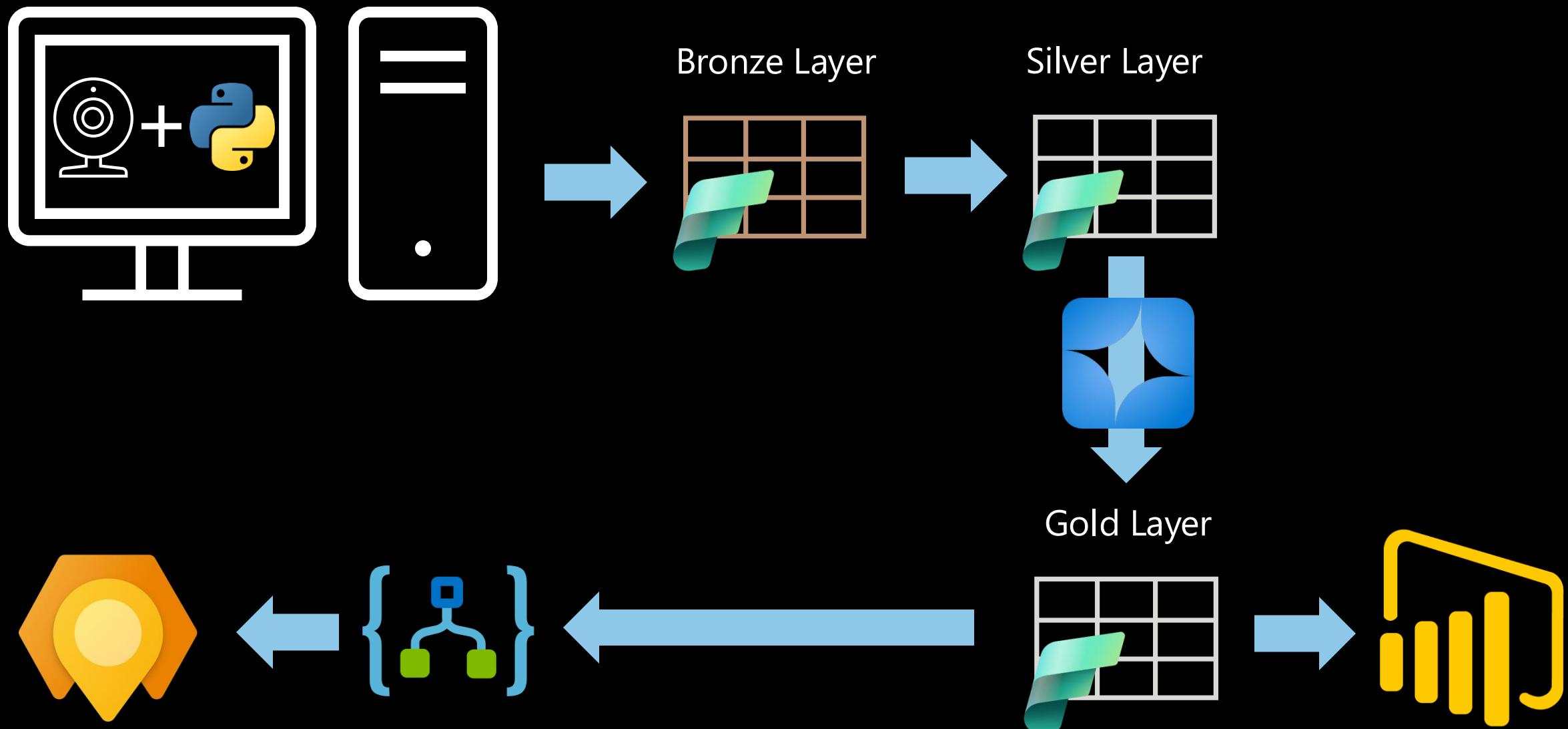


Picture from Bas Land – “That Fabric Guy” - <https://thatfabricguy.com/medallion-architecture-microsoft-fabric-theory-guide/>

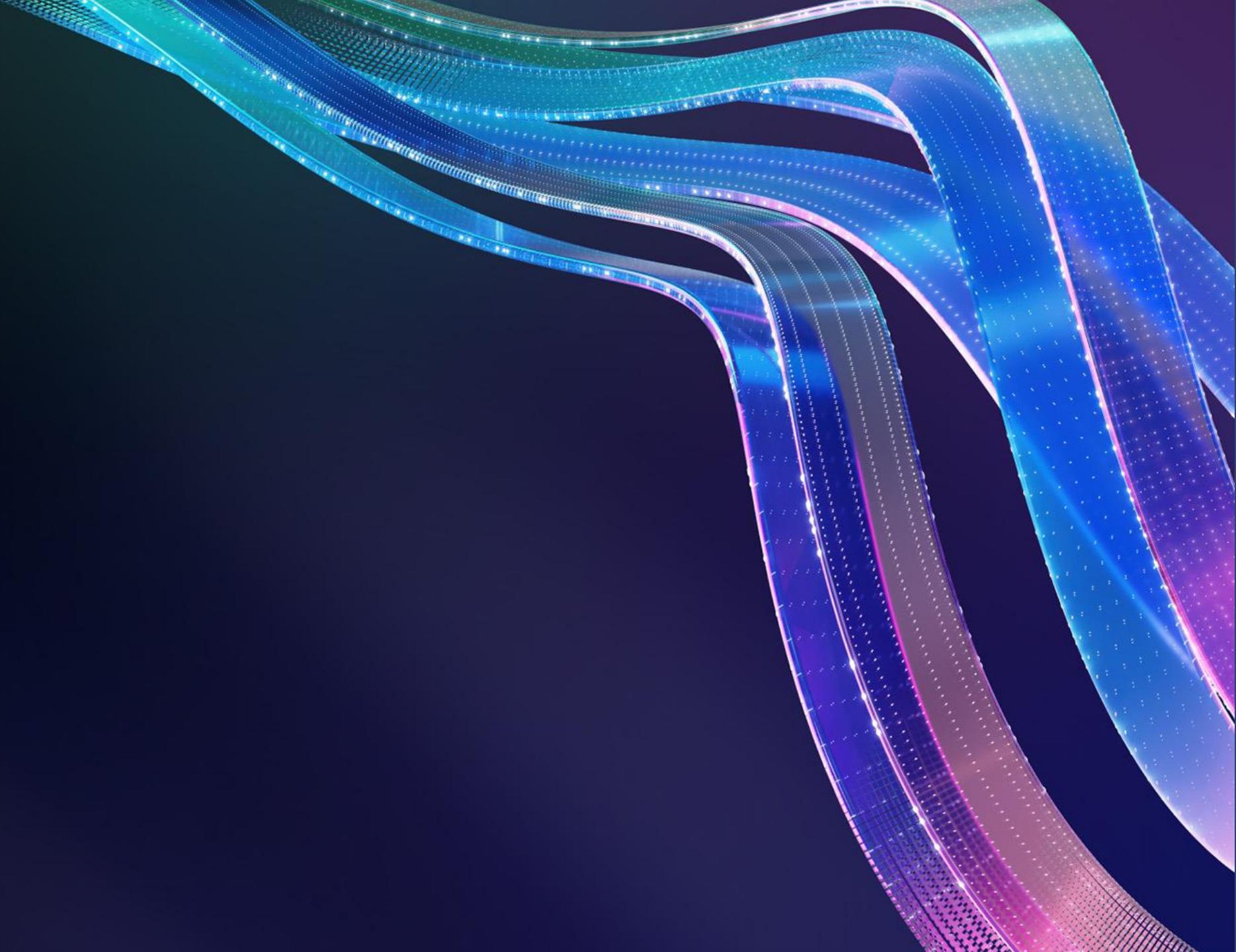
Demo



Demo Flow



Demo

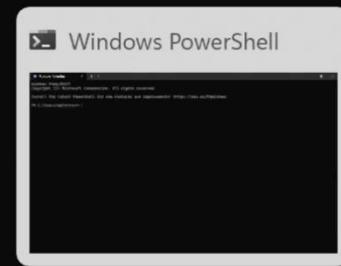


Windows PowerShell - X

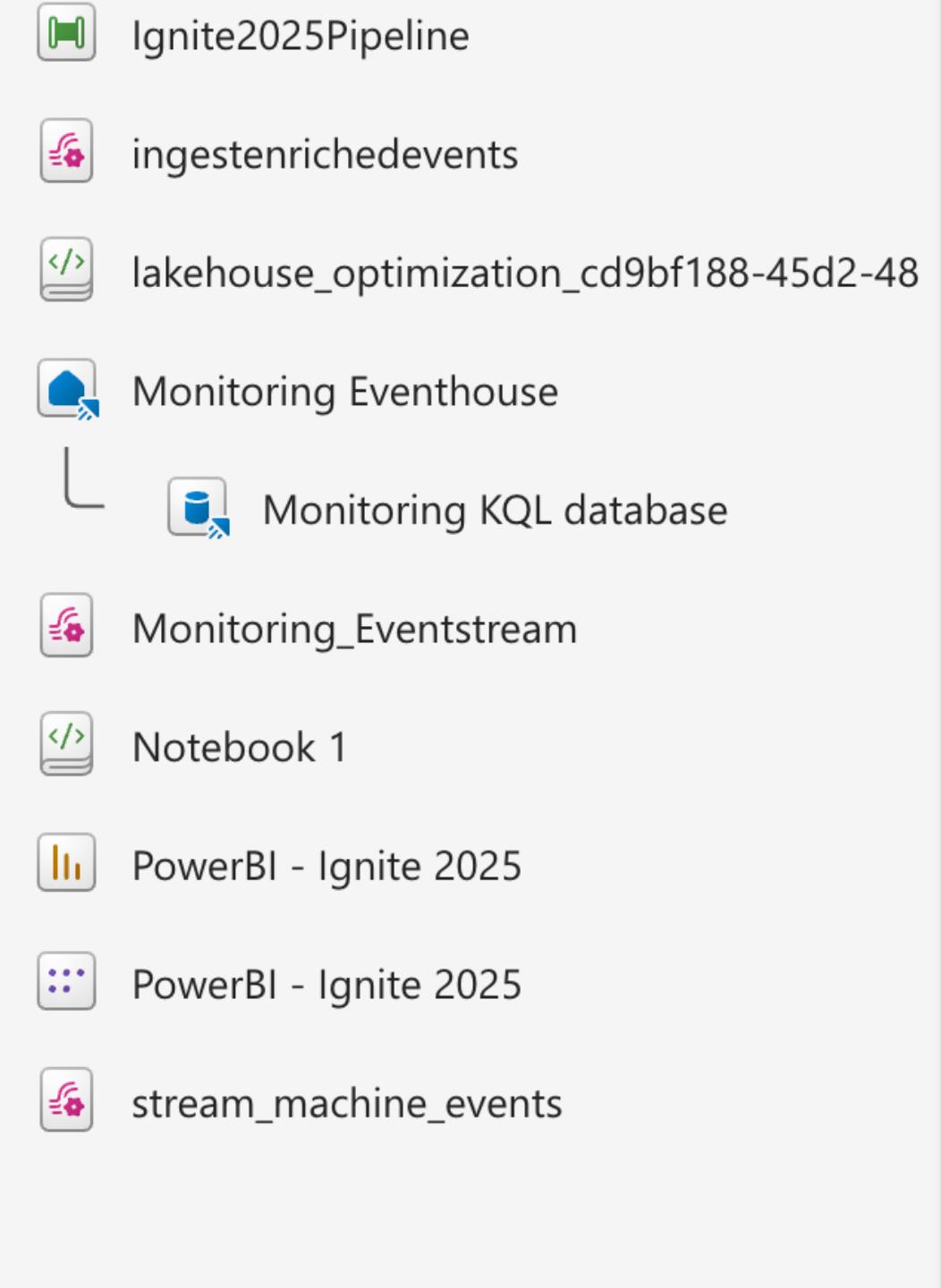
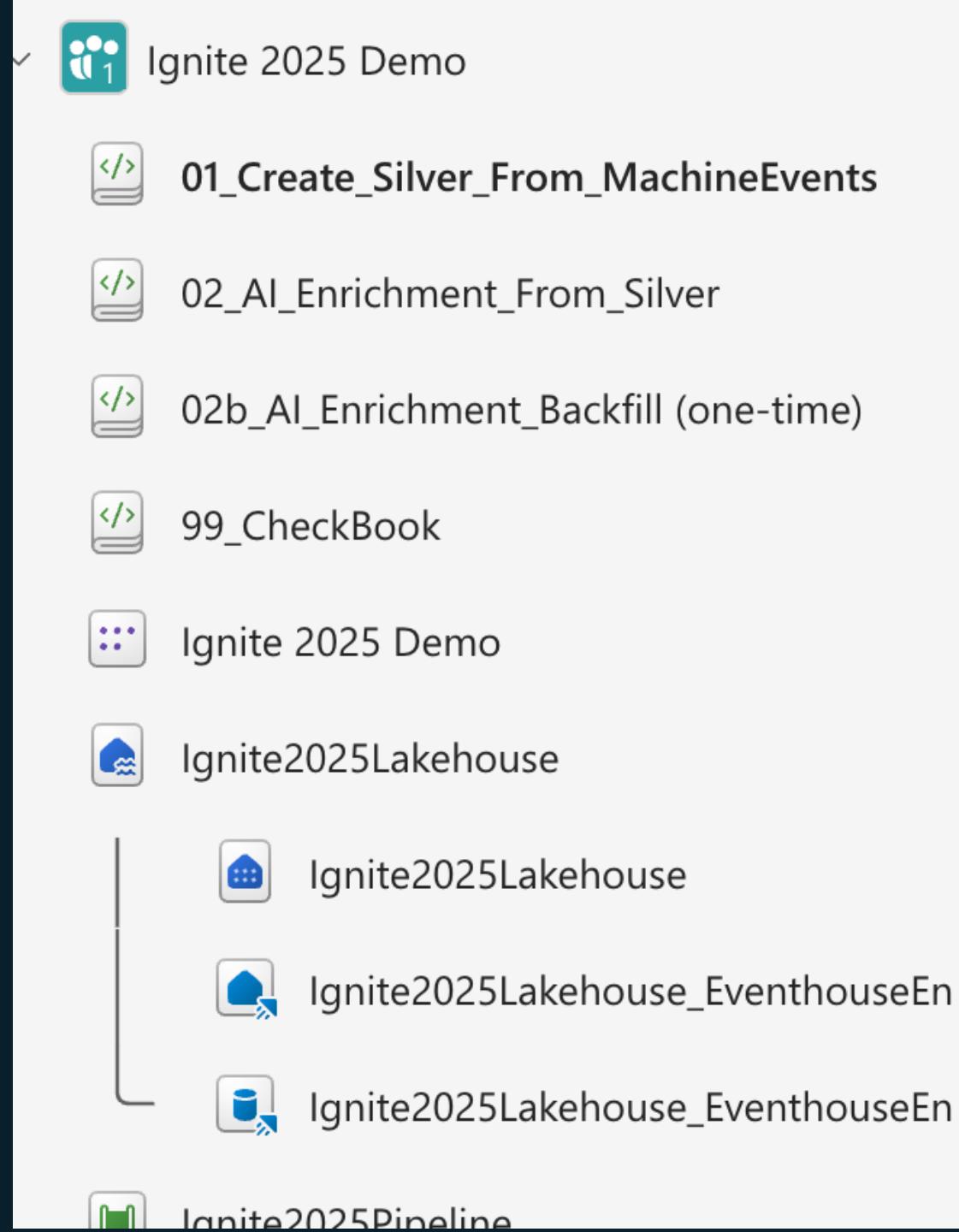
```
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

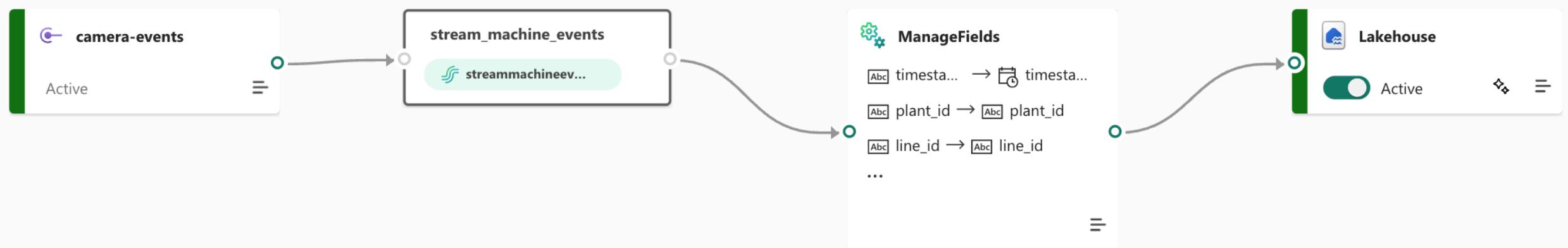
Install the latest PowerShell for new features and improvements! https://aka.ms/PSWindows

PS C:\Users\mplettner> |
```



Activate Windows
Go to Settings to activate Windows.







Ignite2025Lakehouse



Tables

>  machine_events_gold

>  machine_events_quarantine

>  machine_events_silver

>  machine_events_v5



Files

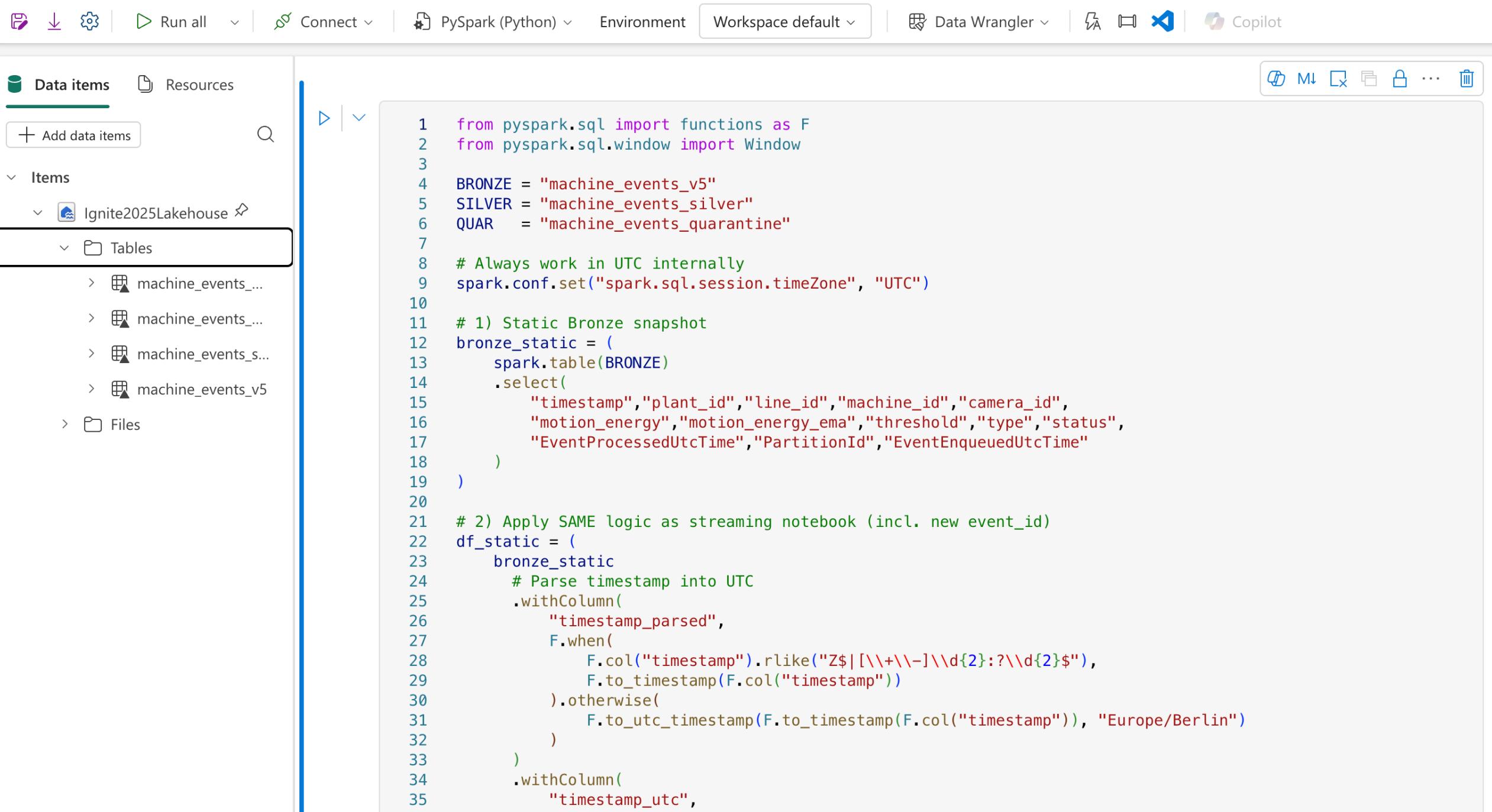
>  _checkpoints

	⌚ timestamp	ABC plant_id	ABC line_id	ABC machine_id	ABC camera_id	1.2 motion_ene...	1.2 motion_ene...	1.2 threshold	ABC type	ABC status	🖨
688	2025-11-20T18:00:00Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0034	0.0129	0.01	telemetry	OK	20:
689	2025-11-20T18:00:02Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0042	0.0126	0.01	anomaly	ALERT	20:
690	2025-11-20T18:00:04Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0047	0.0124	0.01	telemetry	OK	20:
691	2025-11-20T18:00:06Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0205	0.0126	0.01	telemetry	OK	20:
692	2025-11-20T18:00:08Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0082	0.0125	0.01	telemetry	OK	20:
693	2025-11-20T18:00:10Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0088	0.0124	0.01	telemetry	OK	20:
694	2025-11-20T18:00:12Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0107	0.0123	0.01	telemetry	OK	20:
695	2025-11-20T18:00:14Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0123	0.0123	0.01	telemetry	OK	20:
696	2025-11-20T18:00:16Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0128	0.0123	0.01	telemetry	OK	20:
697	2025-11-20T18:00:18Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.013	0.0123	0.01	telemetry	OK	20:
698	2025-11-20T18:00:20Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.013	0.0124	0.01	telemetry	OK	20:
699	2025-11-20T18:00:22Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0118	0.0124	0.01	telemetry	OK	20:
700	2025-11-20T18:00:24Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0104	0.0123	0.01	telemetry	OK	20:
701	2025-11-20T18:00:26Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0094	0.0122	0.01	telemetry	OK	20:
702	2025-11-20T18:00:28Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.01	0.0121	0.01	telemetry	OK	20:
703	2025-11-20T18:00:30Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0084	0.012	0.01	telemetry	OK	20:
704	2025-11-20T18:00:32Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0079	0.0119	0.01	telemetry	OK	20:
705	2025-11-20T18:00:34Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0094	0.0118	0.01	telemetry	OK	20:
706	2025-11-20T18:00:36Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0117	0.0118	0.01	telemetry	OK	20:
707	2025-11-20T18:00:38Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0124	0.0118	0.01	telemetry	OK	20:
708	2025-11-20T18:00:40Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0521	0.0131	0.01	telemetry	OK	20:
709	2025-11-20T18:00:42Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0077	0.0129	0.01	telemetry	OK	20:
710	2025-11-20T18:00:44Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0076	0.0128	0.01	telemetry	OK	20:
711	2025-11-20T18:00:46Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0089	0.0126	0.01	anomaly	ALERT	20:
712	2025-11-20T18:00:48Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0068	0.0125	0.01	telemetry	OK	20:
713	2025-11-20T18:00:50Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0077	0.0123	0.01	telemetry	OK	20:
714	2025-11-20T18:00:52Z	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	0.0104	0.0122	0.01	telemetry	OK	20:

on_ene...	1.2 motion_ene...	1.2 threshold	ABC type	ABC status	20:
	0.0129	0.01	telemetry	OK	20:
	0.0126	0.01	anomaly	ALERT	20:
	0.0124	0.01	telemetry	OK	20:
	0.0126	0.01	telemetry	OK	20:
	0.0125	0.01	telemetry	OK	20:
	0.0124	0.01	telemetry	OK	20:
	0.0123	0.01	telemetry	OK	20:



01_Create_Silver_From_MachineEvents



```
161   ,
162
163 print("✅ Batch sync Bronze → Silver + Quarantine finished.")
```

[1] ✓ 3 min 15 sec - Session ready in 12 sec 441 ms. Command executed in 3 min 3 sec 35 ms by Michael Plettner on 2:17:21 PM

> Spark jobs (20 of 20 succeeded) Resources Log

> Diagnostics 4 |

... Good rows before dedup: 941060

Good rows after dedup: 50353

✓ Batch sync Bronze → Silver + Quarantine finished.

machine_events_silver

Showing 1000 rows

Table view



ABC event_id	ABC timestamp	ABC site	ABC line_id	ABC machine_id	ABC camera_id	ABC status	ABC event_type	1.2 motion_energy	1.2 movement_intensity	1.2...
1d220020ad540...	2025-11-20T13:...	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	OK	telemetry	0	0	0.
222980ef4e3941...	2025-11-20T13:...	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	OK	telemetry	0	0	0.
0b44ded770116...	2025-11-20T13:...	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	OK	telemetry	0	0	0.
2d58e7c450213f...	2025-11-20T13:...	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	OK	telemetry	0	0	0.
093b425a8e09a...	2025-11-20T13:...	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	ALERT	movement_alert	0.0001	0.01	0.
0fd26cfec5d59...	2025-11-20T13:...	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	ALERT	movement_alert	0.0001	0.01	0.
1eba7f492f984f7...	2025-11-20T13:...	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	ALERT	movement_alert	0.2304	23.04	0.
2c2ff686a21a53...	2025-11-20T13:...	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	ALERT	movement_alert	0.2304	23.04	0.
29b84ed85b789...	2025-11-20T13:...	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	ALERT	movement_alert	0.2304	23.04	0.
23c1c691477f19...	2025-11-20T13:...	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	ALERT	movement_alert	0.2304	23.04	0.
281501c8fb1afcc...	2025-11-20T13:...	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	ALERT	movement_alert	0.2304	23.04	0.
1f0a49a0e862ed...	2025-11-20T13:...	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	OK	telemetry	0.0012	0.12	0.
02fa317b5bcdae...	2025-11-20T13:...	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	OK	telemetry	0.0002	0.02	0.
1229264f178f80...	2025-11-20T13:...	DE-MUC	Line-01	LegacyPress-A	FacecamPro-Front	OK	telemetry	0.0002	0.02	0.

id	ABC camera_id	ABC status	ABC event_type	1.2 motion_energy		1.2 movement_intensity	1.2...
				0	0		
	FacecamPro-Front	OK	telemetry	0	0	0	0.
	FacecamPro-Front	OK	telemetry	0	0	0	0.
	FacecamPro-Front	OK	telemetry	0	0	0	0.
	FacecamPro-Front	OK	telemetry	0	0	0	0.
	FacecamPro-Front	ALERT	movement_alert	0.0001	0.01	0	0.
	FacecamPro-Front	ALERT	movement_alert	0.0001	0.01	0	0.
	FacecamPro-Front	ALERT	movement_alert	0.2304	23.04	0	0.
	FacecamPro-Front	ALERT	movement_alert	0.2304	23.04	0	0.
	FacecamPro-Front	ALERT	movement_alert	0.2304	23.04	0	0.
	FacecamPro-Front	ALERT	movement_alert	0.2304	23.04	0	0.
	FacecamPro-Front	ALERT	movement_alert	0.2304	23.04	0	0.
	FacecamPro-Front	OK	telemetry	0.0012	0.12	0	0.
	FacecamPro-Front	OK	telemetry	0.0002	0.02	0	0.



02_AI_Enrichment_From_Silver

Other people in your organization may have access to notebooks and Spark job definitions in this workspace. Carefully review this item before running it.

Resources

Q

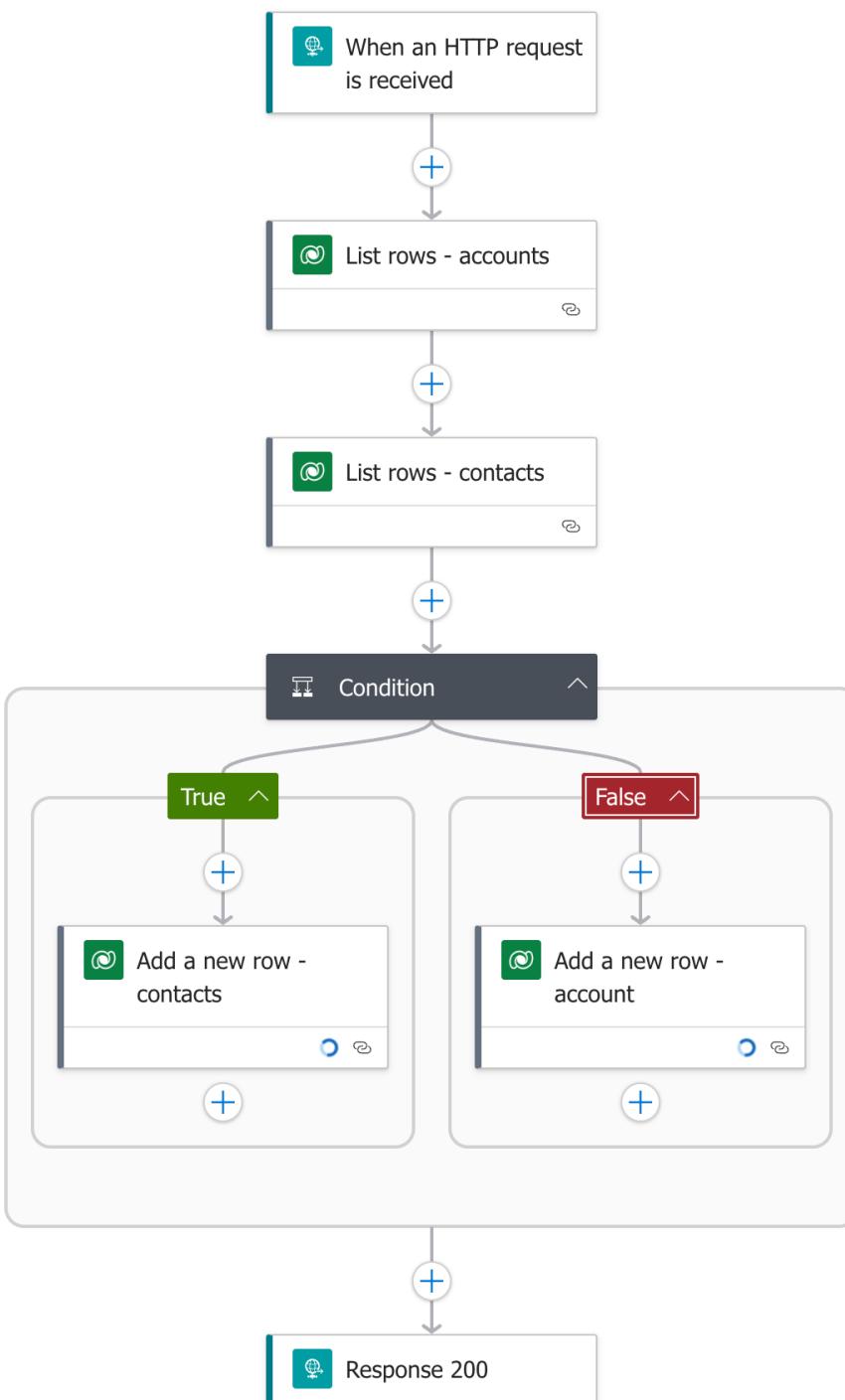
025Lakehouse

```
1 # === AT_Enrichment - Webhook (D365 via Logic App) - BATCH VERSION =====
2 import (module) typing requests
3 from typing import Dict, Tuple
4 from pyspark.sql import functions as F, types as T
5 from pyspark.sql import DataFrame
6
7 # ----- Config -----
8 SILVER      = "machine_events_silver"
9 ENRICHED    = "machine_events_gold"
10
11 # Azure OpenAI (Reasoning model)
12 AOAIEndpoint = "https://ignitedemoopenai.openai.azure.com" # demo endpoint
13 AOAIDeployment = "gpt-5-mini" # exact deployment name
14 AOAIAPIVer = "2025-01-01-preview"
15 AOAIAKey = "REDACTED" # redacted
16
17 # Logic App (HTTP Trigger) - full URL incl. sia=...
18 LOGICAPP_URL = "REDACTED" # redacted
19
20 # Enrichment logic
21 SEND_ONLY_HIGH = True # only send SLA High to D365
22 CONF_THRESHOLD = 0.75 # confidence threshold for SLA=High
23 INTENSITY_HIGH = 1.50 # High also for very high intensity
24
25 # Optional: Power BI link template
26 POWERBI_BASELINK = "" # e.g. "https://app.powerbi.com/...&filter=events/event_id eq '{event_id}'"
27
28 # Timezone
29 spark.conf.set("spark.sql.session.timeZone", "UTC")
30
31 # Ensure target table exists
```

Machine Events Gold											
Machine Events Data							AI Diagnostics & Root Cause				
Index	Event ID	Timestamp	Plant ID	Line ID	Machine ID	Status	Movement ID	AI Explanation	AI Root Cause	Next Action	Score
1	afdfd66418ef94...	2025-11-20T14:...	DE-MUC	Line-01	LegacyPress-A	ALERT	3.51	Hydraulic pressu...	Pump wear or h...	Safely stop press...	0.7
2	501c3e11d05c63...	2025-11-20T14:...	DE-MUC	Line-01	LegacyPress-A	ALERT	1.97	Mild abnormal v...	Possible bearing...	Inspect bearings...	0.6
3	27eb19eda421a...	2025-11-20T13:...	DE-MUC	Line-01	LegacyPress-A	ALERT	23.04	AI empty	no content	manual inspect	0
4	c31a41a2336c45...	2025-11-20T13:...	DE-MUC	Line-01	LegacyPress-A	ALERT	23.04	Unusual vibratio...	Imbalanced flyw...	Stop press, inspe...	0.6
5	8e2e01797cbd8	2025-11-20T13:...	DE-MUC	Line-01	LegacyPress-A	ALERT	23.04	Unexpected high	Possible bearing	Stop press isolat	0.6

Showing 537 rows

ABC	ai_explanati...	ABC	ai_root_cause	ABC	ai_next_acti...	ABC
1.2	movement_i...					1.2
3.51	Hydraulic pressu...		Pump wear or h...		Safely stop press...	0.7
1.97	Mild abnormal v...		Possible bearing...		Inspect bearings...	0.6
23.04	AI empty		no content		manual inspect	0
23.04	Unusual vibratio...		Imbalanced flyw...		Stop press, inspe...	0.6
23.04	Unexpected hig...		Possible bearing...		Stop press, isolat...	0.6



My Active Cases*

Edit columns Edit filters Filter by keyword

<input type="checkbox"/> Case Title	Case Number	Priority	Origin	Customer	Status Reason	Created On
<input type="checkbox"/> [Auto] LegacyPress-A anomaly (8186bd51)	CAS-01772-F9G0G6	Normal		Claus Rottenberger	In Progress	20.11.2025 21:51
<input type="checkbox"/> [Auto] LegacyPress-A anomaly (4517a373)	CAS-01771-T8M1Y3	Normal		Claus Rottenberger	In Progress	20.11.2025 21:51
<input type="checkbox"/> [Auto] LegacyPress-A anomaly (6aa20e65)	CAS-01770-Q7N0D7	Normal		Claus Rottenberger	In Progress	20.11.2025 21:51
<input type="checkbox"/> [Auto] LegacyPress-A anomaly (b3452de8)	CAS-01769-N0X7P7	Normal		Claus Rottenberger	In Progress	20.11.2025 21:51
<input type="checkbox"/> [Auto] LegacyPress-A anomaly (97b1a4a1)	CAS-01768-R1H5L3	Normal		Claus Rottenberger	In Progress	20.11.2025 21:51
<input type="checkbox"/>						

My Active Cases* ▾

<input type="checkbox"/> Case Title ▾	<input type="checkbox"/> Case Number ▾	<input type="checkbox"/> Priority ▾
<input type="checkbox"/> [Auto] LegacyPress-A anomaly (8186bd51)	CAS-01772-F9G0G6	 Normal
<input type="checkbox"/> [Auto] LegacyPress-A anomaly (4517a373)	CAS-01771-T8M1Y3	 Normal
<input type="checkbox"/> [Auto] LegacyPress-A anomaly (6aa20e65)	CAS-01770-Q7N0D7	 Normal
<input type="checkbox"/> [Auto] LegacyPress-A anomaly (b3452de8)	CAS-01769-N0X7P7	 Normal
<input type="checkbox"/> [Auto] LegacyPress-A anomaly (97b1a4a1)	CAS-01768-R1H5L3	 Normal
<input type="checkbox"/>		

Blueprint



Day 0 - Starting Point

Production and Monitoring Highlights

- Legacy production line lacks extensive telemetry
- Access available to Azure and Microsoft Fabric workspace
- Concentrate on one or two critical machines
- Resolve known issues and patterns causing downtime

Day 0 |
Starting



Day 30 | Connect
and Collect



Day 30 - 60 | Unify
and Understand



Day 60 - 90 | Scale
and Sustain

First 30 Days - Connect & Collect

Machine Data Visibility Steps

1. Make machine data visible
2. Install non-invasive sensors
(vibration, current, temperature, camera)
3. Stream data through Eventstream to
Lakehouse (Bronze table)
4. Perform basic transformations and create
Power BI dashboard
5. Produce machine heartbeat dashboard
6. Establish governance
(naming, retention, access roles)

Day 0 | Starting



Day 30 | Connect
and Collect



Day 30 - 60



Day 60 - 90

Next 30 Days (Day 31-60) - Unify & Understand

Steps to Develop Signal Insights

1. Turn signals into structured insights
2. Build Silver table with computed metrics
3. Use Azure OpenAI for anomaly explanations
4. Validate AI output with experts
5. Deliver enrichment pipeline and prompt logic
6. Send confirmed alerts to e.g. Dynamics 365 Field Service

Day 0 | Starting



Day 30 | Connect and Collect



Day 30 - 60 | Unify and Understand



Day 60 - 90

Final 30 Days (Day 61-90) - Scale & Sustain

Steps to Operationalize Fabric Solution

1. Move beyond pilot phase
2. Automate and schedule enrichment jobs
3. Define SLA thresholds and risk scores
4. Monitor success metrics like downtime and MTTR
5. Train maintenance team and document workflow
6. Deliver productionized Fabric solution and training kit

Day 0 | Starting



Day 30 | Connect and Collect



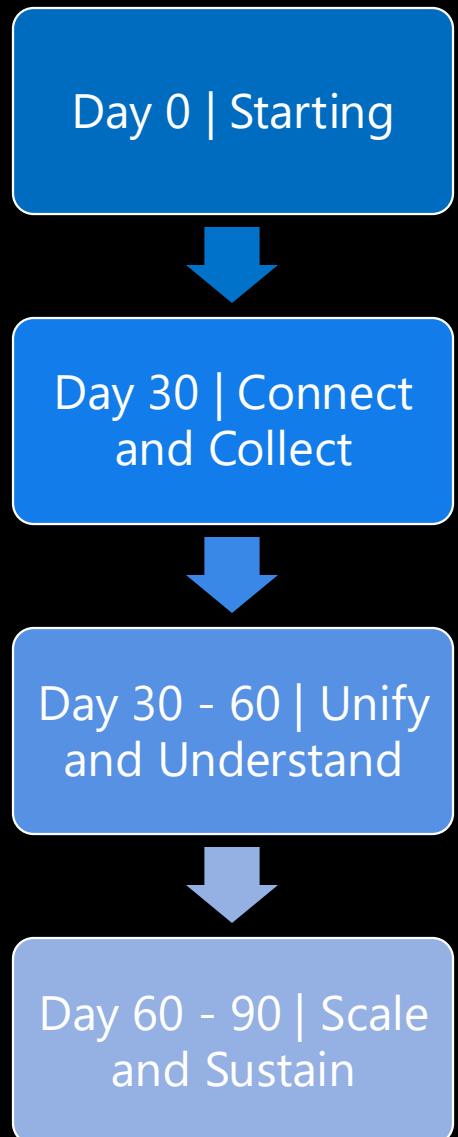
Day 30 - 60 | Unify and Understand



**Day 60 - 90 |
Scale and Sustain**

Outcome Roadmap Summary

- 0-30 days | Connect & Collect
Sensor installation, Bronze data aggregation, Power BI dashboard creation
- 31-60 days | Unify & Understand
Silver table development, AI-driven insights, D365 case automation implementation
- 61-90 days | Scale & Sustain
Scheduled data pipelines, training sessions, ROI reporting



Key Takeaways

- Begin by establishing visibility prior to focusing on intelligence
- Leverage Azure OpenAI to transform limited data into practical insights
- Integrate Dynamics 365 to automate service processes and close the feedback loop



<https://bio.link/plemich>

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