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Unleashing the Power of AI in IoT with InfluxDB 3.0

Agenda

- Data Pipelines, HiveMQ, and InfluxDB
- AI and ML in Data Pipelines
- Real-world Applications in IIoT
- Building in HiveMQ, Quix, and InfluxDB
- Conclusions, Questions, and Source Code

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Anais Dotis-Georgiou
Developer Advocate

LinkedIn

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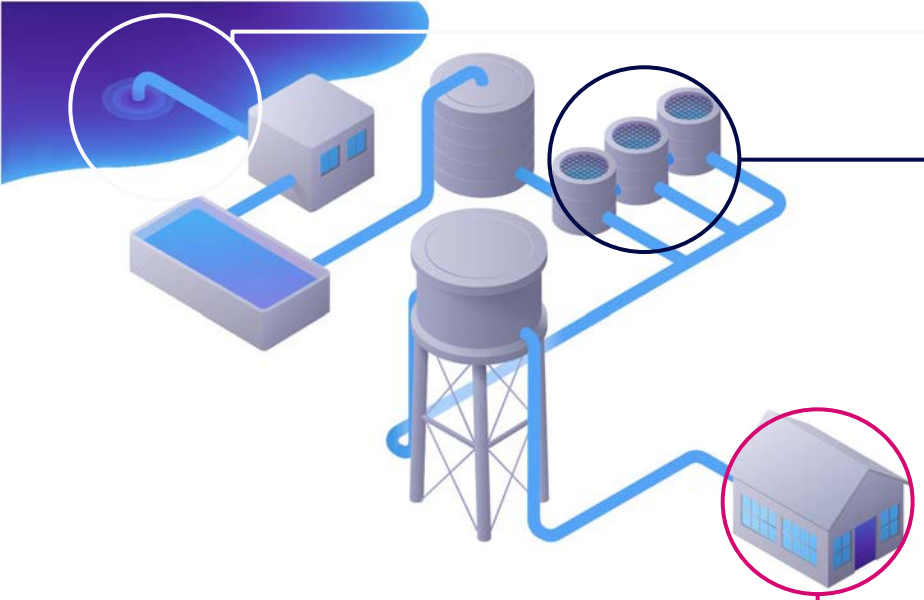


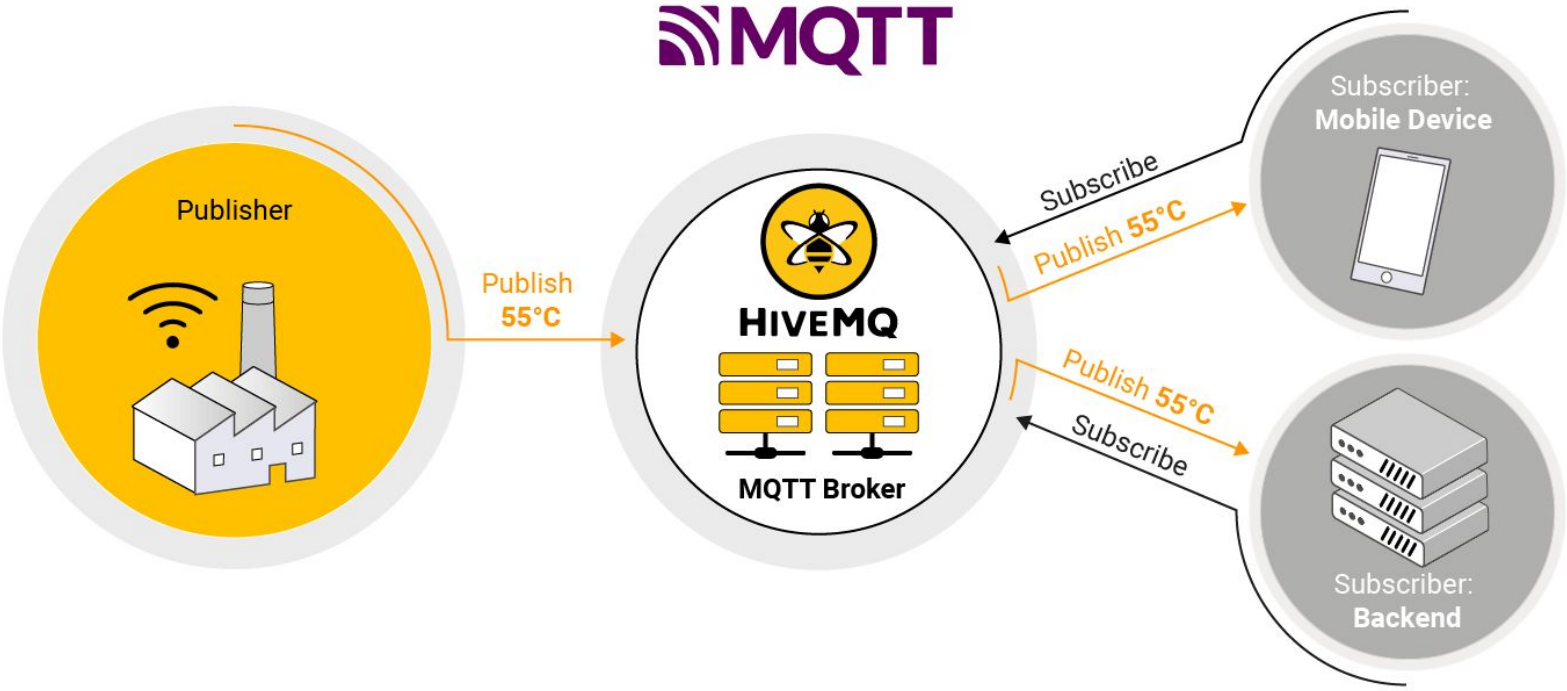
Source

Transformation

Destination

What are data pipelines?

Piping with MQTT and Pub/Sub



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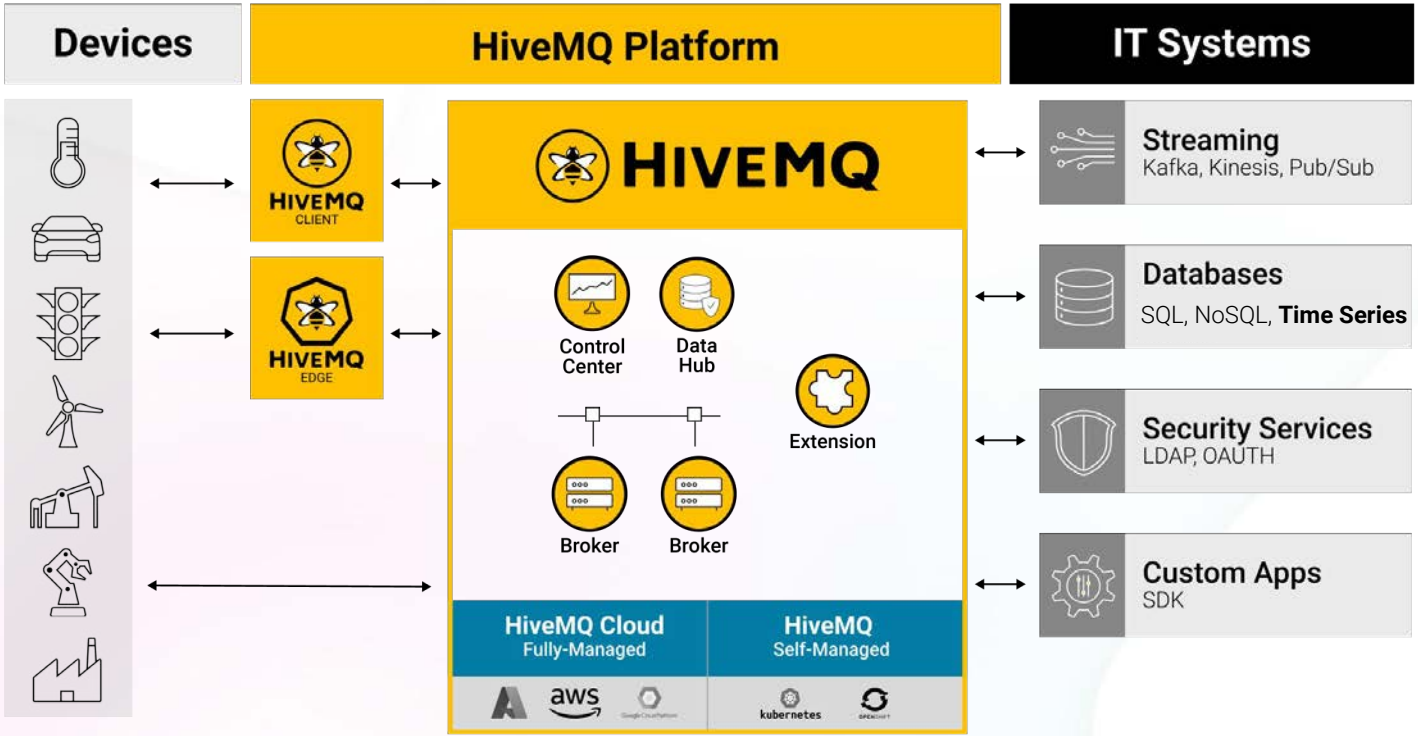
HiveMQ - The most trusted MQTT platform



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A Critical Component of Modern Data Pipelines

Time Series Data

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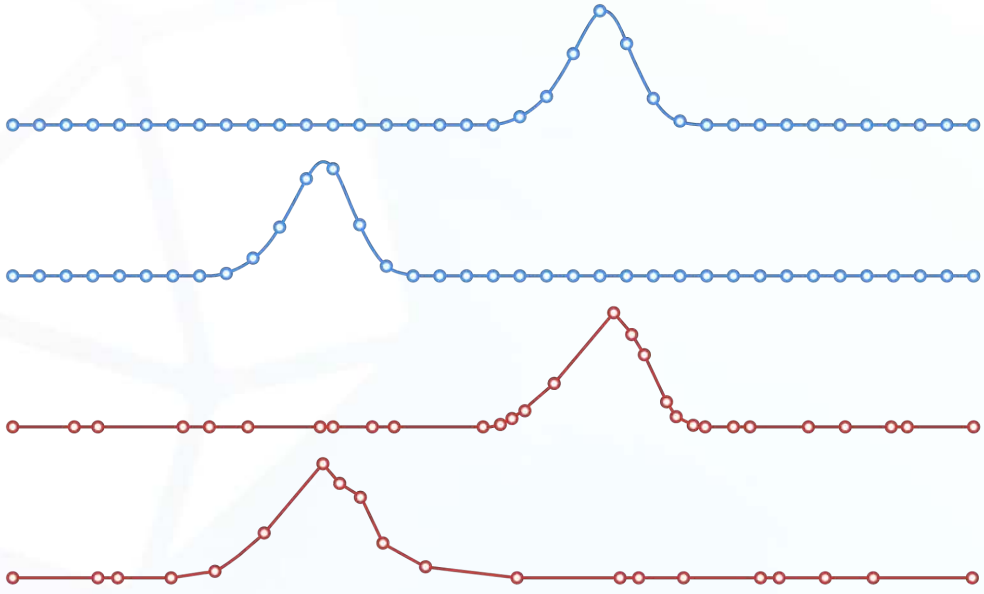
Time Series Data Types

Metrics

Measurements at **regular** time intervals

Events

Measurements at **irregular** time intervals



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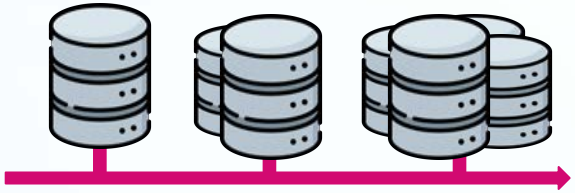
Time Series Databases

Time Series Data

High write throughput

Efficient Queries Over Time Ranges



Scalability and Performance

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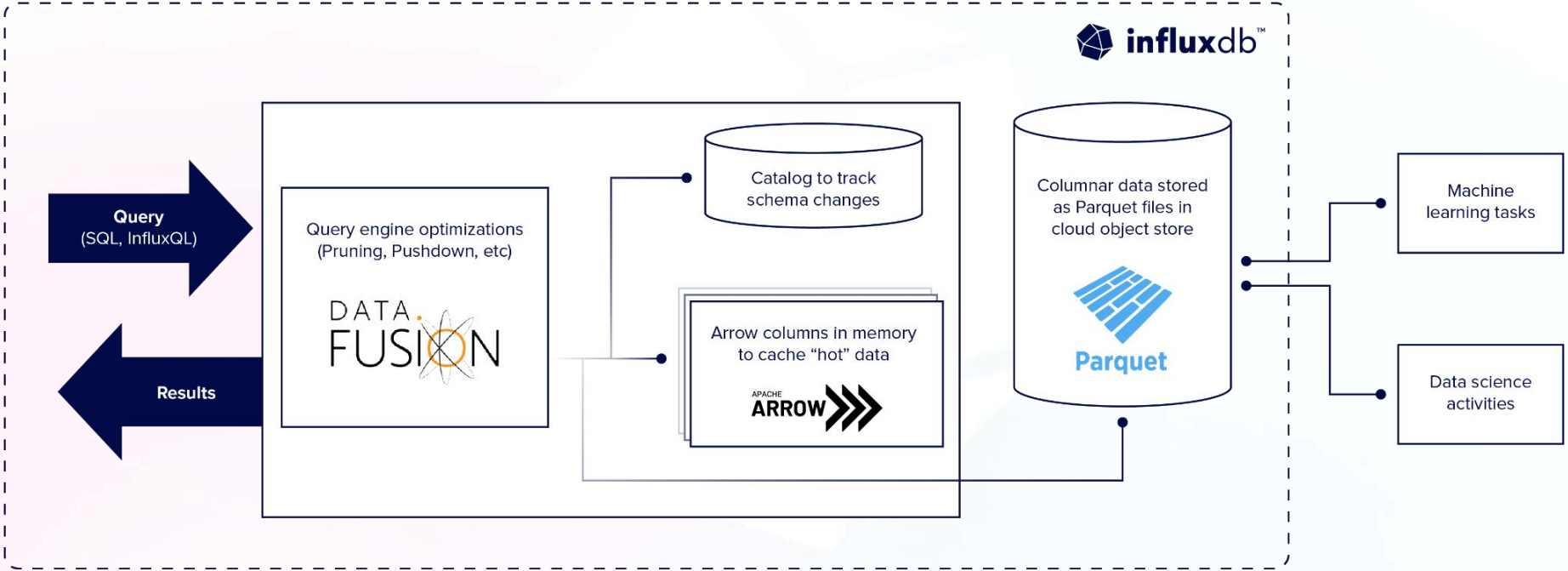
InfluxDB 3.0



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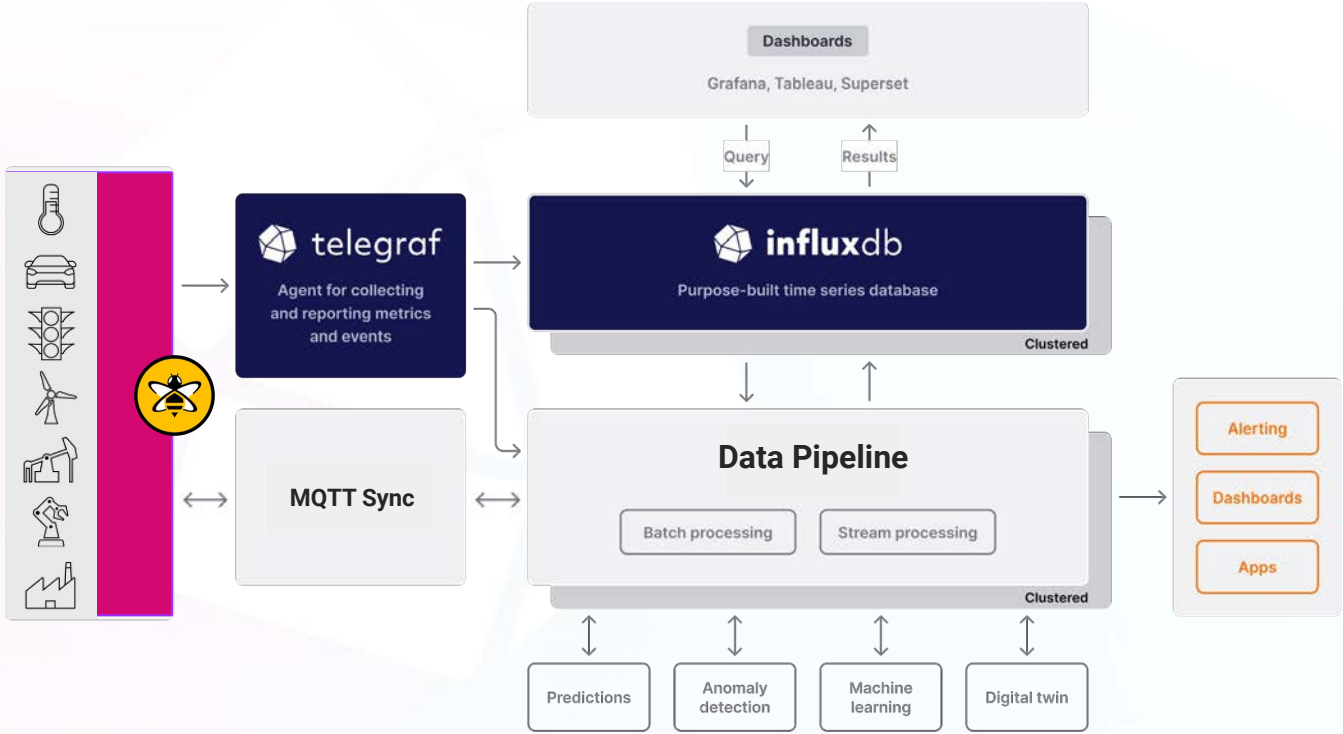
Integrating Data Pipelines in Application Architectures

- Speed
- Security
- Scalability
- Interoperability



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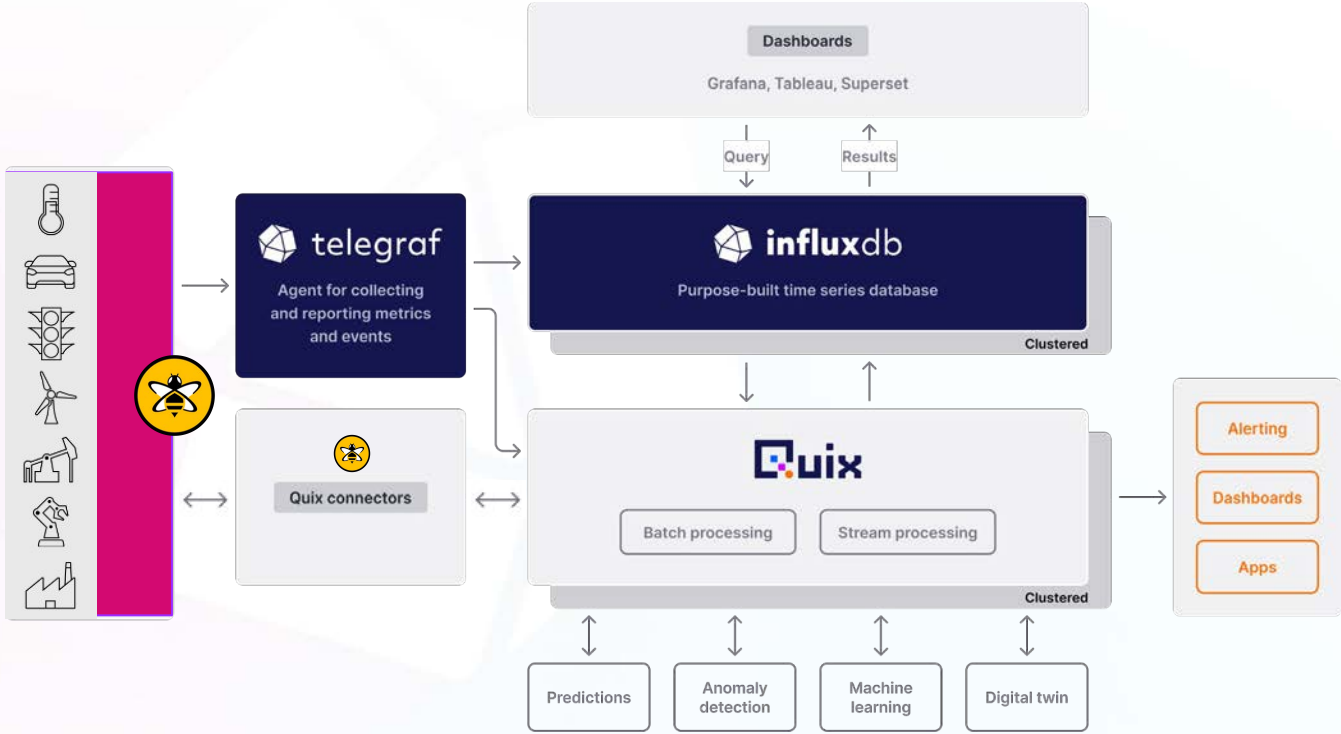
Using Quix

- Built on Kafka
- Build applications using python
- MQTT and InfluxDB connector support



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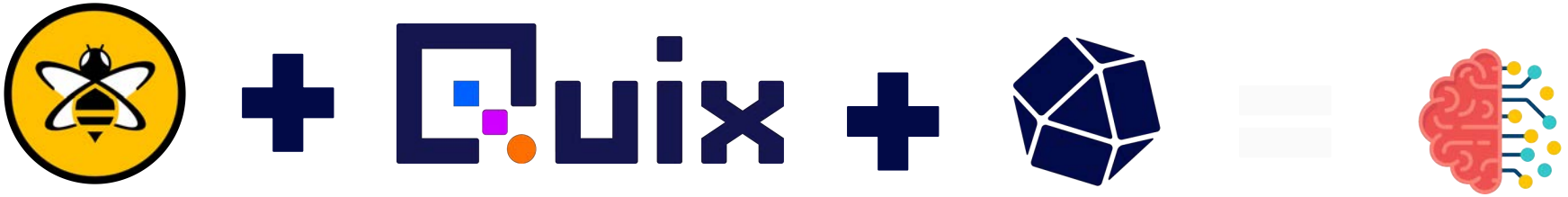
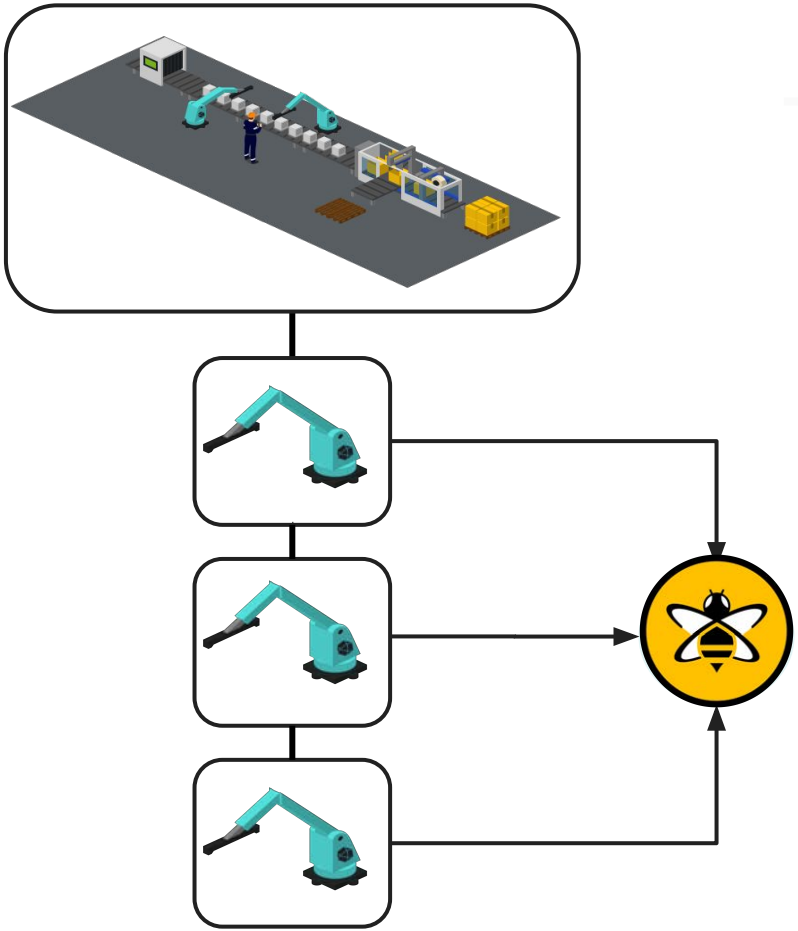


Real-world Challenges: Architectures



📦 Packing Co — Anomaly Detection

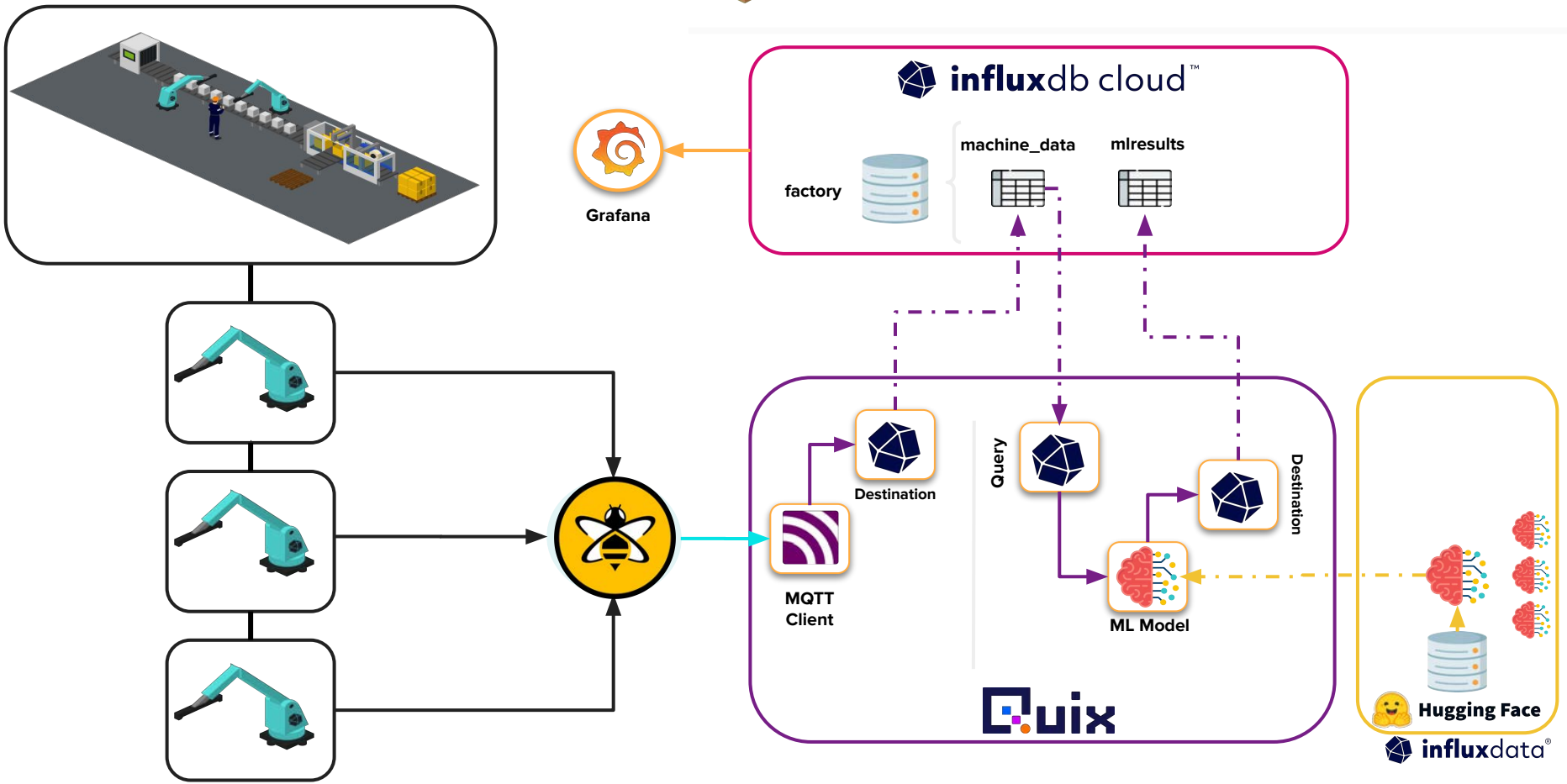
😢 Packing Co is having **recurring issues** with one of their packaging machines.

🤖 Unexpectedly, 1 of the machines will enter a **failing state** which requires a manual reset by an engineer.

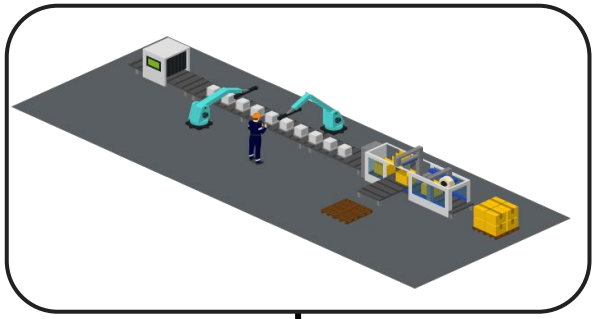
📊 The Plant Manager has advised, **when running normally** all machine sensors will follow **similar output patterns**. If a machine is at **fault** these will **fluctuate abnormally.**

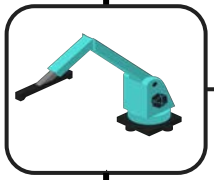
🤔 **How can we use HiveMQ, Quix and InfluxDB to solve this?**

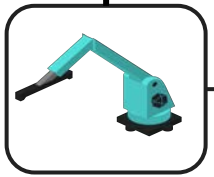
Solution Architecture



Data Ingest







Grafana

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factory

machine_data

Destination

MQTT Client

Quix

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Robot Machine Simulator

x3

Create machine → Create HiveMQ Connection → Write JSON payload to topic

```
{
"metadata": {
"machineID": "machine1",
"barcode": "29557462",
"provider": "Cain, Gibson and Robertson"
},
"data": [
{"temperature": 38},
{"load": 41},
{"power": 200},
{"vibration": 91}
]
}
```

Topic: machine/**machine1**

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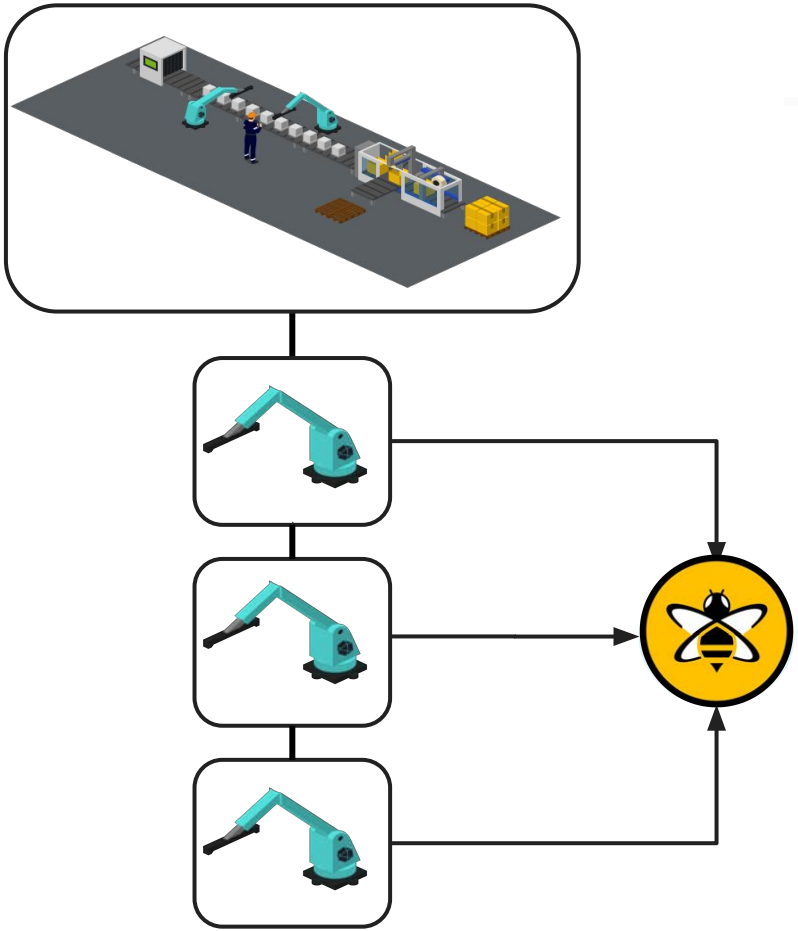

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🤔 **How can we use HiveMQ, Quix and InfluxDB to solve this?**

```
import paho.mqtt.client as paho
from paho import mqtt
import json

class mqtt_publisher:
    def __init__(self, address, port, clientID) -> None:

        self.mqttBroker = address
        self.port = port
        self.clientID = clientID
        self.client = None

    def connect_client(self):
        MQTT_KEEPALIVE_INTERVAL = 45
        self.client = paho.Client(self.clientID)
        self.client.connect(host=self.mqttBroker,port=self.port, keepalive=MQTT_KEEPALIVE_INTERVAL)

    def connect_client_secure(self, username, password):
        print("Creating secure connection", flush=True)
        MQTT_KEEPALIVE_INTERVAL = 45

        self.client = paho.Client(userdata=None, protocol=paho.MQTTv5)

        self.client.tls_set(tls_version=mqtt.client.ssl.PROTOCOL_TLS)
        self.client.username_pw_set(username=username, password=password)

        self.client.connect(host=self.mqttBroker,port=self.port, keepalive=MQTT_KEEPALIVE_INTERVAL)
        print("connected to MQTT broker", flush=True)

    def publish_to_topic(self, topic: str, data: dict):
        topic = topic +"/"+ str(data["metadata"]["machineID"])
        message = json.dumps(data)
        self.client.publish(topic=topic, payload=message)
        print(message, flush=True)
```

Insecure connection to broker for testing against public broker.

Choose your protocol in paho (default 3.1.1)

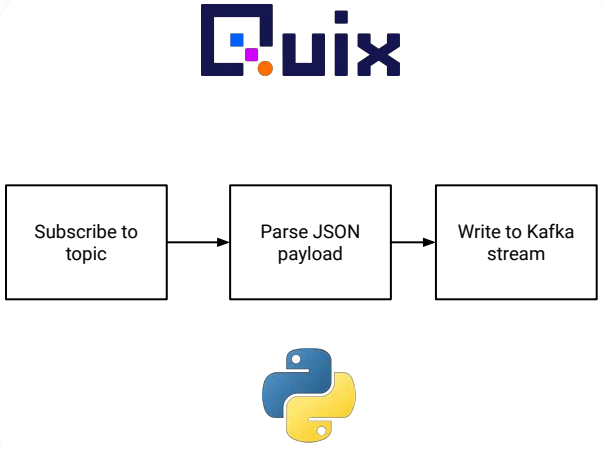
A must within HiveMQ broker connections. **There is no unsecure port**

We can construct our parent child topic here and also write our payload

Quix MQTT Subscriber

Topic: machine/#

{
"metadata": {
"machineID": "machine1",
"barcode": "29557462",
"provider": "Cain, Gibson and Robertson"
},
"data": [
{"temperature": 38},
{"load": 41},
{"power": 200},
{"vibration": 91}
]
}



Topic: rawdata

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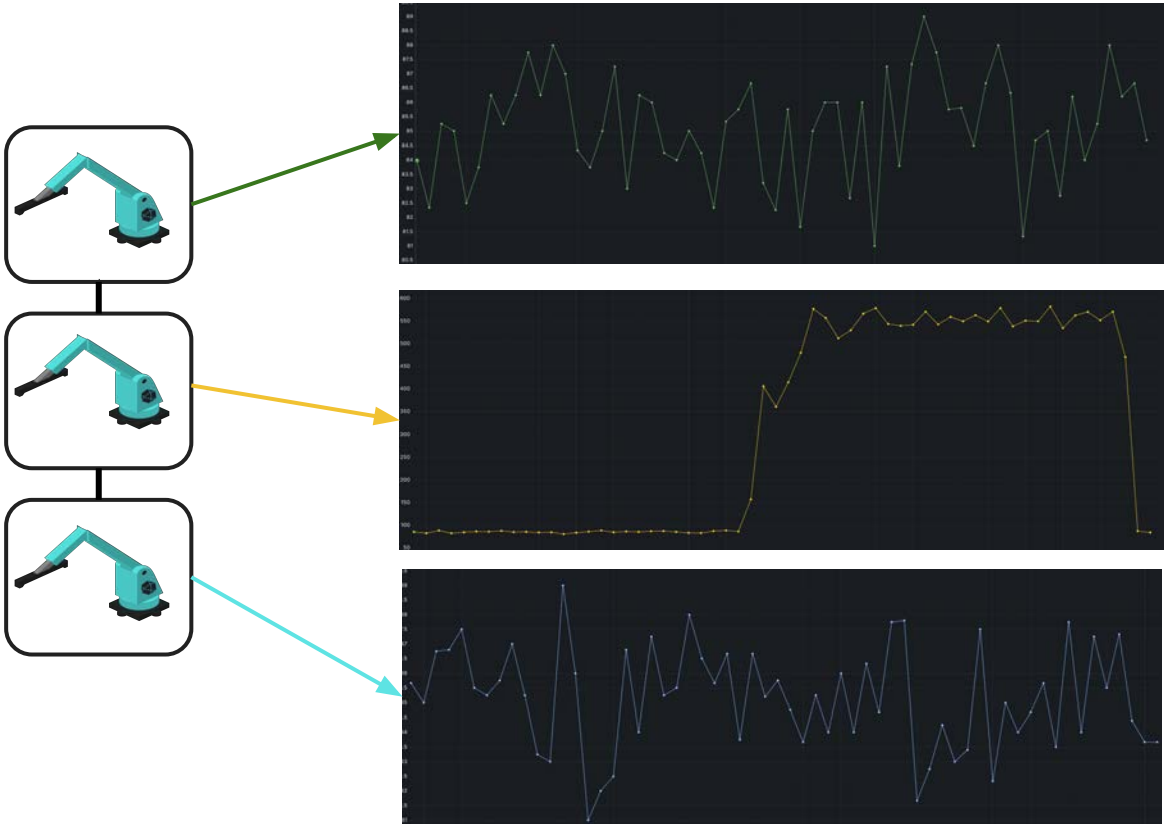
Real-world Challenges: Data Science

In an ideal word



This could easily be solved with thresholding

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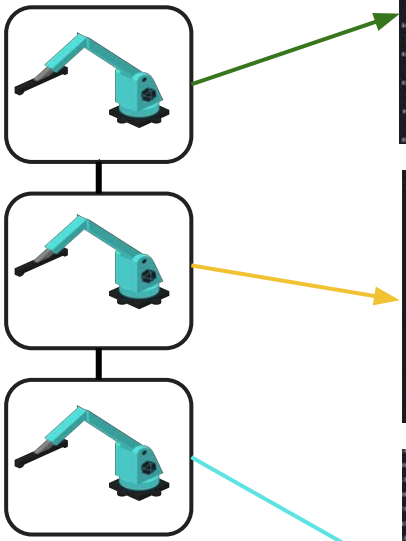
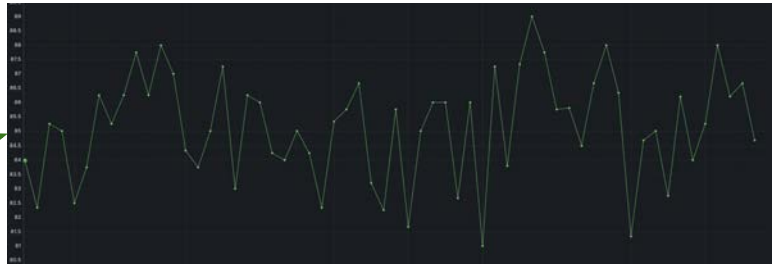
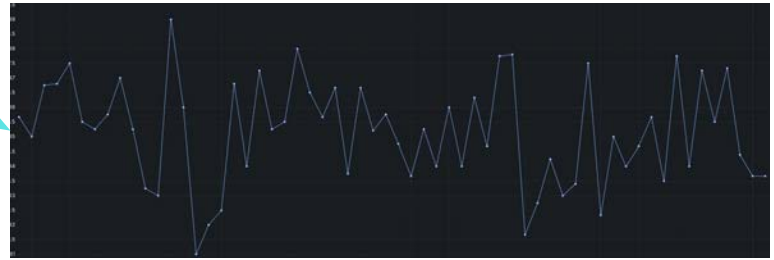
Realistically...







What do we do when our result becomes unpredictable by conventional means?

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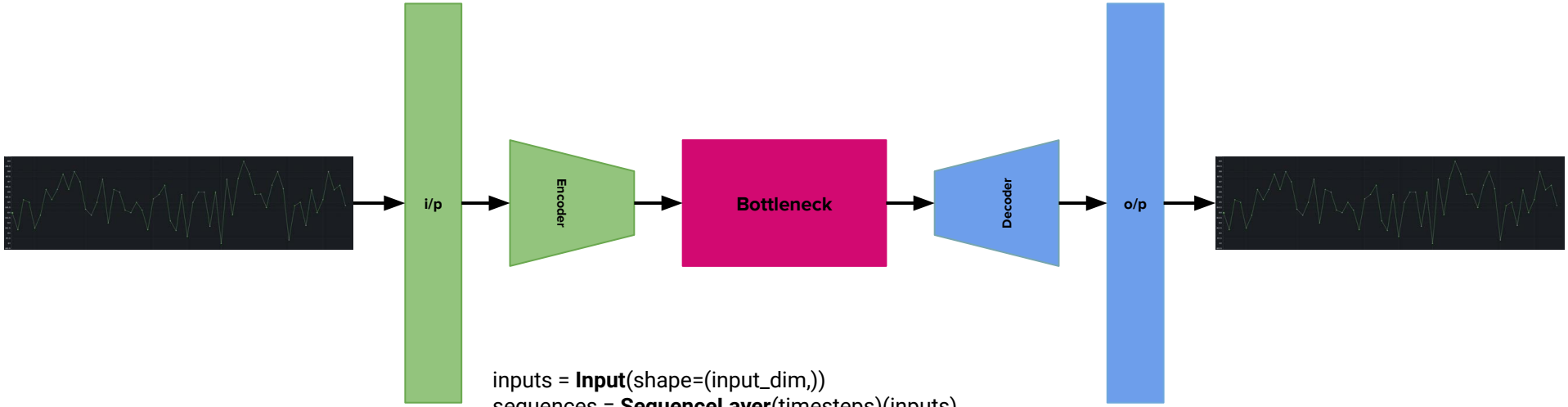
Artificial Neural Networks - Autoencoder




```
inputs = Input(shape=(input_dim,))
sequences = SequenceLayer(timesteps)(inputs)
inputs = Input(shape=(timesteps, input_dim))
encoded = LSTM(16, activation='relu', return_sequences=True)(inputs)
encoded = LSTM(4, activation='relu', return_sequences=False)(encoded)
decoded = RepeatVector(timesteps)(encoded)
decoded = LSTM(4, activation='relu', return_sequences=True)(decoded)
decoded = LSTM(16, activation='relu', return_sequences=True)(decoded)
decoded = TimeDistributed(Dense(input_dim))(decoded)
```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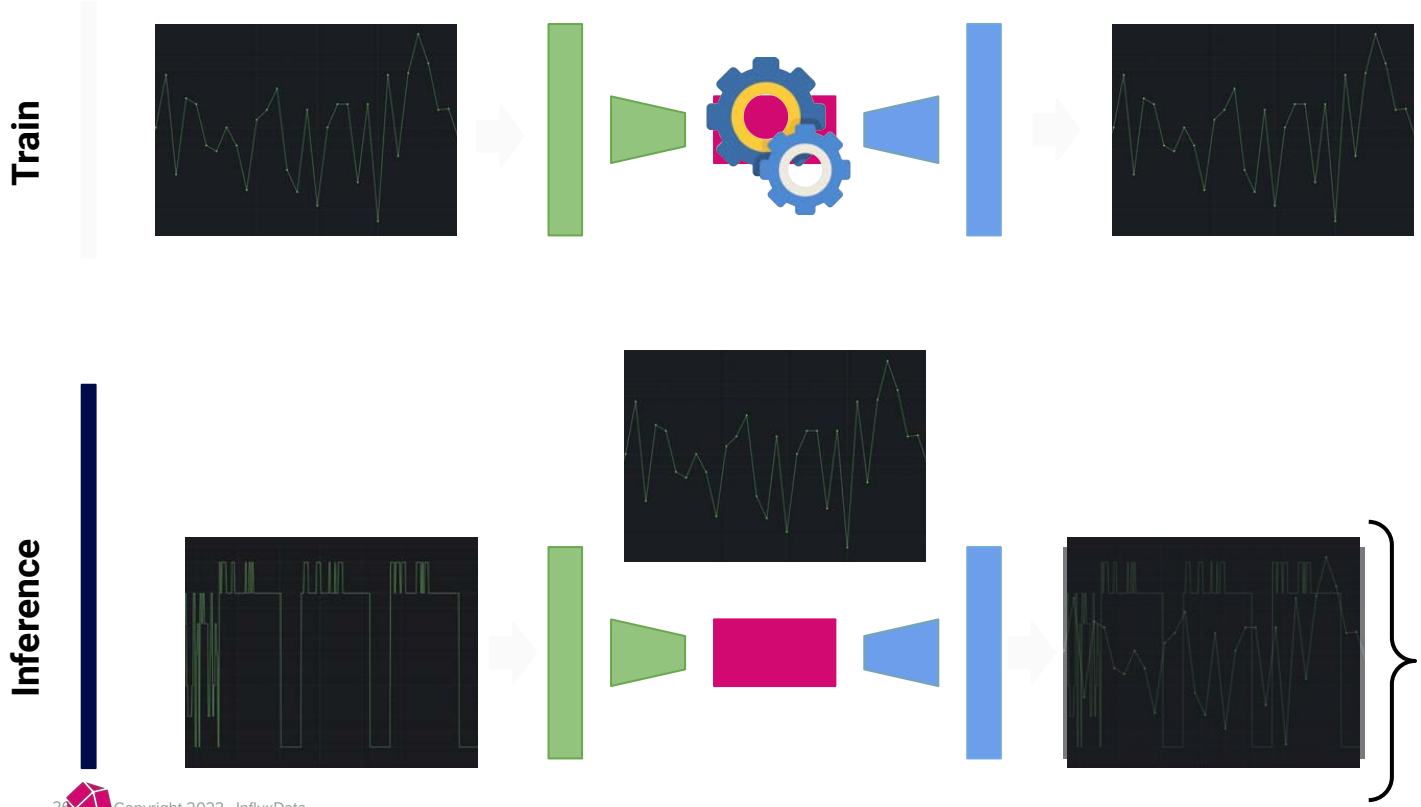
How does it detect anomalies?



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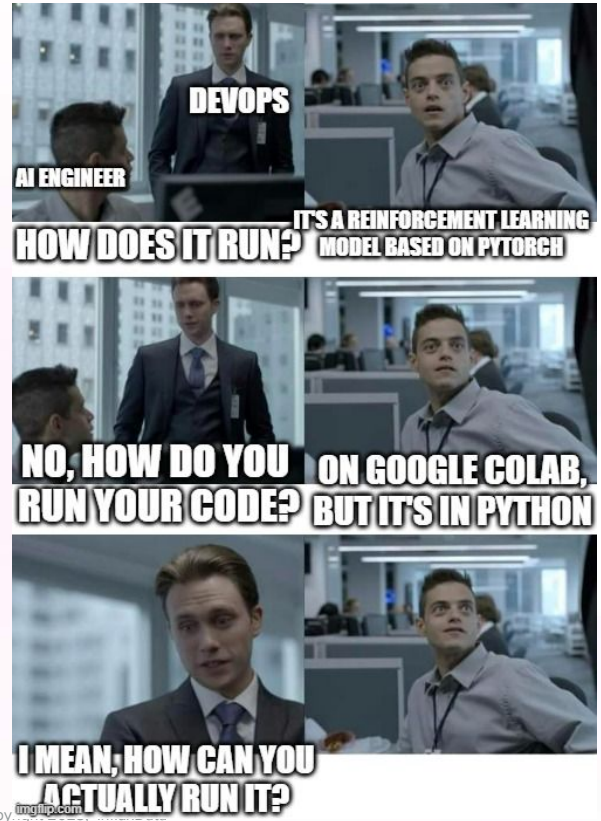
Real-world Challenges: Going Operational

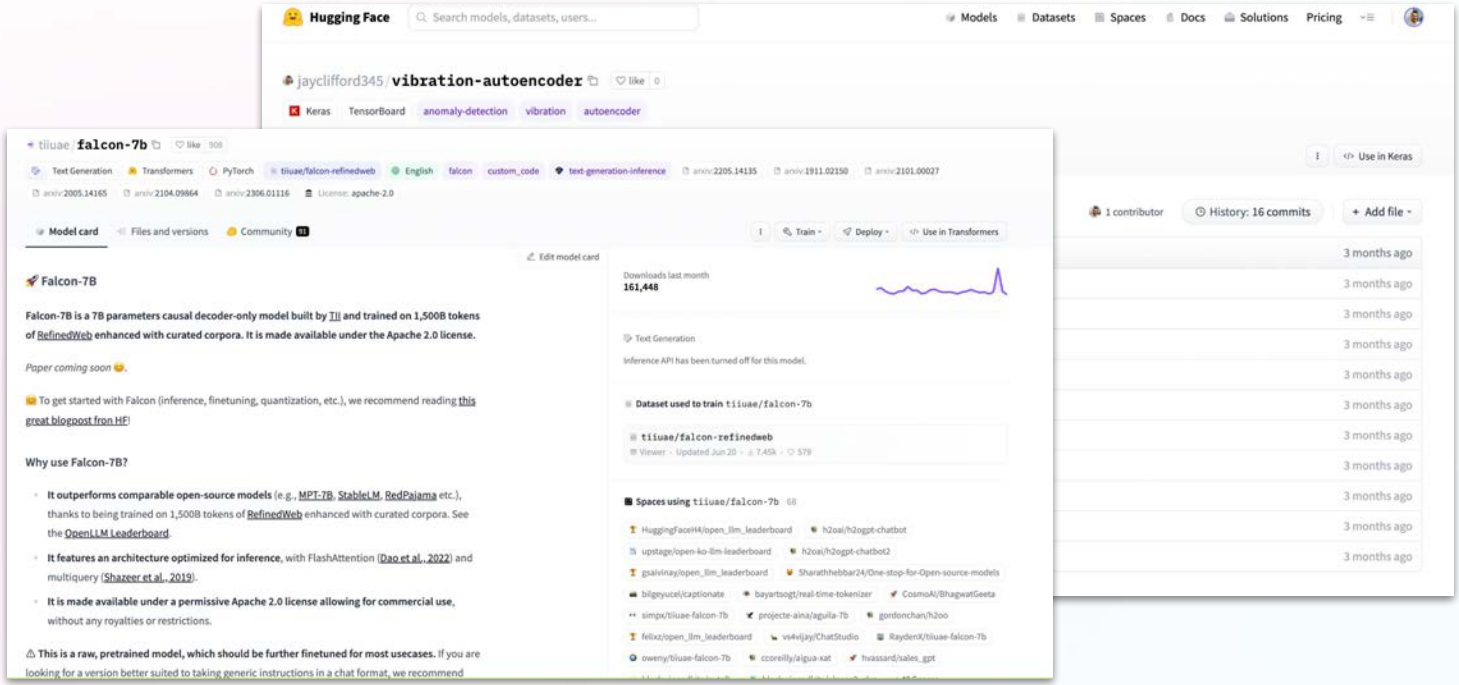
MLOps - Design, Deploy & Monitor

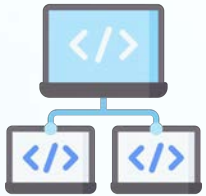


model.h5

Copyright

Hugging Face





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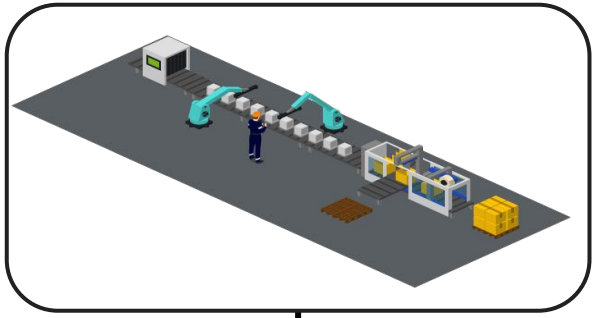
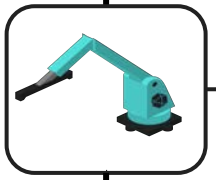
ML Deployment and Inference





Grafana

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factory

machine_data

mlresults

MQTT Client

Destination

Query

ML Model

Destination

Quix

Hugging Face

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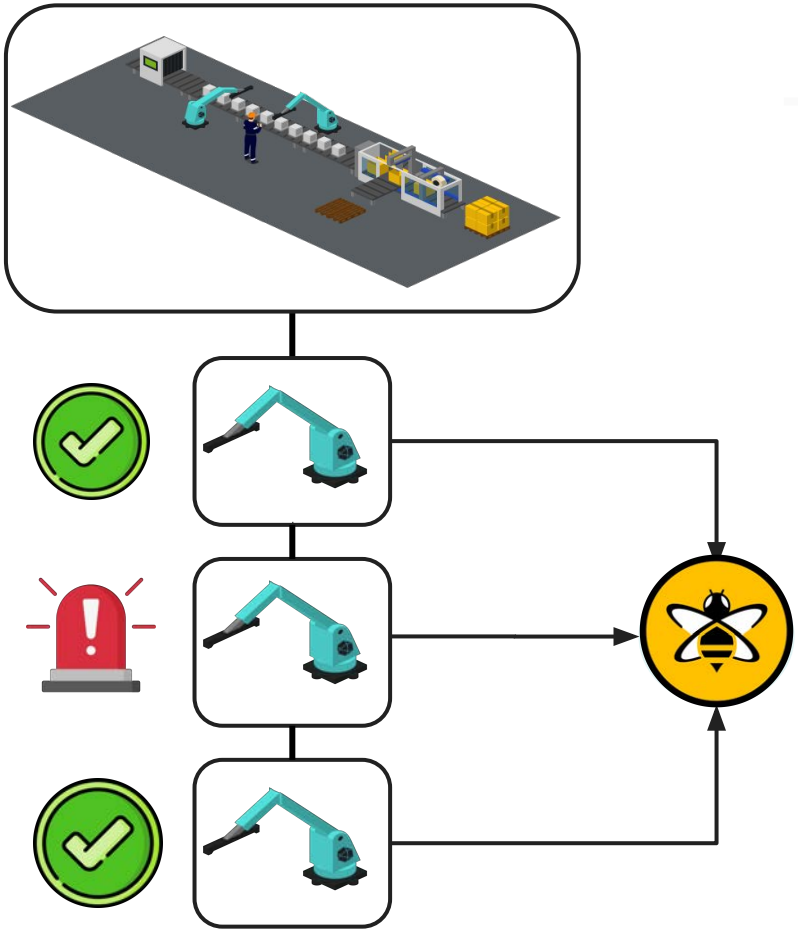
Summary and Conclusion



📦 Packing Co — Anomaly Detection

✅ Enabled the **ingest, transformation and storage** of their machine data.

✅ Deployed an initial **machine learning model** to detect potential malfunctions using vibration data from the machines.

✅ Provided the foundations of a **scalable data pipeline**.

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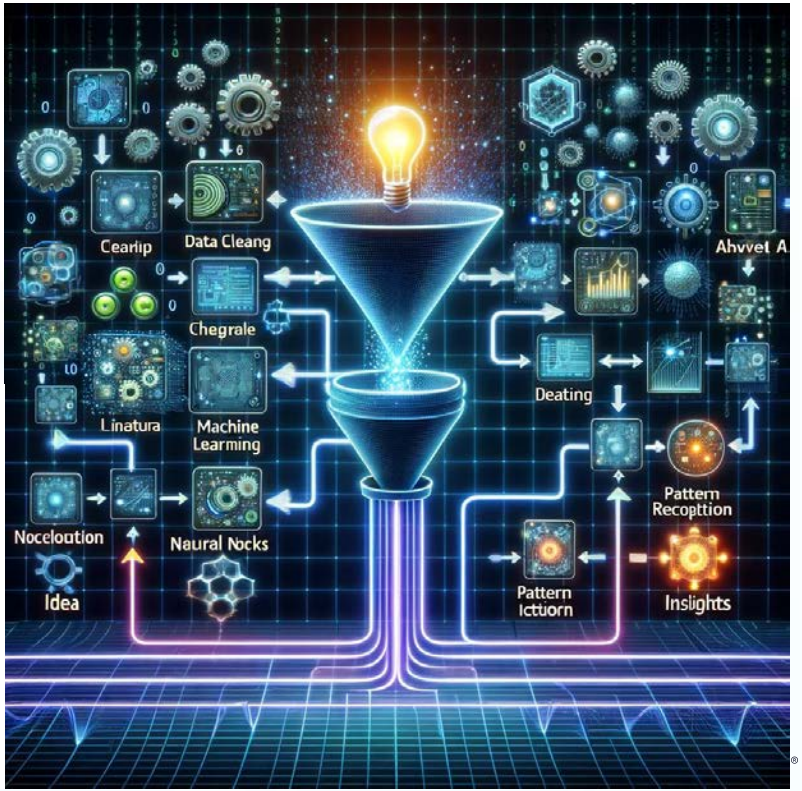
Where could we go next?

- Anomaly Detection->Condition Labeling
- Explore LLMs as “real-time” processors
- Natural Language User Experiences
- Encode the Expert
- Application and Outcomes Assistants
- Dynamic User Interfaces
- Self-defined Digital Twins



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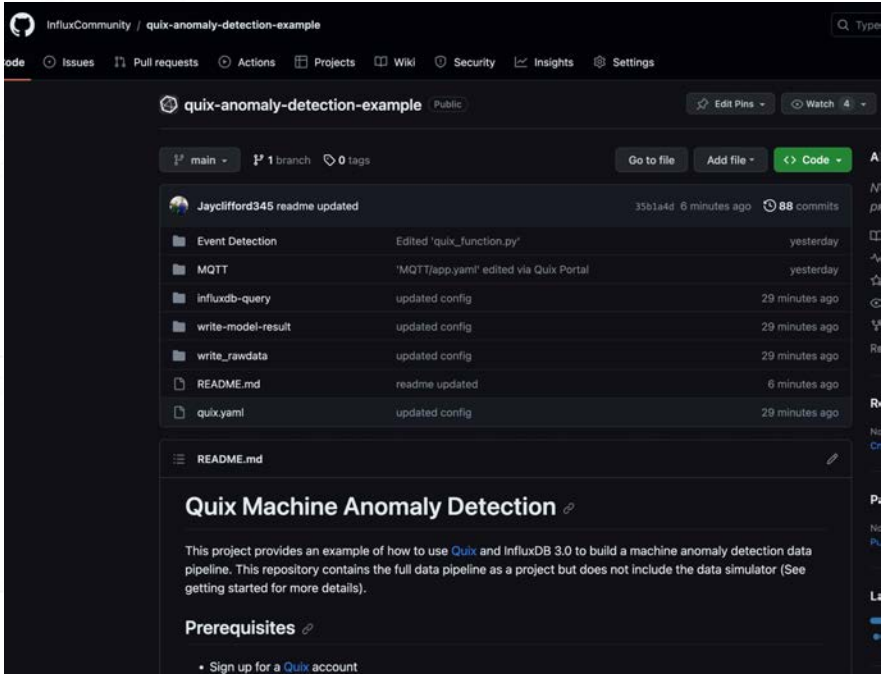
Next Steps

Try it yourself

https://github.com/InfluxCommunity/quix-anomaly-detection-example



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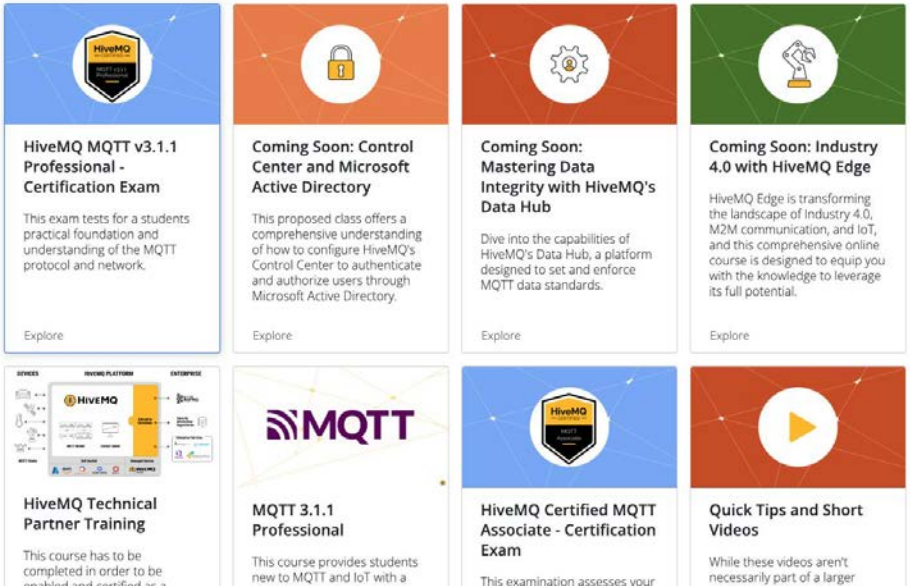

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Any Questions?

Thank you

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