



# Predictive Analytics with InfluxDB



# 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

# Anais Dotis-Georgiou

## Developer Advocate

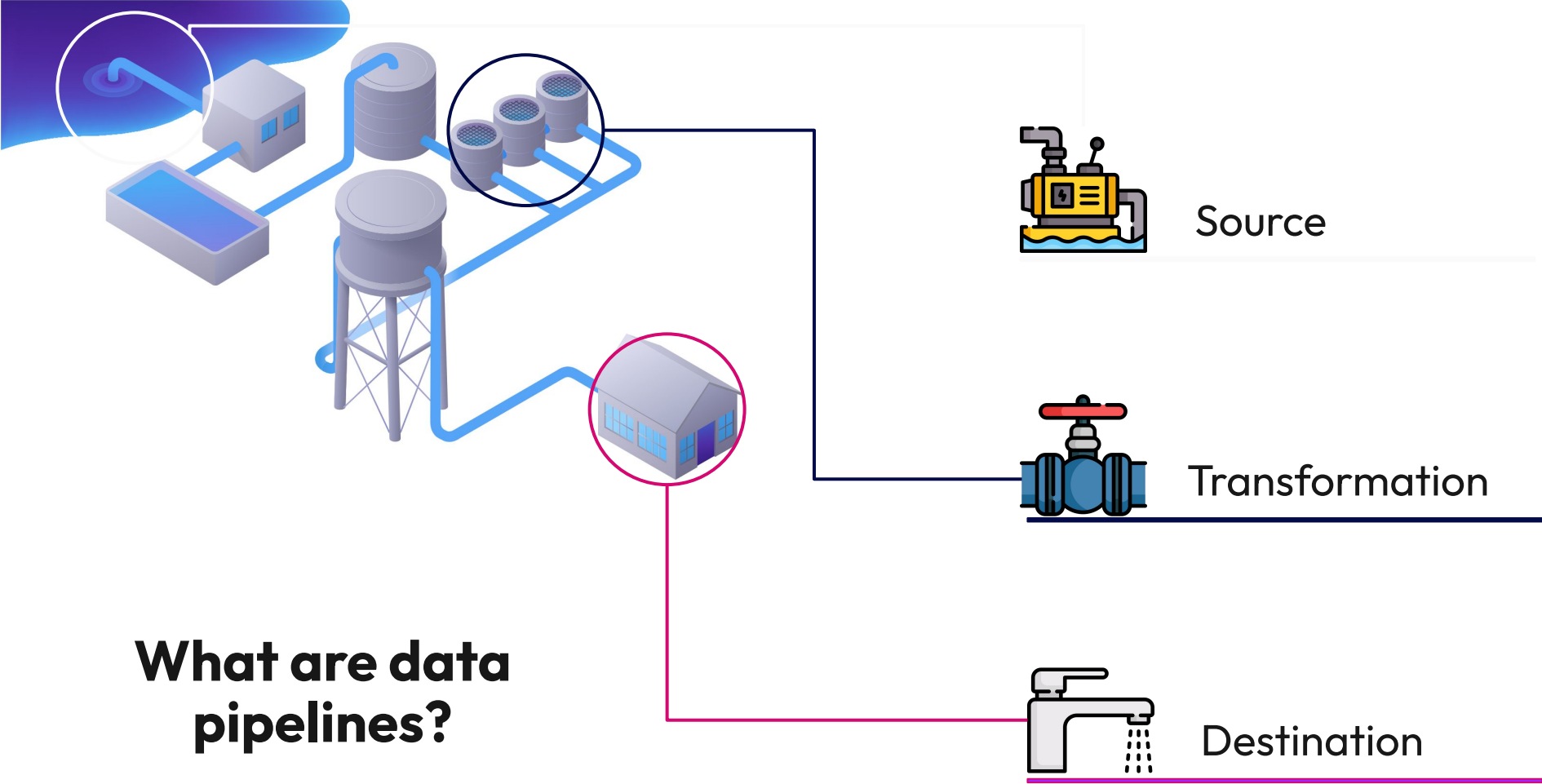
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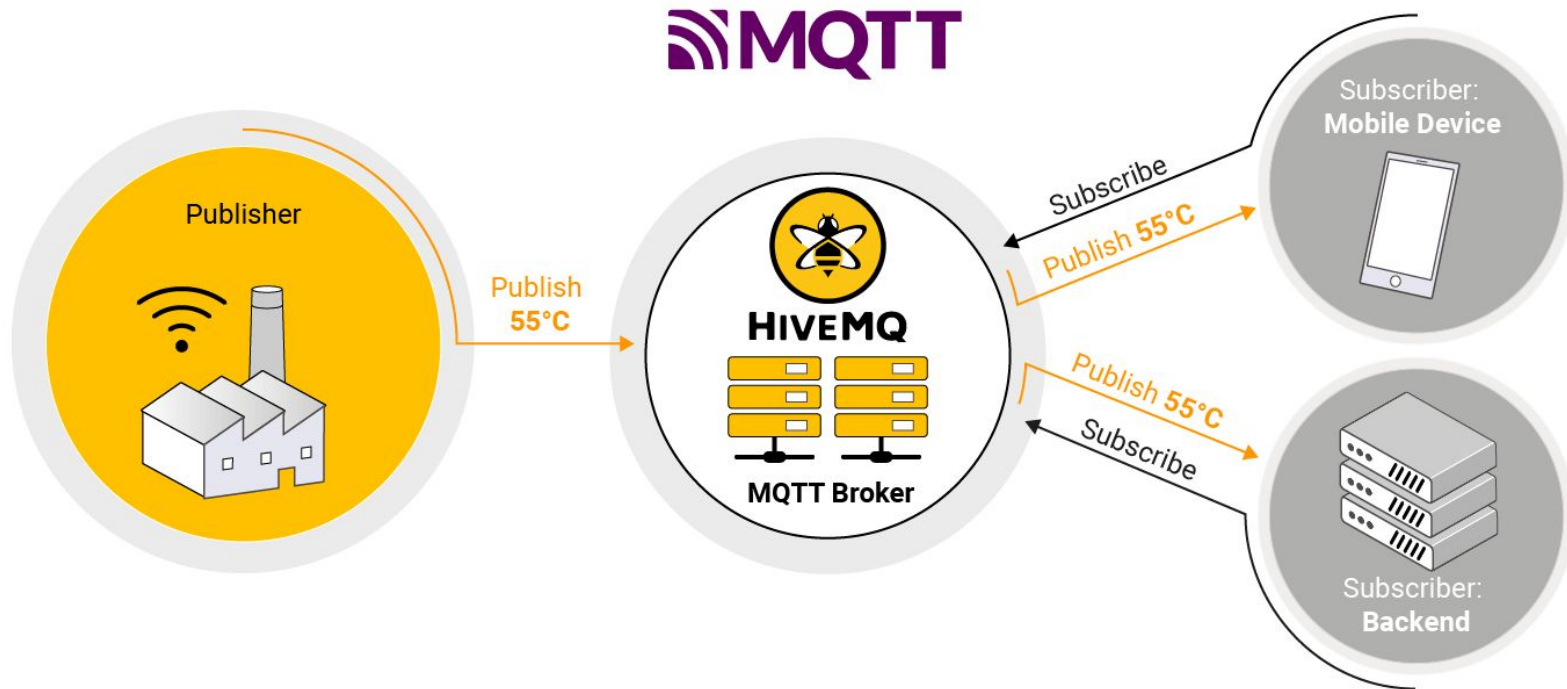
**LinkedIn**



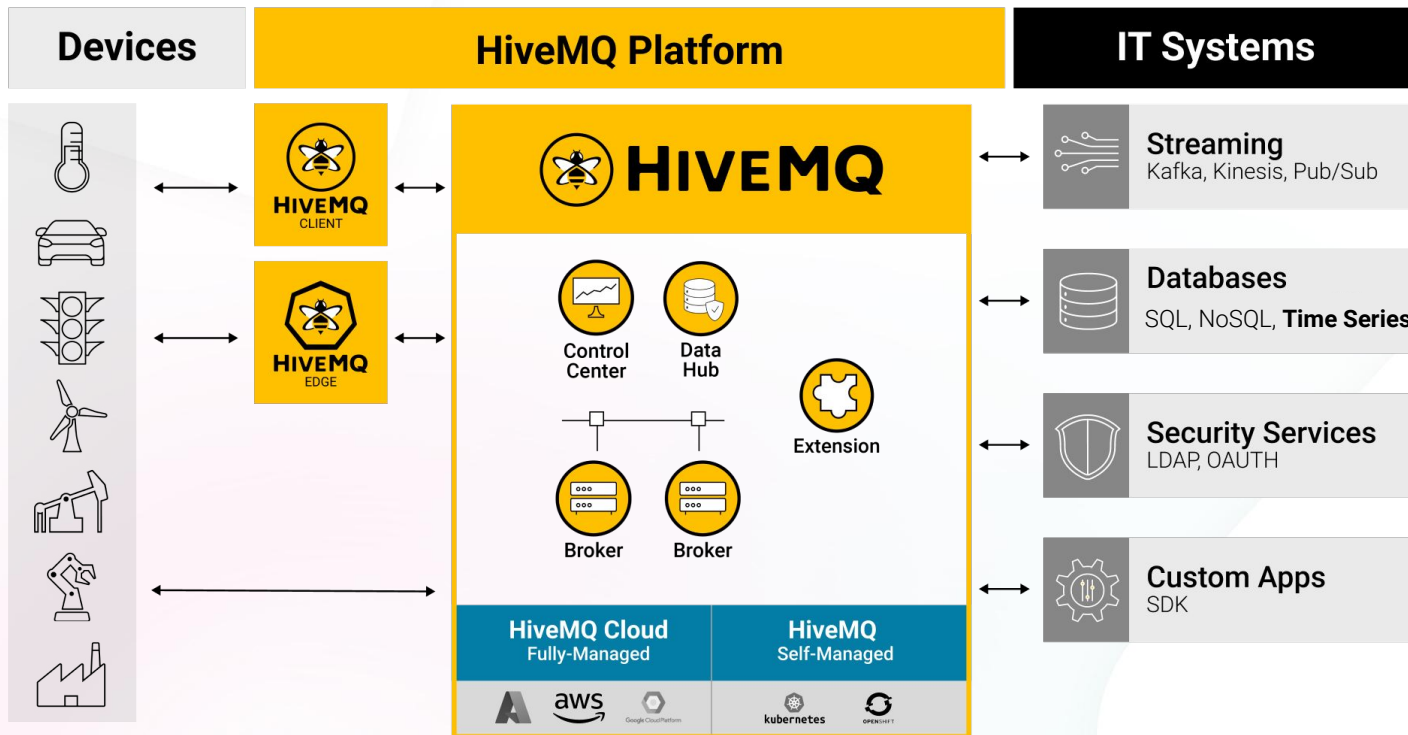
# What are data pipelines?



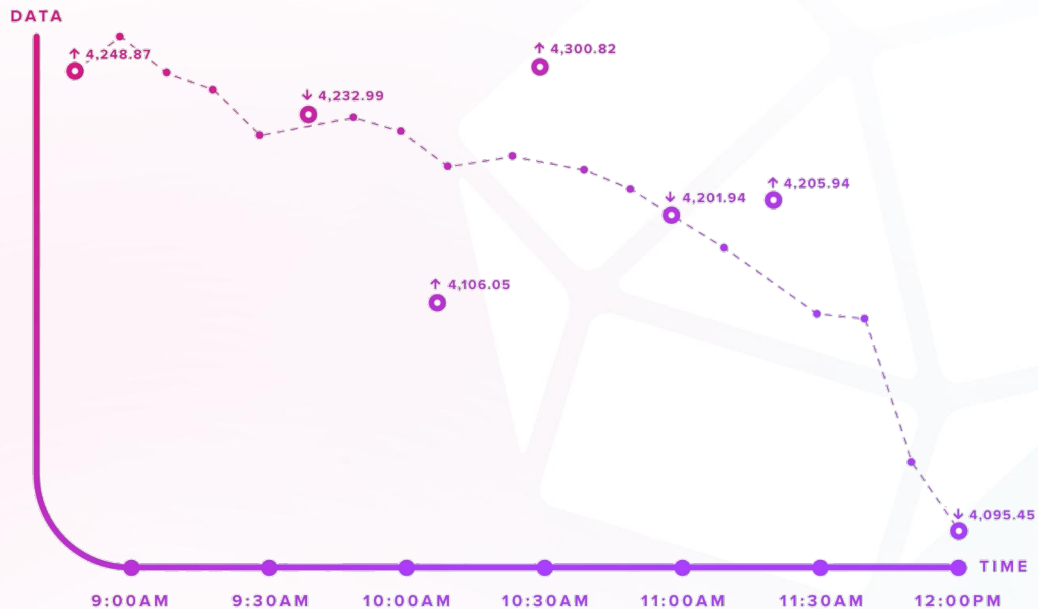
# Piping with MQTT and Pub/Sub



# HiveMQ - The most trusted MQTT platform



# A Critical Component of Modern Data Pipelines



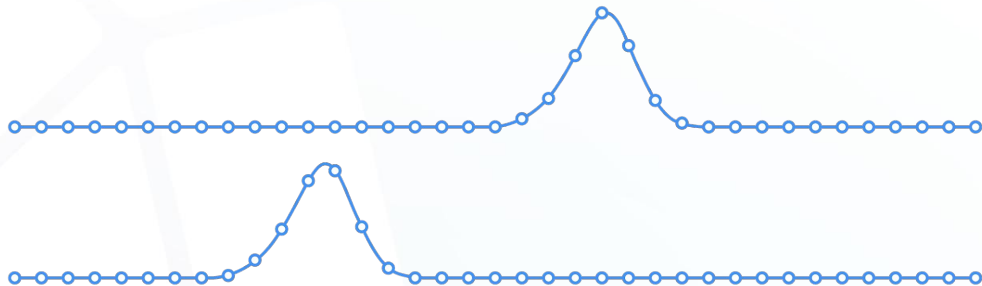
## Time Series Data



# Time Series Data Types

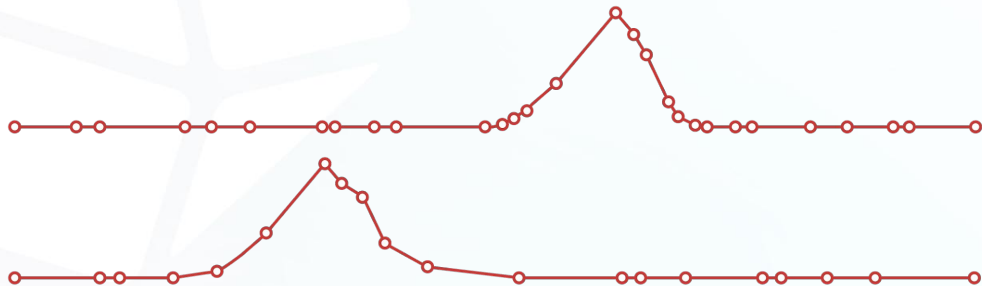
## Metrics

Measurements at **regular**  
time intervals



## Events

Measurements at **irregular**  
time intervals



# Time Series Databases



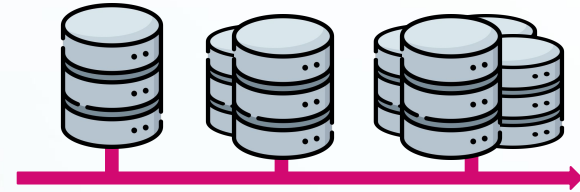
**Time Series  
Data**



**High write  
throughput**

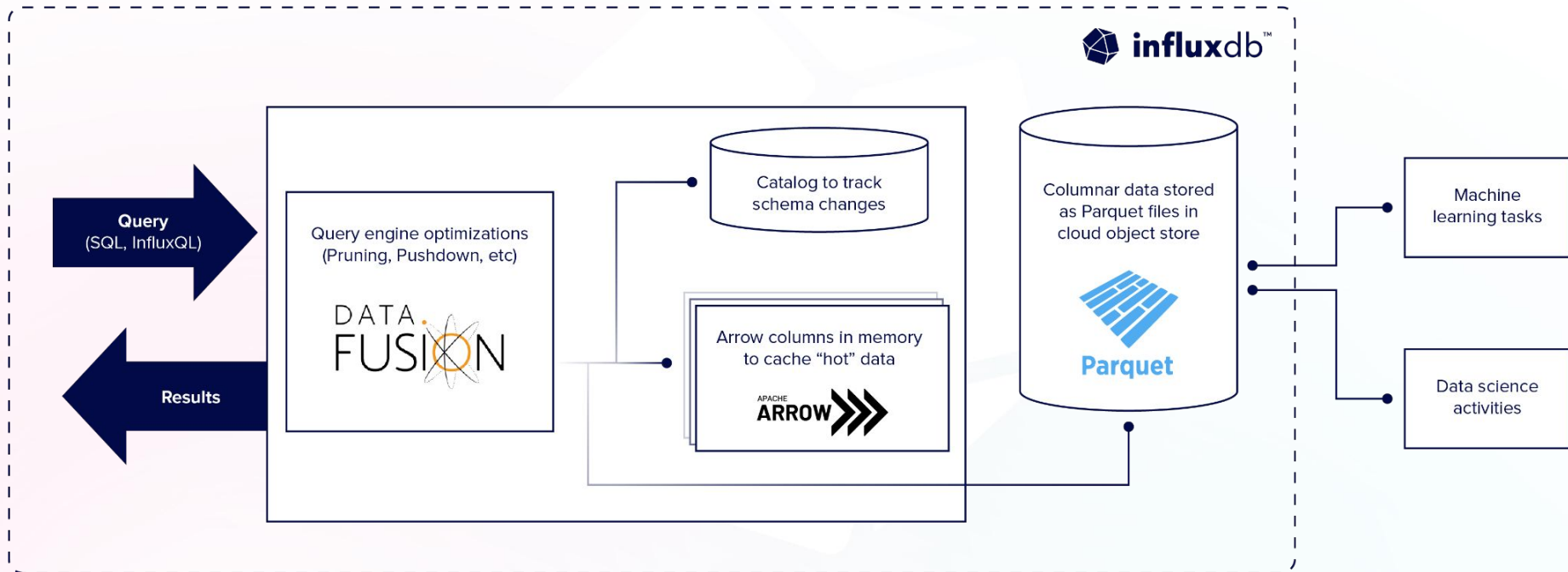


**Efficient  
Queries Over  
Time Ranges**



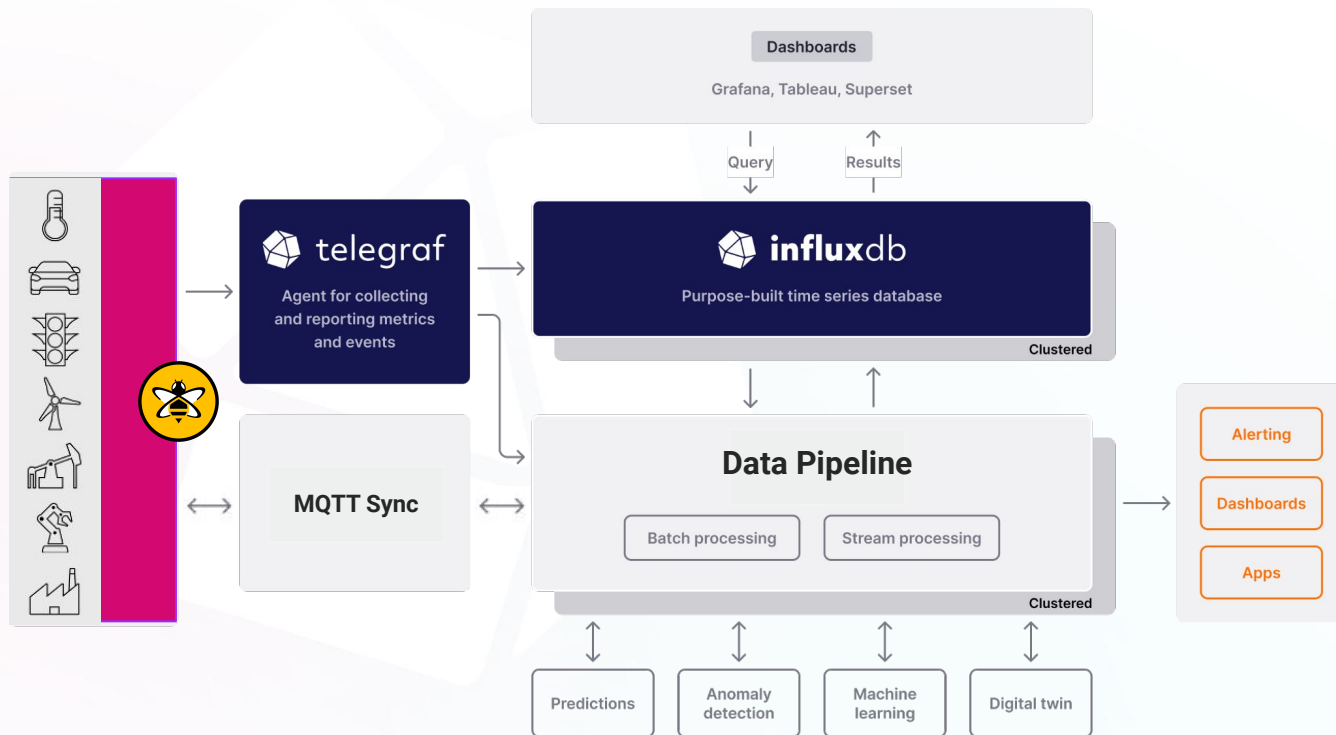
**Scalability  
and  
Performance**

# InfluxDB 3.0



# Integrating Data Pipelines in Application Architectures

- Speed
- Security
- Scalability
- Interoperability



# Using Quix



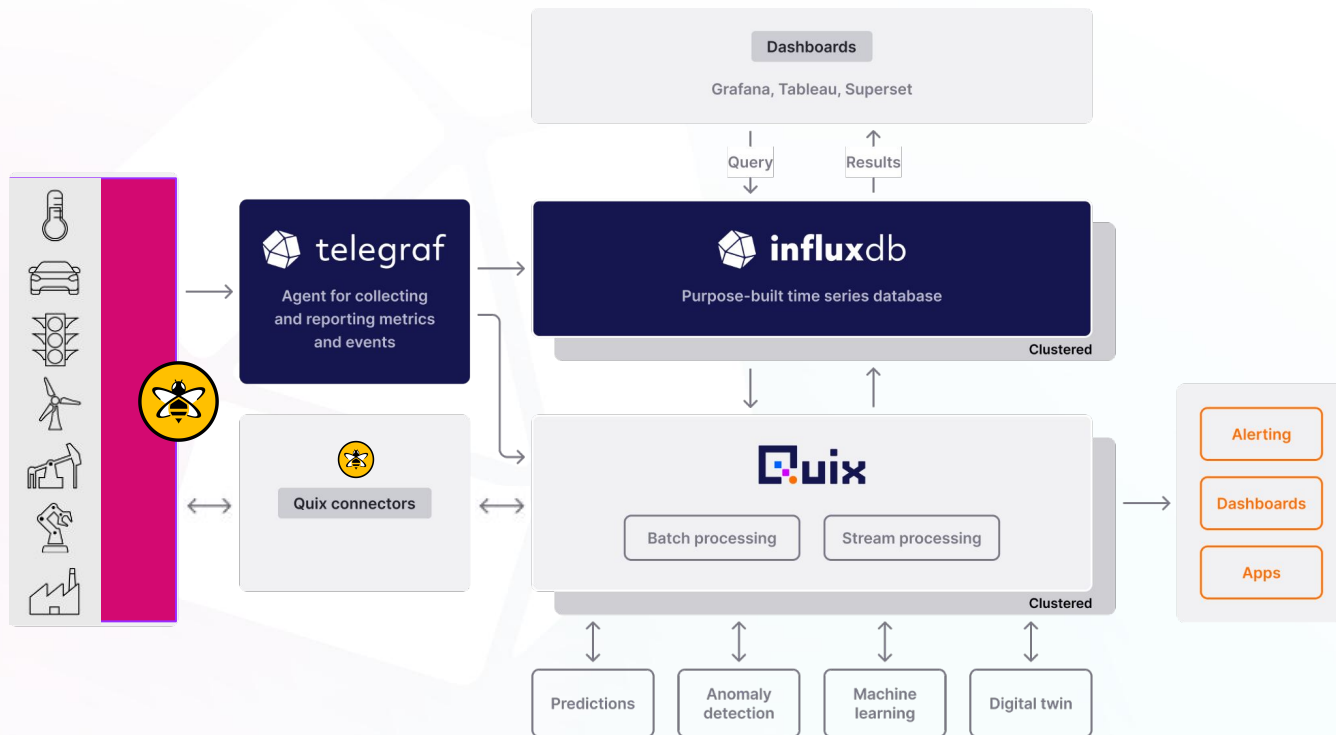
Built on Kafka



Build applications using python



MQTT and InfluxDB connector support





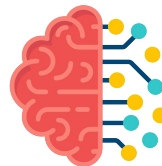
+



+



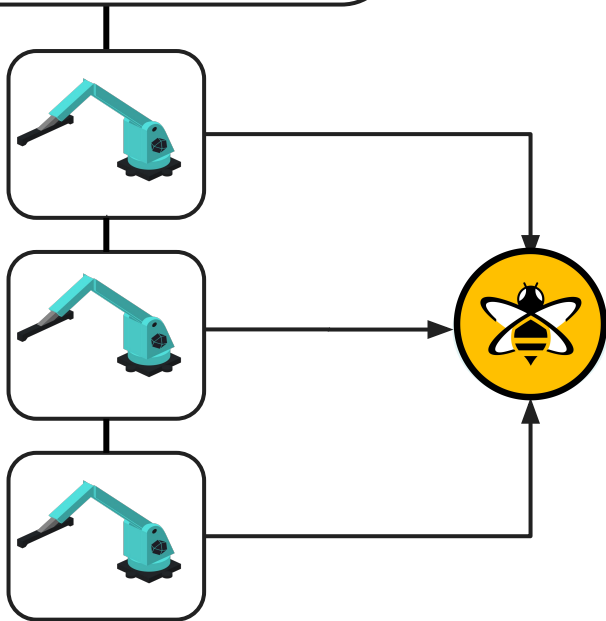
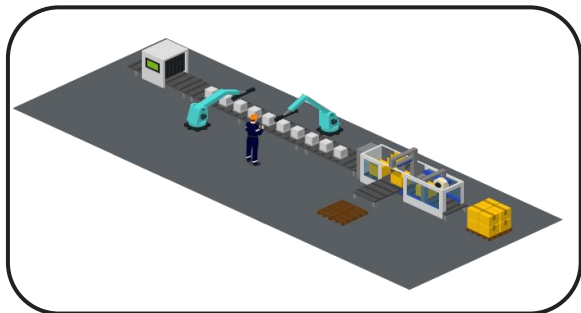
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# Real-world Challenges: Architectures





## 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.



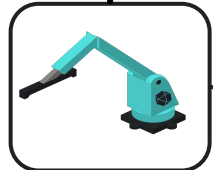
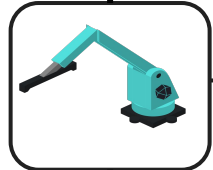
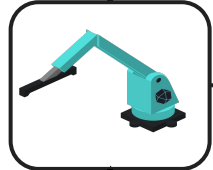
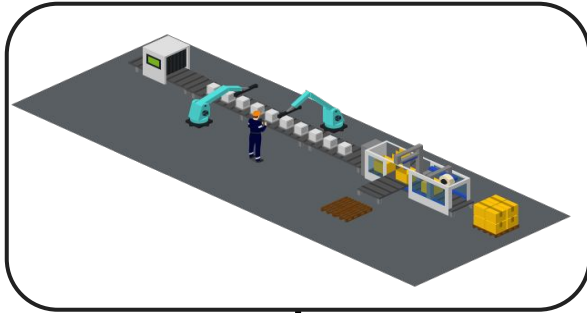
The Plant Manager has advised, **when running normally** all machine sensors will follow **similar output patterns**. If a machine is at **fault** these will **fluctuate abnormally**.



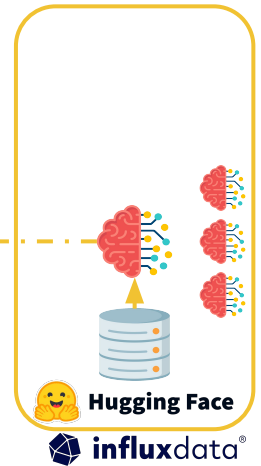
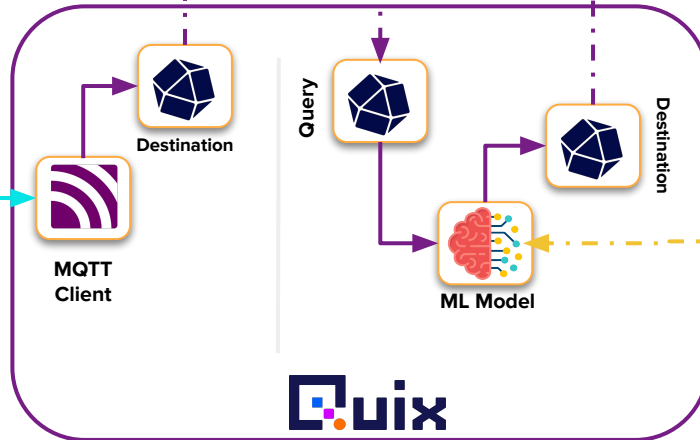
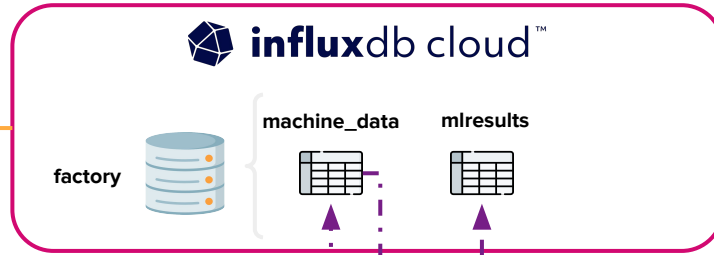
**How can we use HiveMQ, Quix and InfluxDB to solve this?**



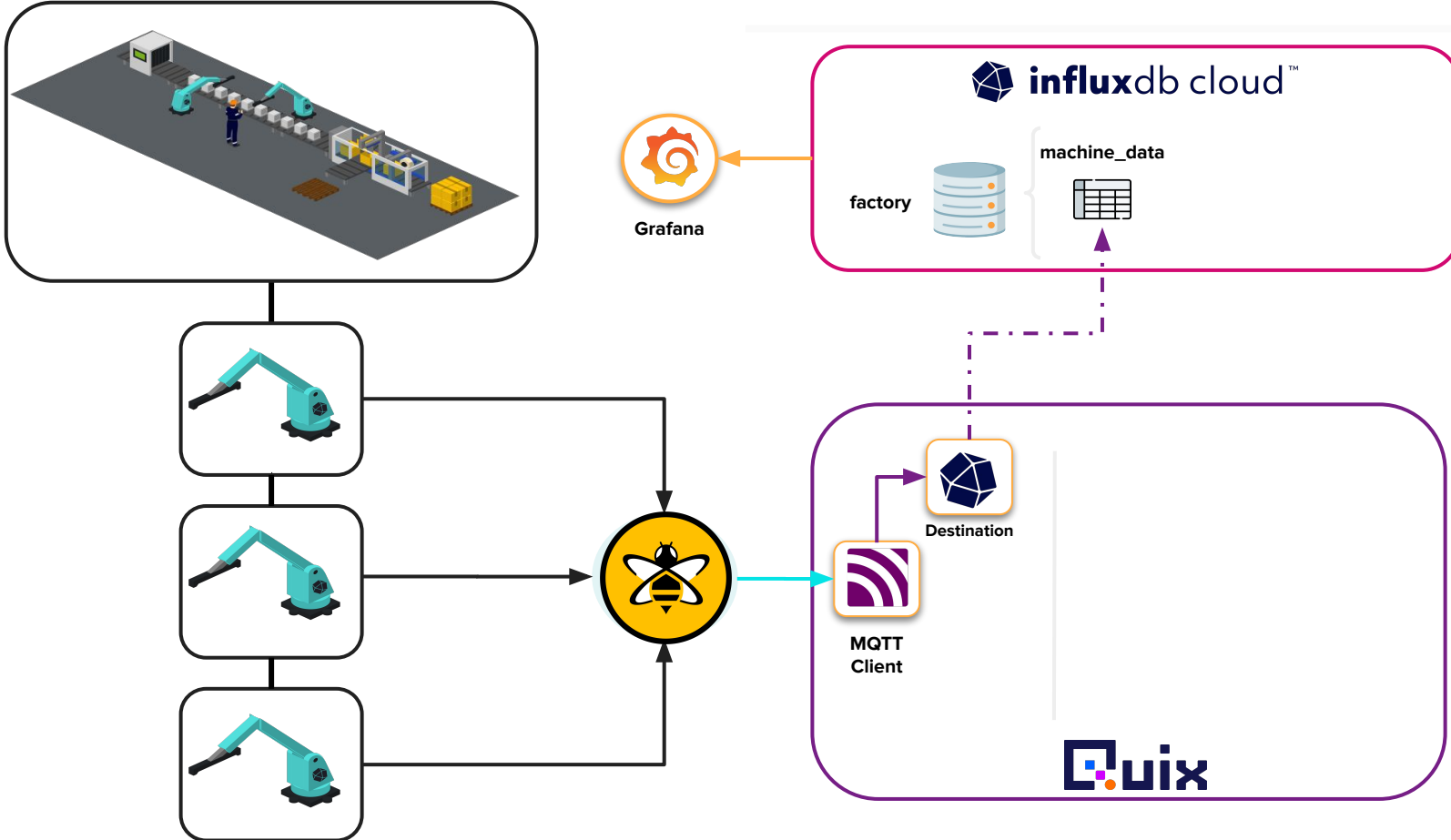
# Solution Architecture



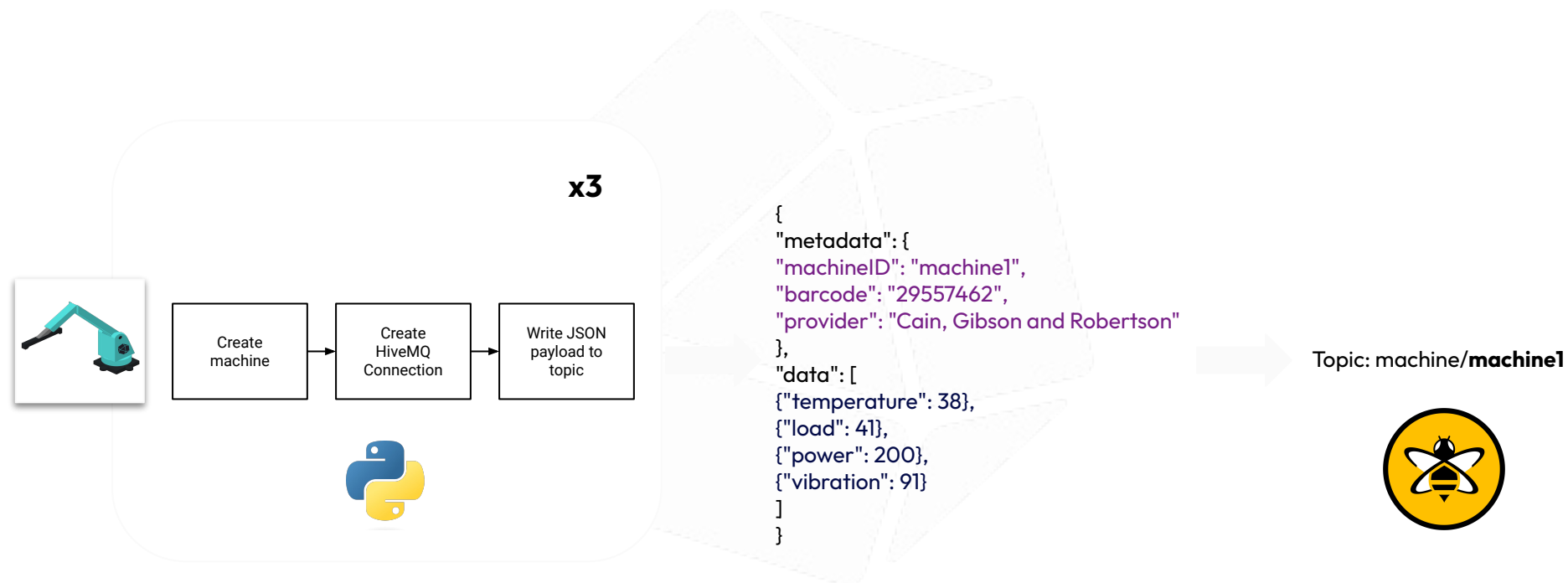
Grafana

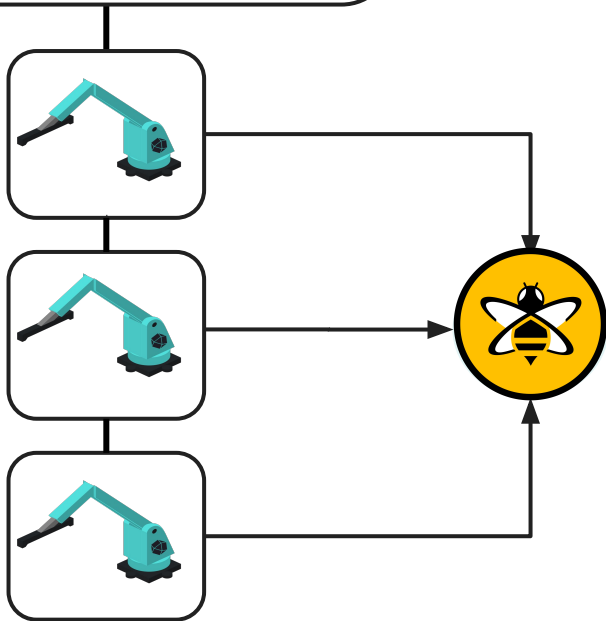
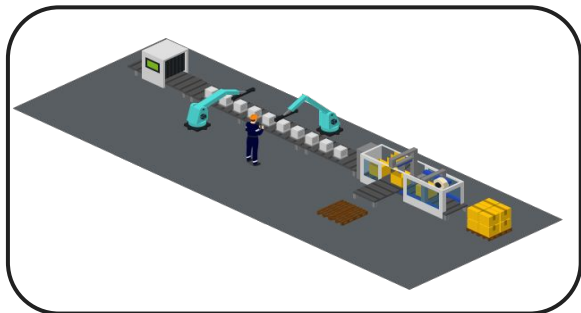


## Data Ingest



# Robot Machine Simulator





## Packing Co — Anomaly Detection



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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?**



```
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=paho.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}  
  ]  
}
```



Subscribe to  
topic

Parse JSON  
payload

Write to Kafka  
stream



Topic: rawdata

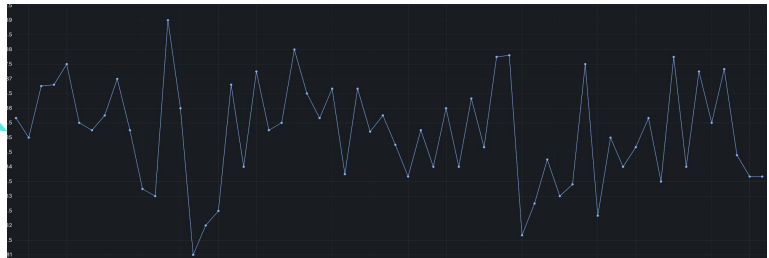
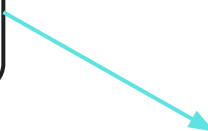
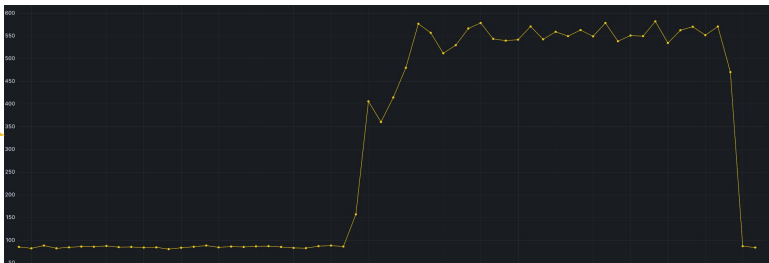
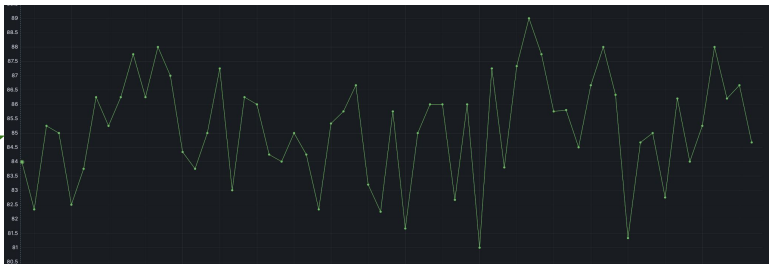


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# Real-world Challenges: Data Science

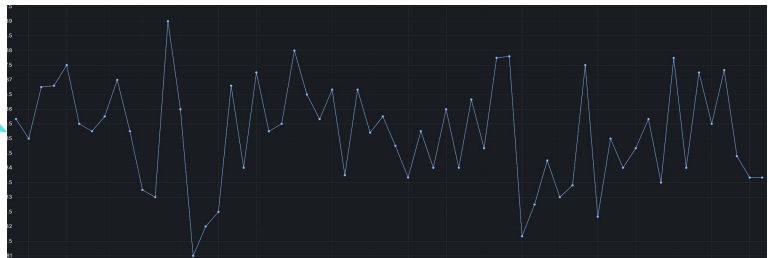
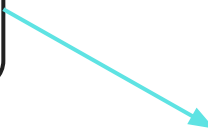
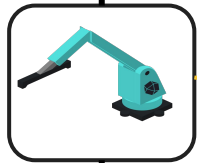


# In an ideal word



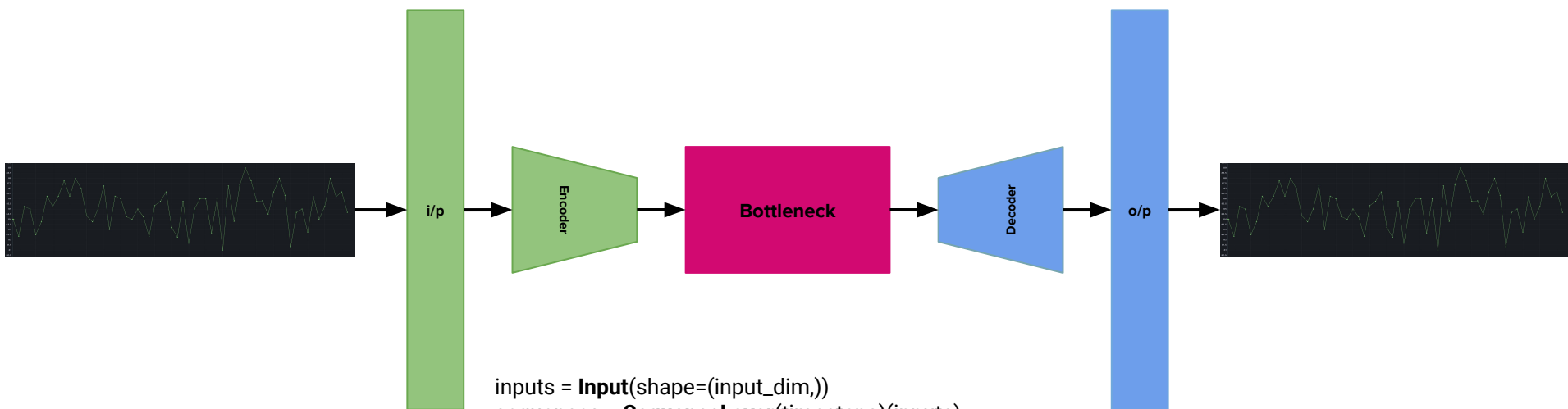
This could easily be solved with thresholding

# Realistically...



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

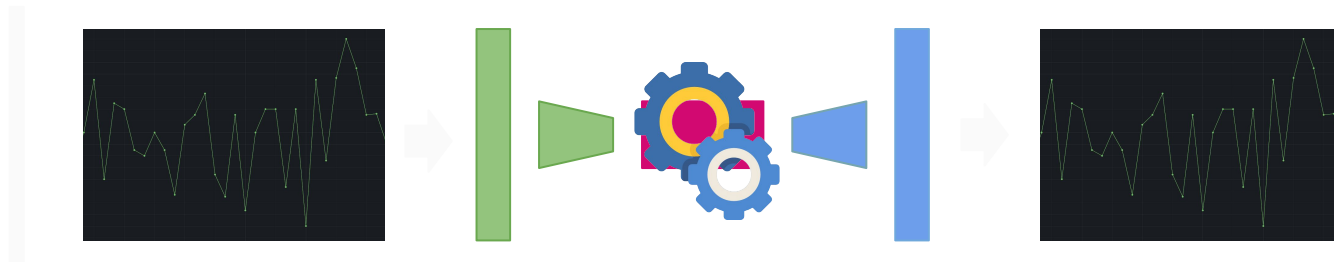
# Artificial Neural Networks - Autoencoder



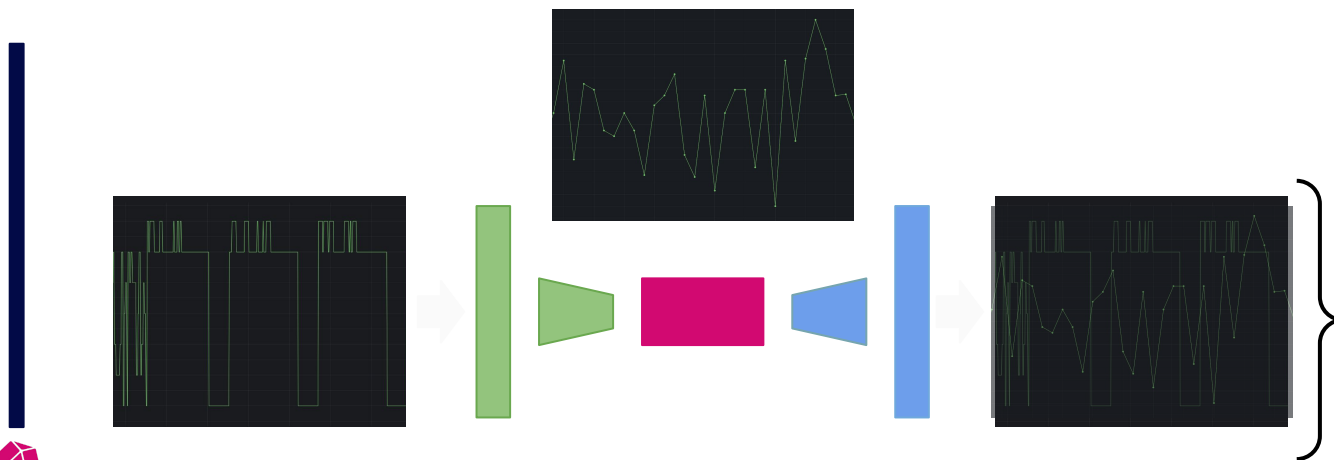
```
inputs = Input(shape=(input_dim,))
sequences = SequenceLayer(timesteps)(inputs)
inputs = Input(shape=(timesteps, input_dim))
encoded = LSTM(16, activation='relu', return_sequences=True)(inputs)
encoded = LSTM(4, activation='relu', return_sequences=False)(encoded)
decoded = RepeatVector(timesteps)(encoded)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

# How does it detect anomalies?

Train



Inference



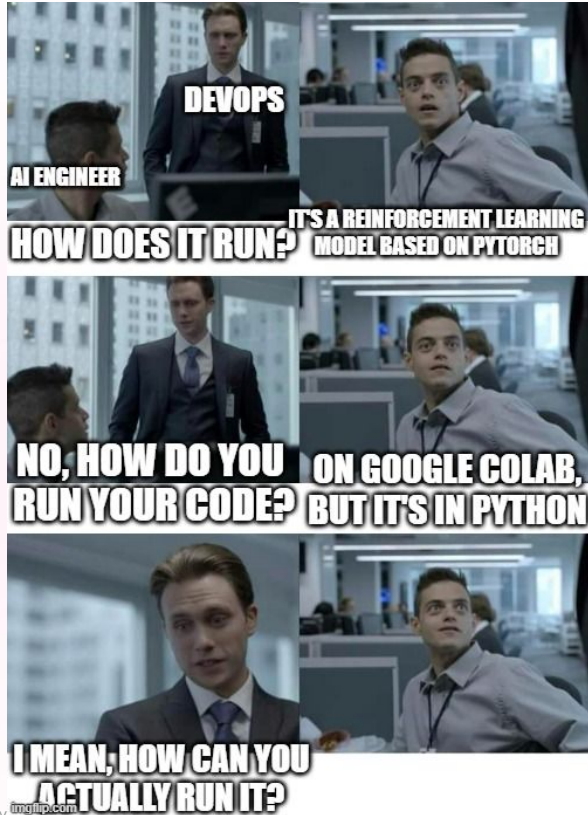
MSE  
Percentage  
**85%**

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# Real-world Challenges: Going Operational



# MLOps - Design, Deploy & Monitor



model.h5



# Hugging Face



The screenshot displays the Hugging Face interface. At the top, the navigation bar includes 'Models', 'Datasets', 'Spaces', 'Docs', 'Solutions', and 'Pricing'. The main content area shows the model card for 'tiiaue/falcon-7b', which has 908 likes. The card includes a description of the model, its training details, and a list of spaces using it. A sidebar on the right shows the model's history, including 16 commits and a list of contributors.

**Model card** | Files and versions | Community

### Falcon-7B

Falcon-7B is a 7B parameters causal decoder-only model built by [TII](#) and trained on 1,500B tokens of [RefinedWeb](#) enhanced with curated corpora. It is made available under the Apache 2.0 license.

Paper coming soon 📄

📖 To get started with Falcon (Inference, finetuning, quantization, etc.), we recommend reading [this great blogpost from HF](#)

#### Why use Falcon-7B?

- It outperforms comparable open-source models (e.g., [MPT-7B](#), [StableLM](#), [RedPajama](#) etc.), thanks to being trained on 1,500B tokens of [RefinedWeb](#) enhanced with curated corpora. See the [OpenLM Leaderboard](#).
- It features an architecture optimized for inference, with FlashAttention ([Dao et al., 2022](#)) and multiquery ([Shazeer et al., 2019](#)).
- It is made available under a permissive Apache 2.0 license allowing for commercial use, without any royalties or restrictions.

⚠️ This is a raw, pretrained model, which should be further finetuned for most usecases. If you are looking for a version better suited to taking generic instructions in a chat format, we recommend

Downloads last month: 161,448

Text Generation: Inference API has been turned off for this model.

Dataset used to train tiiaue/falcon-7b

tiiaue/falcon-refinedweb

Spaces using tiiaue/falcon-7b: 68

Contributors: 1 contributor

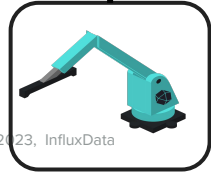
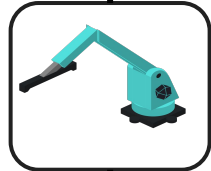
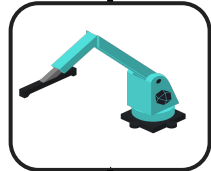
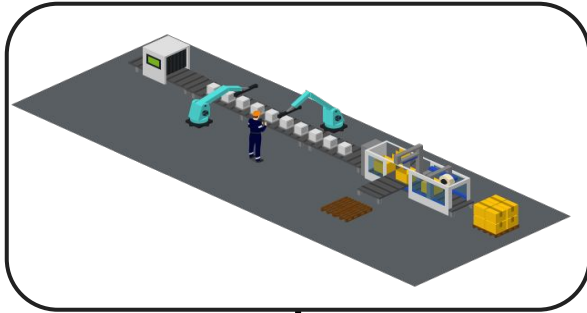
History: 16 commits

+ Add file





# ML Deployment and Inference



Grafana

 **influxdb cloud™**

factory



machine\_data



mlresults



Destination



MQTT Client

Query

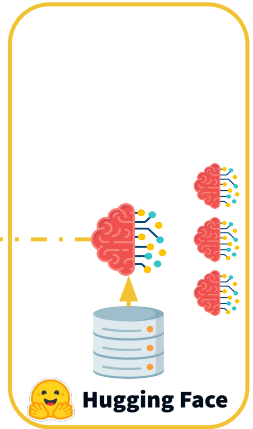


ML Model



Destination

**Quix**



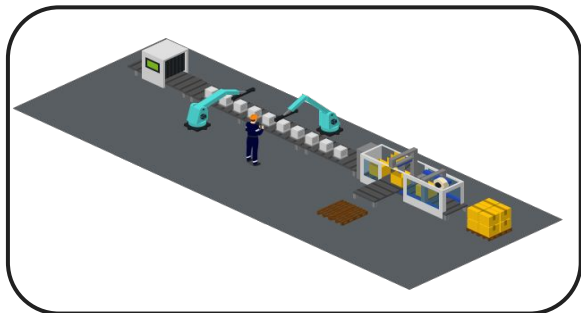
**Hugging Face**

**influxdata®**

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# Summary and Conclusion





## Packing Co — Anomaly Detection



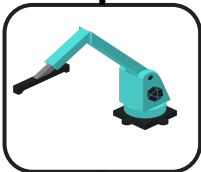
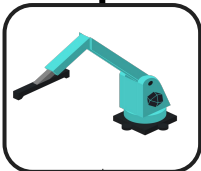
Enabled the **ingest, transformation and storage** of their machine data.



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

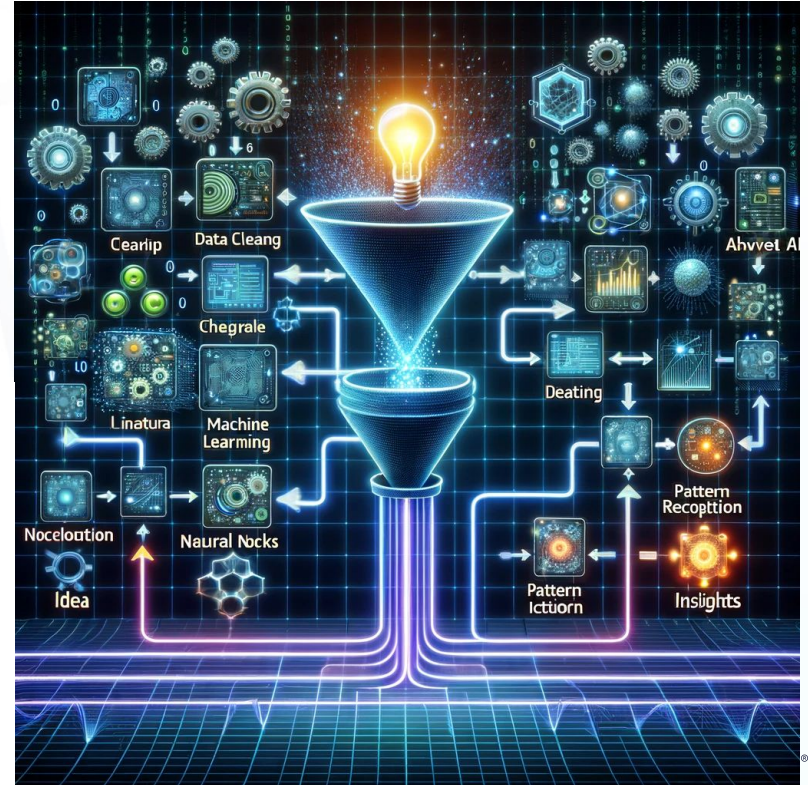


Provided the foundations of a **scalable data pipeline**.



# 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



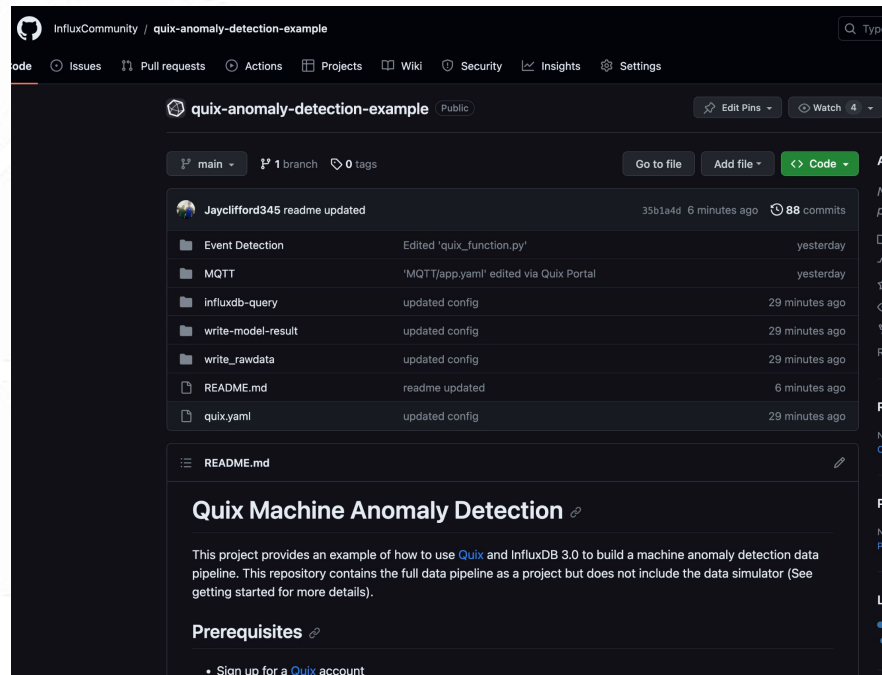
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# Next Steps

# Try it yourself



[https://github.com/InfluxCommunity/  
quix-anomaly-detection-example](https://github.com/InfluxCommunity/quix-anomaly-detection-example)



# Join the InfluxDB Community

## Sign up

Influxdata.com

Get InfluxDB

Via cloud marketplace



## Learn

- ✓ Self-service content
- ✓ Documentation
- ✓ InfluxDB University
- ✓ Community

<https://influxdbu.com/>

<https://influxcommunity.slack.com/>



# Join the HiveMQ Community

## Get HiveMQ

<https://www.hivemq.com/download/>  
<https://www.hivemq.com/download/docker/>  
<https://console.hivemq.com/>

## Learn

- ☒ [university.hivemq.com](https://university.hivemq.com)
- ☒ [docs.hivemq.com](https://docs.hivemq.com)
- ☒ [community.hivemq.com](https://community.hivemq.com)



**CONNACK! Munich:**  
The ultimate gathering of MQTT enthusiasts to explore practical applications of MQTT for Connected Industries.



**HiveMQ MQTT v3.1.1 Professional - Certification Exam**

This exam tests for a student's practical foundation and understanding of the MQTT protocol and network.


Explore



**Coming Soon: Control Center and Microsoft Active Directory**

This proposed class offers a comprehensive understanding of how to configure HiveMQ's Control Center to authenticate and authorize users through Microsoft Active Directory.


Explore



**Coming Soon: Mastering Data Integrity with HiveMQ's Data Hub**

Dive into the capabilities of HiveMQ's Data Hub, a platform designed to set and enforce MQTT data standards.


Explore



**Coming Soon: Industry 4.0 with HiveMQ Edge**

HiveMQ Edge is transforming the landscape of Industry 4.0, M2M communication, and IoT, and this comprehensive online course is designed to equip you with the knowledge to leverage its full potential.

Explore




**HiveMQ Technical Partner Training**

This course has to be completed in order to be considered a certified partner.




**MQTT 3.1.1 Professional**

This course provides students new to MQTT and IoT with a



**HiveMQ Certified MQTT Associate - Certification Exam**

This examination assesses your



**Quick Tips and Short Videos**

While these videos aren't necessarily part of a larger

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Any Questions?

Thank you



**influxdata**<sup>®</sup>

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THANK YOU