

Unleashing the Power of AI in IoT: A Deep Dive into HiveMQ Cloud and InfluxDB 3.0



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In Collaboration with:  **influxdata**[®]

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



Speakers



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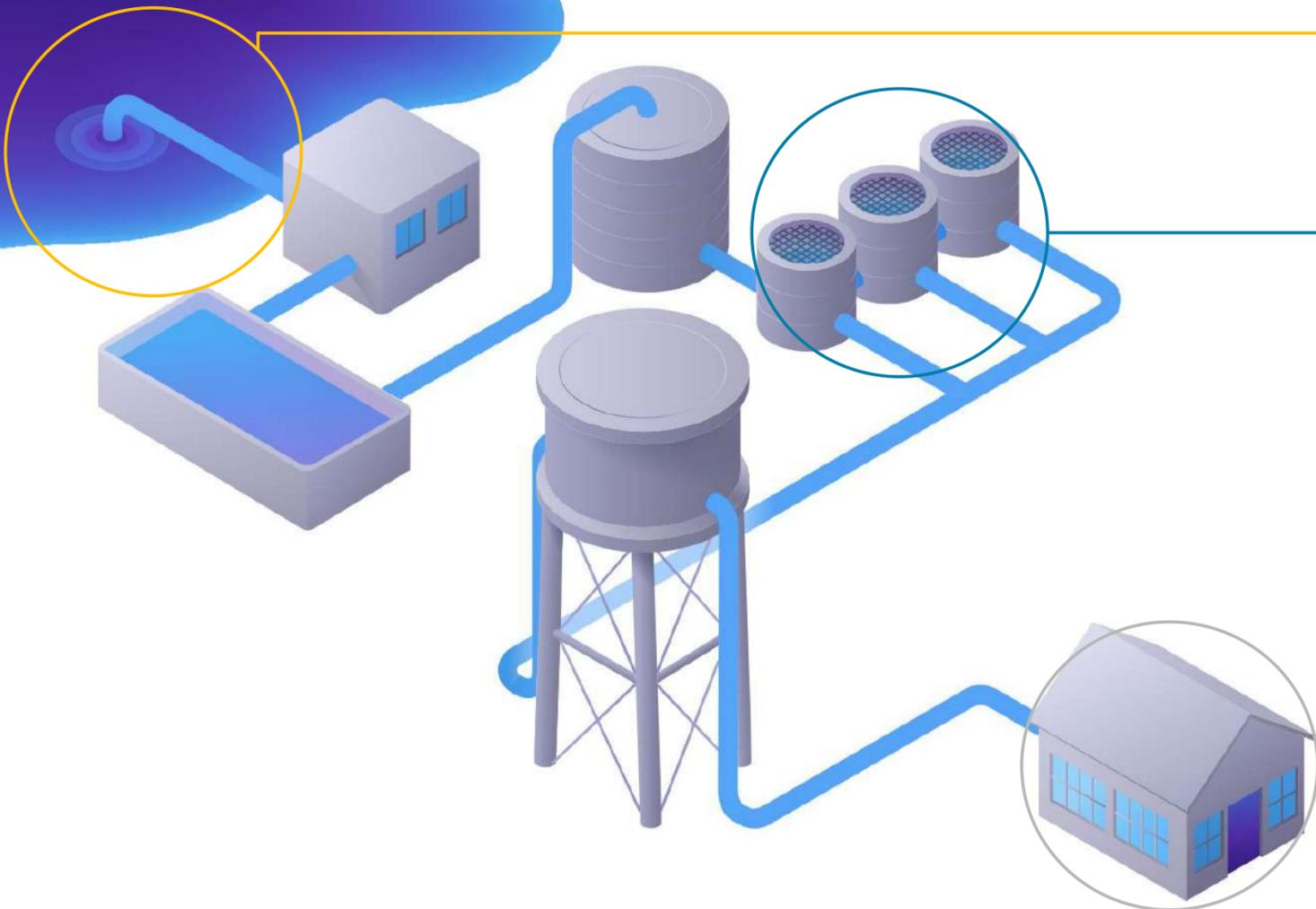
Jay Clifford

Developer Advocate at InfluxData

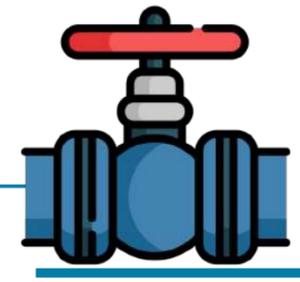
 jclifford@influxdata.com

 <https://www.linkedin.com/in/jaymand13>

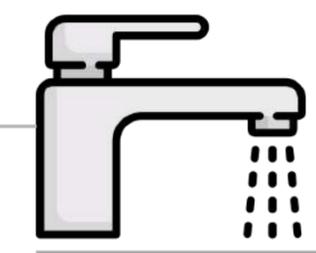




Source



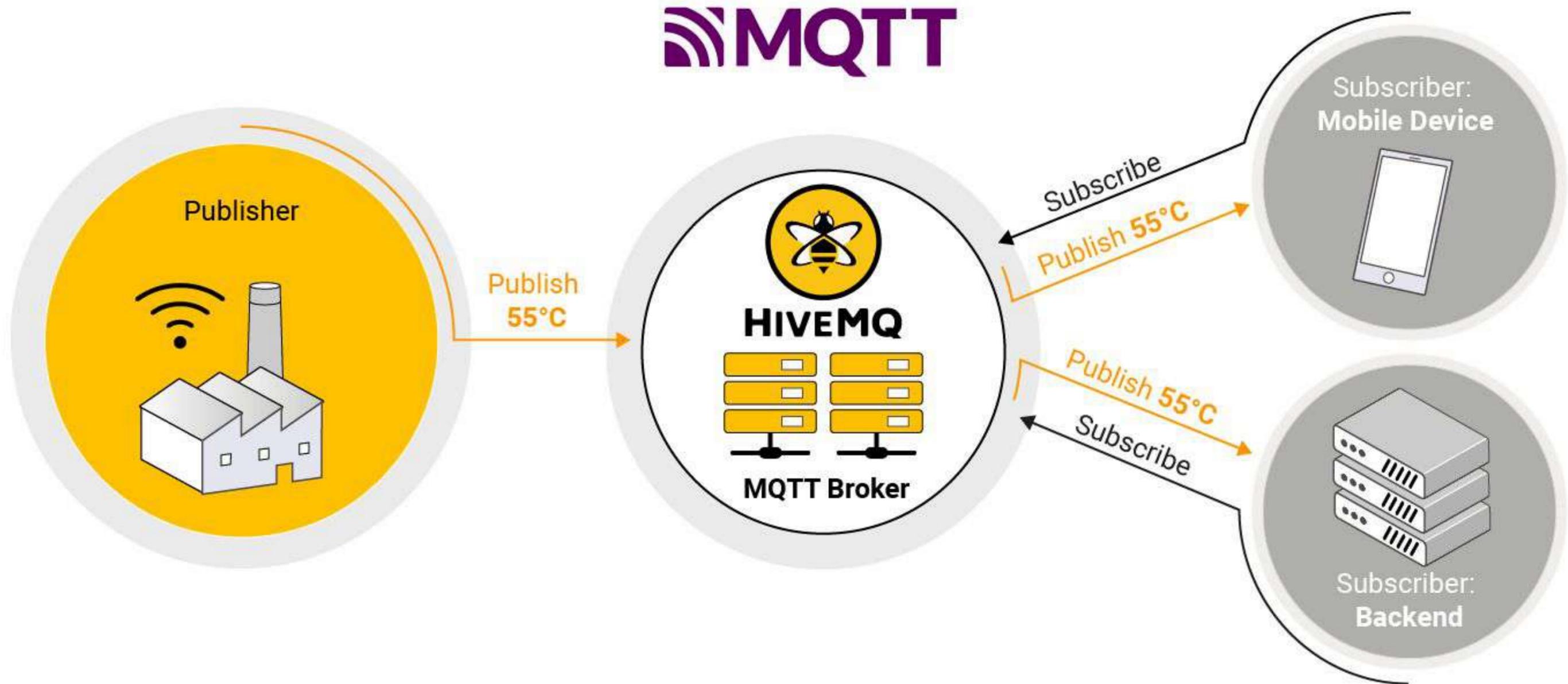
Transformation



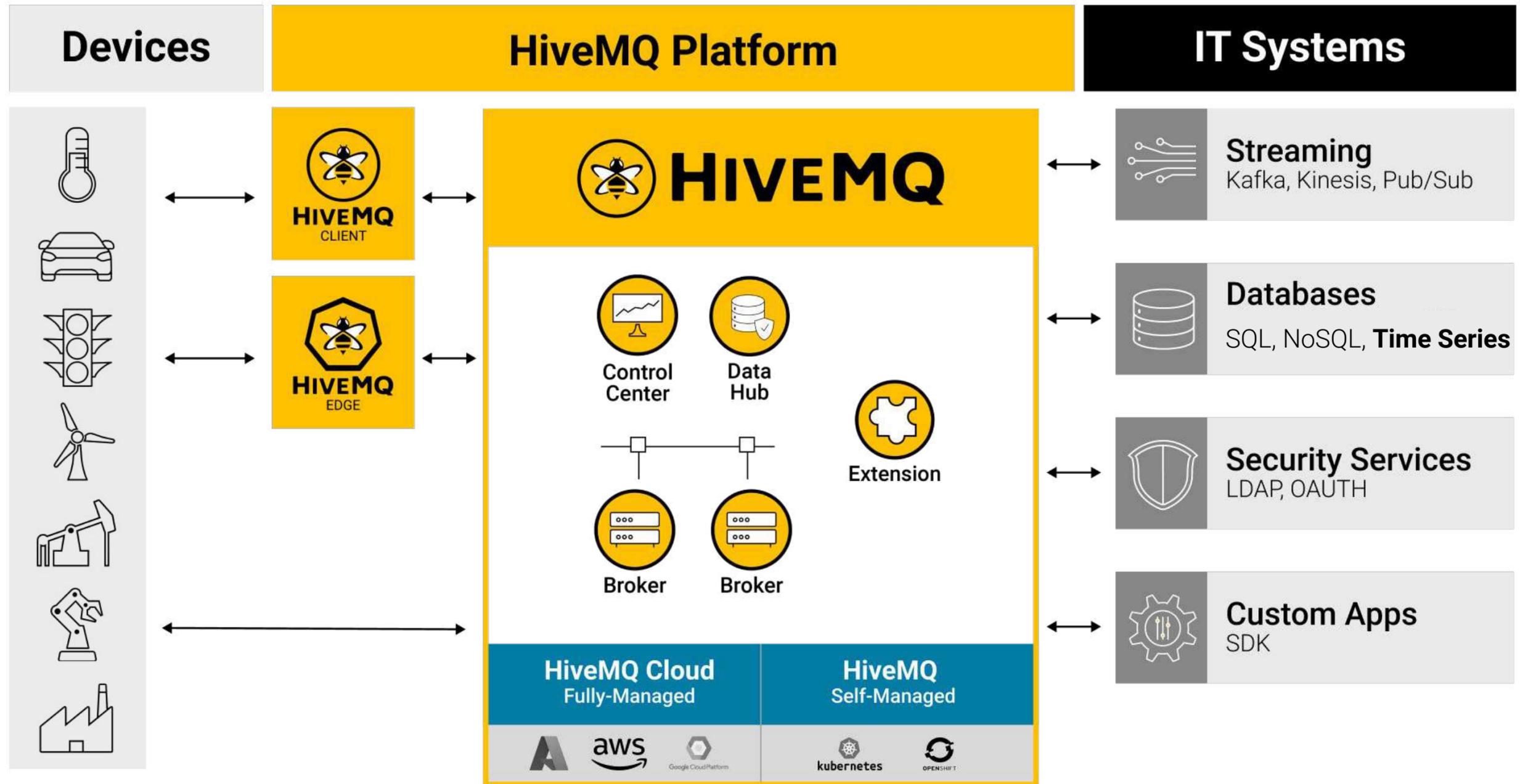
Destination

What are data pipelines?

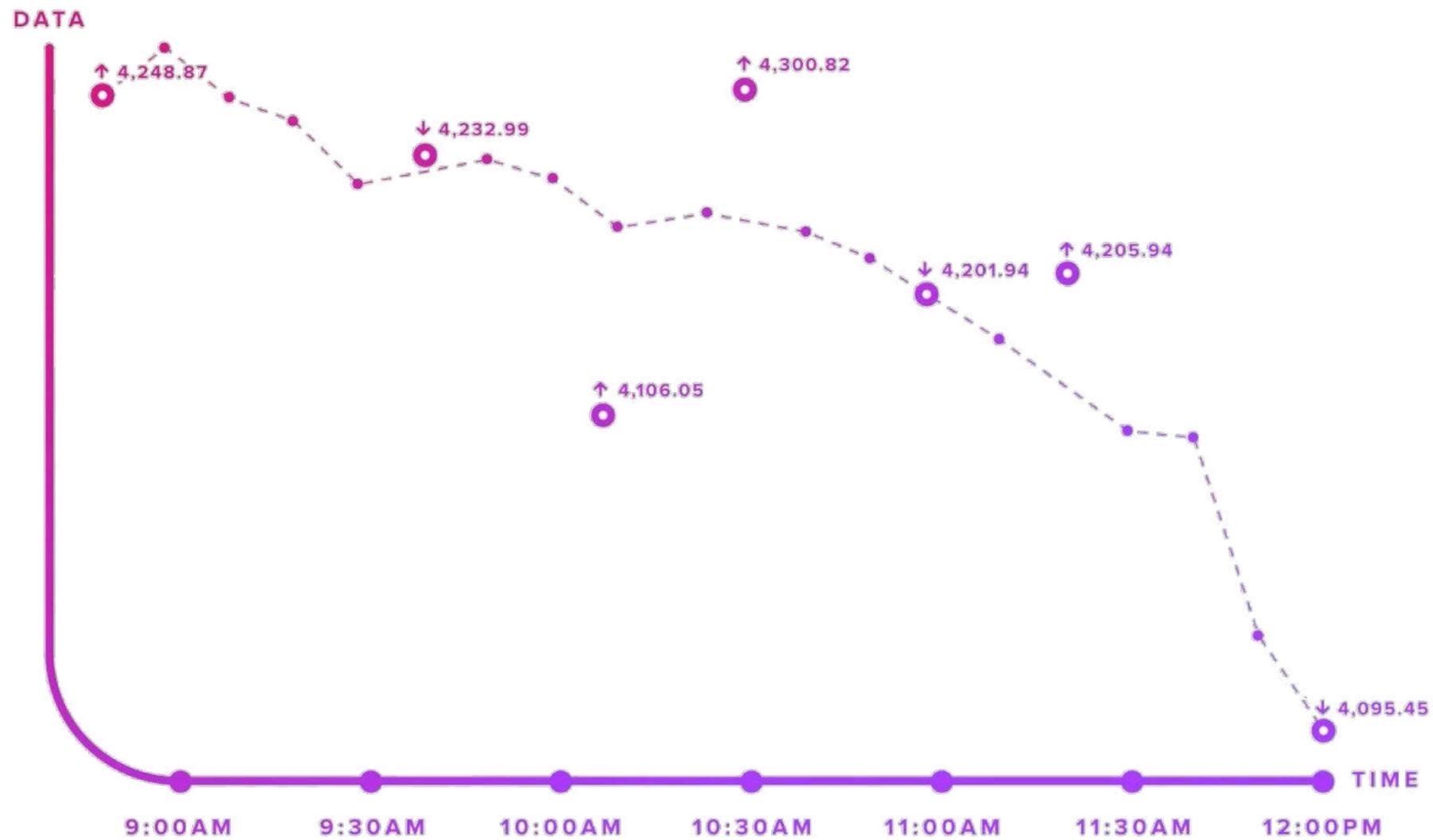
Piping with MQTT and Pub/Sub



HiveMQ - The most trusted MQTT platform



A Critical Component of Modern Data Pipelines



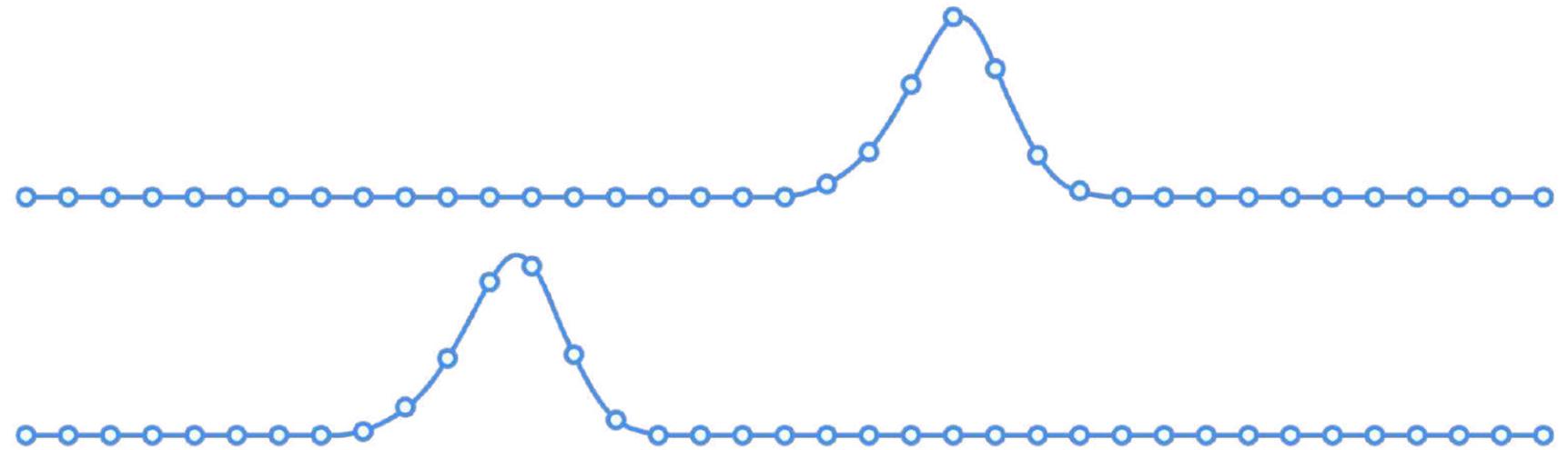
Time Series Data



Time Series Data Types

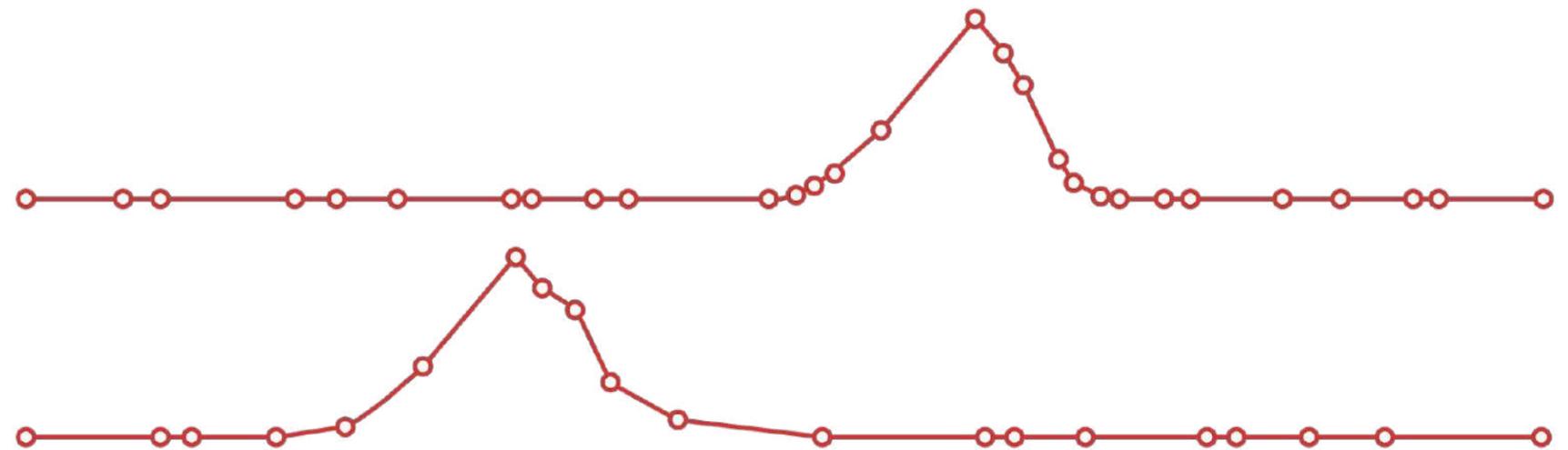
Metrics

Measurements at **regular** time intervals

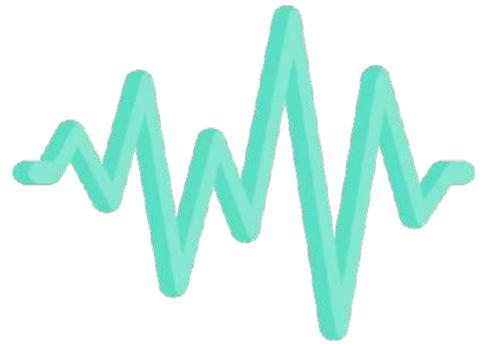


Events

Measurements at **irregular** time intervals



Time Series Databases



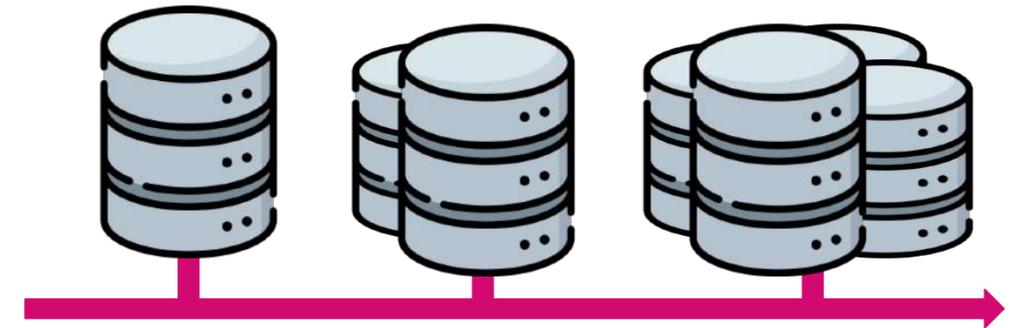
**Time Series
Data**



**High write
throughput**

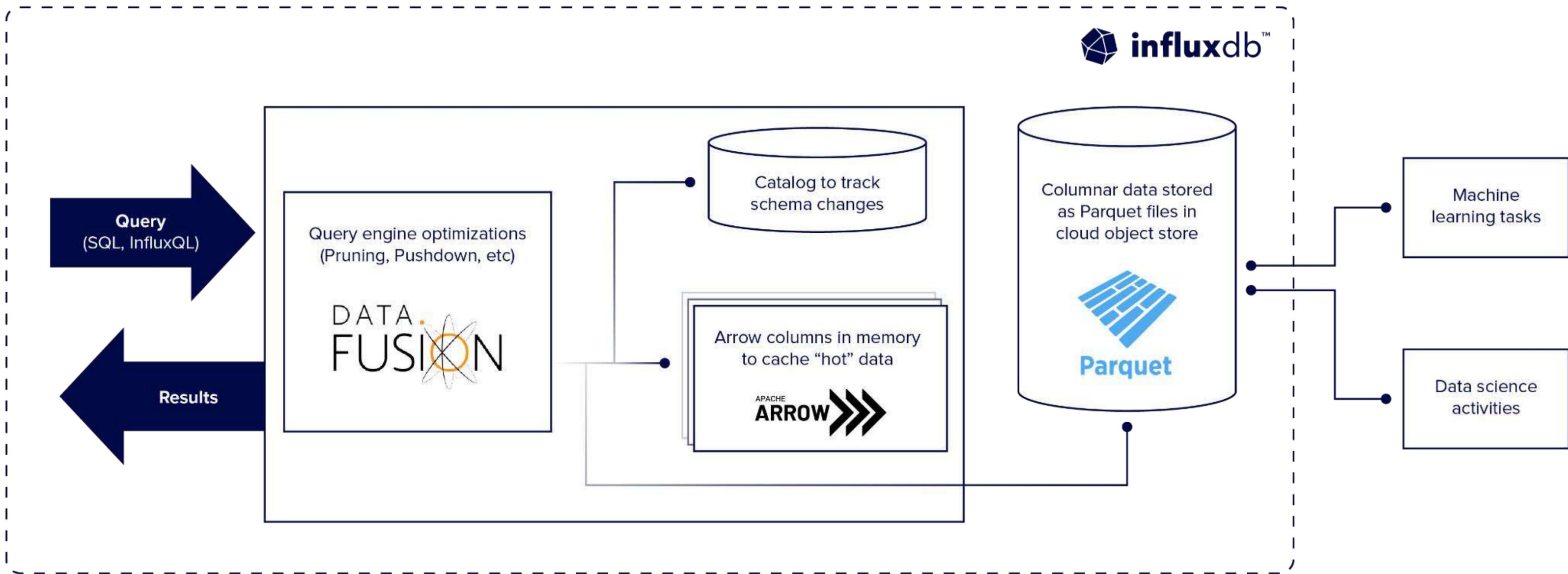


**Efficient
Queries Over
Time Ranges**



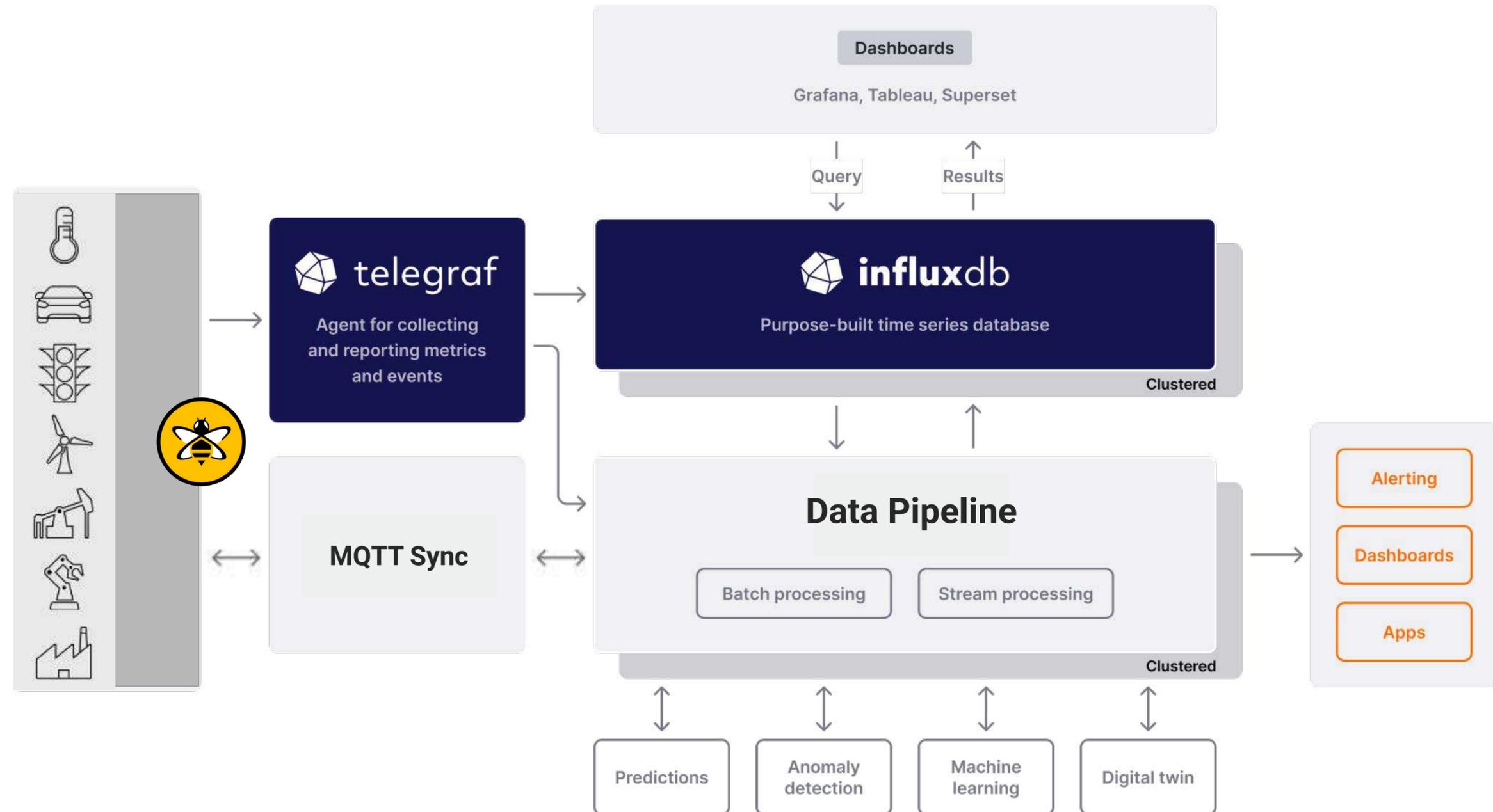
**Scalability
and
Performance**

InfluxDB 3.0



Integrating Data Pipelines in Application Architectures

- Speed
- Security
- Scalability
- Interoperability

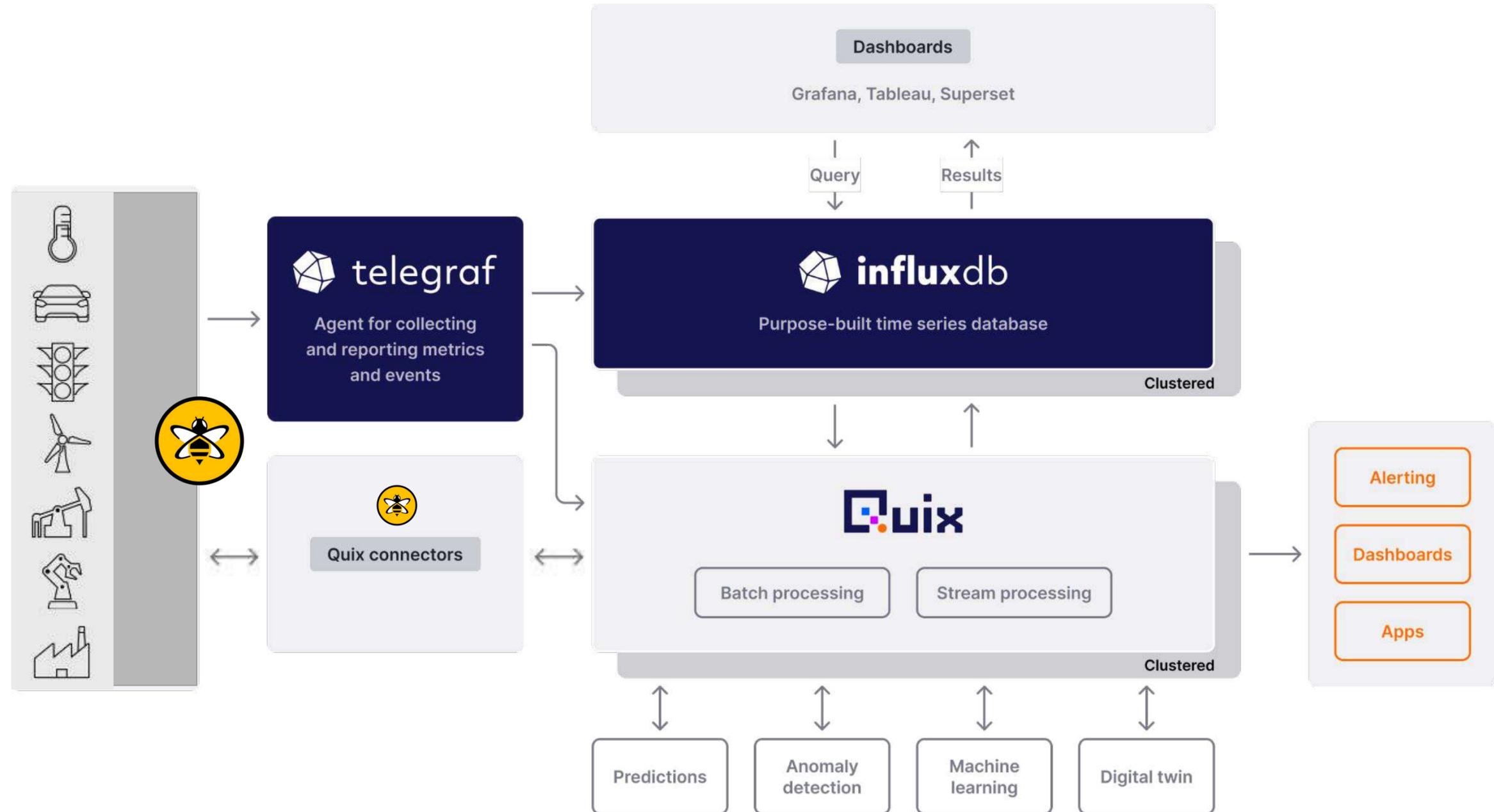


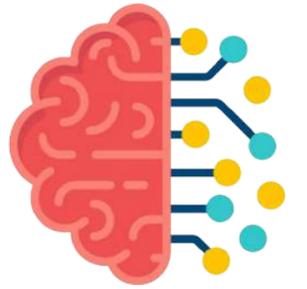
Using Quix

 Built on Kafka

 Build applications using python

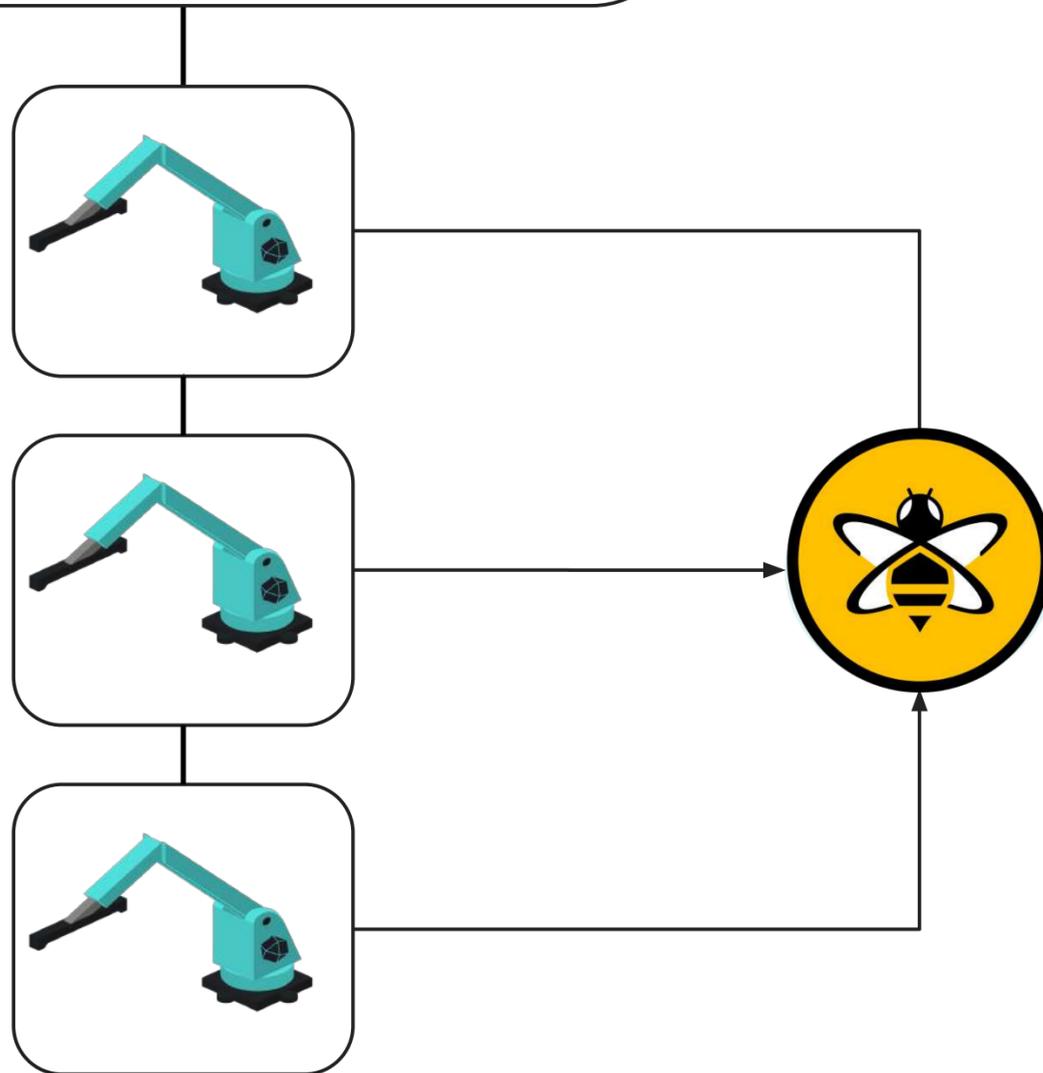
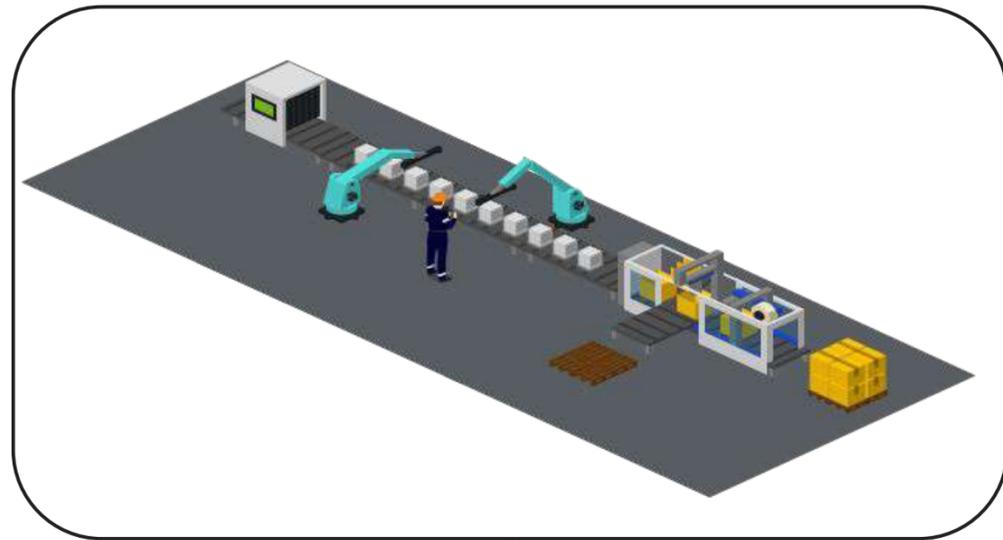
 MQTT and InfluxDB connector support





Real-world Challenges: Architectures

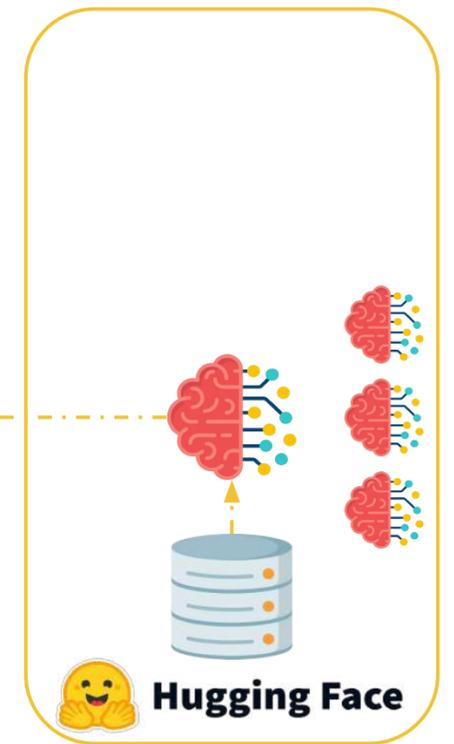
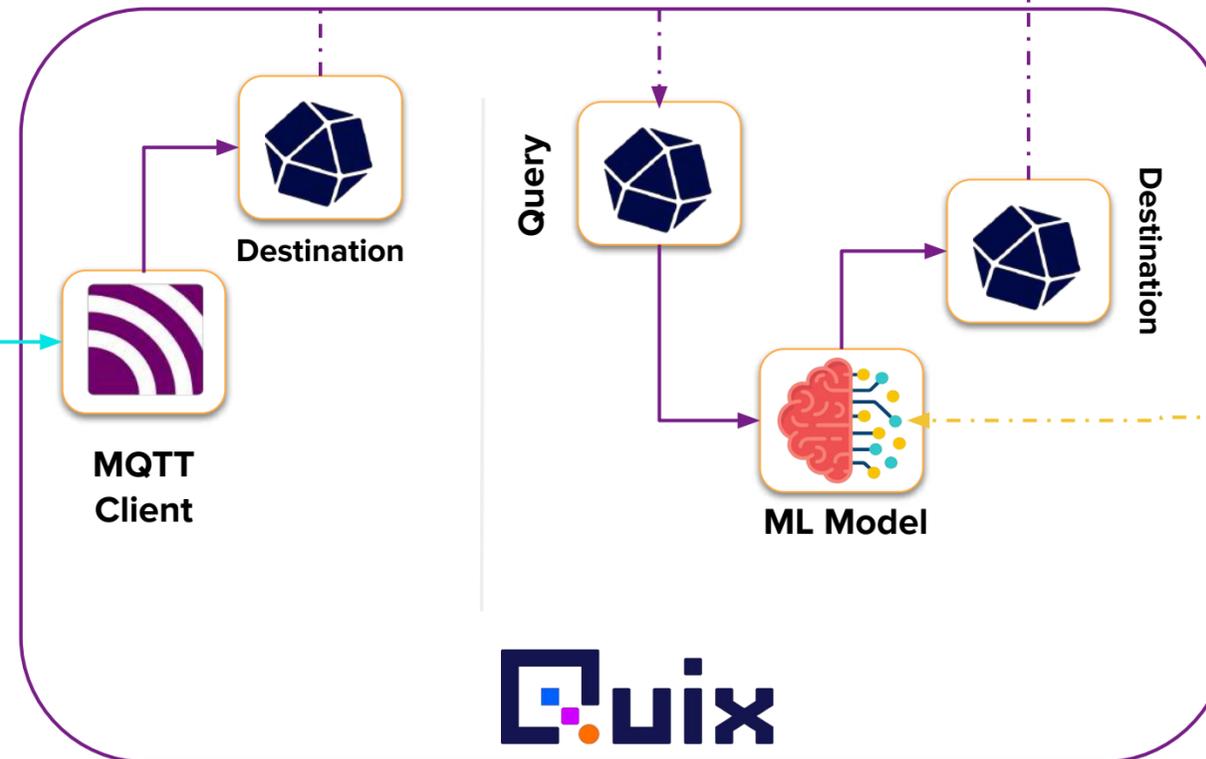
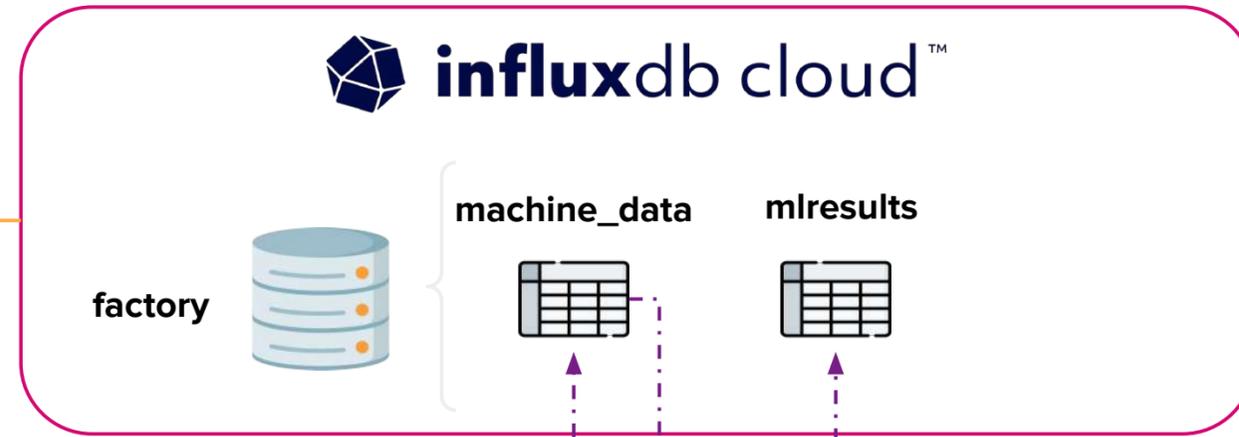
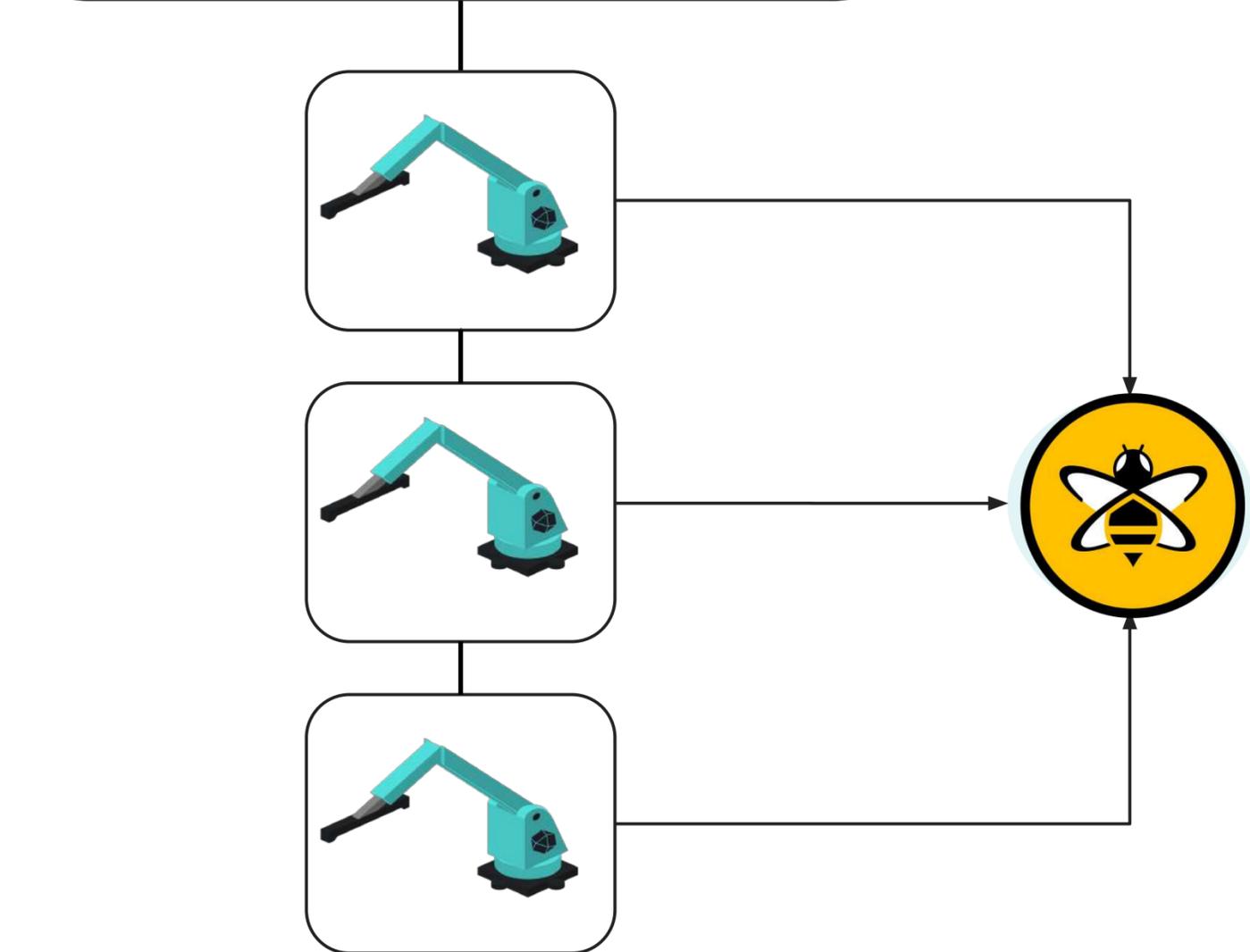
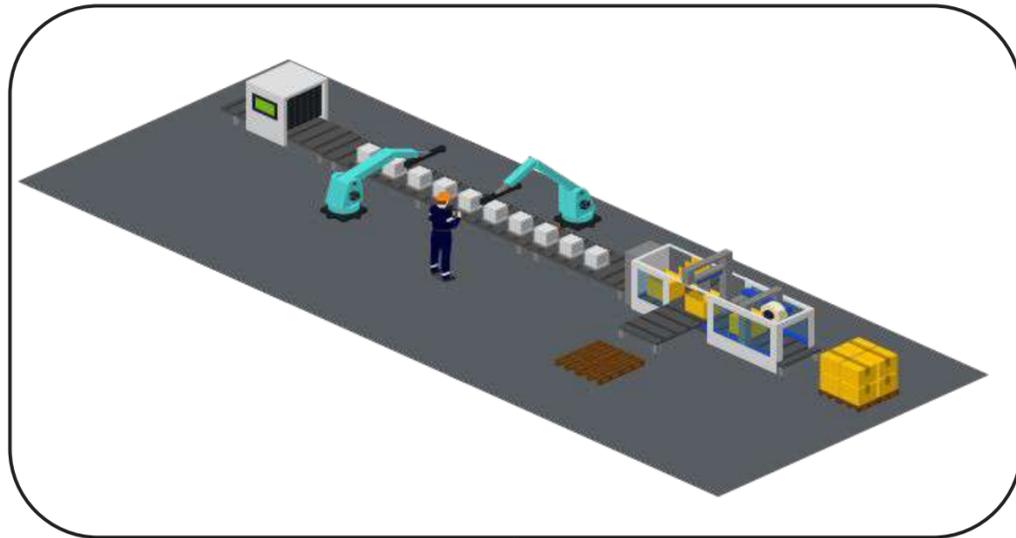




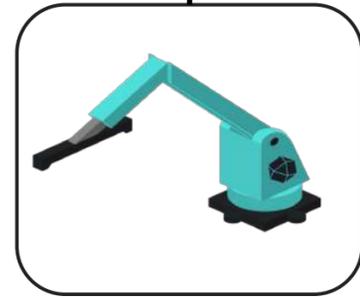
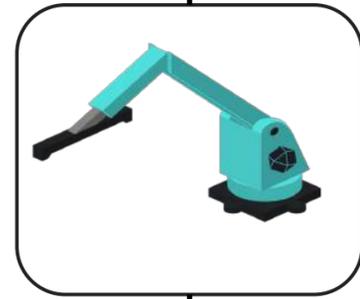
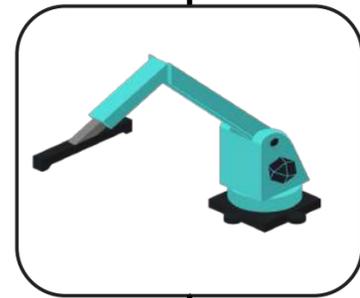
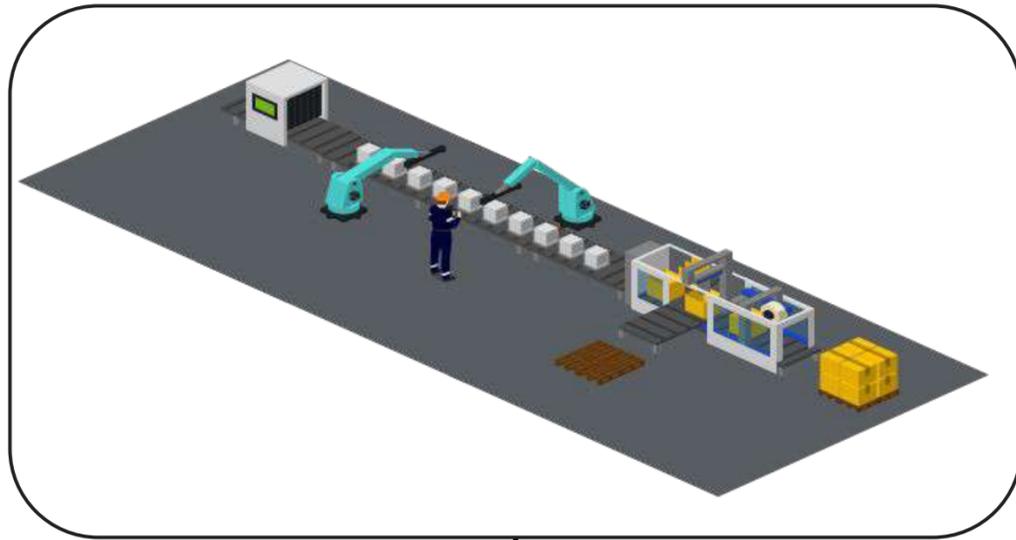
Packing Co – Anomaly Detection

-  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?**

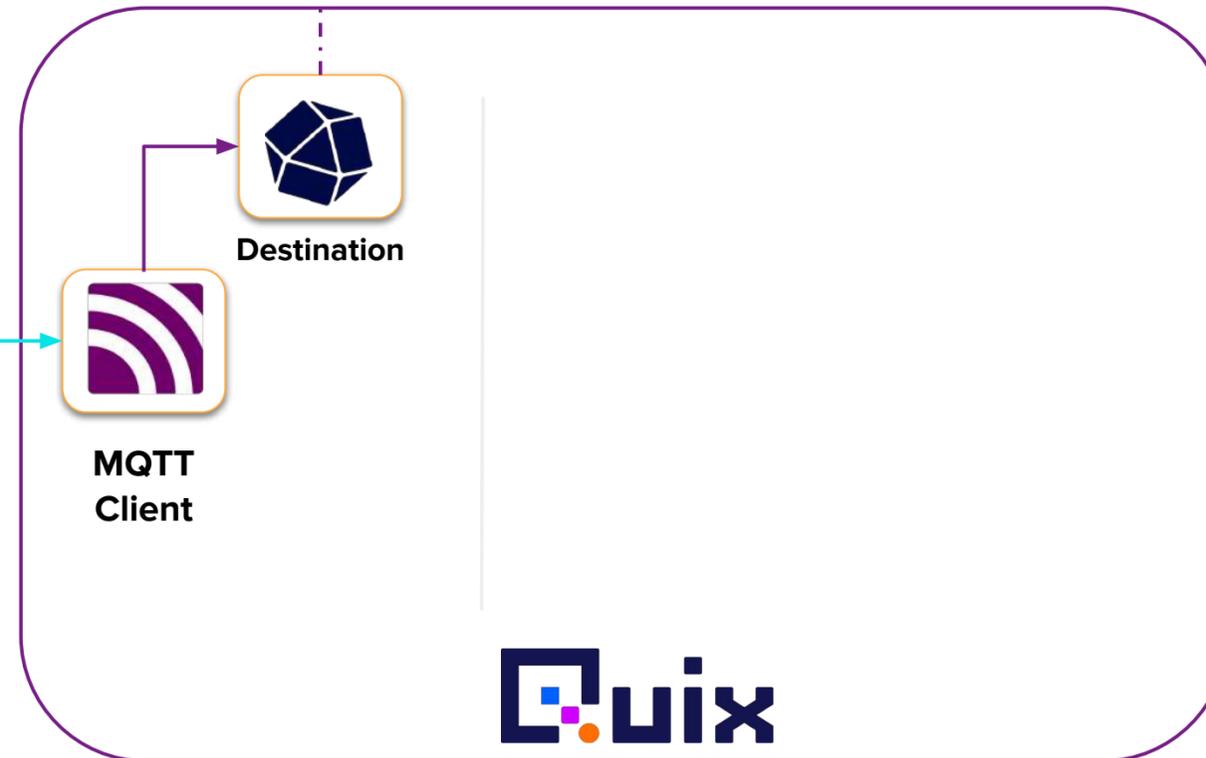
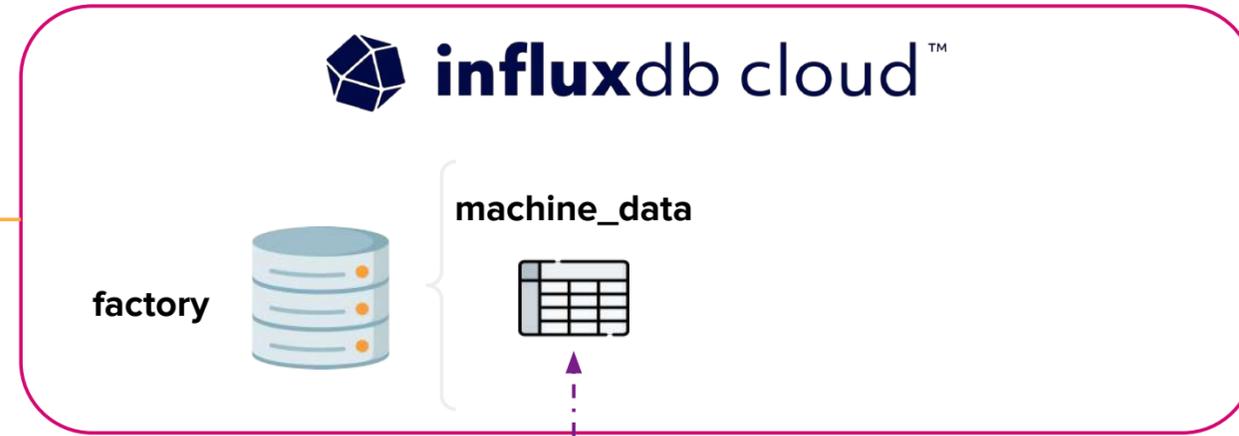
Solution Architecture



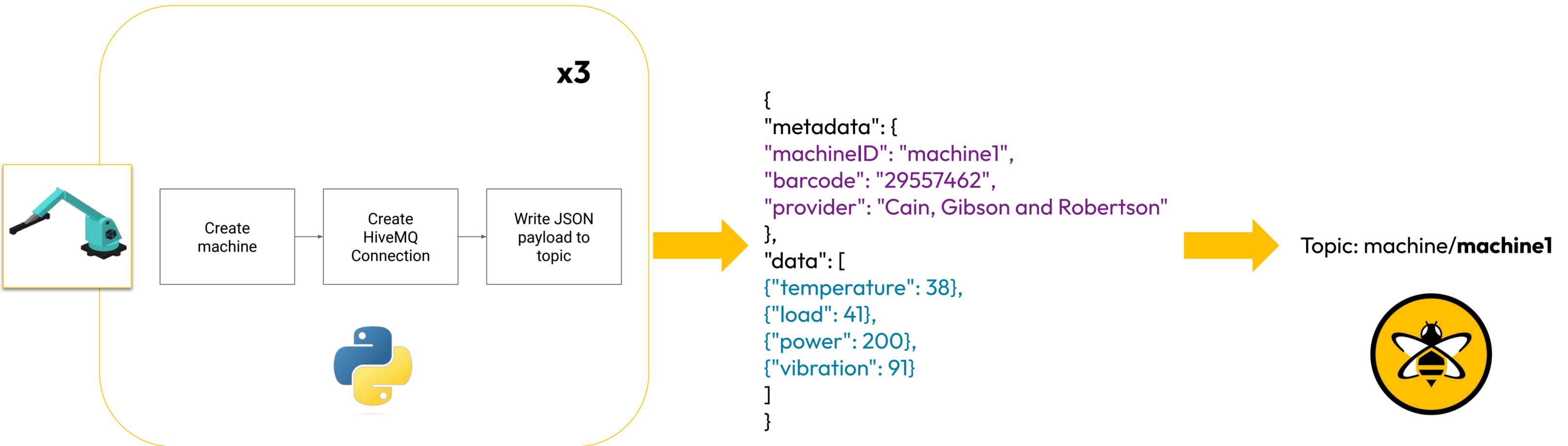
Data Ingest



Grafana



Robot Machine Simulator





```
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.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

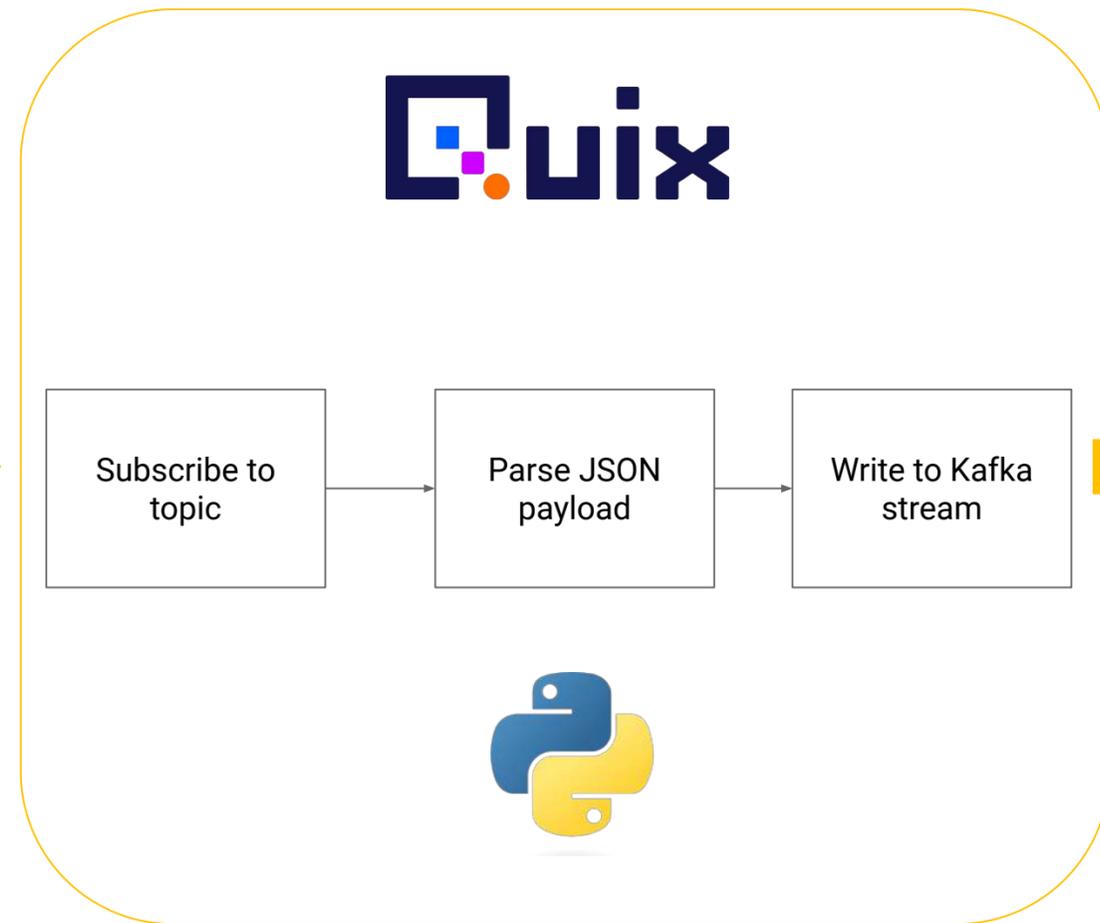


Quix MQTT Subscriber

Topic: machine/#



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



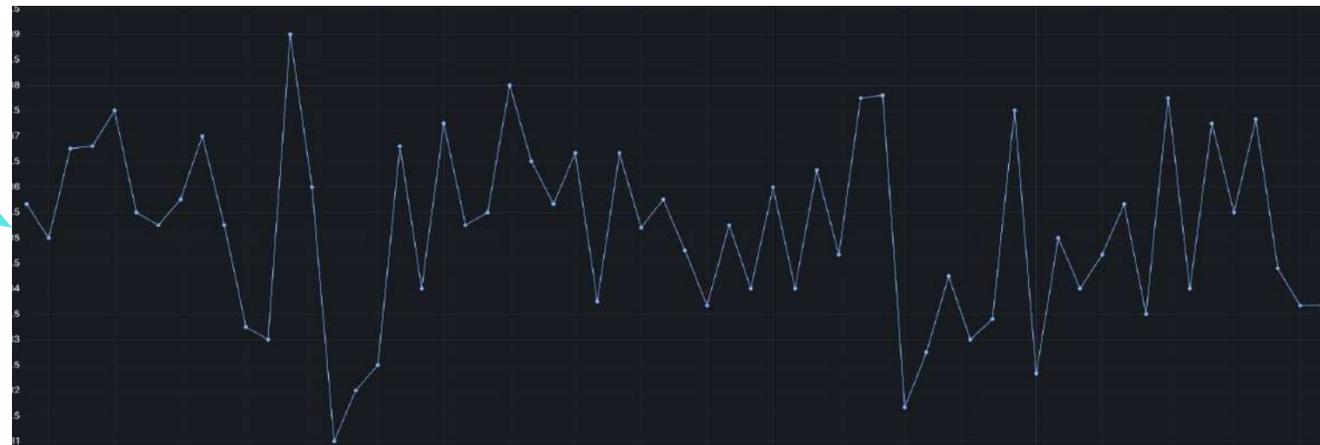
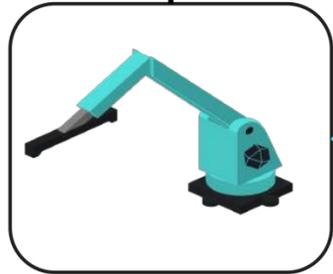
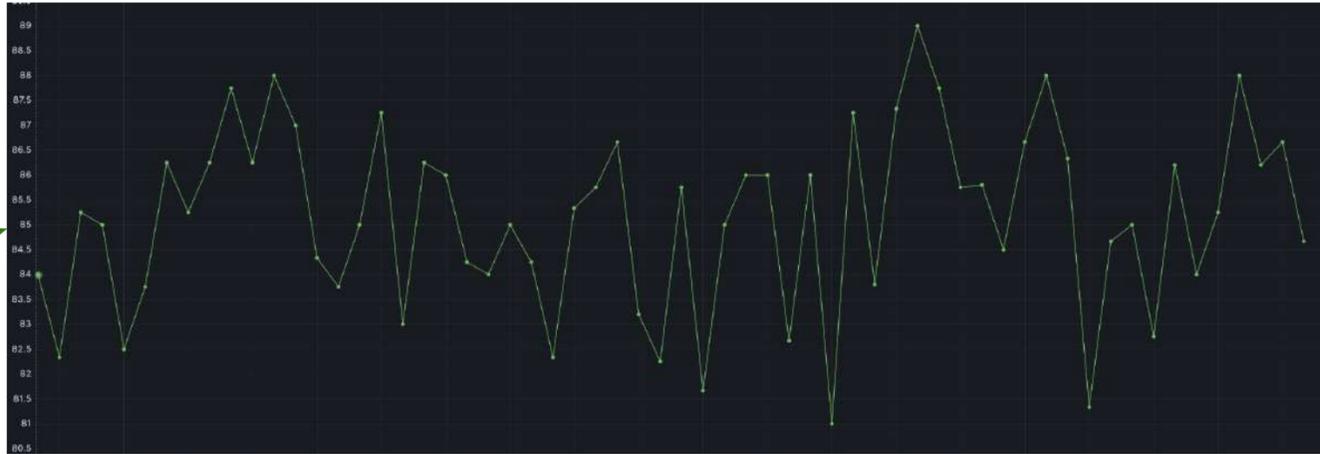
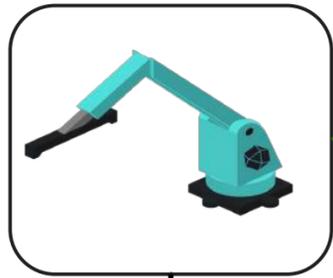
Topic: rawdata



Real-world Challenges: Data Science



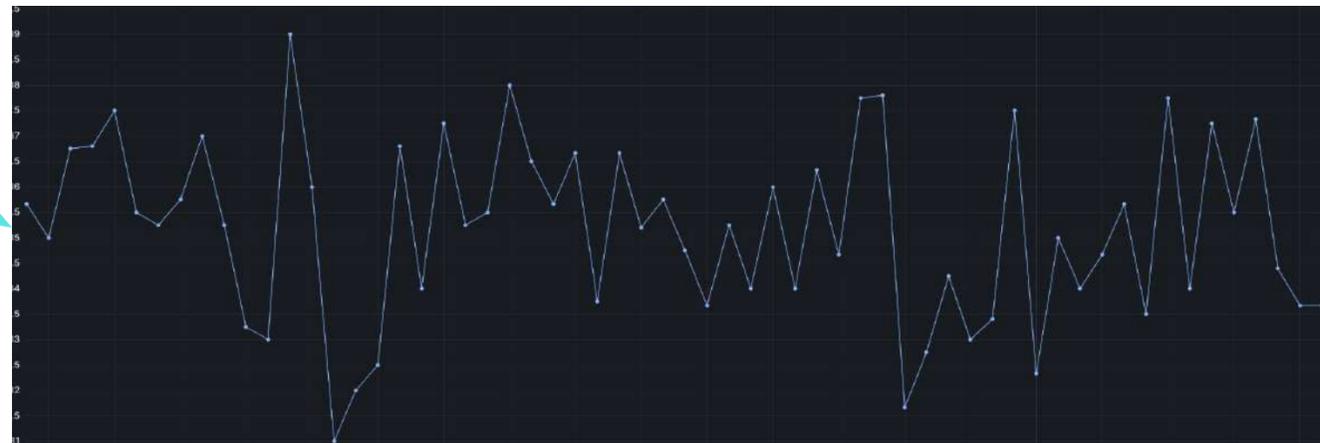
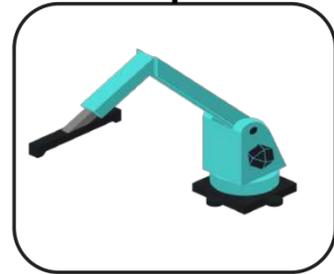
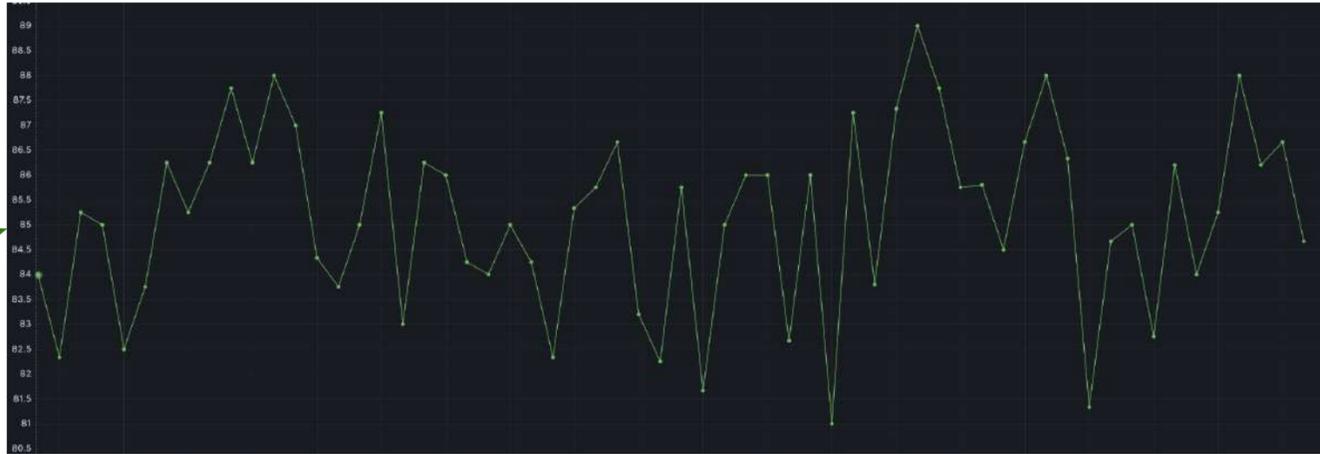
In an ideal world



This could easily be solved with thresholding



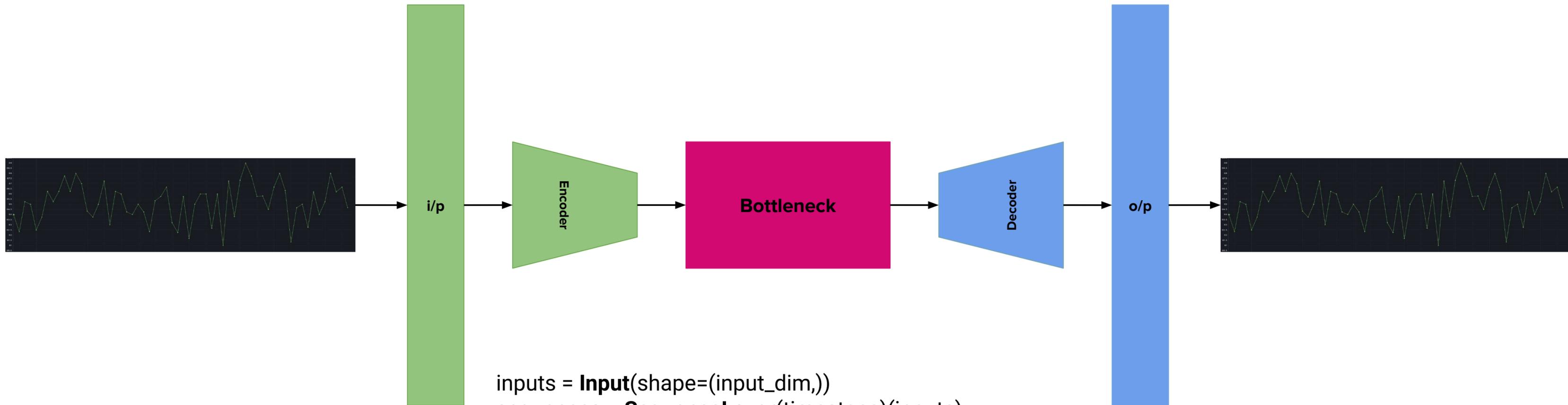
Realistically...



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



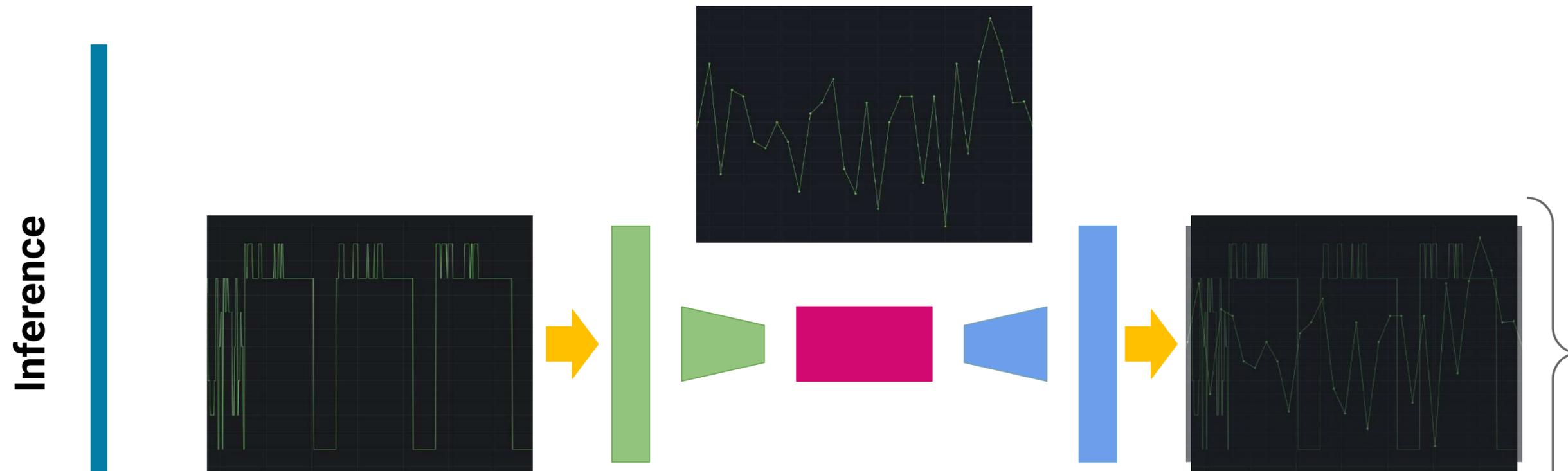
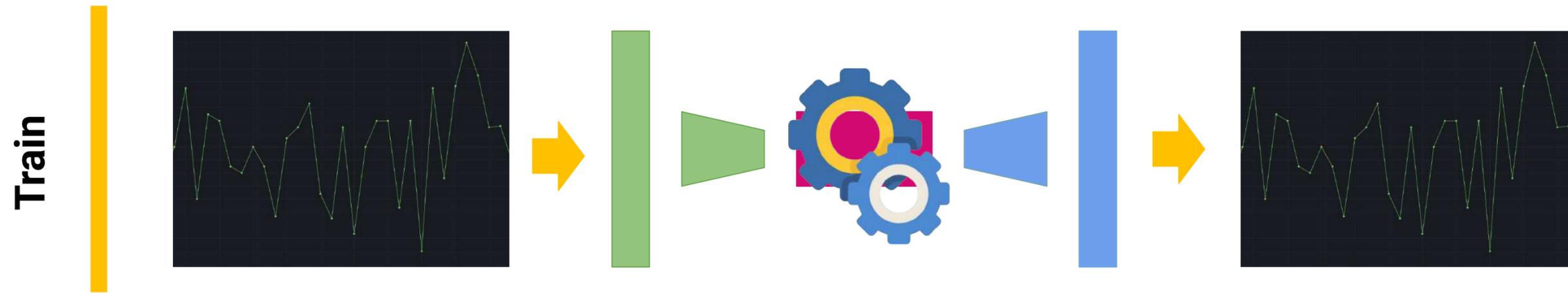
Artificial Neural Networks - Autoencoder



```
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?



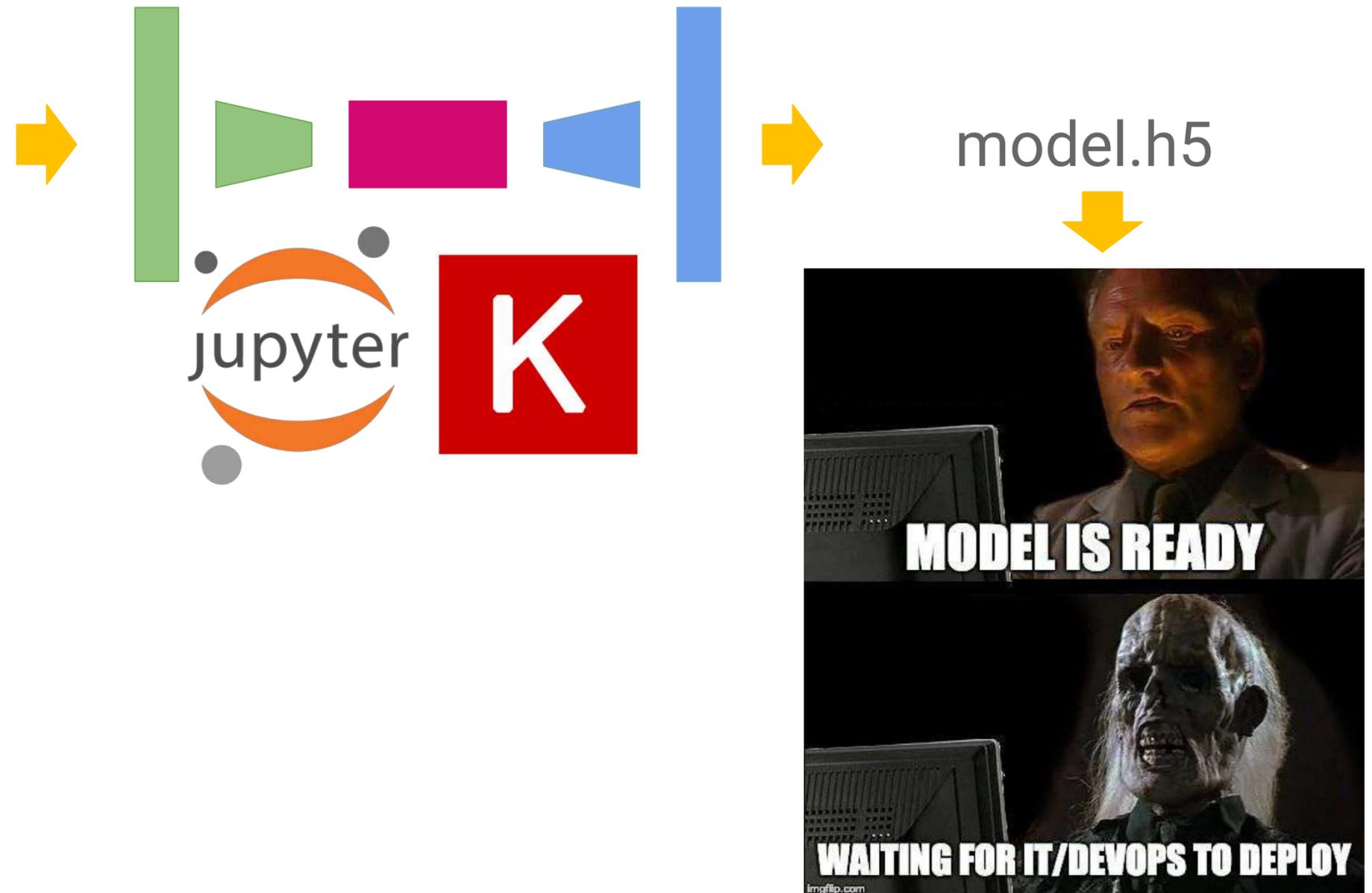
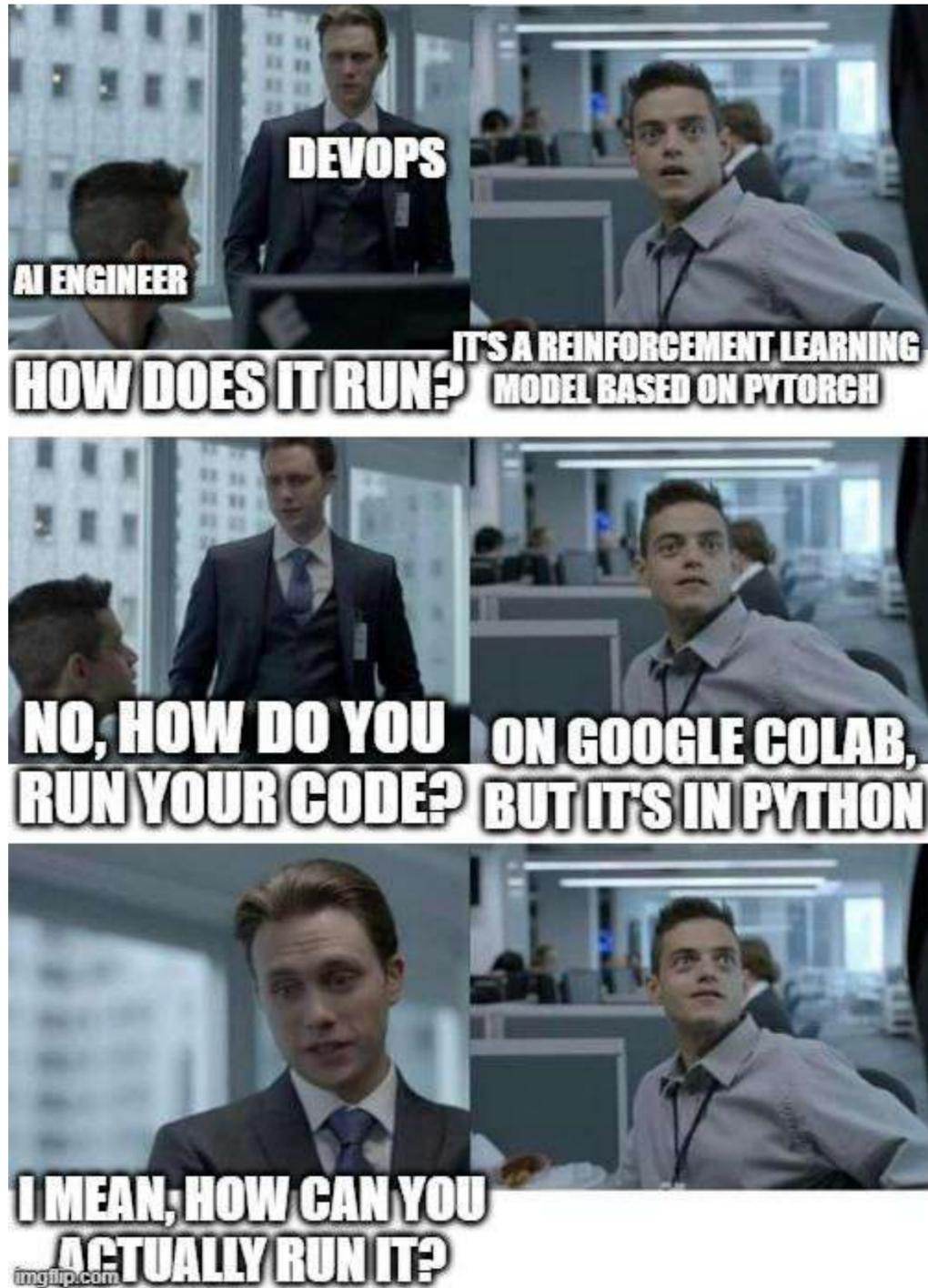
MSE
Percentage
85%



Real-world Challenges: Going Operational



MLOps - Design, Deploy & Monitor



Hugging Face

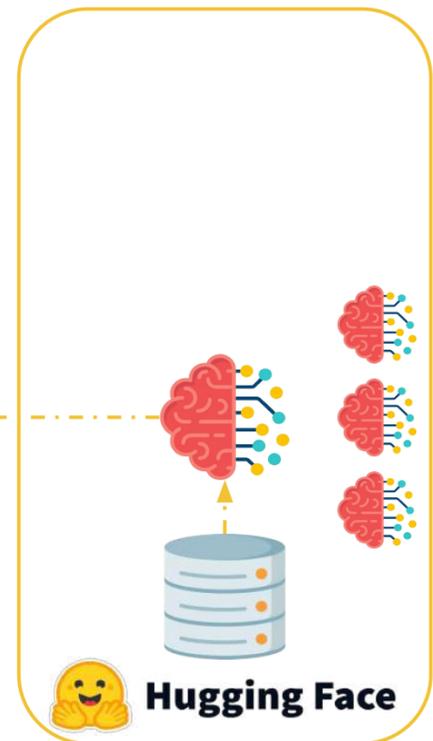
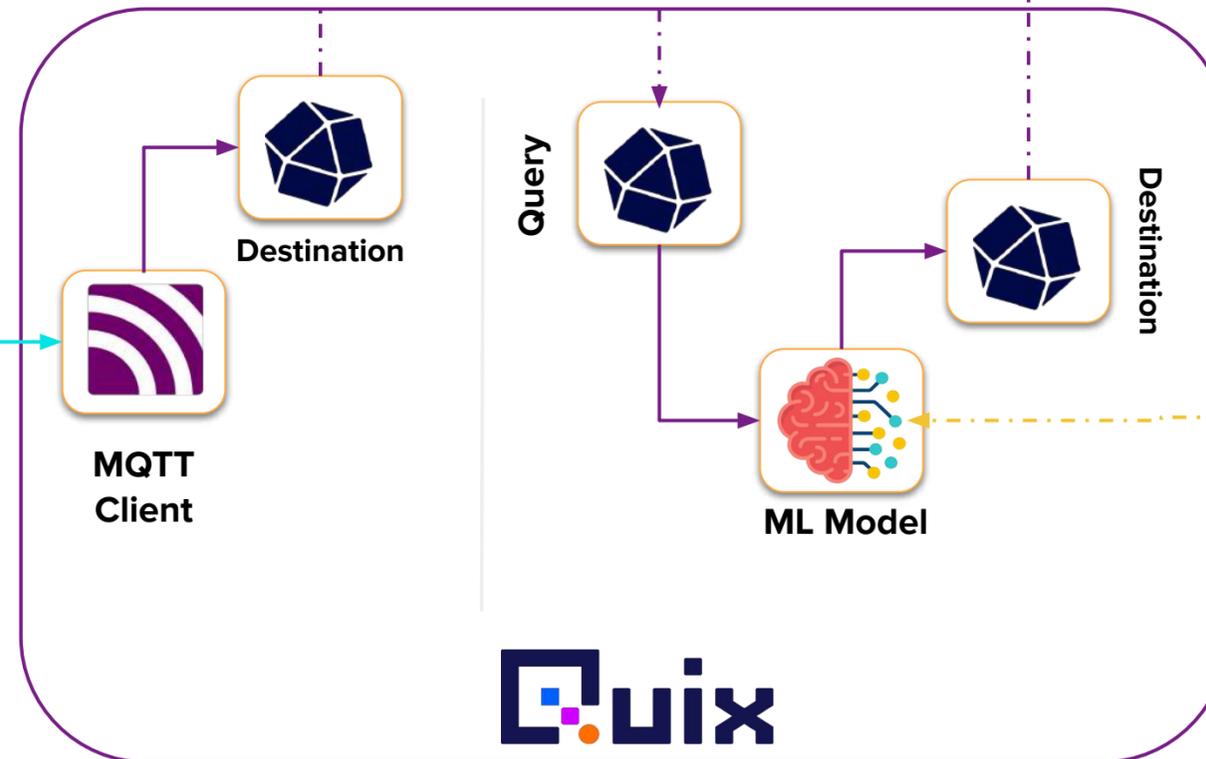
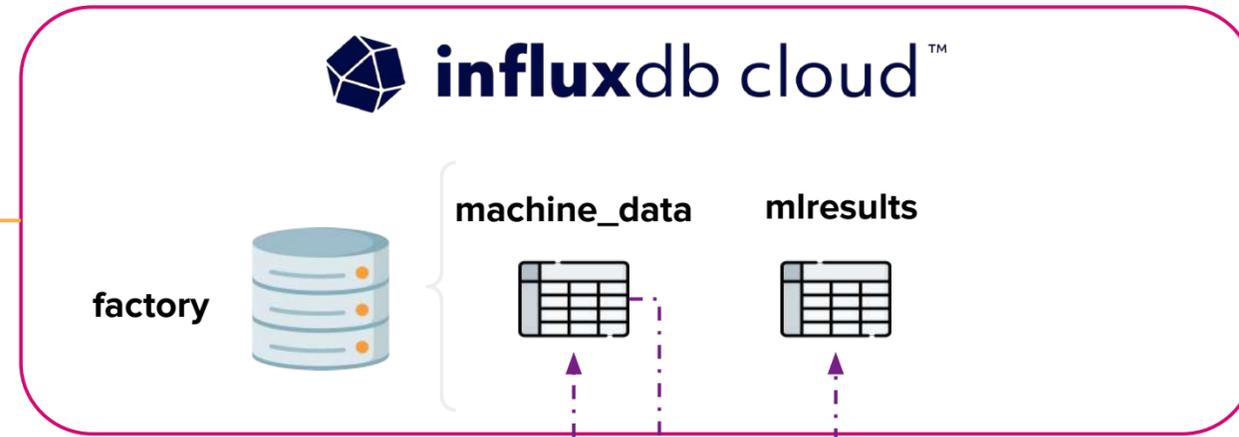
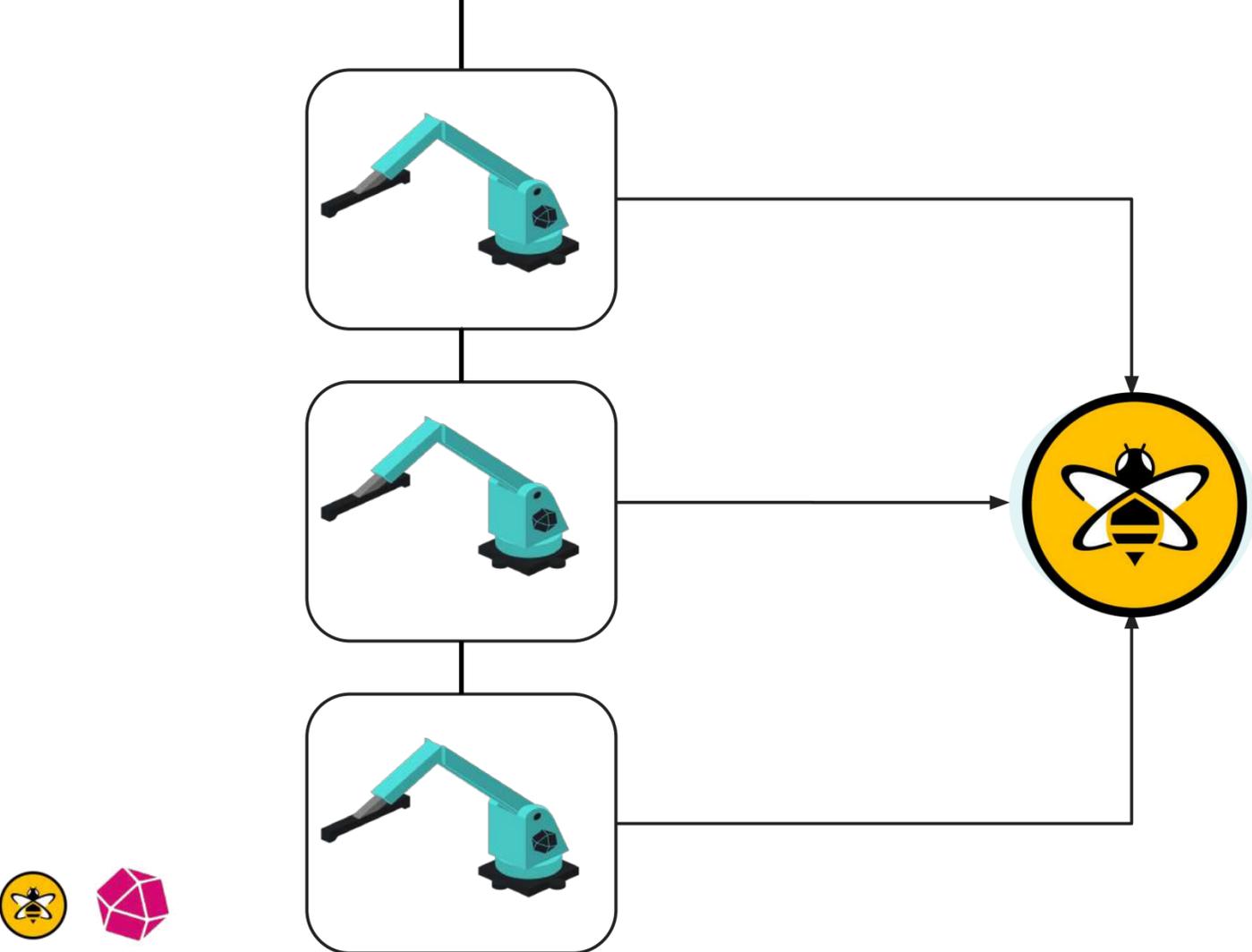
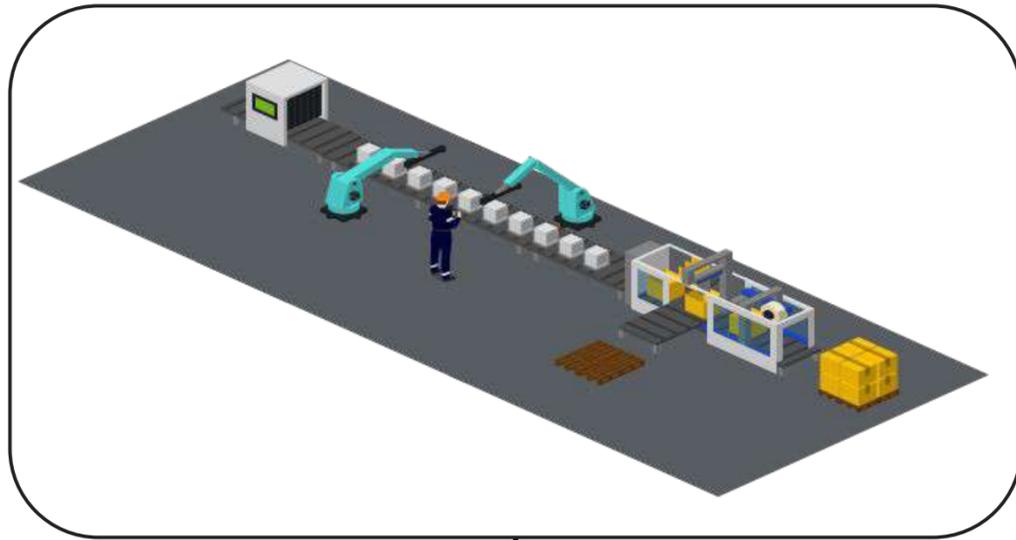


The screenshot displays the Hugging Face interface. At the top, the navigation bar includes 'Models', 'Datasets', 'Spaces', 'Docs', 'Solutions', and 'Pricing'. The main content area shows the 'tiiuae/falcon-7b' model page, which includes a description, a 'Model card' tab, and a 'Community' section. The model card features a line graph showing 'Downloads last month' at 161,448. Below the graph, there are sections for 'Dataset used to train tiiuae/falcon-7b' and 'Spaces using tiiuae/falcon-7b'. To the right, a table lists commit history with columns for contributor, commit count, and date.

Contributor	History	Date
1 contributor	History: 16 commits	3 months ago
		3 months ago

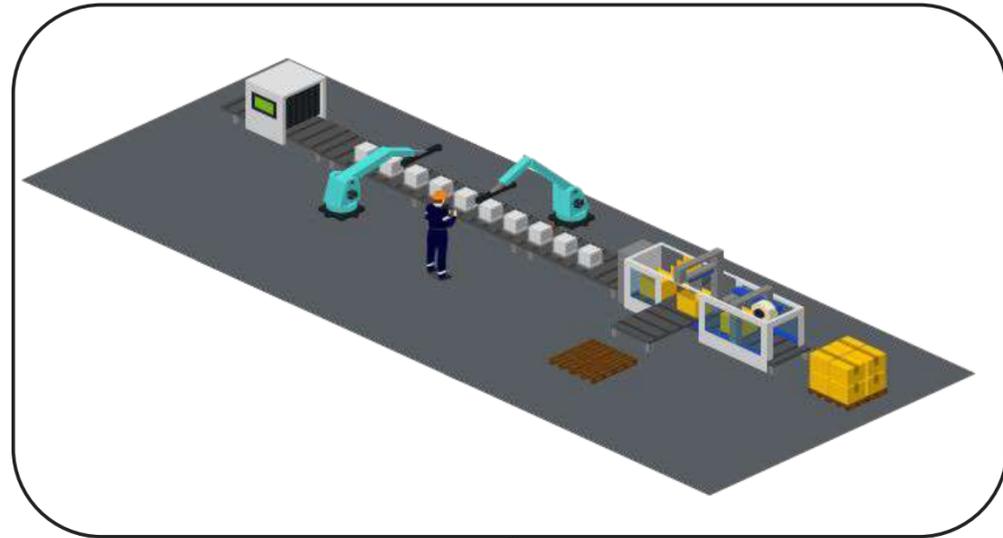


ML Deployment and Inference

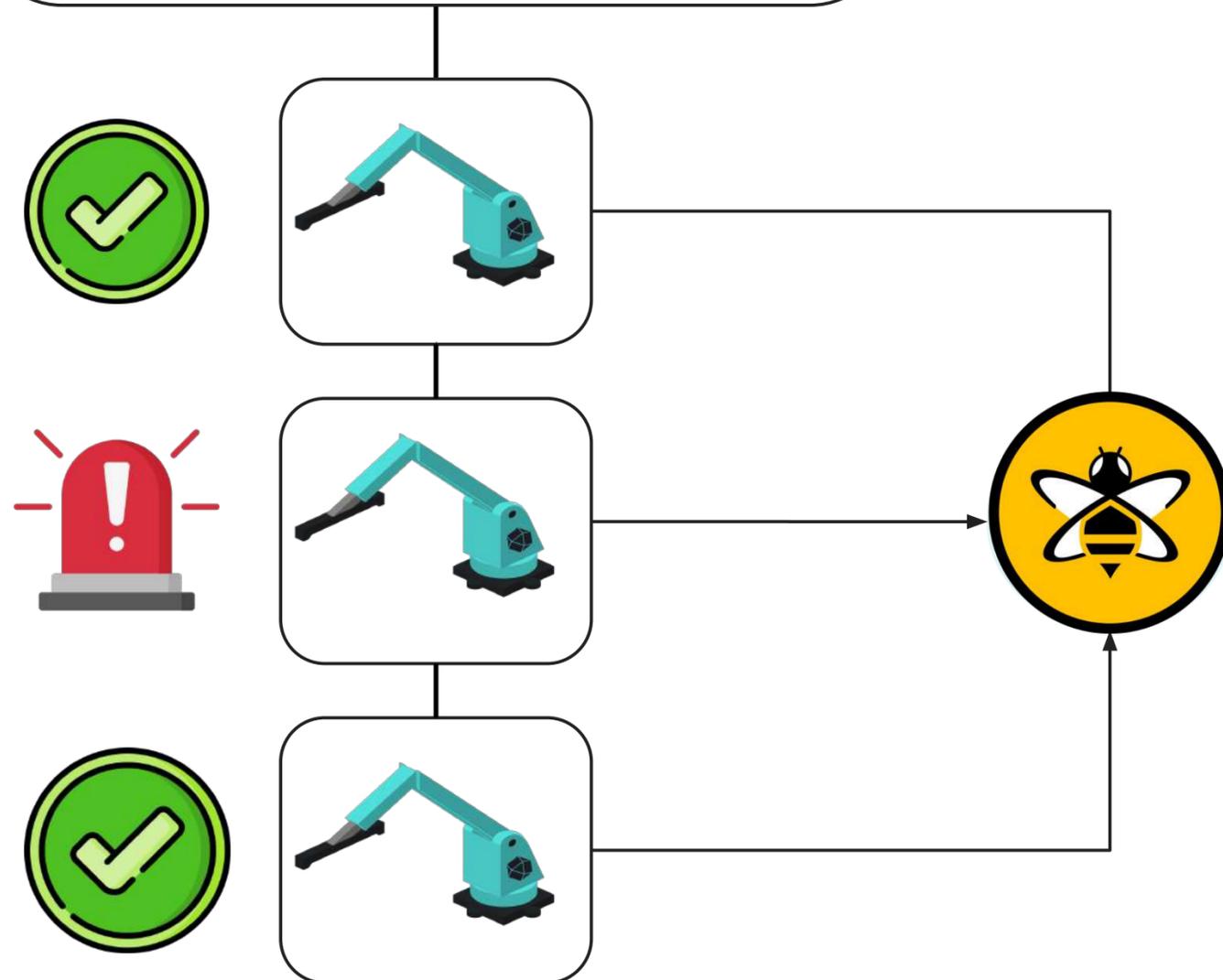


Summary and Conclusion





Packing Co – Anomaly Detection

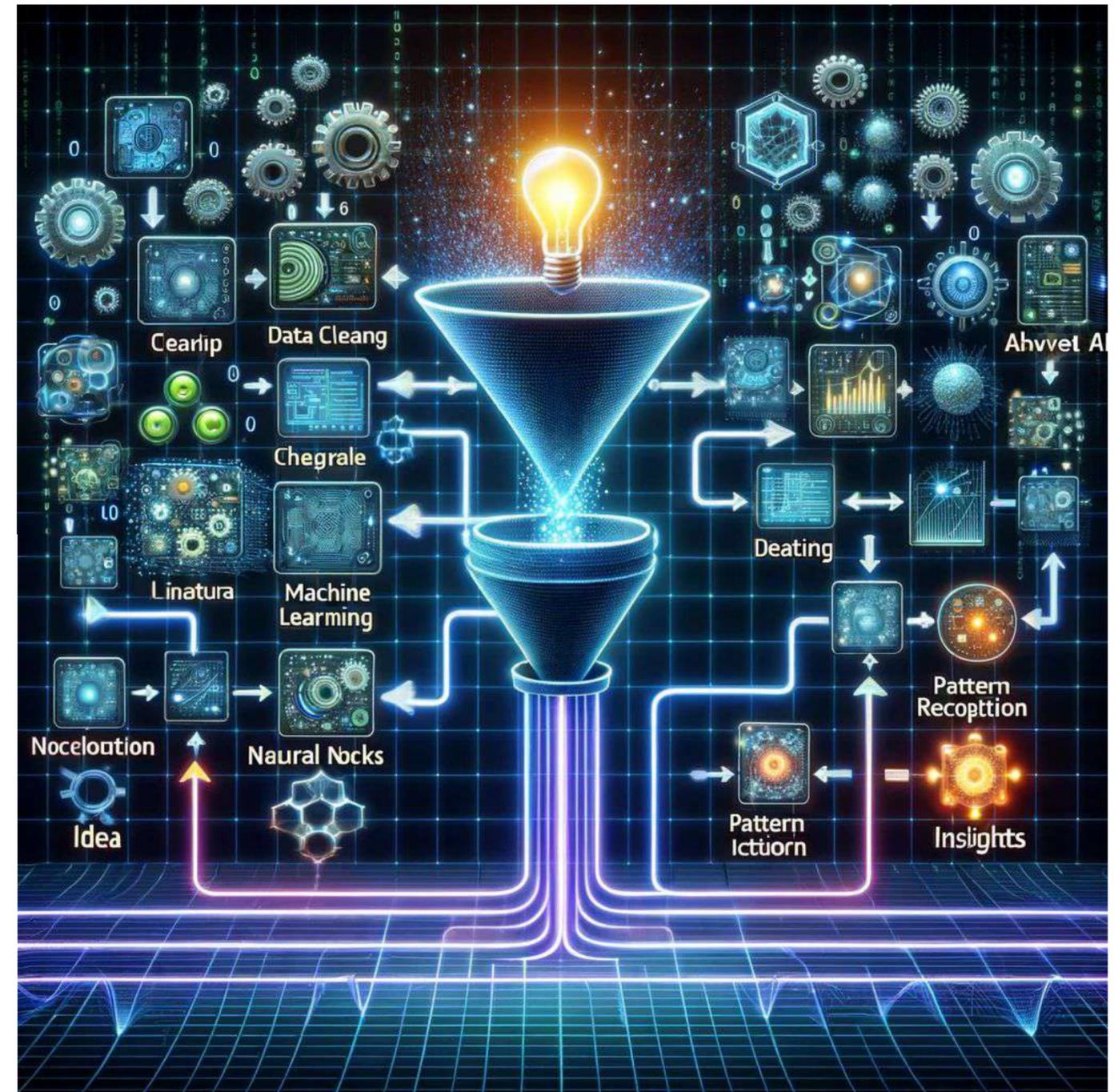


- ✓ Enabled the **ingest, transformation and storage** of their machine data.
- ✓ Deployed an initial **machine learning model** to detect potential malfunctions using vibration data from the machines.
- ✓ Provided the foundations of a **scalable data pipeline**.



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





Next Steps



Try it yourself



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

A screenshot of the GitHub repository page for 'quix-anomaly-detection-example' by 'InfluxCommunity'. The page shows the repository name, a 'Public' badge, and navigation options like 'Go to file', 'Add file', and 'Code'. A commit history table is visible, listing recent updates to files like 'quix_function.py', 'app.yaml', and 'README.md'. The 'README.md' file is expanded, showing the title 'Quix Machine Anomaly Detection' and a description of the project's purpose and prerequisites, such as signing up for a Quix account.



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 HiveMQ Technical Partner Training This course has to be completed in order to be enabled and certified as a	 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



Any Questions?



Thank you

