USING AI AND GPU FOR PREDICTIVE MAINTENANCE IN THE O&G INDUSTRY

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OIL AND GAS MARKET

"Moving from Chasing the Barrels to Chasing the Efficiency"

Aging Infrastructure:
42% of Offshore Oil and Gas infrastructure is 15+ years old

Aging Workforce:
50% set to retire over the next 5 to 10 years

Costly Unplanned downtime:
costs US refiners $6.6bn in margins each year

Image source: Arcadis.com

OCEANS OF DATA

Hand Tailored Analytics

Point Insights Don't Scale

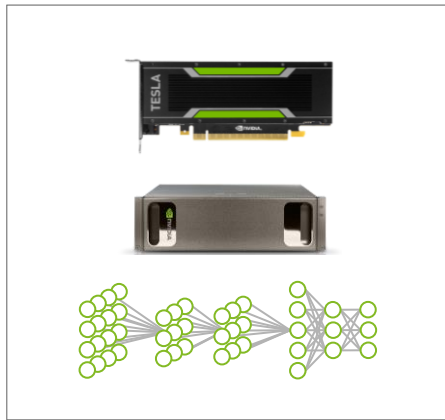Constrained by Moore's Law

95% Data Never Used

Pipeline Inspection: 1.5TB / 600km
Ultrasound: 1.2TB / 8 hours
Process Data: 6GB/plant/day
Drilling: 0.3GB/hour
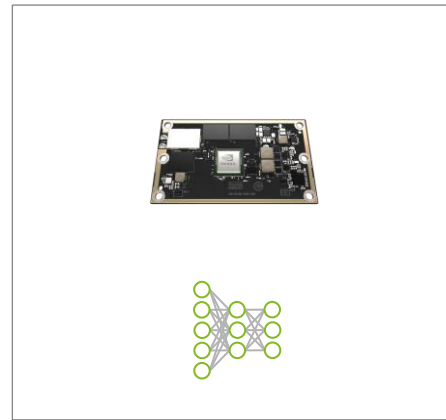**Seismic Data:** 10TB/survey

DEEP LEARNING — A NEW COMPUTING MODEL
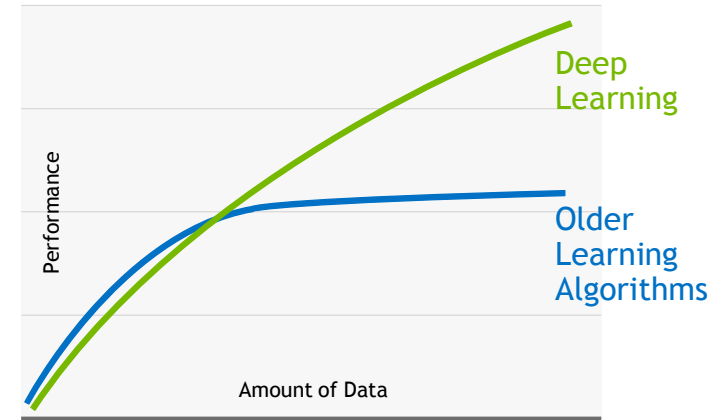## Software That Writes Software

DATA

TRAINING

INFERENCING

Deep Learning

Older Learning Algorithms
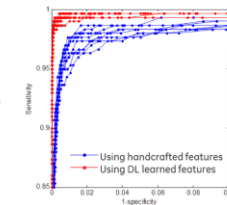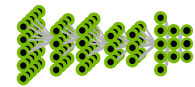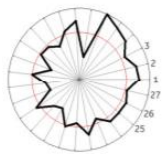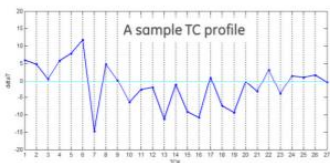
Performance

Amount of Data

DL advantages for PdM

DL automates the feature learning | Ability to model rare events | Benefits from large volume of data
Very extensible architecture extendible to model assets, fleets and processes

INDUSTRIAL ASSETS NEED AI
~$10M/Year in Savings Averting Downtimes

Temperature Profile Data

20% Better Accuracy

AI/DL Benefits:
Data Utilization
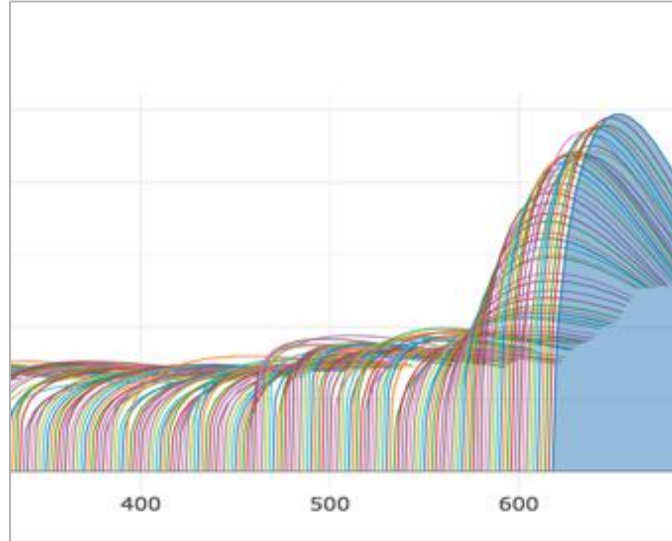Data Scientist Efficiency
Performance:
- 100x Data utilization at the source
- 50x Faster model training
- 5x Faster detection of anomalies

PREDICTIVE MAINTENANCE

Anomaly Detection
Timely Detection of Rare Events to
Avoid Downtime

Usage Based Lifting
Estimating RUL of parts,
systems or processes

Work Scope Optimization
Prescribing Workplan to Minimize Downtime
and Asset Optimization

PREDICTIVE MAINTENANCE

Anomaly Detection
Timely Detection of Rare Events to Avoid Downtime

Usage Based Lifting
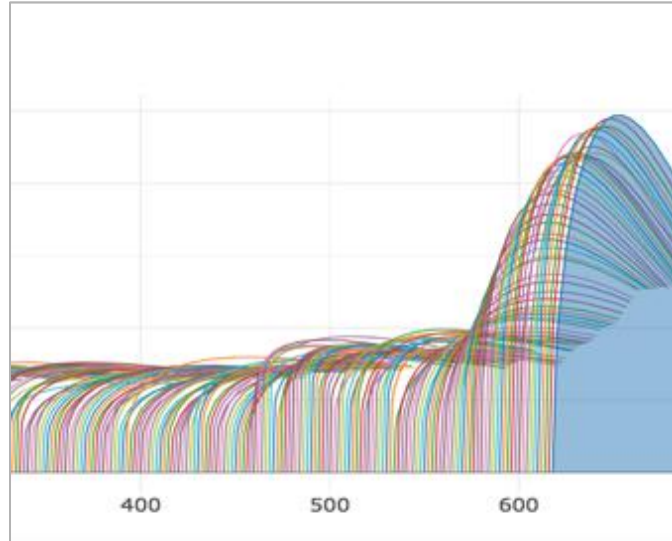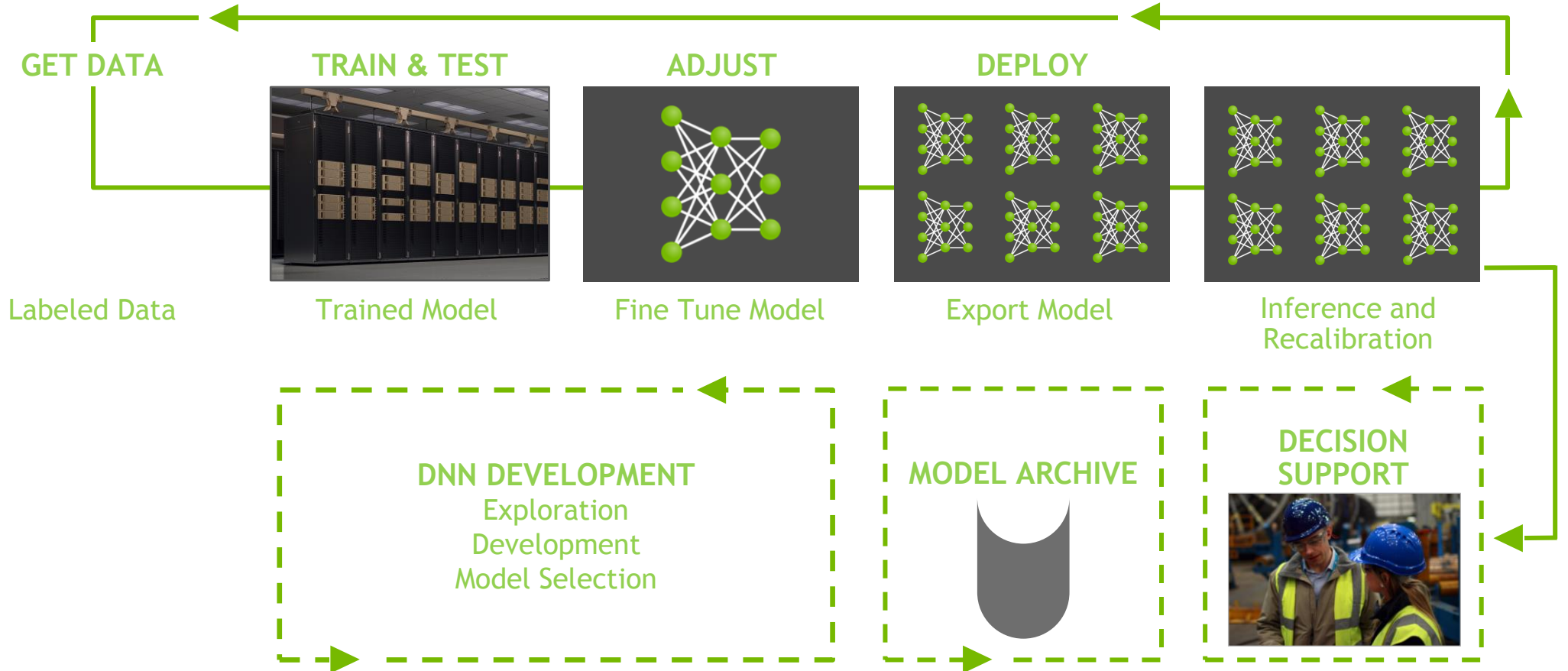Estimating RUL of parts, systems or processes

Work Scope Optimization
Prescribing Workplan to Minimize Downtime and Asset Optimization

Digital Twin

PREDICTIVE MAINTENANCE WORKFLOW

GET DATA

TRAIN & TEST

ADJUST

DEPLOY

Labeled Data

Trained Model

Fine Tune Model

Export Model

Inference and Recalibration

DNN DEVELOPMENT
Exploration
Development
Model Selection

MODEL ARCHIVE
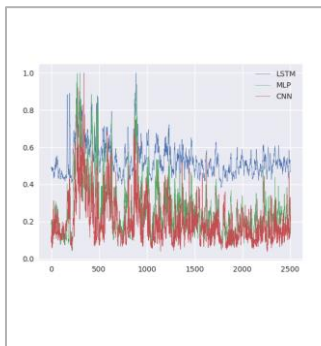
DECISION SUPPORT

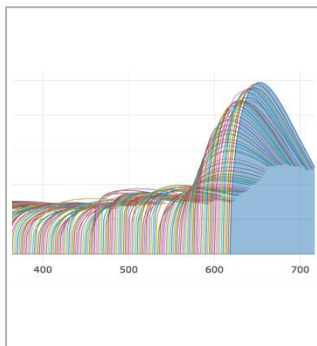# NVIDIA PLATFORM
FOR PREDICTIVE MAINTENANCE
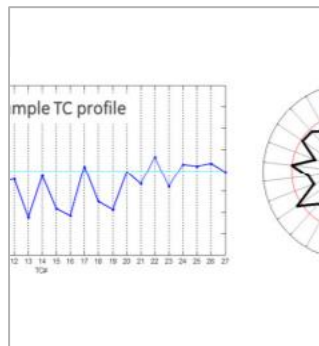
Data Management
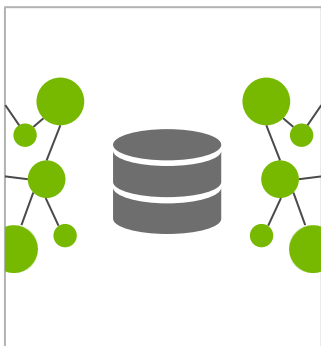
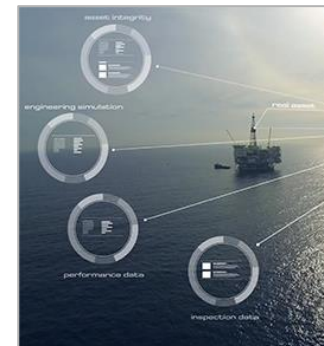Anomaly Detection

Predicting Failures

Time Series Search

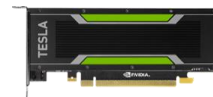Work scope Opt.

Digital Twin

CUSTOMER AI PLATFORM

JETSON SDK, DEEPSTREAM
Anomaly Detection

JETSON

NGC CONTAINERS

TESLA

DGX STATION

DGX

9066

RUL Calculation

```
B10:  16 days
B50:  1 month, 28 days
B90:  4 months, 11 days
Failure Mode : ESP Cable
```

☐ Send Alerts

ESP 9066 Diagnosis

Filter Rows

Date	Days	Info
2016-03-04	610	Alert (High): 59 Remain
2016-02-29 to 2016-0:	606	Anomaly Detected
2016-02-25 to 2016-0:	602	Anomaly Detected
2016-02-22 to 2016-0:	599	Anomaly Detected
2016-01-13	559	Alert (Medium): 110 Rer
2015-12-28 to 2015-12	543	Anomaly Detected

30 Day Failure Index

Days Elapsed

Stop | Play   **Current Date:** 2016-03-12, Days: 619

25%   50%   75%

Instantaneous Failure Probability

Oct 2014   Jan 2015   Apr 2015   Jul 2015   Oct 2015   Jan 2016
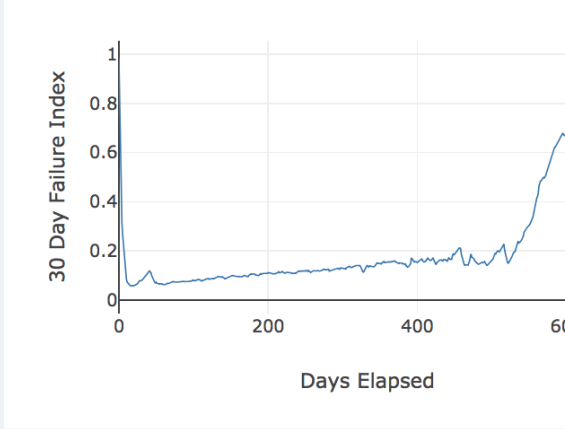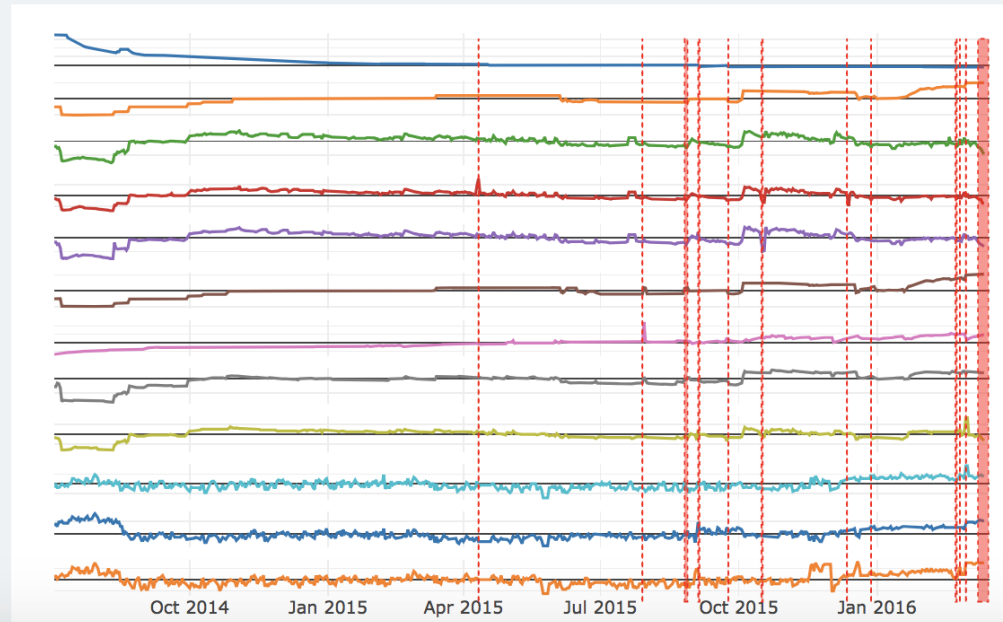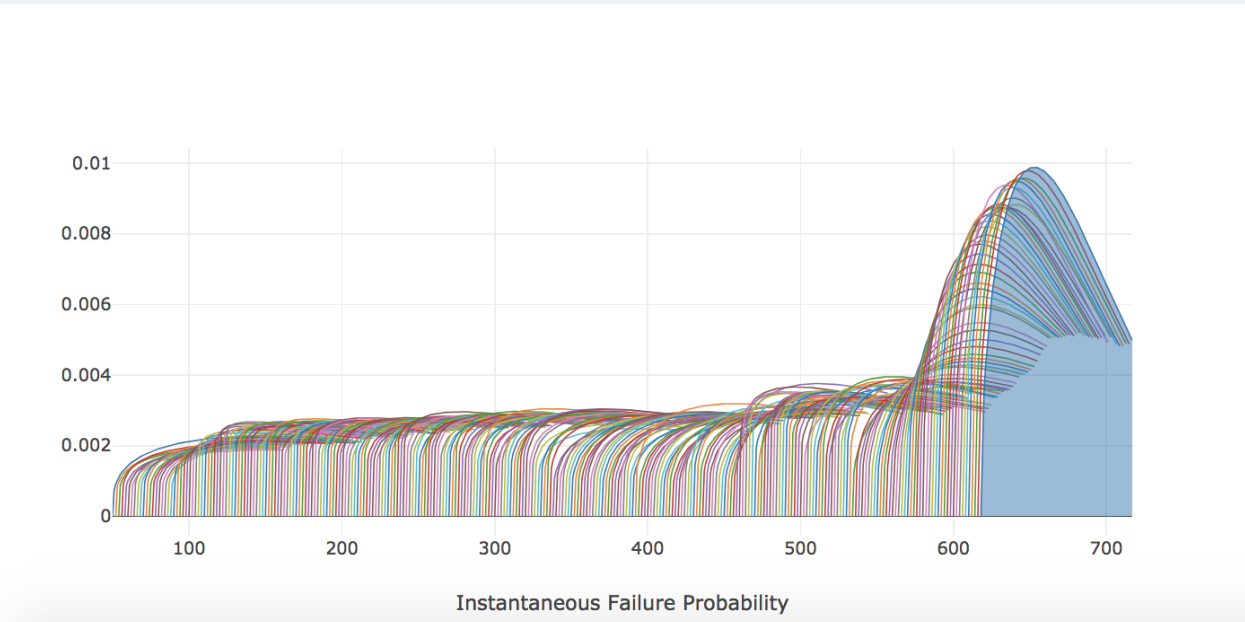
COMPUTATIONAL SCALE GUIDELINE

Plan for each asset type and associated component models

6x DNNs required per industrial asset (see calculator)

Every quarter these models needs to get updated

1x DGXs-1 per 250x assets

1x Jetson per asset at the edge

DGX stations for POC and onsite data science team

PREDICTIVE MAINTENANCE

GPU Based

Solution to model assets on large oil fields

↑**100x**
Data
Utilization

↑**50x**
Training
Speed Up

↑**5x**
Early detection
of faults

EXAMPLE: OILFIELD PREDICTIVE MAINTENANCE

Customer confidential   Baker Hughes GE

- 60K oil wells ww equipped with Electric Submersible Pumps (ESP)

- Average Non Producing Time (NPT) due to ESP Failure costs > $150K per day per well
  - ML techniques used historically (Rule based, Fuzzy logic, traditional ML), but they don't scale
  - >50% False Alarms + detect failures too late

- Deep Learning: 93% detection accuracy with 2 months lead time at 5% False Alarm

- At 10% DL based anomaly detection yields $300K per well of lost productivity annually
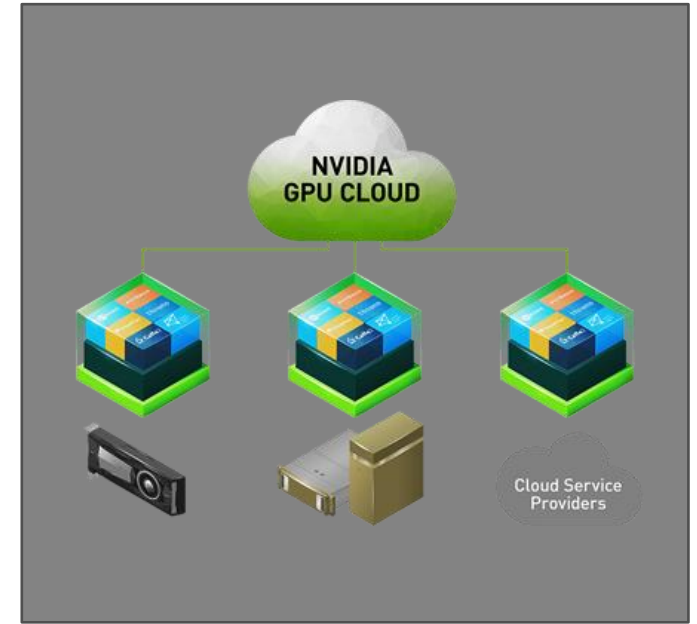
NEXT STEPS

Predictive Maintenance Content

NVIDIA Deep Learning Institute
www.nvidia.com/en-us/deep-learning-ai/education

NGC
www.nvidia.com/en-us/gpu-cloud

Define POC, KPIs and related execution plan | Leverage NVIDIA Deep Learning Institute and Partner ecosystem
Plan AI/DNN development and data center infrastructure

GPU TECHNOLOGY CONFERENCE

OCTOBER 17—18, 2018 | TEL AVIV| #GTC18

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