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Machine Learning for Industrial Process Improvement:

Three lessons learned

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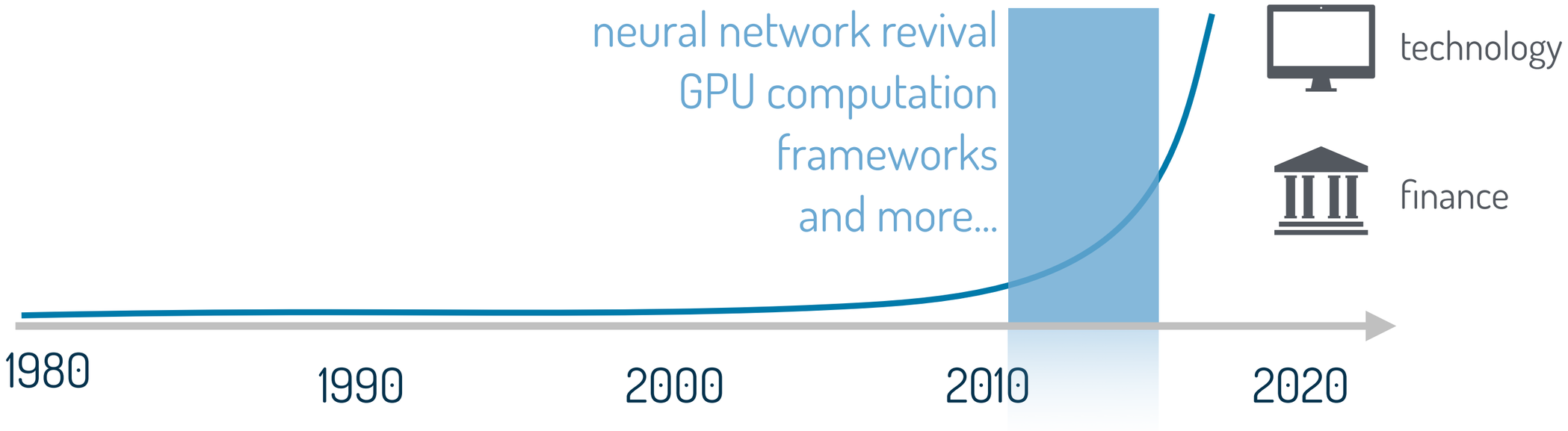
There is great momentum in ML



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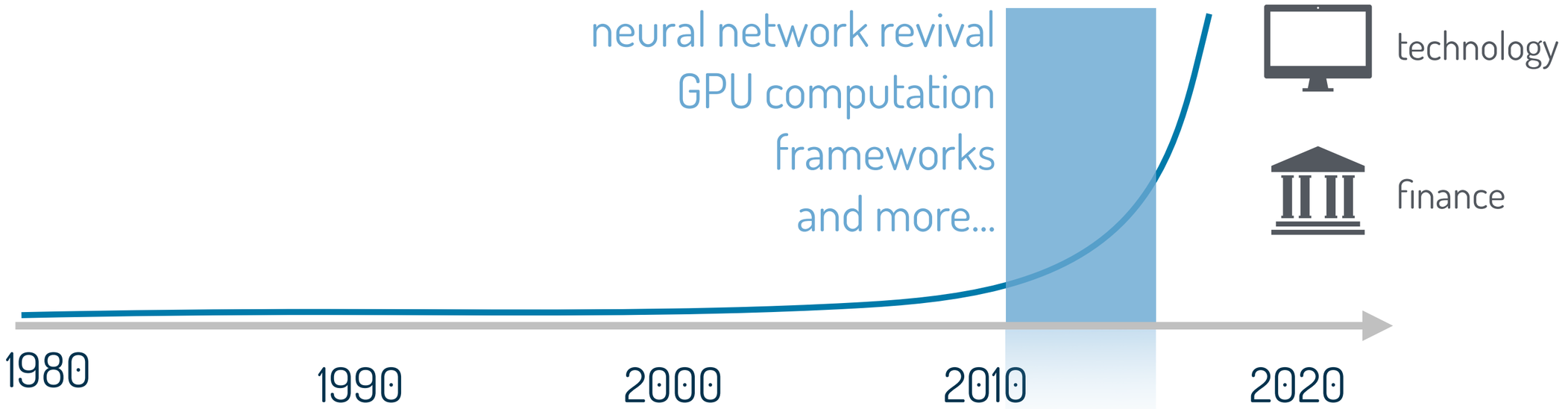


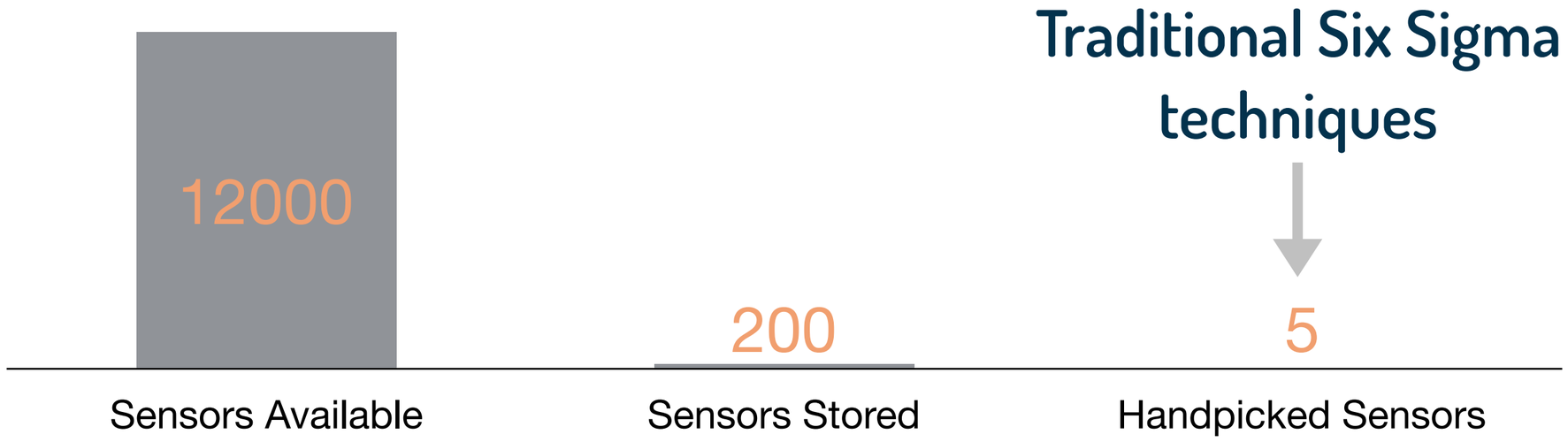
What about the **manufacturing** sector?

How industrial process improvement works

at a steel plant of a $16B revenue firm

PROBLEM: want to reduce faulty production (minimize scrap rate)

DATA: 12k sensors across a production line



How industrial process improvement works

But, we have all this **observational data.**

Let's use the latest ML model/technology!

What is fēro?

An industrial **ML software application** that empowers users to build **interpretable**, **expertise-based**, and **safe** ML models to improve their production.

Who uses fēro?

How do they use fēro?

Our customers:

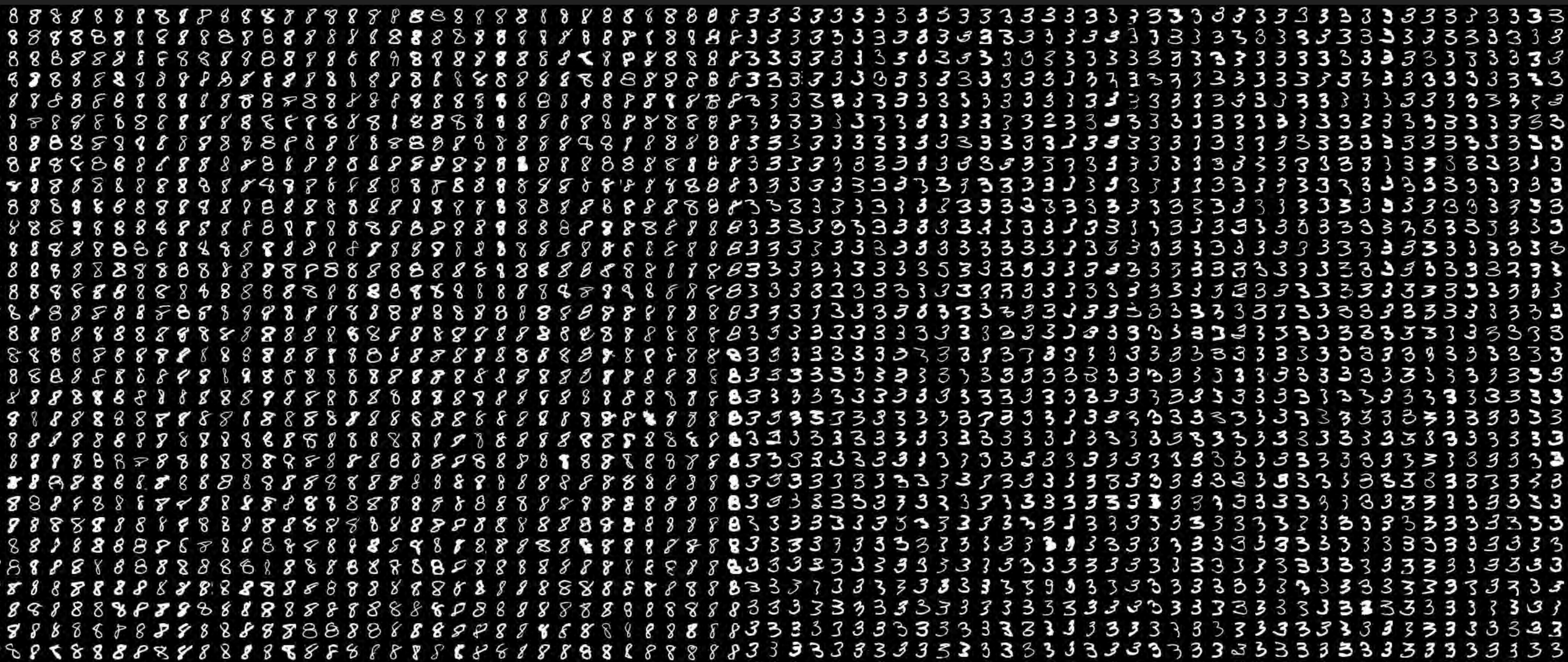
- **adaptively adjust** production for dynamic recipes,
- **maximize uptime** by predicting machine failures,
- **minimize faults** by discovering new product configurations
- **address the root cause** of complex quality and scrap issues,
- identify ways to **reduce emissions** with existing hardware.

Lessons Learned

Lesson One

Interpretability matters.

Sometimes you can't change the inputs

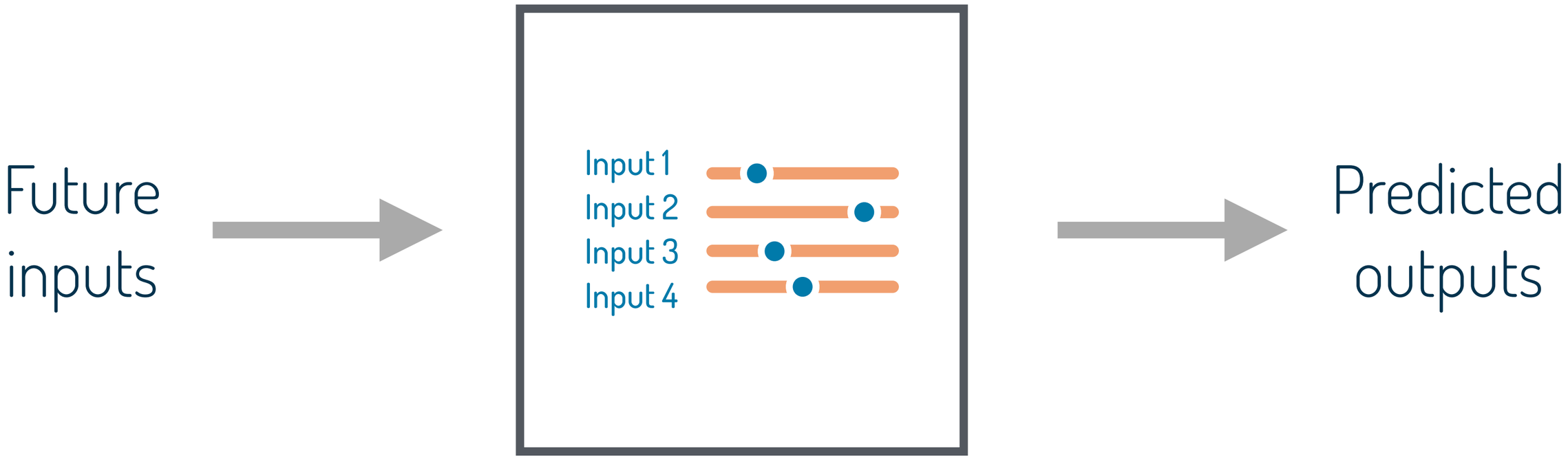


Interpretable Machine Learning

Factories have **superb domain experts**.
We should **complement their knowledge**.

Interpretable Machine Learning

NEED to be open. **NEED** to show relationships. **NEED** to be interpretable.



Interpretable Machine Learning

Factories have **superb domain experts**.
We should **complement their knowledge**.

Lesson Two

Humans are part of "the loop".

Typical ML/AI works great when...

Advertisement: user clicks → **We don't really know how to model** people clicking on websites.

Social Network: face recognition → **We don't really know how to model** 2D images of 3D faces.

Media Company: recommendation → **We don't really know how to model** people consuming media.

...and we can throw massive amounts of data at the problem.

Expertise-based Machine Learning

Factories are **complex engineered systems**.
They operate on **physical principles.**

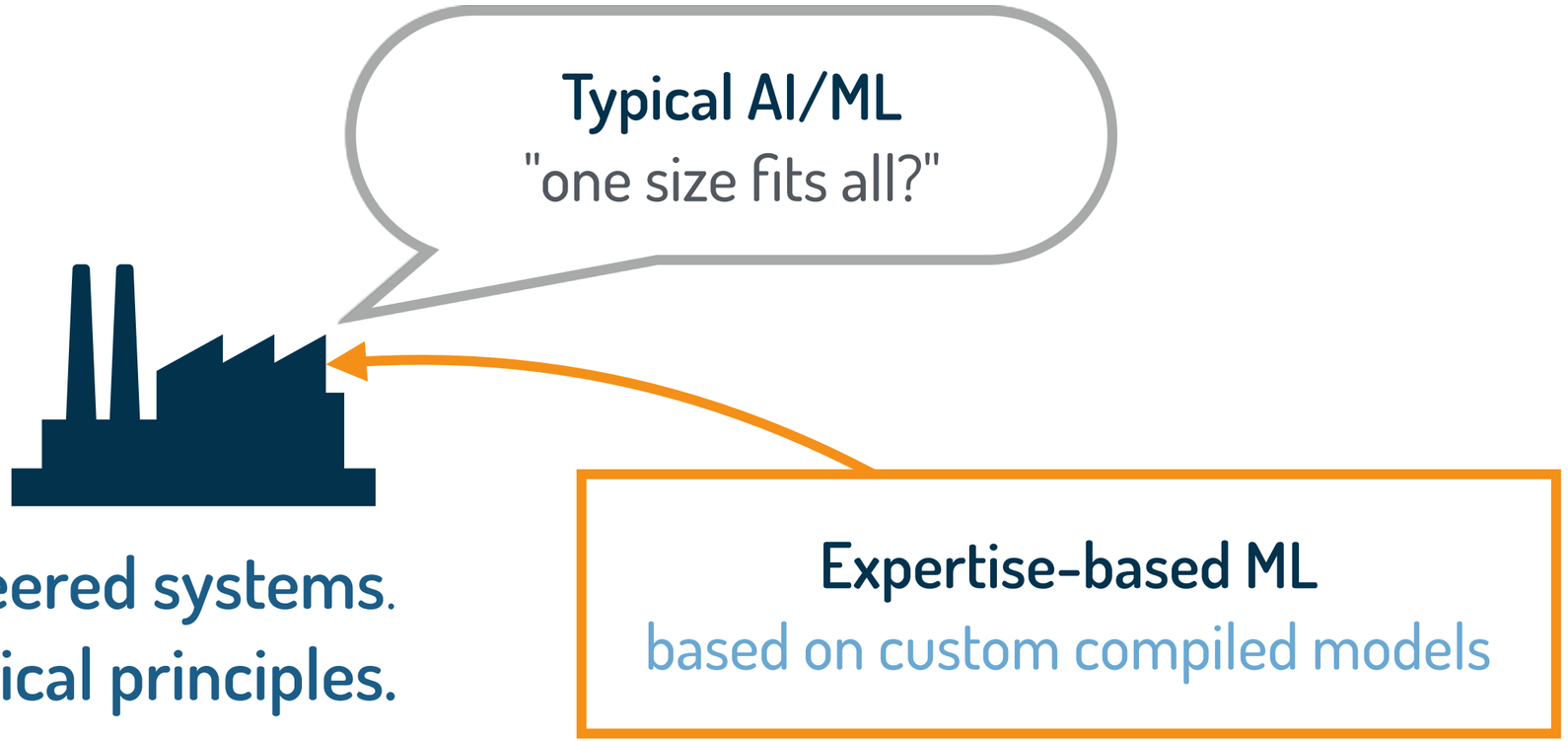
Expertise-based Machine Learning

NEED to be tailored. **NEED** to conform to constraints. **NEED** to be bespoke.

- Hierarchies
- Regression
- Time-series
- Survival
- Inter-arrival
- Hypotheses

Customized solutions for specific use cases.

Expertise-based Machine Learning



Factories are **complex engineered systems**.
They operate on **physical principles.**

Lesson Three

Statistics is still "cool".

The cost of a mistake is enormous

A **social network** picks an irrelevant article or advertisement. → $0.01

A **media company** recommends a boring clip or movie. → $100.00

A **factory** produces an **out of specification set of products**, for 20 minutes. → $100,000.00

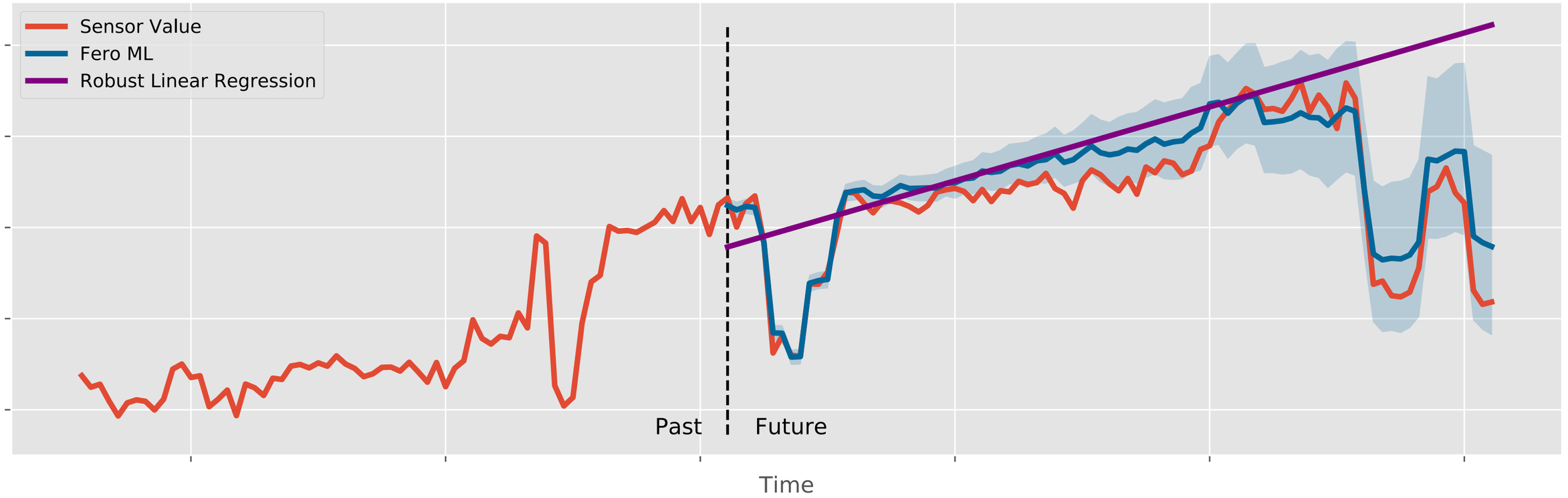
Safe Machine Learning

Typical AI/ML
plain predictions aren't enough

Factories have **excellent workflows**.
They need to know **when to trust predictions**.

Safe Machine Learning

NEED to be honest. **NEED** to provide statistical guarantees. **NEED** to be safe.



Safe Machine Learning

Typical AI/ML
plain predictions aren't enough

Safe Machine Learning
based on statistical models

Factories have **excellent workflows**.
They need to know **when to trust predictions**.

META LESSON

To **create value**, must **change behavior**.

To **change behavior**, must **empower users**.

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