**IBM Sustainability**

# AI and Generative AI in Sustainability Software

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IBM

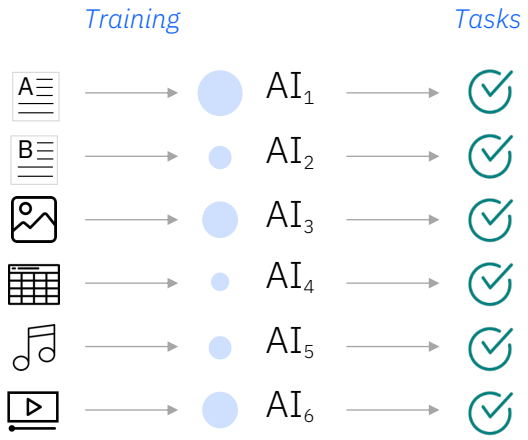
# Agenda

- How Foundation Models Work
- GenAI in Sustainability Software (Maximo)
- AI in Sustainability Software

# Foundation models establish a new paradigm for AI capabilities

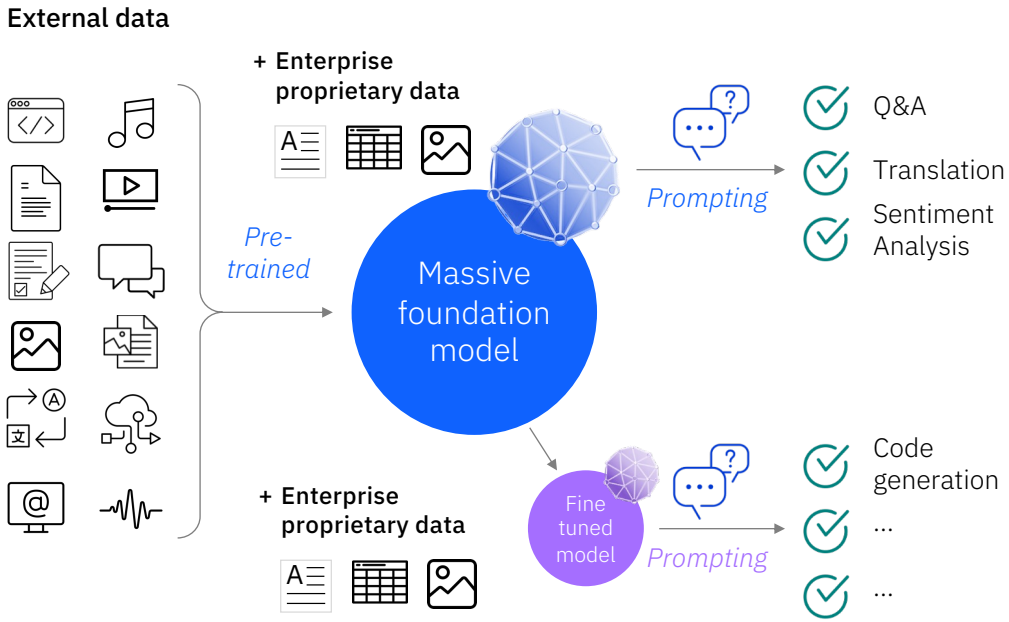
**The impact of generative AI**

## Traditional AI models




- Individual siloed models
- Require task specific training
- Lots of human supervised training

## Foundation models




- Massive multi-tasking model
- Adaptable with minimized training
- Pre-trained unsupervised learning

- Massive unlabeled data
- Self-supervision at scale

## Enhanced capabilities

- Summarization
- Conversational Knowledge
- Content Creation
- Code Co-Creation

## Key advantages

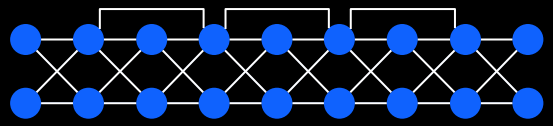
- Lower upfront costs through less labeling
- Faster deployment through fine tuning and inferencing
- Equal or better accuracy for multiple use cases
- Incremental revenue. through better performance

up to **70% reduction** in certain NLP tasks

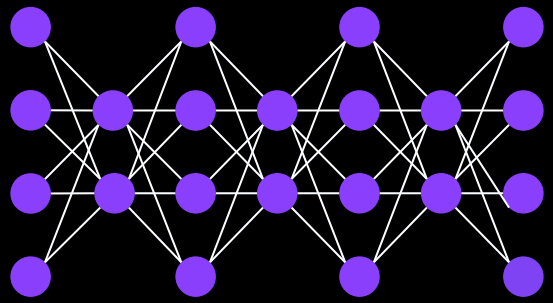
# Data is the lifeblood of AI

# Classical AI models: purpose-built and siloed

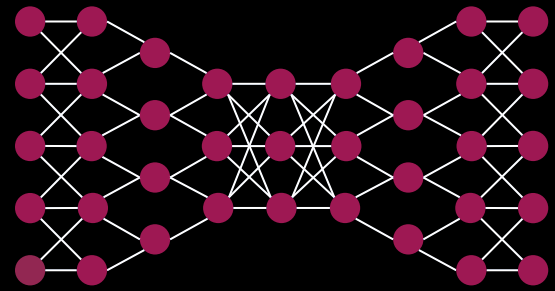
Translation



Summarization

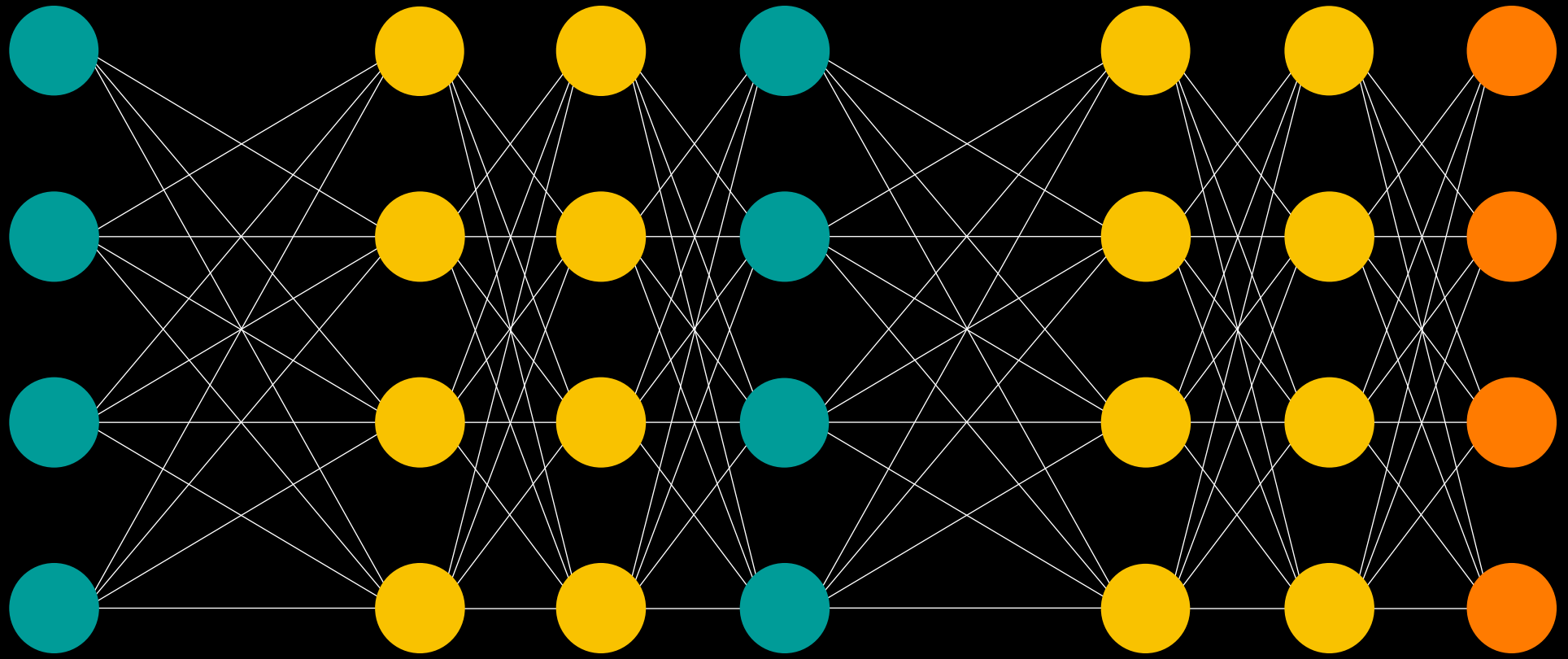


Question Answering



Each model performs a discrete task

# Foundation models



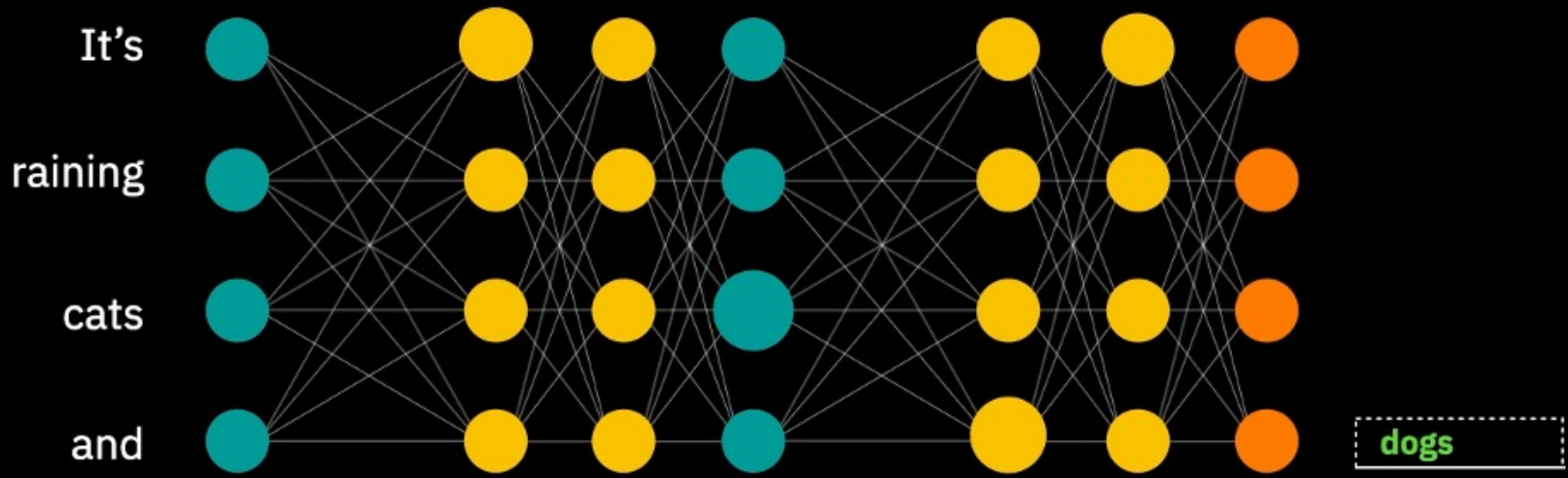
# Foundation model training:

## a lot of unlabeled data + a little labeled data


Unlabeled data for training:
100 billion sentences

Labeled data for fine tuning:
1000 examples

# Training a foundation model: Self-supervision



# Foundation model training:

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Unlabeled data for training:
100 billion sentences

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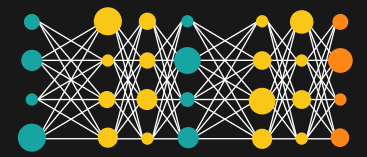
1000 examples

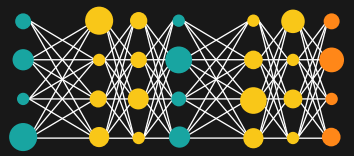
# Foundation models: How do they work?

Self-supervised training


Foundation model



Task-specific fine-tuning



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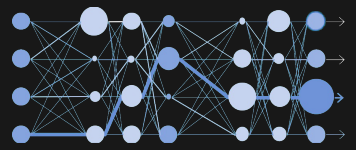
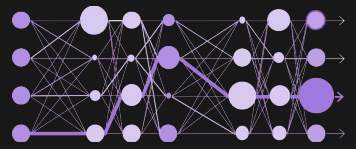


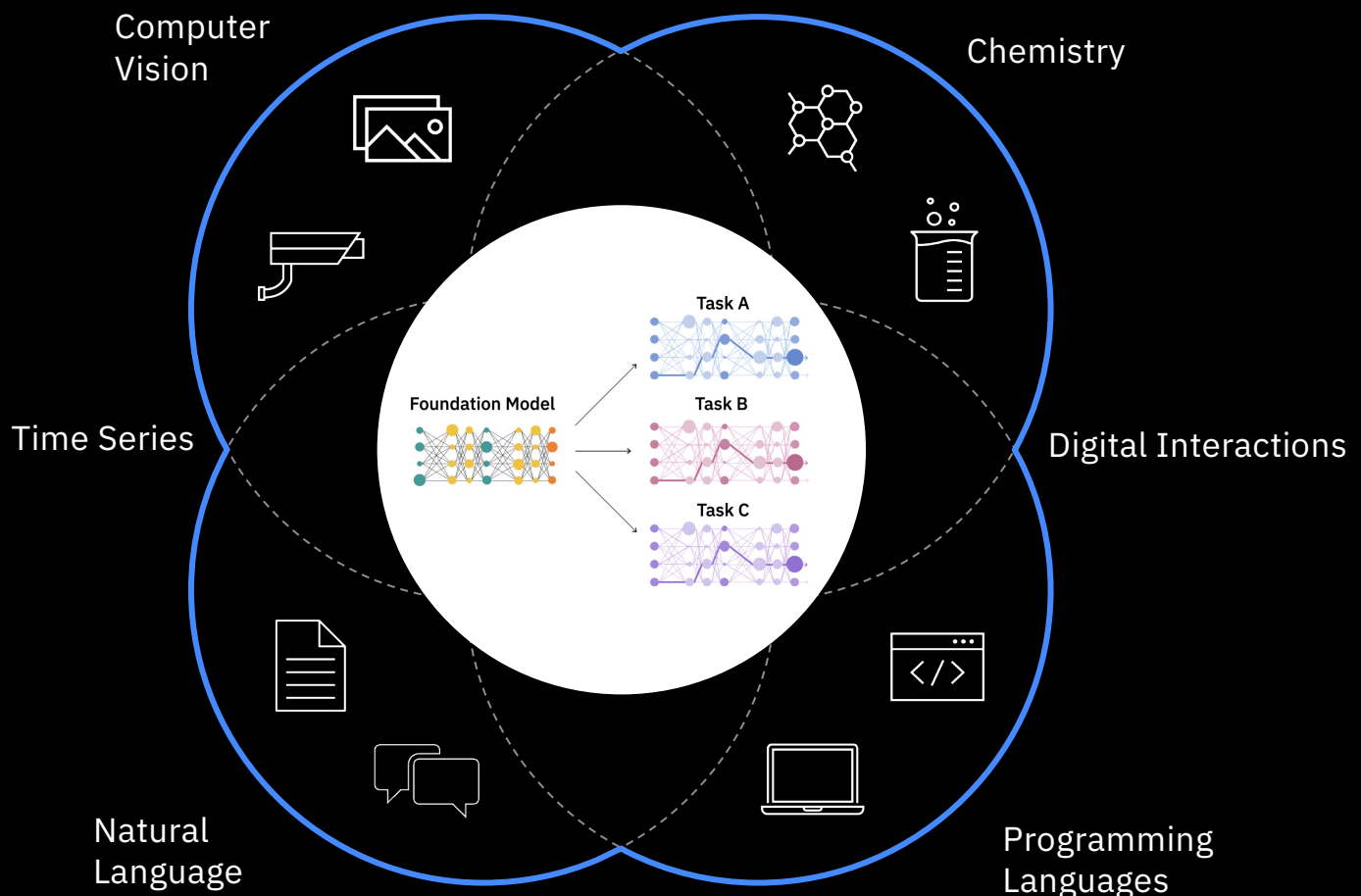
Translation model

Summarization model



Answer finding model

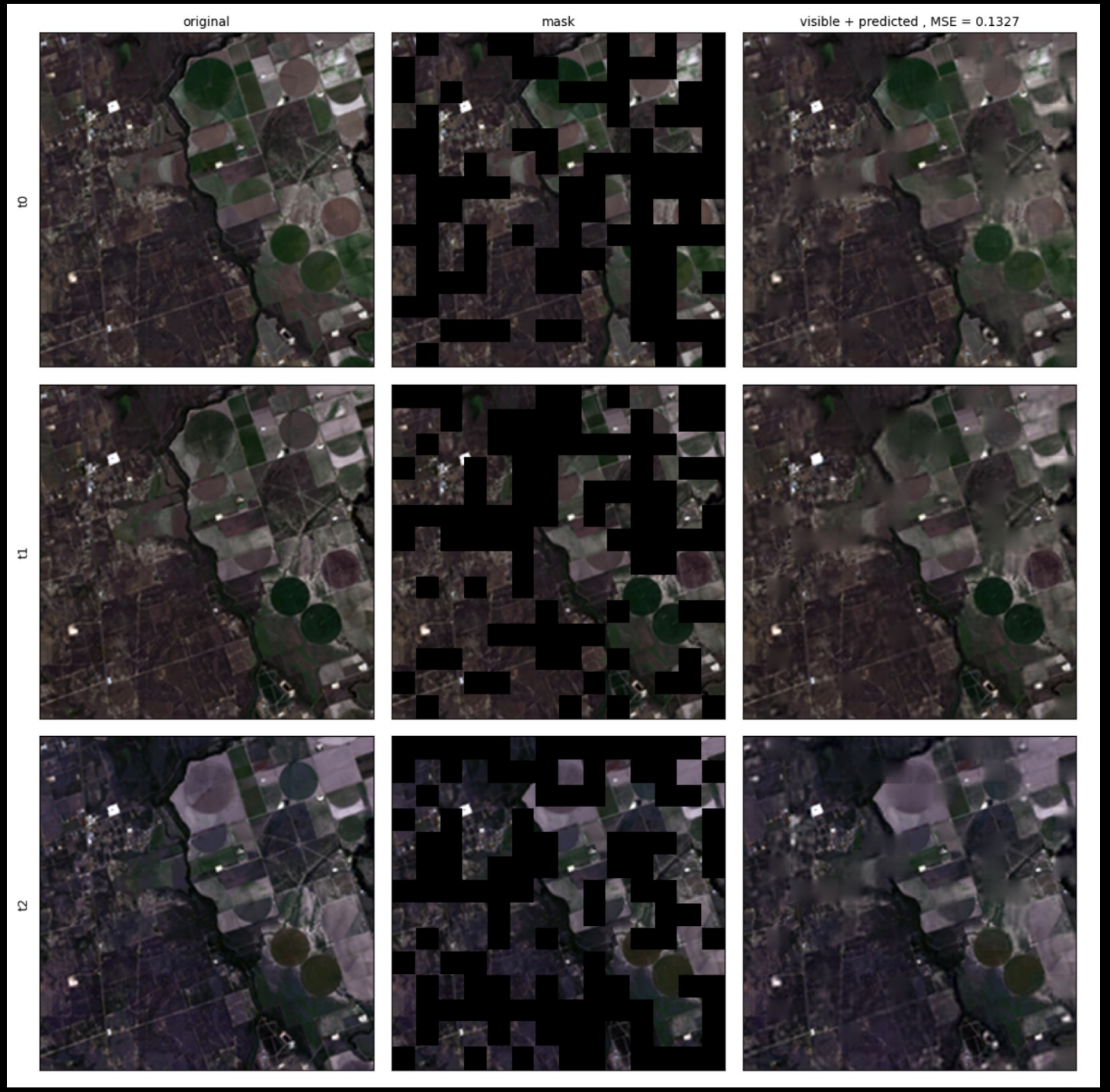
# But the implications of foundation models go well beyond Large Language Models (LLMs)



# We collaborated with NASA to develop a Geospatial foundation model trained on HLS data.

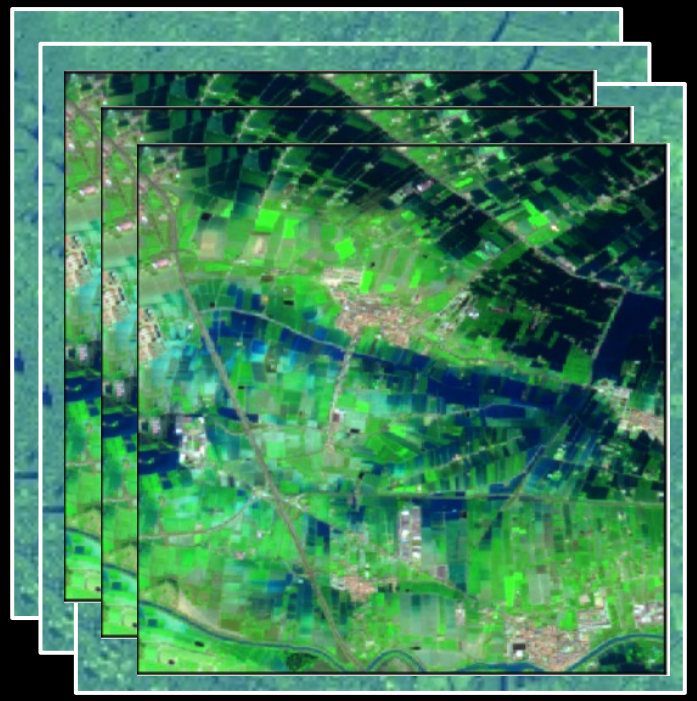
The Harmonized Landsat Sentinel-2 (HLS) dataset provides global land observations every 2-3 days at 30 meter resolution.

# Geospatial Foundation Model Training Result



# Fine tuning a trained Foundation Model

## Transformer Architecture consists of an Encoder & Decoder



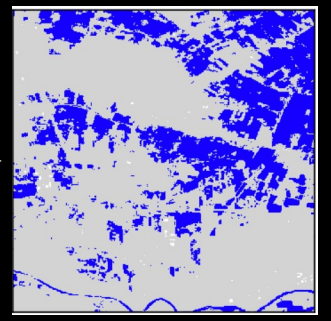
Encoder
(Large Transformer)

Foundation Model

Decoder

Flood Mapping

Semantic Segmentation



Biomass Detection

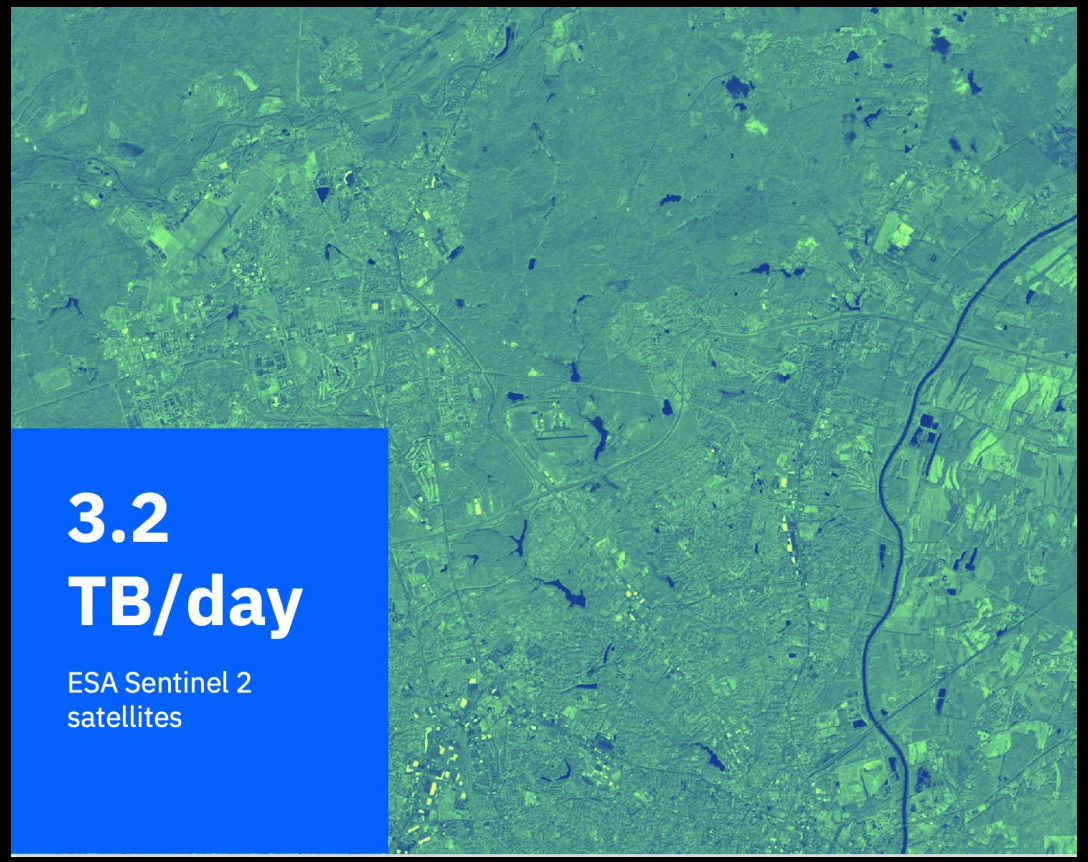
Classification

Bare
Developed
Forest
Herbaceous
Shrub
Water

# Two core types of geospatial data relevant for sustainability

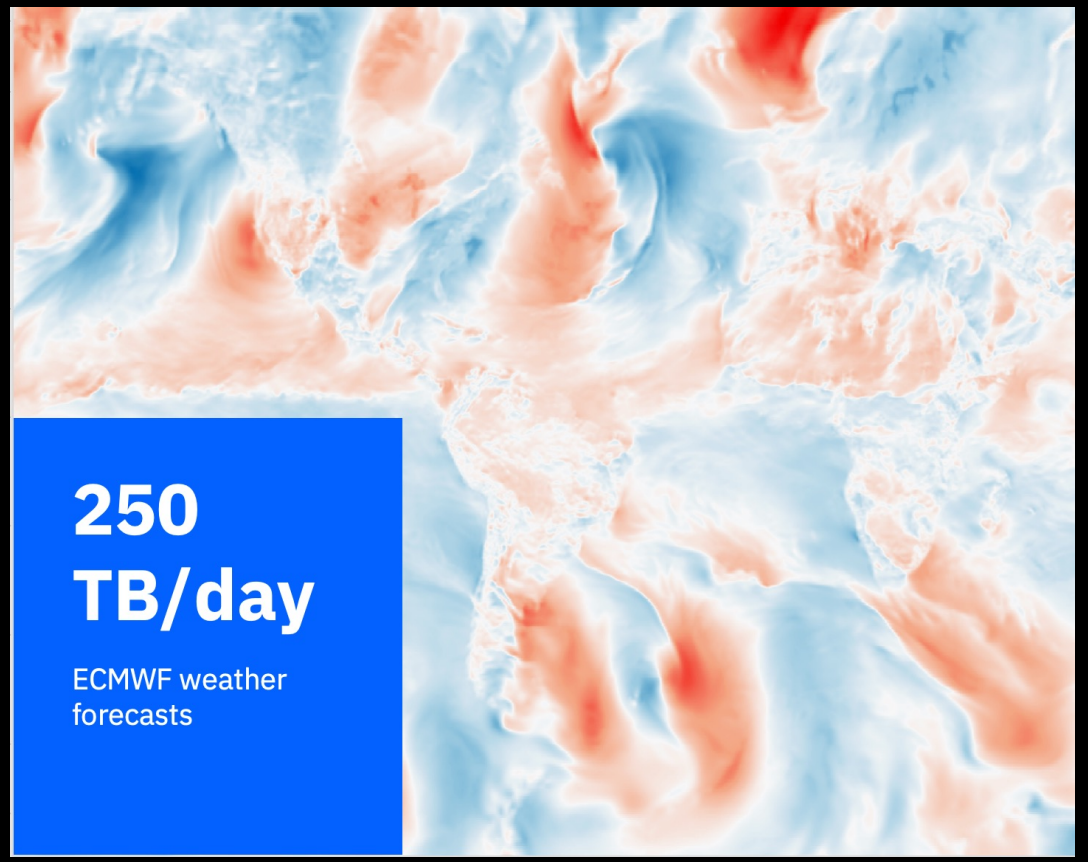
## Satellite and aerial imagery

- Multimodal – images from multiple satellites representing different spectral bands



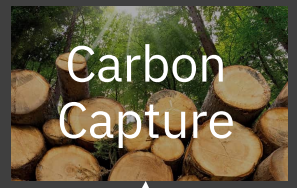

## Weather measurements & forecasts

- Multimodal – time series from different processes (temperature, precipitation, wind,...)



# Foundation models for sustainability

## Image Segmentation Use Cases



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Task Specific Model

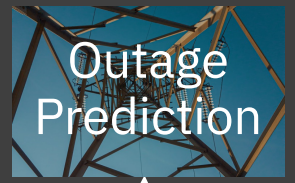
Task Specific Model

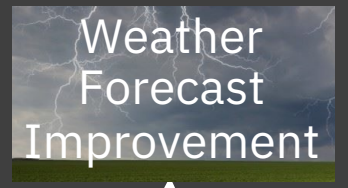
Task Specific Models

Foundation Model (Spatiotemporal Transformer)

Satellite & Aerial Data

## Weather Use Cases





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Task Specific Model

Task Specific Models

Task Specific Model

Foundation Model (Temporal Patch Transformer)

Weather Observations/Forecasts Data

# Why NASA, IBM, And Hugging Face's Open Source Model Is A Big Deal

Ted Schadler, VP, Principal Analyst

What do you get when you combine an open source platform, a massive and critically useful dataset, and an ability to open-source an AI foundation model?

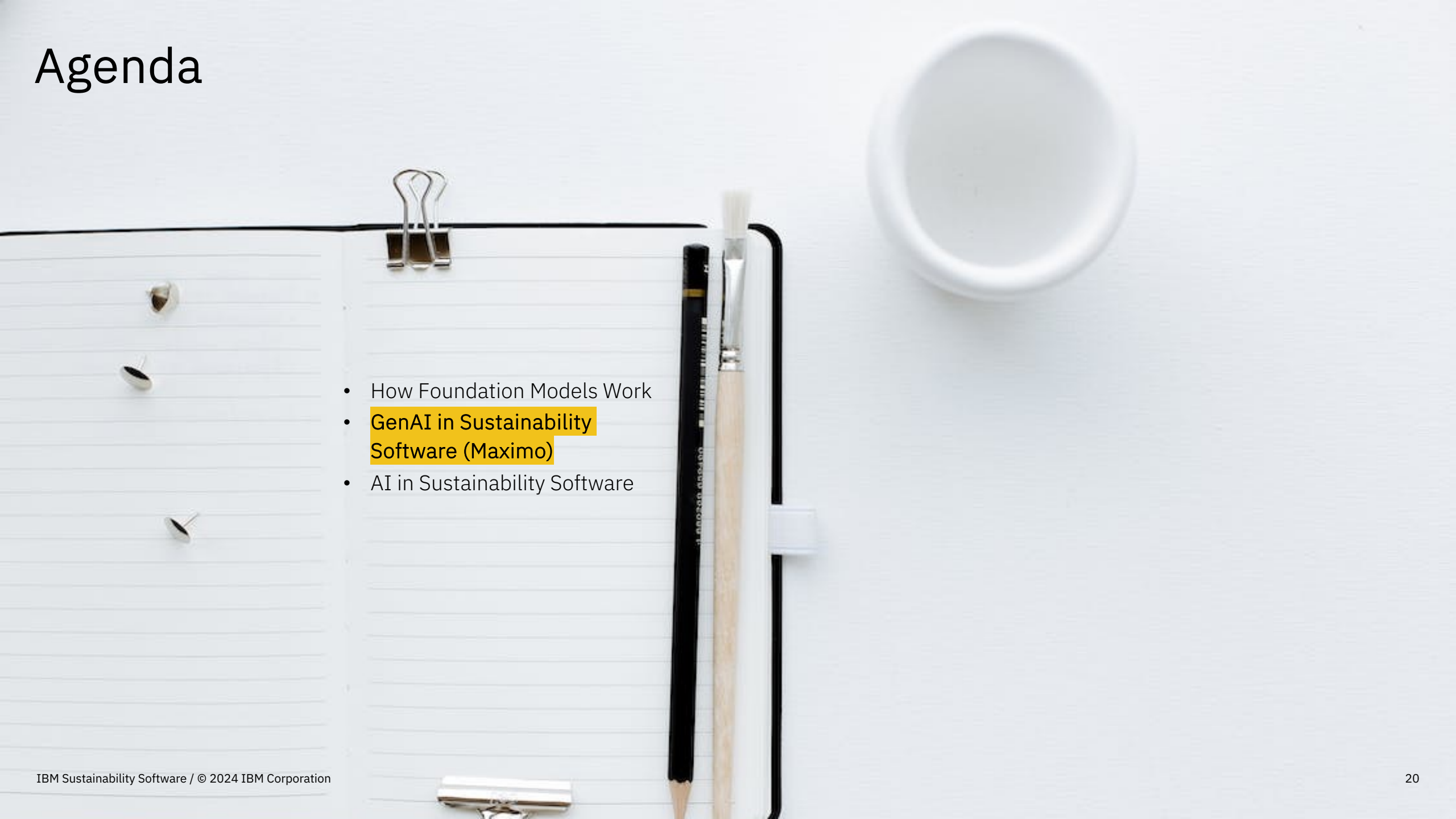
If you're NASA, IBM, and Hugging Face, you get a massive opportunity to make geospatial data available to all through an open source geospatial AI foundation model. We like this open source geospatial intelligence resource and commitment for three reasons:

This is also a great reminder to technology executives that you will incorporate many intelligences into your genAI-fueled applications. Do not expect or plan to rely solely on a large language model from Microsoft or Google. Most of the specific value will lie in these domain-specific genAI intelligences.

You will create real applications by orchestrating the intelligences you need (including your own knowledge foundation models and your machine-learning models and software).

*Source: https://www.forrester.com/blogs/why-nasa-ibm-and-hugging-faces-open-source-model-is-a-big-deal/*

# Agenda



- How Foundation Models Work
- GenAI in Sustainability Software (Maximo)
- AI in Sustainability Software

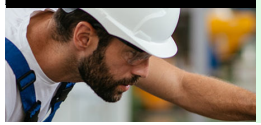
# Generative AI Opportunities: Applying foundation models in our Sustainability Software portfolio

## In flight

### Failure mode context understanding

We are training a GenAI model to understand failure points. FMEA (Failure Mode and Effects Analysis) data is not available for many kinds of assets, and it can take time to acquire. This model can then be applied to other assets where data does not exist.

### Work order intelligence



We are training an LLM to classify and recommend work order codes, which will enable auto-approval of work orders overcoming human error and limitations.

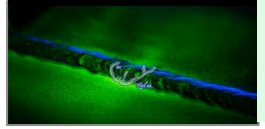
### Health: prediction & anomaly

We are using GenAI to create sensor-level models trained on a small sample of sensor data. This greatly speeds time to value for asset health prediction.

### MVI anomaly detection

MVI AI currently can lack accuracy for “Few-Shot” anomaly detection. We are building a transformer-based foundation model that will fill these gaps.

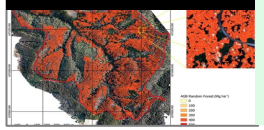
### MVI prompt tuning



We are using foundation models and prompt-tuning to dramatically reduce the effort required to train the model for MVI.

### Above ground biomass measurement

Preview Q1



Use Geospatial Foundation Models to measure above ground biomass for known land cover and vegetation species.

### Flood and fire detection

Use geospatial model to detect fire tracks and floods leveraging data from NASA. Would enable stakeholders to quickly understand the impacts of flood and fire.

### Activity based scope 3 estimation

GA

Leverage LLM to ingest and understand invoice level data to categorize business activities and estimate carbon emissions generated by the business at a more granular level.

## In pipeline

### Assist: technician assistant

We are using a GenAI assistant trained on service manuals and work orders to give technicians the latest asset service info and generate repair workflows.

### MAS onboarding assistant


We are training an LLM model to answer questions that arise in implementation that can guide clients about costs, effort and risks.

### Envizi SRM assistant


The sustainability disclosure environment is complex. We hope to train a GenAI virtual assistant to help guide our users through the process.

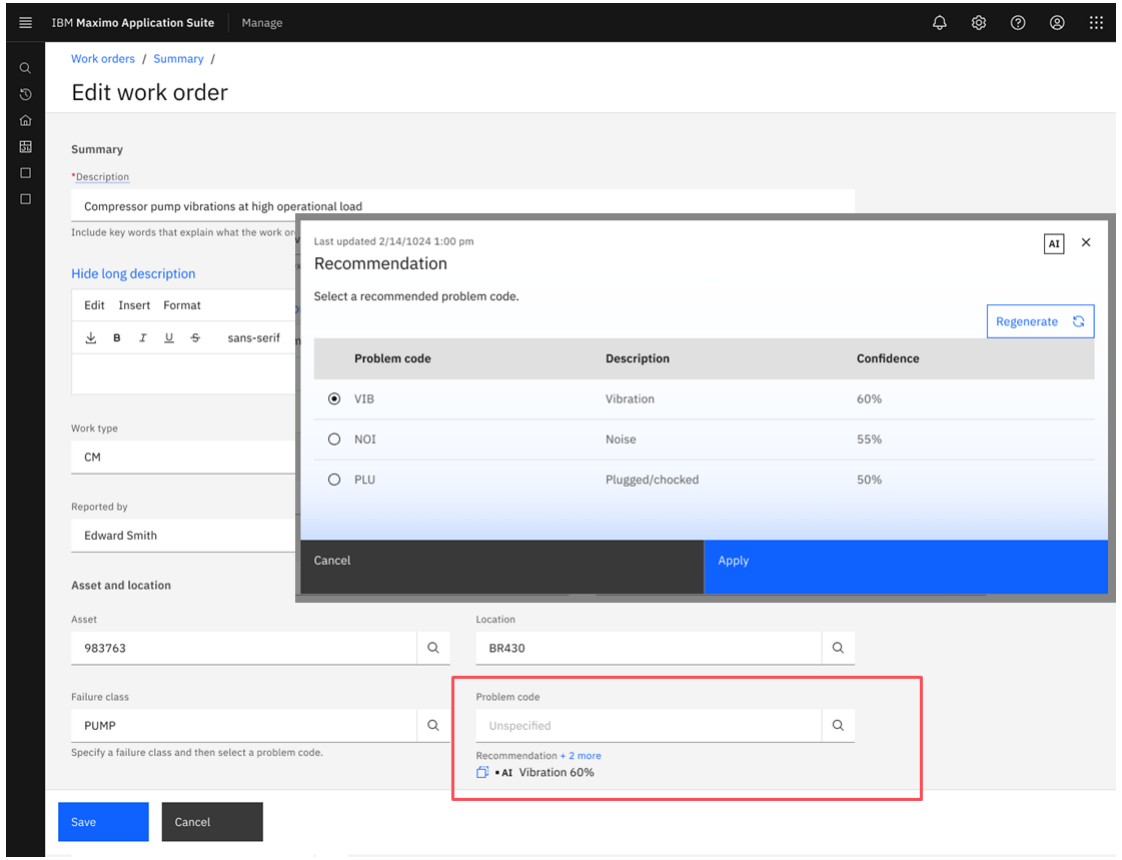
### Envizi sustainability assistant

Sustainability journeys can be complex and require digesting vast amounts of data. We hope to train a Gen AI model to assist our users in this journey.

# WO Intelligence Problem Code Recommendations using watsonx

New GenAI feature recommends problem codes to assist with existing challenges faced by customers to address poor quality (or missing) work order data, impacting effective maintenance prioritization decisions as well as time spent on review and approval.

- AI model trained using long and short descriptions from a small set of related work orders
- Work Orders displays the AI recommendations for review/accept
  - Uses new IBM AI Design UI elements incorporated into Graphite
  - Provides confidence score of the predictions
- Work queue surfaces the top AI recommendation to accept
- Leverages watsonx



Hide long description

Edit Insert Format

B I U S sans-serif

Work type

CM

Reported by

Edward Smith

Asset and location

Asset

983763

Failure class

PUMP

Specify a failure class and then select a problem code.

Location

BR430

Problem code

Unspecified

Recommendation + 2 more

AI Vibration 60%

Save Cancel

Last updated 2/14/1024 1:00 pm

AI

## Recommendation

Select a recommended problem code.

Regenerate

| | Problem code | Description | Confidence |
|---|---|---|---|
| ◉ | VIB | Vibration | 60% |
| ○ | NOI | Noise | 55% |
| ○ | PLU | Plugged/chocked | 50% |

Cancel Apply

# Agenda

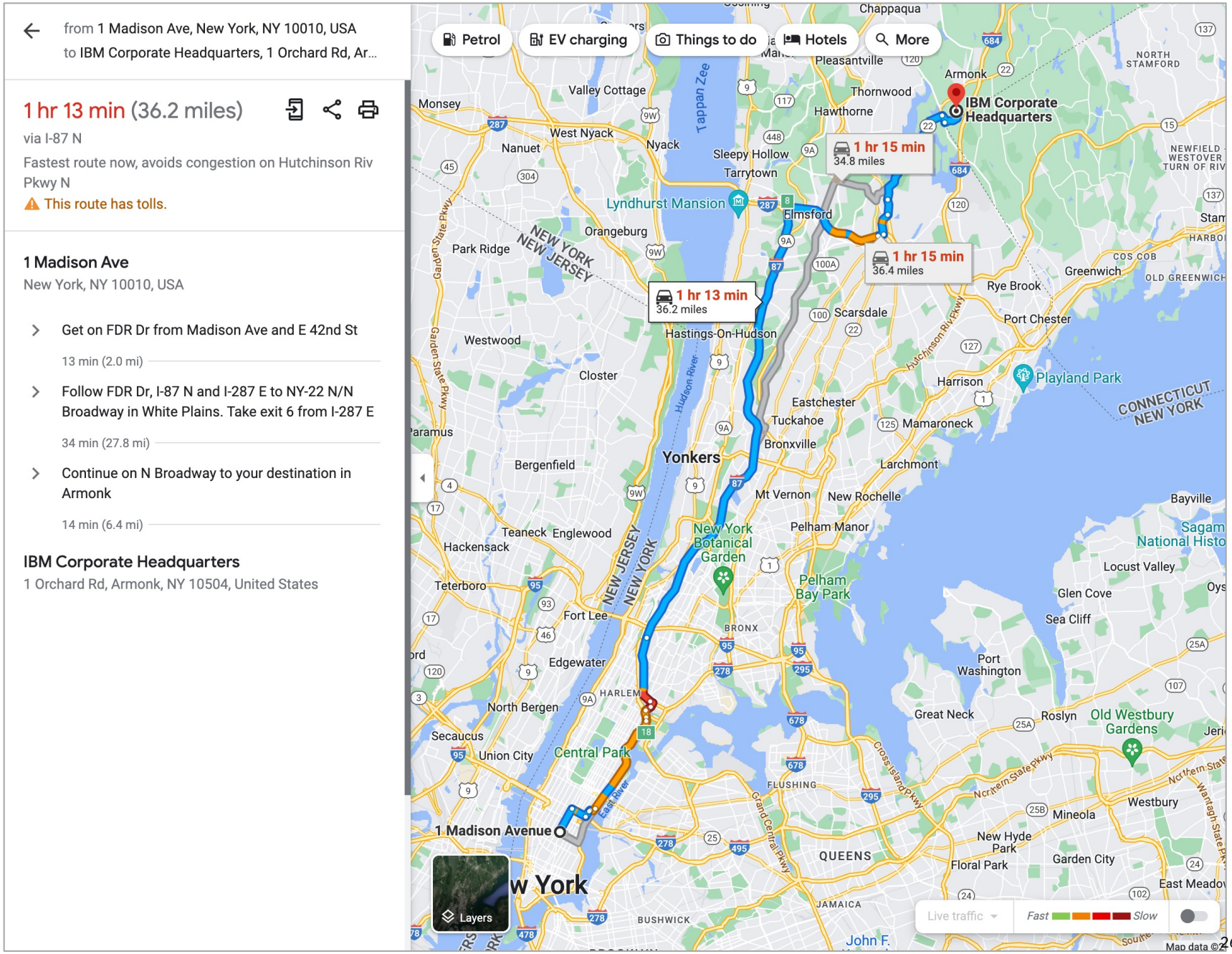
- How Foundation Models Work
- GenAI in Sustainability Software (Maximo)
- AI in Sustainability Software

# Where is AI in Sustainability Software?

# Route maps

Directions in Route planners

- Provide origin
- Provide destination
- Planner plots points between
- Shows route options



# AI+ Offering Map

| Offering | Business Imperative | AI Type | AI Method | AI Model | AI Capability | Application / Use Case |
|---|---|---|---|---|---|---|
| Above Ground Biomass | Sustainability Strategy and Roadmap | Decision Mgmt | Constraint Satisfaction | Classification | Anomaly Detection | Action Recognition |
| EIS Outage Prediction | ESG Data, Reporting and Risk Management | Interaction | Dynamic Programming | Closed Form Optimization | API Task Orchestration | Anomaly removal from data for KPIs |
| EIS Thematic Change Maps | Intelligent assets, facilities and infrastructure | Deep Learning | Motion & Manipulation | Clustering | Association Rules | Anomaly detection from asset sensors |
| EIS Vegetation Mgmt | Responsible Computing and Green IT | Machine Learning | Optimization | Constraint Propagation | Augmentation for Supervised Learning | Anomaly detection for doc flows |
| ELM RQA | Sustainable supply chain and circularity | Generative/FM | Perception | Constraint Satisfaction | Computer Vision | Apportionment |
| Envizi | | | Probabilistic Models | Dimension Reduction | Data Augmentation | Asset Failure Probability Prediction |
| Maximo Assist | | | Reinforcement Learning | Direct Policy Search | Data Compression | Asset Failure Date Prediction |
| Maximo Monitor | | | Rules Engine | Distributional Methods | Factor analysis | Asset Failure Progression Prediction |
| Maximo Predict | | | Self-Supervised Learning | Dynamic Programming | Failure Detection | Business Milestone Interval Prediction |
| Maximo Scheduler | | | Simulation | Linear Programming | Forecasting and Prediction | Demand and Inventory Prediction |
| Maximo Visual Insights | | | Supervised Learning | Mixed Integer Programming | Fraud Detection | Finds documents associated with a business transaction flow |
| MRO IO | | | Unsupervised Learning | Nonlinear Programming | Gradient Boosted Decision Trees | Fulfillment optimization |
| SCIS Research Asst | | | | Regression | Hierarchy Discovery | Image Classification for assets |
| SCIS Watson Asst | | | | Search | Image Classification | Inventory Optimization |
| Sterling BTI | | | | Simulation | Image Generation | Object Detection for assets |
| Sterling BTI Doc Corr | | | | Structure Discovery | Language Understanding | Power Outage Forecasting |
| Sterling FO | | | | Time Series Analysis | Movement Planning | Product Requirements Quality Analysis |
| TRIRIGA Building Insights | | | | Value Function Estimation | Multi-objective Optimization | Product Usage forecasting |
| | | | | | Object Detection | Q & A Assistant on client data |
| | | | | | Pixel Segmentation | Scheduling optimization |
| | | | | | Product Segmentation | Scope 3 emissions estimation |
| | | | | | Recommendation Systems | Vegetation proximity to Power Lines |
| | | | | | Relationship Discovery | Visual Change Detection for Satellite Imagery |
| | | | | | Sales Forecasting | Visual Defect Detection for assets |
| | | | | | Scheduling optimization | |
| | | | | | Spam Detection | |
| | | | | | Text Generation | |
| | | | | | Time Series Forecasting | |
| | | | | | Time to Failure | |
| | | | | | Video classification | |
| | | | | | Video Generation | |
| | | | | | Visualization | |


謝謝
DZIĘKUJĘ CI
TAPADH LEIBH
KEA LEBOHA
NGIYABONGA
БАЯРЛАЛАА
MISAOTRA ANAO
TEŞEKKÜR EDERIM
WHAKAWHETAI KOE
DANKIE
TERIMA KASIH
DANKON
TANK
TAPADH LEAT
СПАСИБО
GRAZIE
MATUR NUWUN
ХВАЛА ВАМ
MULȚUMESC
РАКМЕТ СІЗГЕ
고맙습니다
GRAZIE شكرا
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RAHMAT
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ありがとうございました
DI OU MÈSI
ĎAKUJEM
HATUR NUHUN
PAXMAT САГА
SIPAS JI WERE
TERIMA KASIH
CẢM ƠN BẠN
UA TSAUG RAU KOJ
WAZVIITA
ТИ БЛАГОДАРАМ
СИПОС
KÖSZÖNÖM
GRÀCIES
SALAMAT
MAHADSANID
HVALA
ДЯКУЙ
FALEMINDERIT