



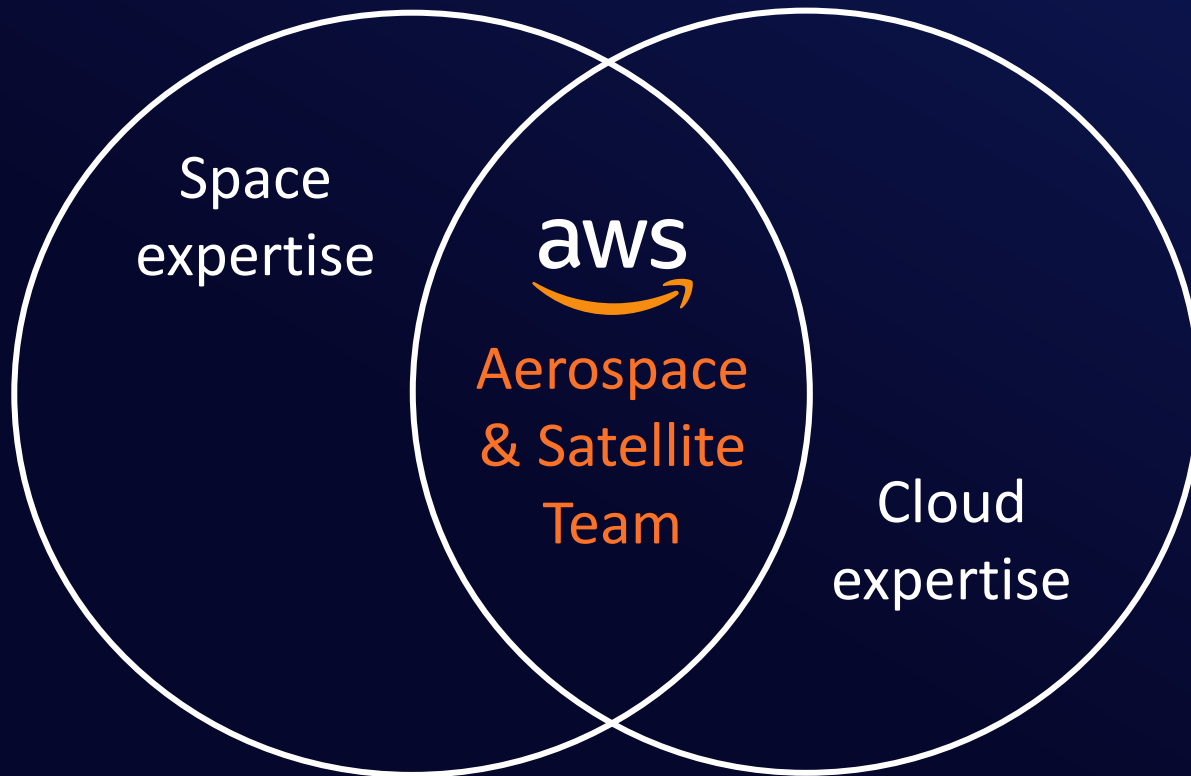
Generative AI for Space

ALAN CAMPBELL, PRINCIPAL SPACE SPECIALIST SOLUTIONS ARCHITECT

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We **help customers**:

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- Transform their space enterprises
- Launch new services that process space data on Earth and in orbit
- Pursue their public sector and commercial missions by advancing space around the world

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The tipping point for Generative AI



MASSIVE PROLIFERATION
OF DATA

AVAILABILITY OF
SCALABLE COMPUTE
CAPACITY

MACHINE LEARNING
INNOVATION

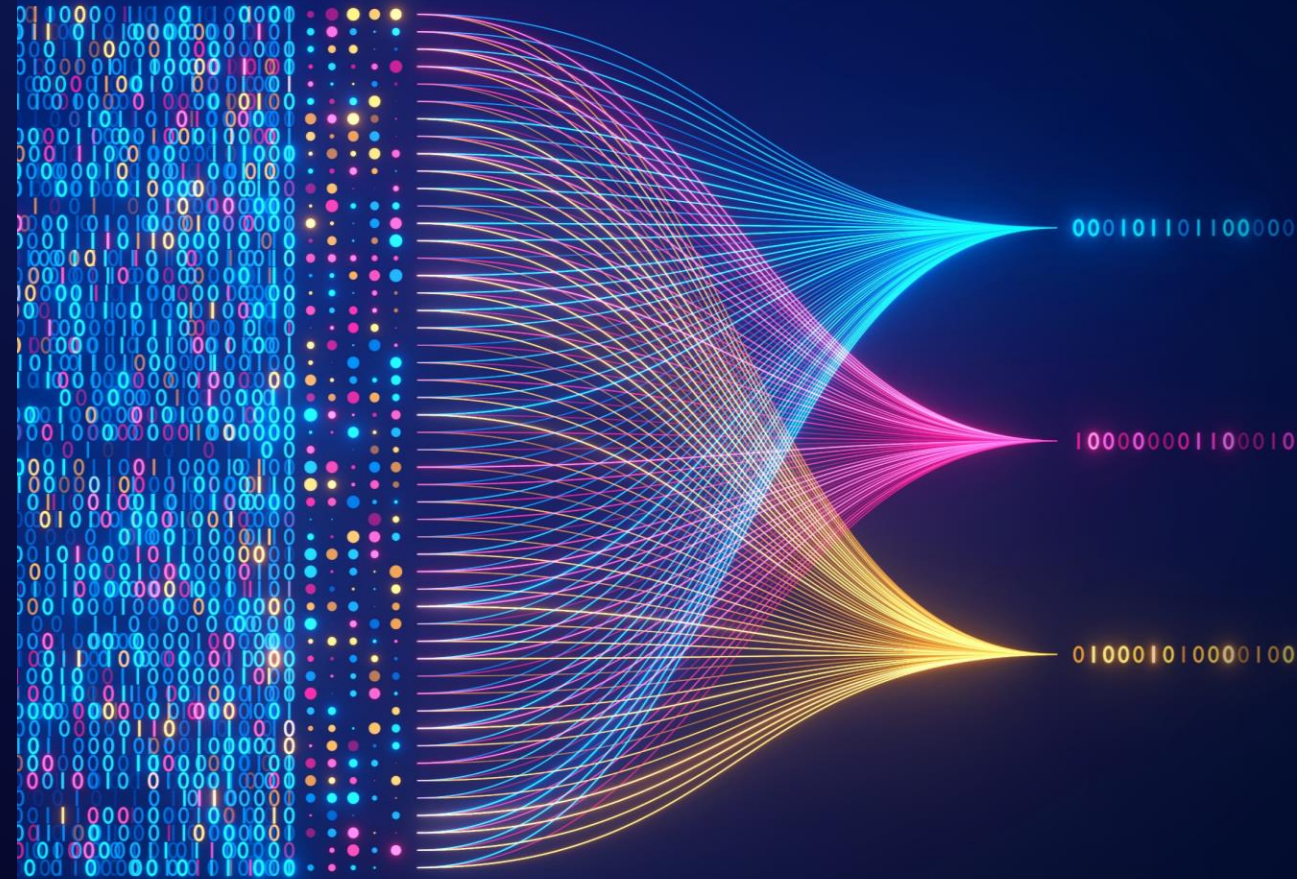
Generative AI is powered by foundation models

Pretrained on vast amounts of unstructured data

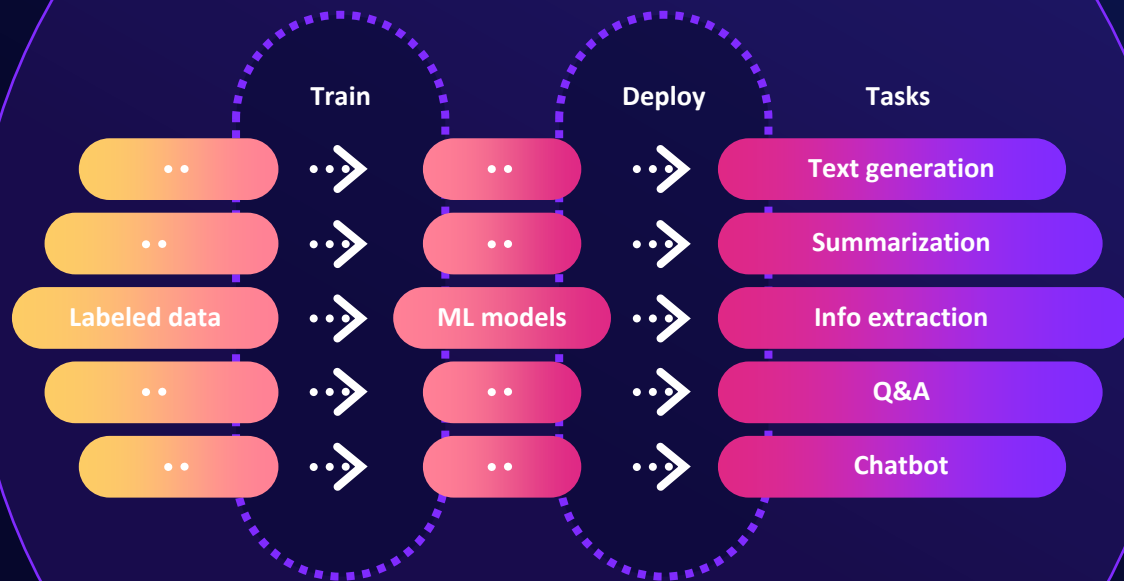
Contain large number of parameters that make them capable of learning complex concepts

Can be applied in a wide range of contexts

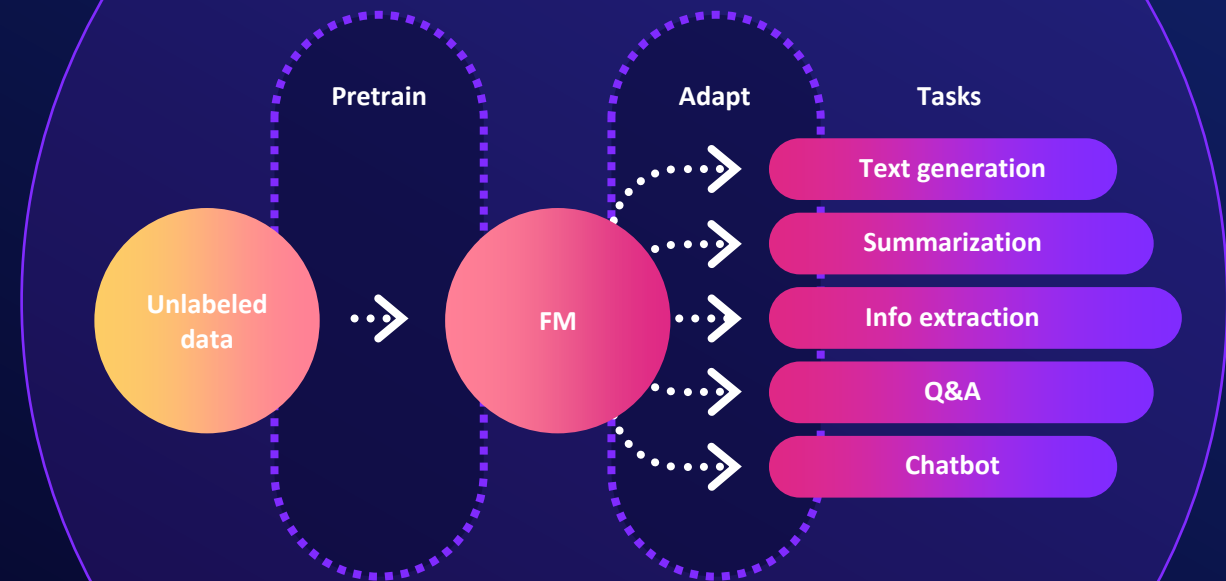
Customize FMs using your data for domain specific tasks



TRADITIONAL ML MODELS



FOUNDATION MODELS





Amazon Bedrock

The easiest way to build and scale generative AI applications with LLMs and other FMs

Choice of industry-leading FMs from AI21 Labs, Amazon, Anthropic, Cohere, Meta, and Stability AI

Customize FMs using your organization's data

Enterprise-grade security and privacy

Generative AI is expected to accelerate growth in the space industry, which is forecast to reach **\$1 trillion** by 2040.



Aerospace & Satellite: Geospatial & Remote Sensing



Enhance satellite
imagery analysis
through predictive
scenario generation



Improve object
identification with
training data set
augmentation using
synthetic generated
data



Deliver better query
results using natural
language over
satellite imagery sets



Keep imagery secure
by detecting doctored
images

Natural Language Query on Images



CHALLENGE

Satellite imagery consumers need to be able to find the images relevant to their missions quickly. However, satellite imagery data sets can be large, and tagging images a time-intensive and expensive task.

SOLUTION

Using a multi-modal foundation model, users can pose natural language queries to identify points of interest within images, get an analysis of what is occurring within an image, or even track changes occurring in images taken over time – without needing to perform manual analysis over the entire data set. Users can even fine-tune existing foundation models with their own existing tagged data sets for custom mission needs.

OUTCOME

- ✓ Faster time-to-insight
- ✓ Reduced manual efforts and associated costs
- ✓ Improved user experience



Images captured from <https://www.cnn.com/2022/06/16/weather/yellowstone-flood-satellite-before-and-after/index.html>

PROMPT

You are a satellite imagery analyst. Describe these two images and give an opinion on the cause of the differences.

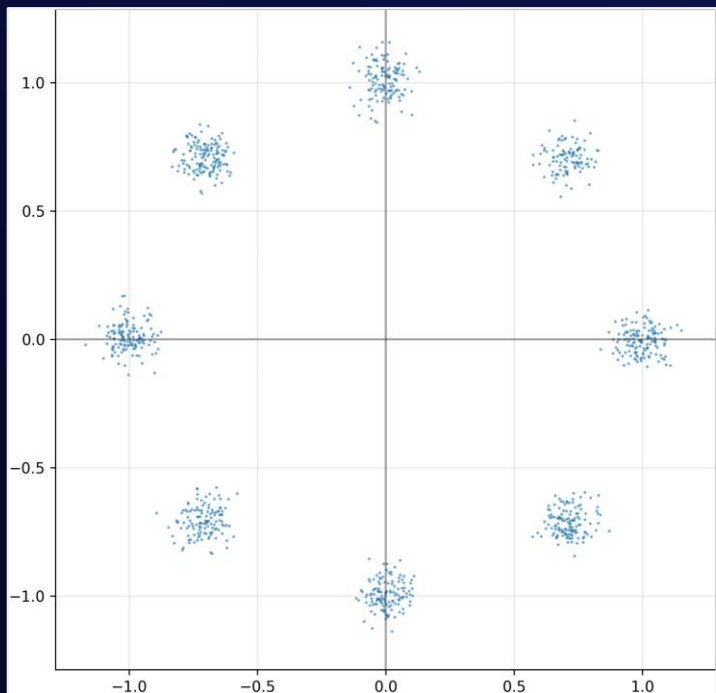
CLAUDE-3 SONNET

The two satellite images appear to depict the same geographic area, likely a coastal region with a winding river or waterway. However, there are significant differences between the images that suggest some form of environmental disturbance or disaster occurring.

In the first image, the waterway appears to be relatively clear, with defined banks and surrounding vegetation or agricultural fields. The areas near the water's edge seem undisturbed.

In contrast, the second image shows the waterway heavily discolored and turbid, indicating the presence of suspended sediments or pollutants. The banks and adjacent areas are also visibly disturbed, with large portions appearing muddy or flooded.

Based on these observations, it is possible that a significant flooding event or environmental disaster, such as a chemical spill or industrial accident, occurred between the times when these two images were captured. The influx of sediments, debris, or contaminants into the waterway could have caused the drastic changes in water clarity and the disturbance to the surrounding areas.



PROMPT

"You are an RF Analyst looking at IQ constellation modulation diagrams. You need to determine the modulation type. You also need to determine if the constellation has noise present, and if so what type of noise or imbalance? Finally indicate the typical causes of the noise."

CLAUDE-3.5 SONNET v2

Looking at this IQ constellation diagram, I can make the following analysis:

1. Modulation Type:

- This appears to be an 8-PSK (8-Phase Shift Keying) modulation

2. Noise Present:

- Yes, there is visible noise in the constellation
- The constellation points show spreading/scatter around their ideal positions
- The spread appears to be roughly Gaussian in nature

3. Typical Causes:

- Additive White Gaussian Noise (AWGN) is likely the primary contributor
- Could be caused by:
 - * Low signal-to-noise ratio (SNR)
 - * Channel interference
 - * Phase noise in the local oscillator
- There doesn't appear to be any significant amplitude or phase imbalance, as the constellation points are relatively symmetrical

Overall, while there is noticeable noise, the constellation points are still clearly distinguishable, suggesting this is still a functional communication link

Summary

GENAI FOR SPACE OPPORTUNITIES

- Natural language queries
 - Earth Observation imagery analysis – *“Are there wildfires occurring at location X”*
 - Satcom – *“Is there any interference on this IQ constellation. If so, what type is it?”*
- Use-cases
 - Edge computing – distil LLM to targeted, specific Small Language Model
 - Intelligent document search – improve workforce efficiency



Thank you!

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