



Deploying and optimizing onboard machine learning algorithms with Amazon Web Services (AWS)

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AWS Aerospace & Satellite Professional Services

AWS Aerospace & Satellite

AWS Aerospace & Satellite helps our customers:

- Reimagine how they design, launch, operate, and maintain space systems
- Derive insights to make better decisions faster
- Accelerate innovation.



Smart Design & Manufacturing



Ground Services



Geospatial Analysis



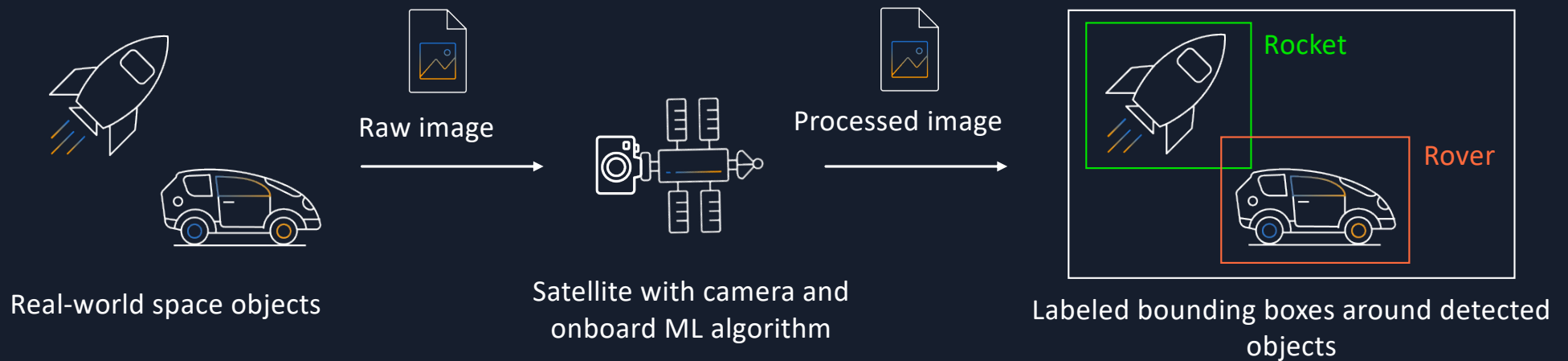
Satellite Operations



Research & Exploration

Onboard machine learning use case

- Collect images with an onboard camera
- Use onboard hardware to label bounding boxes around detected objects
- Deploy an updated version of the ML model to detect new objects

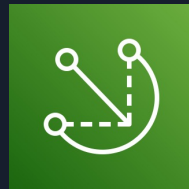


Key open-source components



AWS Cloud Development Kit (CDK)

AWS CDK is an open-source software development framework for defining cloud infrastructure-as-code.



AWS IoT Greengrass

AWS IoT Greengrass is an IoT open-source edge runtime and cloud service that helps you build, deploy, and manage device software.



TensorFlow

TensorFlow is an open-source software library for machine learning and artificial intelligence.

www.tensorflow.org

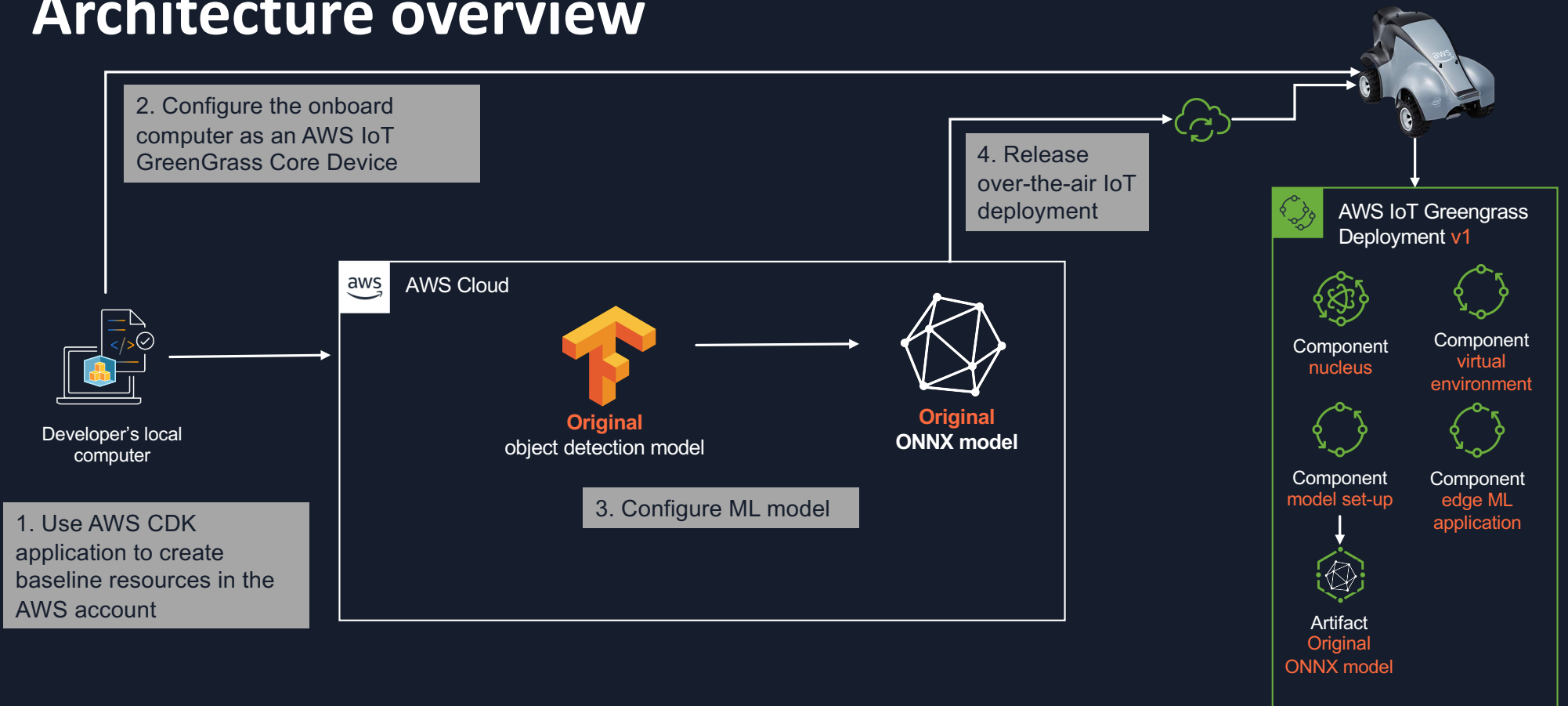


ONNX

ONNX is an open format built to represent machine learning models.

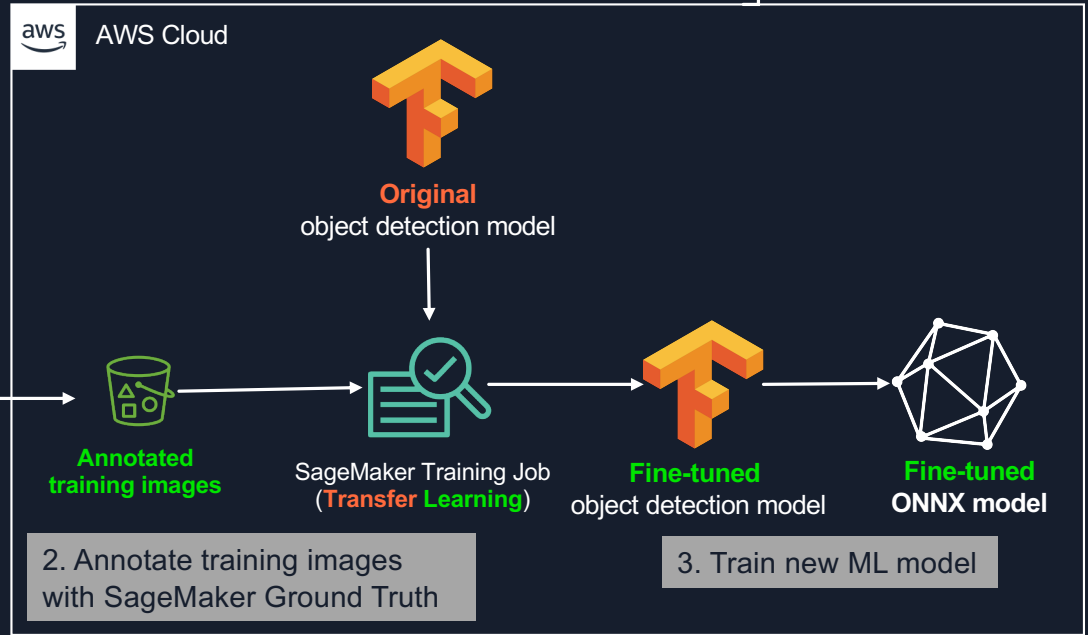
onnx.ai

Architecture overview

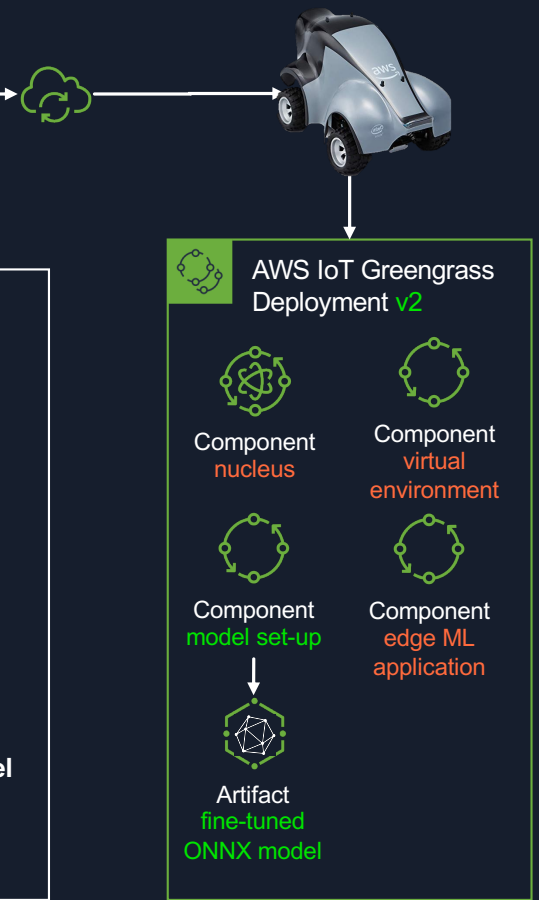


Architecture overview

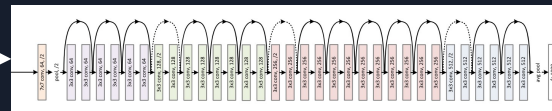
1. Upload training images



4. Release over-the-air IoT deployment



Original model



<https://arxiv.org/pdf/1512.03385.pdf>



Input

- JPG image
- Any height and width

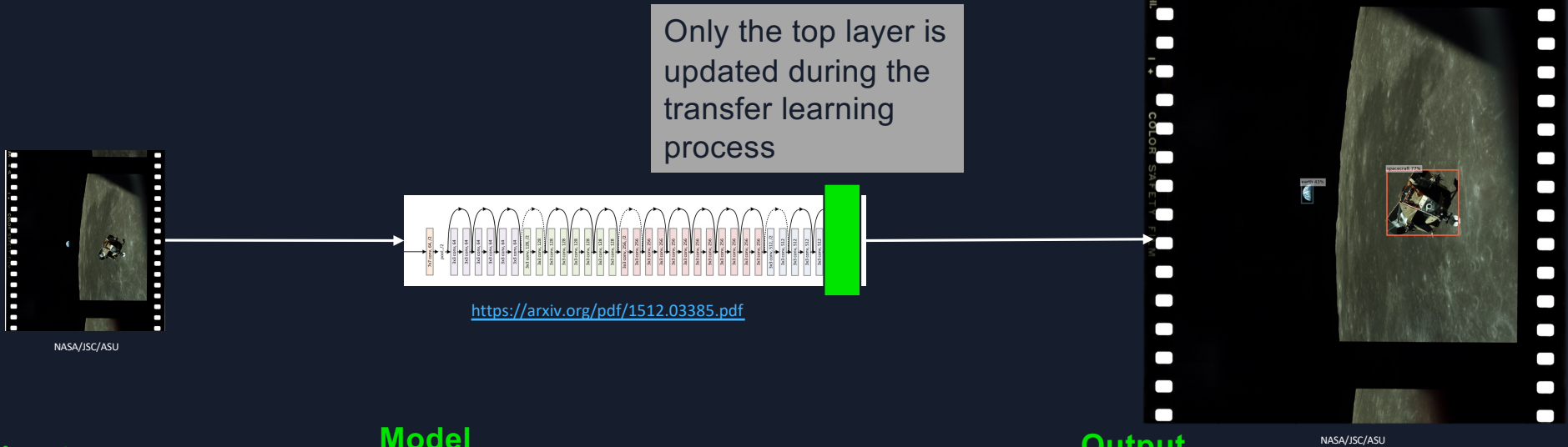
Model

- tensorflow-od1-ssd-resnet50-v1-fpn-640x640-coco17-tpu-8
- One of many pre-built models available in the AWS SageMaker JumpStart machine learning hub
- Trained to recognize **80** classes, including: **chair** and **umbrella**

Output

- Bounding boxes, classification labels, and confidence scores
- Plotted on top of original image

Fine-tuned model



Input

- JPG image
- Any height and width

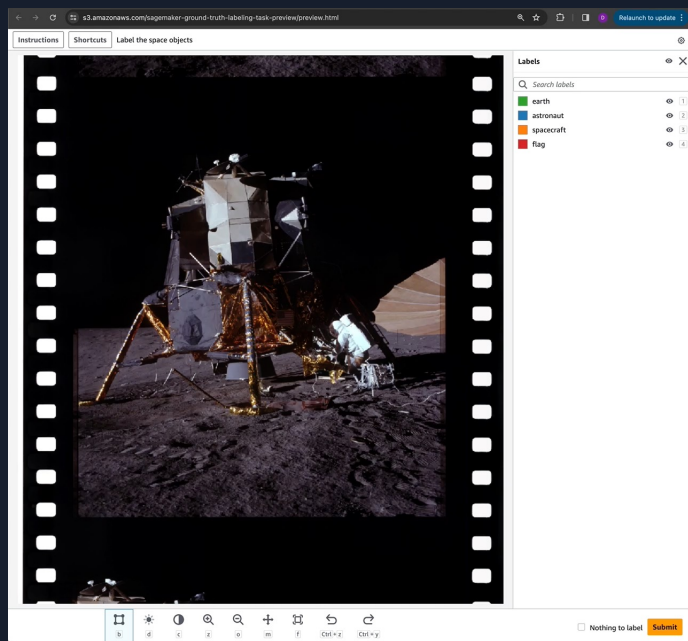
Model

- Trained to recognize 4 classes:
 - Earth
 - Astronaut
 - Spacecraft
 - Flag

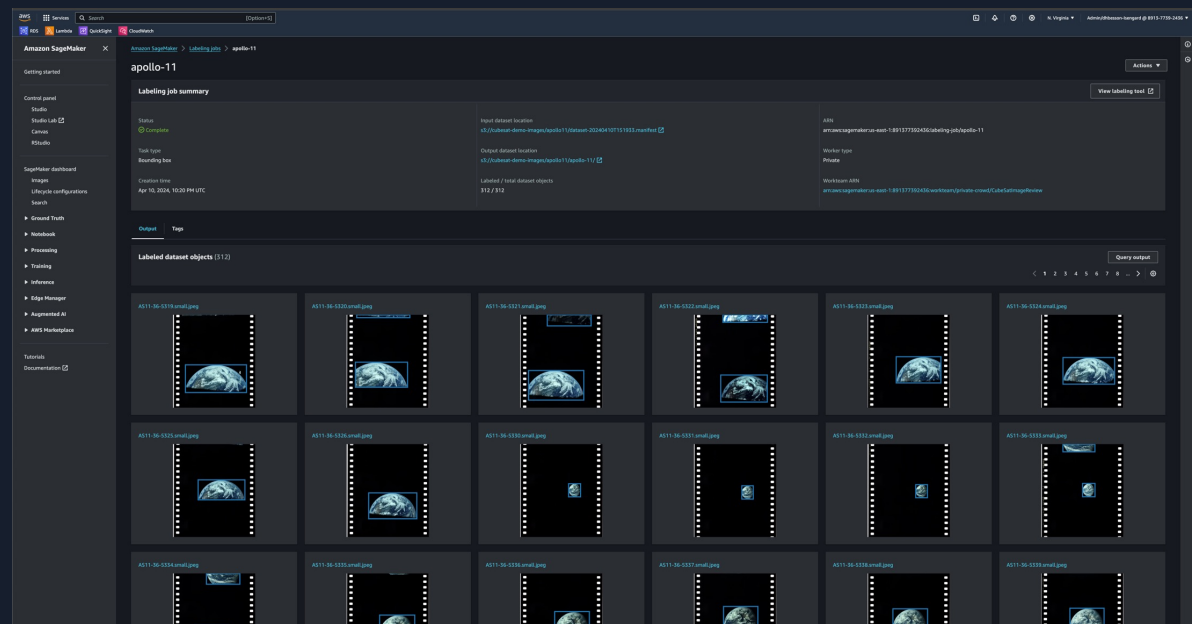
Output

- Bounding boxes, classification labels, and confidence scores
- Plotted on top of original image

Annotating training data with Amazon SageMaker Ground Truth



Ground Truth labeling tool



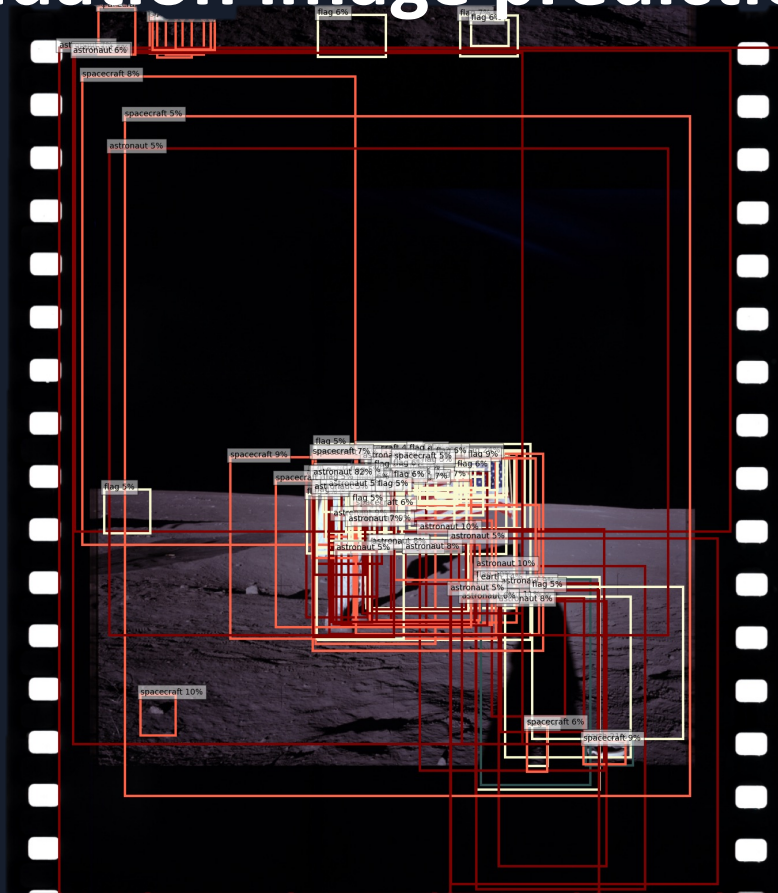
Labeled training data

Apollo images were retrieved from the Mercury, Gemini, and Apollo Digital Image Archive maintained by NASA Johnson Space Center and Arizona State University.

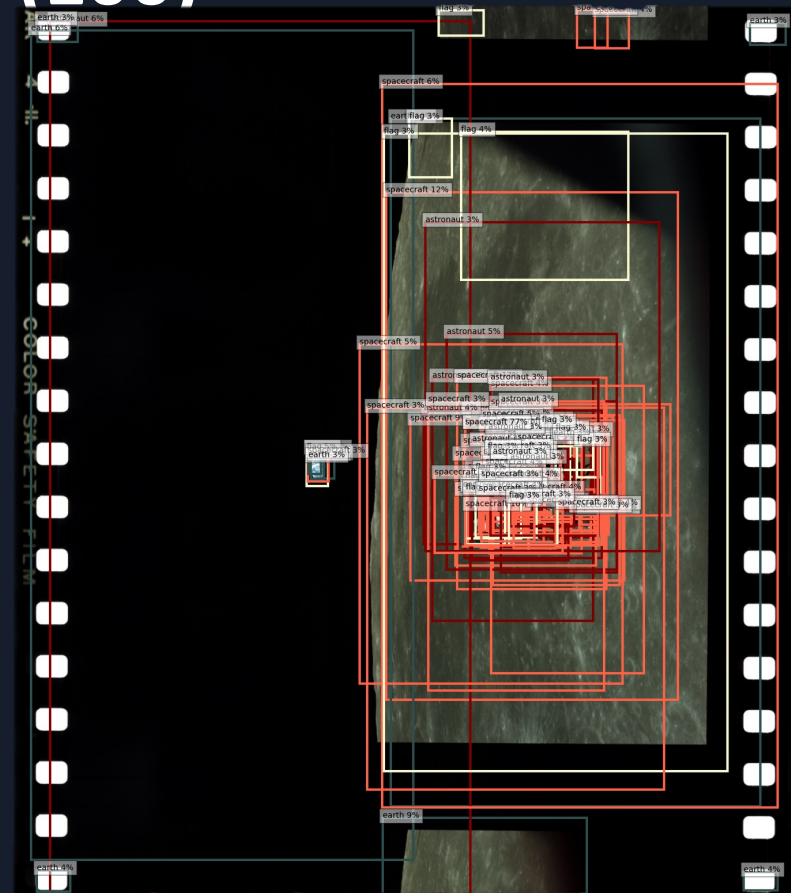
<https://tothemoon.ser.asu.edu/>



Validation image predictions (100)



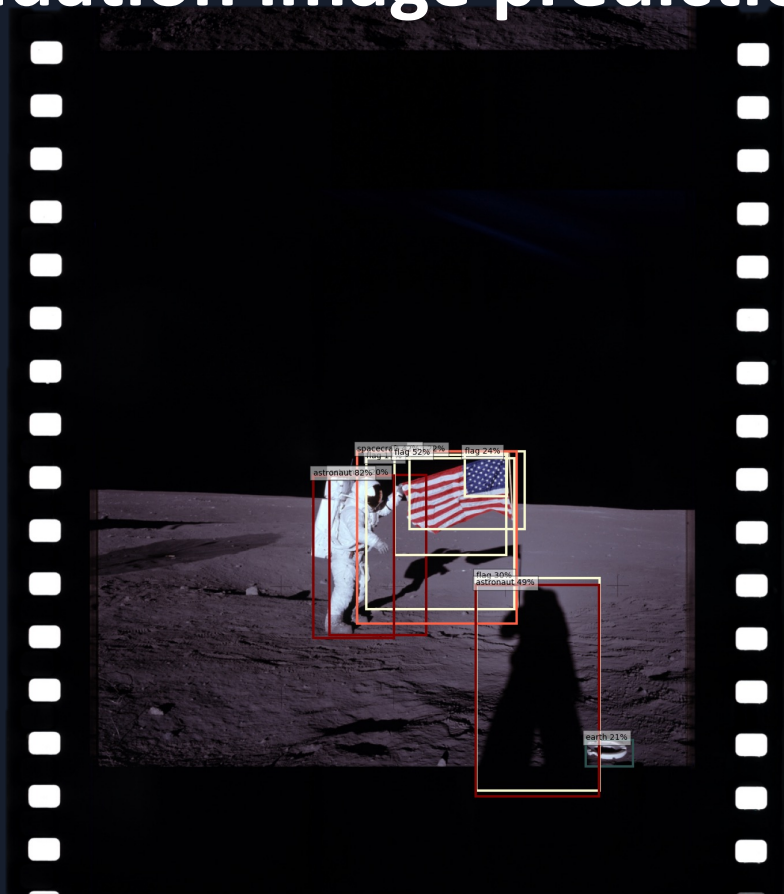
NASA/ISC/ASU



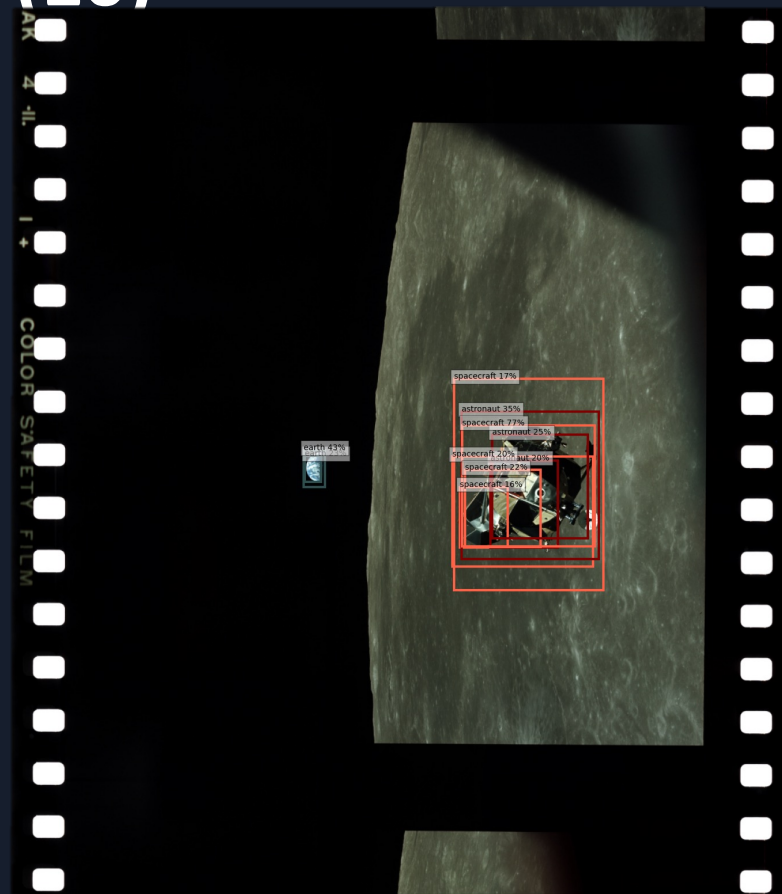
NASA/ISC/ASU



Validation image predictions (10)



NASA/ISC/ASU

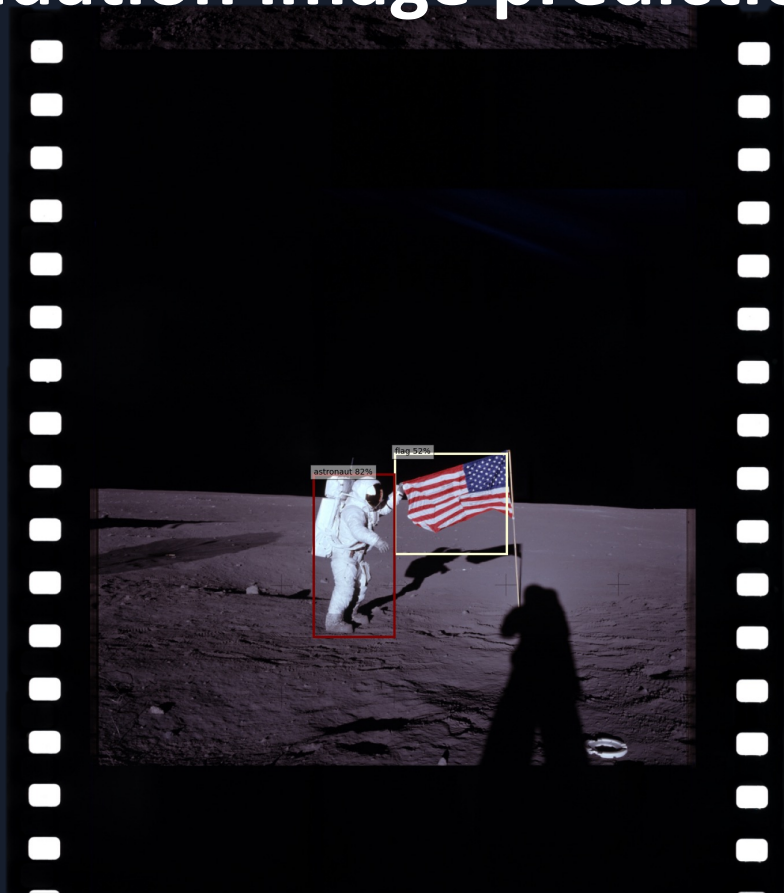


NASA/ISC/ASU

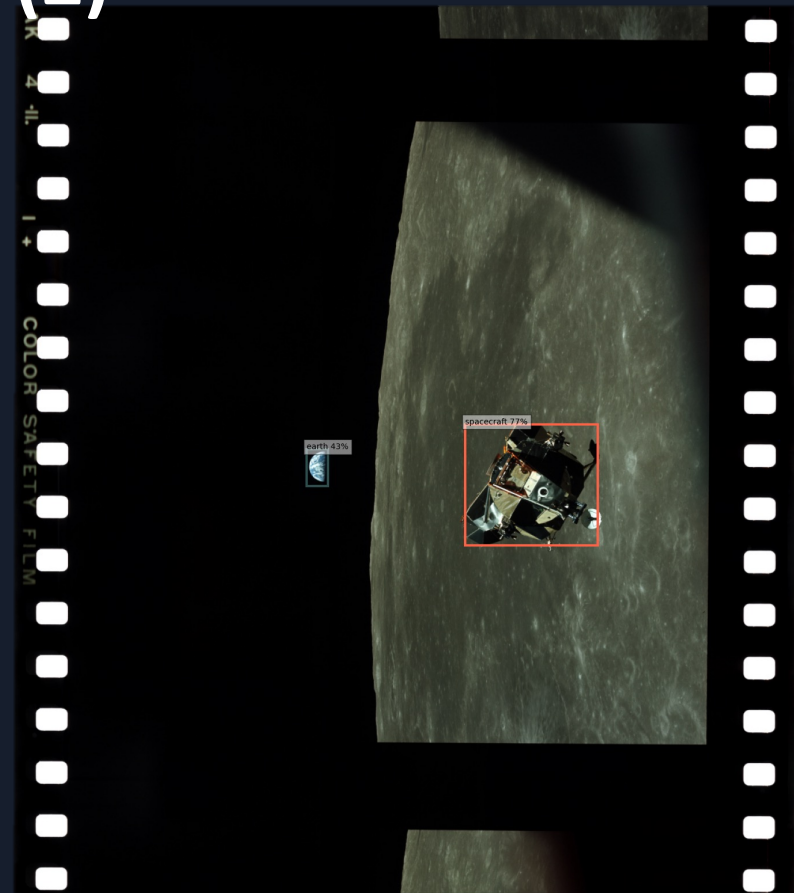


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Validation image predictions (2)



NASA/ISC/ASU



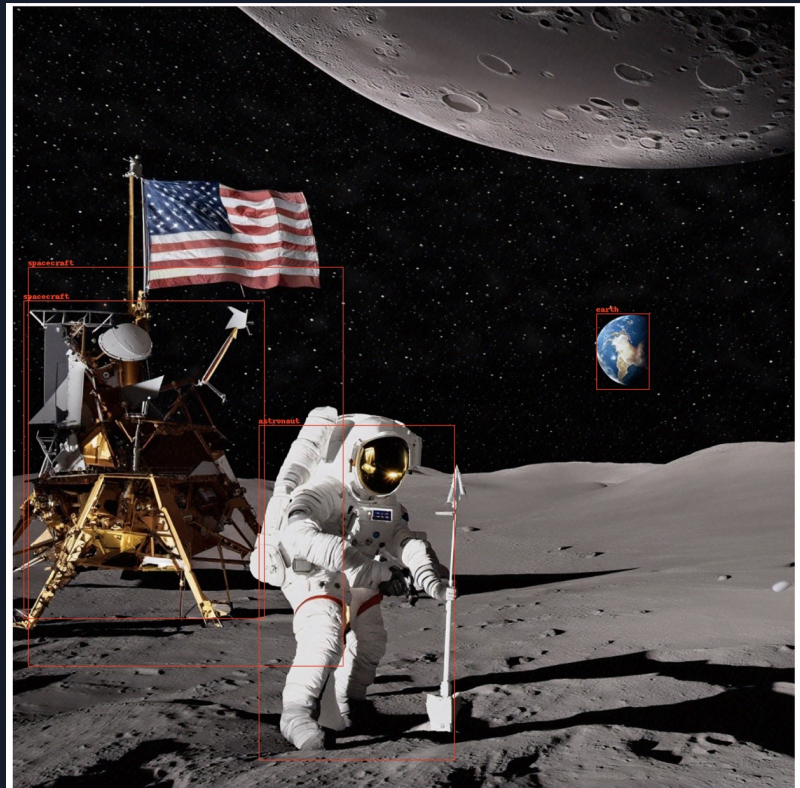
NASA/ISC/ASU



Field testing



Generative AI integration with Amazon Bedrock



Prompt given to Amazon Titan Image Generator G1 model

astronaut on the moon planting a flag in front of lunar lander with Earth in the background

Resources to learn more

[AWS IoT GreenGrass V2 Workshop](#)



[AWS SageMaker Workshops](#)



[Getting Started with AWS ML Edge](#)



[AWS DeepRacer](#)



Thank you!

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