

# Foundation Model Fine-Tuning Workshop

**Michael Lin**

Sr. Solutions Architect  
Amazon Web Services



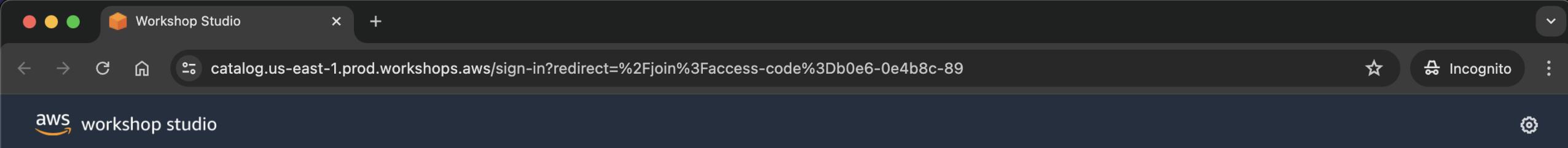
# Labs

- Bedrock Console: text generation with Titan Text
- Bedrock Console: news summary with Command Light
- Bedrock SDK: news summary with Llama 2
- Bedrock SDK: image generation with Titan Image Generator
- SageMaker JumpStart console: text generation with Mistral
- SageMaker JumpStart SDK: dialog summary with LLama 3

<https://ppt.cc/f5NCLx>

# Workshop Setup

- Workshop Access
- Bedrock Model Access
- Bedrock Playground Test-Drive
- SageMaker Studio Access
- Bedrock API Test-Drive



[Workshop Studio](#) > Sign in

## Sign in

Choose a preferred sign-in method

Email one-time password (OTP)

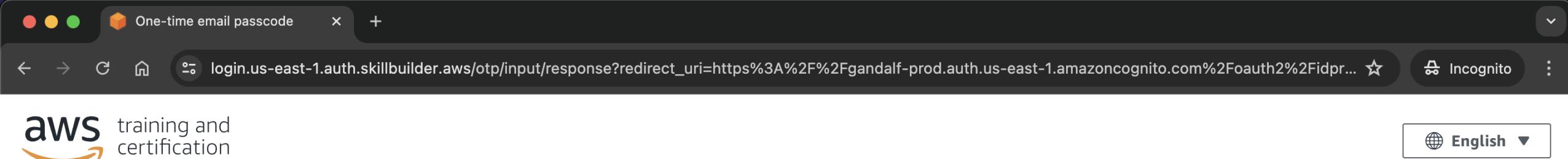
Enter your personal or corporate email to receive a one-time password

AWS Builder ID

Login with AWS Builder ID, a new personal profile for builders

Amazon employee

Login with your Amazon Corporate account. Only for Amazon Employees.



## One-time email passcode

Send a passcode to the email below.

Email

michael.tw.lin@

Back

Send passcode

[Get help signing in](#)

Verify one-time email passcode

← → G ⌂ login.us-east-1.auth.skillbuilder.aws/otp/challenge?redirect\_uri=https%3A%2F%2Fgandalf-prod.auth.us-east-1.amazoncognito.com%2Foauth2%2Fidprespo... ☆ Incognito :

aws training and certification

English ▾

### One-time email passcode

We sent a passcode to michael.tw.lin@gmail.com. You should receive it within 5 minutes.

Passcode (9-digit) [Resend passcode](#)

529717102

[Back](#) [Sign in](#)

[Get help signing in](#)

- Step 1  
Enter event access code
- Step 2  
**Review and join**

## Review and join

### Event details

Name  
bedrock-finetune-20240712

Start time  
7/12/2024 10:54 AM

Duration  
72 hours

Level  
300

### Description

bedrock-finetune-20240712

### Terms and Conditions

Read and accept before joining the event

Read and accept before joining the event:

1. By using AWS Workshop Studio for the relevant event, You agree to [the AWS Event Terms and Conditions](#), the [AWS Responsible AI Policy](#), and the [AWS Acceptable Use Policy](#).
2. If You are under 18 years old, you may participate in the relevant event using AWS Workshop Studio: (a) if You are at least the minimum age below based on the country or region in which You reside, and (b) with the involvement of a parent, guardian, or educator.

Country or region	Minimum age
All countries or regions not listed below (including the United States, Brazil, the United Kingdom, and India)	13
Canada, China, Republic of Korea (South Korea)	14
Australia	15



- Philippines, Thailand, Turkey, and countries in Africa
3. You acknowledge and agree that You are using an AWS-owned account that You will only be able to access during the relevant event. You have no ownership rights over this AWS-owned account.
  4. During the relevant event, while using this AWS-owned account, You will not use, import, input, or introduce any data, dataset, or other material that contains personal data, financial information, or any other data or materials that may be subject to laws and regulations (such as the General Data Protection Regulation or The Health Insurance Portability and Accountability Act of 1996).
  5. If You find residual resources or materials in this AWS-owned account, You will notify your Event Operator immediately.
  6. AWS, its affiliates, and any entities or persons acting on AWS's behalf reserves the right to terminate this AWS-owned account and to delete its contents at any time, without any notice to You.
  7. During the relevant event, while using this AWS-owned account, You will not process or run any operation on any data other than test datasets or lab materials that have been approved by AWS.
  8. You will not copy, import, export or otherwise create derivative works of materials provided by AWS for use outside of the relevant event.
  9. AWS, its affiliates, and any entities or persons acting on AWS's behalf have no obligation to enable the transmission of Your materials through AWS Workshop Studio, and may, in their discretion, edit, block, refuse to post, or remove Your materials at any time, without notice to You.
  10. If You access and use a service and/or third-party models that have their own terms during the relevant event, while in the AWS-owned account, You agree to review those terms and comply with them during the event.
  11. If You are an AWS Partner using AWS Workshop Studio as part of Your participation in the AWS Partner Network Program, Your use of AWS Workshop Studio is governed by these terms, the AWS Partner Network Terms and Conditions, and the AWS Customer Agreement or other agreement with us governing your use of AWS Services.
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- Philippines, Thailand, Turkey, and countries in Africa
3. You acknowledge and agree that You are using an AWS-owned account that You will only be able to access during the relevant event. You have no ownership rights over this AWS-owned account.
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  8. You will not copy, import, export or otherwise create derivative works of materials provided by AWS for use outside of the relevant event.
  9. AWS, its affiliates, and any entities or persons acting on AWS's behalf have no obligation to enable the transmission of Your materials through AWS Workshop Studio, and may, in their discretion, edit, block, refuse to post, or remove Your materials at any time, without notice to You.
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I agree with the Terms and Conditions

Cancel

Previous

Join event



bedrock-finetune-20240712 x +

catalog.us-east-1.prod.workshops.aws/event/dashboard/en-US

aws workshop studio michael\_tw\_lin

bedrock-finetune-20240712 < X ⓘ

Event ends in 1 hour 27 minutes.

Event dashboard > Amazon Bedrock Workshop

# bedrock-finetune-20240712

**Event information**

Start time 7/12/2024 10:54 AM	Duration 72 hours	Accessible regions us-west-2, us-east-1
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Description  
bedrock-finetune-20240712

**Workshop**

Title Amazon Bedrock Workshop	Complexity level 300	AWS services Amazon Bedrock	Topics Machine Learning (ML/AI), Generative AI
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Description  
Amazon Bedrock workshop with main design patterns

**Event Outputs (0)**

Get started >

Open AWS console (us-west-2) ←

Get AWS CLI credentials

Exit event

bedrock-finetune-20240712 x Console Home | Console Hom +

us-west-2.console.aws.amazon.com/console/home?region=us-west-2

aws Services Search [Option+S] Oregon WSParticipantRole/Participant @ 6534-0549-1536

# Console Home Info

Reset to default layout + Add widgets

### Recently visited Info

- Amazon SageMaker
- CloudFormation
- IAM
- S3
- Amazon Bedrock
- Cloud9
- RDS
- EC2

[View all services](#)

### Applications (0) Info

Region: US West (Oregon)

us-west-2 (Current Region) Find applications

Name	Description	Region	Originating account
No applications			

Get started by creating an application.

[Create application](#)

[Go to myApplications](#)

### Welcome to AWS

Getting started with AWS 

Learn the fundamentals and best practices for AWS services.

### AWS Health Info

### Cost and usage Info

Current month costs	Cost (\$)
\$70.51	80

# Workshop Setup

- Workshop Access
- Bedrock Model Access
- Bedrock Playground Test-Drive
- SageMaker Studio Access
- Bedrock API Test-Drive



Services

bedrock



Oregon ▾

WSParticipantRole/Participant @ 6534-0549-1536 ▾

## Console

Services (1)

Recent

Resources New

Documentation (2,575)

Knowledge Articles (12)

Amazon

Marketplace (368)

IAM

Blogs (217)

S3

Events (1)

Amazon

Cloud

RDS

EC2

Welcome



get the most out of AWS.

Search results for 'bedrock'

## Services



Amazon Bedrock ☆

The easiest way to build and scale generative AI applications with foundation models (F...)

## Resources / for a focused search



Introducing resource search

To search for resources, Resource Explorer must be active in at least one AWS Region and you must have permission to use the default view in the account. Learn more [\[ \]](#)

Dismiss

## Documentation

See all 2,575 results ►

Amazon Bedrock [\[ \]](#)

User Guide

Deleting an Bedrock Studio project [\[ \]](#)

User Guide

Getting started with Amazon Bedrock Studio [\[ \]](#)

User Guide

Deleting apps and components from an Amazon Bedrock Studio [\[ \]](#)

Default layout

+ Add widgets

Create application

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on ▾ | Originating account

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40

A screenshot of the Amazon Bedrock service homepage in the AWS console. The browser tab is titled "Amazon Bedrock | us-west-2". The main content area features the heading "Amazon Bedrock" and the subtext "The easiest way to build and scale generative AI applications with foundation models (FMs)". To the right, there is a call-to-action box with the heading "Try Bedrock" and a "Get started" button. A red arrow points to the three-dot menu icon in the top-left corner of the page header.

# Amazon Bedrock

The easiest way to build and scale generative AI applications with foundation models (FMs)

Try Bedrock

Get started

## Overview

Amazon Bedrock is a fully managed service that makes FMs from leading AI startups and Amazon available via an API, so you can choose from a wide range of FMs to find the model that is best suited for your use case. With Bedrock's serverless experience, you can get started quickly, privately customize FMs with your own data, and easily integrate and deploy them into your applications using the AWS tools without having to manage any infrastructure.

## Benefits

bedrock-finetune-20240712 x Amazon Bedrock | us-west-2 x +

us-west-2.console.aws.amazon.com/bedrock/home?region=us-west-2#/

aws Services Search [Option+S] Oregon WSParticipantRole/Participant @ 6534-0549-1536

Amazon Bedrock Machine Learning

**Amazon Bedrock**  
The easiest way to build and scale generative AI applications with foundation models (FMs)

Try Bedrock  
Get started

Getting started  
Overview  
Examples  
Providers

Foundation models  
Base models  
Imported models [Preview](#)

Playgrounds  
Chat  
Text  
Image

Safeguards  
Guardrails  
Watermark detection

Builder tools  
Knowledge bases  
Agents  
Prompt management [Preview](#)  
Prompt flows [Preview](#)

Assessment & deployment

**Overview**

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**Benefits**



bedrock-finetune-20240712 x Amazon Bedrock | us-west-2 x +

us-west-2.console.aws.amazon.com/bedrock/home?region=us-west-2#/

aws Services Search [Option+S] Oregon WSParticipantRole/Participant @ 6534-0549-1536

Foundation models

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- Image

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- Guardrails
- Watermark detection

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- Knowledge bases
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- Prompt management [Preview](#)
- Prompt flows [Preview](#)

Assessment & deployment

- Model Evaluation

Model access [Preview](#) ←

Bedrock Studio [Preview](#)

Settings

User guide ↗

Machine Learning

# Amazon Bedrock

The easiest way to build and scale generative AI applications with foundation models (FMs)

Try Bedrock

Get started

## Overview

Amazon Bedrock is a fully managed service that makes FMs from leading AI startups and Amazon available via an API, so you can choose from a wide range of FMs to find the model that is best suited for your use case. With Bedrock's serverless experience, you can get started quickly, privately customize FMs with your own data, and easily integrate and deploy them into your applications using the AWS tools without having to manage any infrastructure.

## Benefits

bedrock-finetune-20240712 x Amazon Bedrock | us-west-2 x +

us-west-2.console.aws.amazon.com/bedrock/home?region=us-west-2#/modelaccess

aws Services Search [Option+S] Oregon WSParticipantRole/Participant @ 6534-0549-1536

## Amazon Bedrock

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### Amazon Bedrock > Model access

#### What is Model access?

To use Bedrock, account users with the correct [IAM Permissions](#) must enable access to available Bedrock foundation models (FMs). View all [Bedrock Model Terms](#) for [Bedrock FMs](#).

[Modify model access](#)

Visit [Amazon Bedrock Quotas](#) for a quick guide to the default quotas and limits that apply to Amazon Bedrock.

#### Base models (29)

Not seeing a model you're interested in? Check out all supported models by region [here](#).

Find model [Collapse all](#) [Group by provider](#)

Models	Access status	Modality	EULA
▼ AI21 Labs (2)	0/2 access granted		
Jurassic-2 Ultra	<a href="#">Available to request</a>	Text	<a href="#">EULA</a>
Jurassic-2 Mid	<a href="#">Available to request</a>	Text	<a href="#">EULA</a>
▼ Amazon (6)	6/6 access granted		
Titan Embeddings G1 - Text	<a href="#">Access granted</a>	Embedding	<a href="#">EULA</a>
Titan Text G1 - Lite	<a href="#">Access granted</a>	Text	<a href="#">EULA</a>

us-west-2.console.aws.amazon.com/bedrock/home?region=us-west-2#/modelaccess

AWS Services Search [Option+S] Oregon WSParticipantRole/Participant @ 6534-0549-1536

Amazon Bedrock > Model access > Manage model access

Step 1 Edit model access Step 2 Review and submit

## Edit model access

### Base models (16/29)

Not seeing a model you're interested in? Check out all supported models by region [here](#).

Find model Group by provider

Models Access status Modality EULA

Models	Access status	Modality	EULA
AI21 Labs (2)	0/2 access granted		
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Jurassic-2 Mid	Available to request	Text	<a href="#">EULA</a>
Amazon (6)	6/6 access granted		
Titan Embeddings G1 - Text	Access granted	Embedding	<a href="#">EULA</a>
Titan Text G1 - Lite	Access granted	Text	<a href="#">EULA</a>
Titan Text G1 - Express	Access granted	Text	<a href="#">EULA</a>
Titan Image Generator G1	Access granted	Image	<a href="#">EULA</a>
Titan Multimodal Embeddings G1	Access granted	Embedding	<a href="#">EULA</a>
Titan Text Embeddings V2	Access granted	Embedding	<a href="#">EULA</a>
Anthropic (5)	3/5 access granted		

A red arrow points to the checkbox icon next to the "Models" header.

<input checked="" type="checkbox"/>	Embed Multilingual	<span> ⓘ Available to request</span>	Embedding	EULA
<input checked="" type="checkbox"/>	Command	<span> ⓘ Available to request</span>	Text	EULA
<input checked="" type="checkbox"/>	Command Light	<span> ⓘ Available to request</span>	Text	EULA
<input checked="" type="checkbox"/>	▼ Meta (6)	2/6 access granted		
<input checked="" type="checkbox"/>	Llama 3 8B Instruct	<span> ⓘ Access granted</span>	Text	EULA
<input checked="" type="checkbox"/>	Llama 3 70B Instruct	<span> ⓘ Access granted</span>	Text	EULA
<input type="checkbox"/>	Llama 2 Chat 13B	<span> ⓘ Unavailable</span>	Text	EULA
<input type="checkbox"/>	Llama 2 Chat 70B	<span> ⓘ Unavailable</span>	Text	EULA
<input type="checkbox"/>	Llama 2 13B	<span> ⓘ Unavailable</span>	Text	EULA
<input type="checkbox"/>	Llama 2 70B	<span> ⓘ Unavailable</span>	Text	EULA
<input type="checkbox"/>	▼ Mistral AI (3)	3/3 access granted		
<input type="checkbox"/>	Mistral 7B Instruct	<span> ⓘ Access granted</span>	Text	EULA
<input type="checkbox"/>	Mixtral 8x7B Instruct	<span> ⓘ Access granted</span>	Text	EULA
<input type="checkbox"/>	Mistral Large	<span> ⓘ Access granted</span>	Text	EULA
<input checked="" type="checkbox"/>	▼ Stability AI (1)	1/1 access granted		
<input checked="" type="checkbox"/>	SDXL 1.0	<span> ⓘ Access granted</span>	Image	EULA

**Cancel**

Next

bedrock-finetune-20240712 x Amazon Bedrock | us-west-2 x +

us-west-2.console.aws.amazon.com/bedrock/home?region=us-west-2#/modelaccess

aws Services Search [Option+S] | Oregon | WSParticipantRole/Participant @ 6534-0549-1536

Amazon Bedrock > Model access > Manage model access

Step 1  
Edit model access  
Step 2  
**Review and submit**

## Review and submit

### Step 1: Edit model access

[Edit](#)

#### Model access modifications (10)

Models	Modifications
Jurassic-2 Ultra	Request access
Jurassic-2 Mid	Request access
Claude 3 Opus	Request access
Claude 3 Haiku	Request access
Command R+	Request access
Command R	Request access
Embed English	Request access
Embed Multilingual	Request access
Command	Request access
Command Light	Request access



## Model access modifications (10)

## Models

## Modifications

Jurassic-2 Mid	Request access
Claude 3 Opus	Request access
Claude 3 Haiku	Request access
Command R+	Request access
Command R	Request access
Embed English	Request access
Embed Multilingual	Request access
Command	Request access
Command Light	Request access

## Terms

By selecting Submit, you are requesting access to the selected third party models through the AWS Marketplace. By doing so, you agree to the seller's pricing terms and End User License Agreements (EULA), and the [Bedrock Service Terms](#). You also agree and acknowledge that AWS may share information about this transaction with the respective sellers, in accordance with the [AWS Privacy Notice](#).

AWS will issue invoices and collect payments from you on behalf of the seller through your AWS account. Your use of AWS services is subject to the [AWS Customer Agreement](#) or other agreements with AWS governing your use of such services.

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## Model access modifications (10)

Models

Modifications

Jurassic-2 Mid	Request access
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bedrock-finetune-20240712 X Amazon Bedrock | us-west-2 + us-west-2.console.aws.amazon.com/bedrock/home?region=us-west-2#/modelaccess

Services Search [Option+S] Oregon WSParticipantRole/Participant @ 6534-0549-1536

Amazon Bedrock

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**Access request for 10 models failed**

- Jurassic-2 Ultra - User: arn:aws:sts::653405491536:assumed-role/WSParticipantRole/Participant is not authorized to perform: aws-marketplace:Subscribe on resource: \* because no identity-based policy allows the aws-marketplace:Subscribe action
- Jurassic-2 Mid - User: arn:aws:sts::653405491536:assumed-role/WSParticipantRole/Participant is not authorized to perform: aws-marketplace:Subscribe on resource: \* because no identity-based policy allows the aws-marketplace:Subscribe action
- Claude 3 Opus - User: arn:aws:sts::653405491536:assumed-role/WSParticipantRole/Participant is not authorized to perform: aws-marketplace:Subscribe on resource: \* because no identity-based policy allows the aws-marketplace:Subscribe action
- Claude 3 Haiku - User: arn:aws:sts::653405491536:assumed-role/WSParticipantRole/Participant is not authorized to perform: aws-marketplace:Subscribe on resource: \* because no identity-based policy allows the aws-marketplace:Subscribe action
- Command R+ - User: arn:aws:sts::653405491536:assumed-role/WSParticipantRole/Participant is not authorized to perform: aws-marketplace:Subscribe on resource: \* because no identity-based policy allows the aws-marketplace:Subscribe action
- Command R - User: arn:aws:sts::653405491536:assumed-role/WSParticipantRole/Participant is not authorized to perform: aws-marketplace:Subscribe on resource: \* because no identity-based policy allows the aws-marketplace:Subscribe action
- Embed English - User: arn:aws:sts::653405491536:assumed-role/WSParticipantRole/Participant is not authorized to perform: aws-marketplace:Subscribe on resource: \* because no identity-based policy allows the aws-marketplace:Subscribe action
- Embed Multilingual - User: arn:aws:sts::653405491536:assumed-role/WSParticipantRole/Participant is not authorized to perform: aws-marketplace:Subscribe on resource: \* because no identity-based policy allows the aws-marketplace:Subscribe action
- Command - User: arn:aws:sts::653405491536:assumed-role/WSParticipantRole/Participant is not authorized to perform: aws-marketplace:Subscribe on resource: \* because no identity-based policy allows the aws-marketplace:Subscribe action
- Command Light - User: arn:aws:sts::653405491536:assumed-role/WSParticipantRole/Participant is not authorized to perform: aws-marketplace:Subscribe on resource: \* because no identity-based policy allows the aws-marketplace:Subscribe action

Amazon Bedrock > Model access

## What is Model access?

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# Workshop Setup

- Workshop Access
- Bedrock Model Access
- **Bedrock Playground Test-Drive**
- SageMaker Studio Access
- Bedrock API Test-Drive

bedrock-finetune-20240712 x Amazon Bedrock | us-west-2 x +

us-west-2.console.aws.amazon.com/bedrock/home?region=us-west-2#/modelaccess

aws Services Search [Option+S] | [ ] | [ ] | [ ] | Oregon | WSParticipantRole/Participant @ 6534-0549-1536

## Amazon Bedrock

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### Amazon Bedrock > Model access

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[Find model](#) Group by provider Collapse all

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Jurassic-2 Mid	Available to request	Text	<a href="#">EULA</a>
▼ Amazon (6)	6/6 access granted		
Titan Embeddings G1 - Text	Access granted	Embedding	<a href="#">EULA</a>
Titan Text G1 - Lite	Access granted	Text	<a href="#">EULA</a>

bedrock-finetune-20240712 X Amazon Bedrock | us-west-2 +

us-west-2.console.aws.amazon.com/bedrock/home?region=us-west-2#/chat-playground

aws Services Search [Option+S] Oregon WSParticipantRole/Participant @ 6534-0549-1536

## Amazon Bedrock < Chat playground

### Chat playground Info

**Select model**

Load examples Compare mode

Configurations Reset  
Select model to load configs.

Try one of these examples or [view more examples](#)

 Titan Text G1 - Express <b>Action items from a meeting transcript</b>	 Claude <b>Advanced Q&amp;A with Citation</b> An example prompt for long	 Llama 2 Chat 13B <b>Chain of thought</b> An example prompt that uses	 Jurassic-2 Ultra <b>Earnings call summarization</b> A prompt that
--	--	--	---

Run

### Model metrics

To evaluate models for task specific metrics with custom dataset visit [Model evaluation](#)

Define metric criteria

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bedrock-finetune-20240712 x Amazon Bedrock | us-west-2 x +

us-west-2.console.aws.amazon.com/bedrock/home?region=us-west-2#/chat-playground

aws Services Search [Option+S] Oregon WSParticipantRole/Participant @ 6534-0549-1536

### Select model

1. Category

Model providers

- AI21 Labs**
- Amazon
- Anthropic
- Cohere
- Meta
- Mistral AI

2. Model

Models without access (2) Request access

- Jurassic-2 Mid  
Text model | Context size = 8k
- Jurassic-2 Ultra  
Text model | Context size = 8k

3. Throughput

Select model to show throughput options.

Not seeing a model you are interested in? Check out all supported models [here](#)

Cancel Apply

Compare mode

Define metric criteria

Amazon Bedrock

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- Prompt flows [Preview](#)

bedrock-finetune-20240712 x Amazon Bedrock | us-west-2 x +

us-west-2.console.aws.amazon.com/bedrock/home?region=us-west-2#/chat-playground

aws Services Search [Option+S] Oregon WSParticipantRole/Participant @ 6534-0549-1536

### Select model

1. Category

Model providers

- AI21 Labs
- Amazon
- Anthropic**
- Cohere
- Meta
- Mistral AI

2. Model

Models with access (4)

- Claude Instant 1.2 v1.2**  
Text model | Context size = up to 100k
- Claude 2.1 v2.1**  
Text model | Context size = up to 200k
- Claude 2 v2**  
Text model | Context size = up to 100k
- Claude 3 Sonnet v1**  
Text & vision model | Context size = up to 200k

Models without access (2) Request access ↗

- Claude 3 Haiku v1**  
Text & vision model | Context size = up to 200k
- Claude 3 Opus v1**  
Text & vision model | Context size = up to 200k

3. Throughput

Select model to show throughput options.

Compare mode

Cancel Apply

Define metric criteria

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us-west-2.console.aws.amazon.com/bedrock/home?region=us-west-2#/chat-playground

Services Search [Option+S] Oregon WSParticipantRole/Participant @ 6534-0549-1536

## Select model

1. Category

Model providers

- AI21 labs AI21 Labs
- Amazon
- Anthropic**
- Cohere
- Meta
- Mistral AI

2. Model

Models with access (4)

- Claude Instant 1.2 v1.2**  
Text model | Context size = up to 100k
- Claude 2.1 v2.1**  
Text model | Context size = up to 200k
- Claude 2 v2**  
Text model | Context size = up to 100k
- Claude 3 Sonnet v1**  
Text & vision model | Context size = up to 200k

Models without access (2) Request access ↗

- Claude 3 Haiku v1**  
Text & vision model | Context size = up to 200k
- Claude 3 Opus v1**  
Text & vision model | Context size = up to 200k

3. Throughput

On-demand (ODT)

Cancel Apply

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us-west-2.console.aws.amazon.com/bedrock/home?region=us-west-2#/chat-playground?modelId=anthropic.claude-3-sonnet-20240229-v1%3A0

AWS Services Search [Option+S] | | | | | Oregon | WSParticipantRole/Participant @ 6534-0549-1536

## Amazon Bedrock < Chat playground

### Chat playground Info

**Claude 3 Sonnet v1** | ODT Change

Try one of these examples or view more examples

**Claude** Advanced Q&A with Citation An example prompt for long document Q&A

**Claude 3 Sonnet** Advanced Q&A with Citations An example prompt for long document Q&A

**Claude 3 Opus** Analyze a Quarterly Report Synthesize a long corporate annual report

Write a prompt... (Shift + ENTER to start a new line, and ENTER to generate a response) Run

Choose files

The supported file types are .csv, .doc, .docx, .html, .md, .pdf, .txt, .xls, .xlsx, .gif, .jpeg, .png, .webp. Maximum 5 files, 4.5 MB each.

### Model metrics

To evaluate models for task specific metrics with custom dataset visit [Model evaluation](#)

**Configurations** Reset

**System prompts** Add system prompts Close configurations

**Randomness and diversity** Info

Temperature: 1

Top P: 0.999

Top K: 250

Define metric criteria

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bedrock-finetune-20240712 x Amazon Bedrock | us-west-2 x +

us-west-2.console.aws.amazon.com/bedrock/home?region=us-west-2#/chat-playground?modelId=anthropic.claude-3-sonnet-20240229-v1%3A0

aws Services Search [Option+S] Oregon WSParticipantRole/Participant @ 6534-0549-1536

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**Claude 3 Sonnet v1** | ODT Change

Load examples  Compare mode :

Try one of these examples [or view more examples](#)

**Claude** Advanced Q&A with Citation An example prompt for long document Q&A supplemented by evidence and

**Claude 3 Sonnet** Advanced Q&A with Citations An example prompt for long document q&a supplemented by evidence and

**Claude 3 Opus** Analyze a Quarterly Report Synthesize a long corporate annual report into an insightful memo covering

請推薦三款台灣常見的夜市小吃。  

Choose files

The supported file types are .csv, .doc, .docx, .html, .md, .pdf, .txt, .xls, .xlsx, .gif, .jpeg, .png, .webp. Maximum 5 files, 4.5 MB each.

### Model metrics

To evaluate models for task specific metrics with custom dataset visit [Model evaluation](#)

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us-west-2.console.aws.amazon.com/bedrock/home?region=us-west-2#/chat-playground?modelId=anthropic.claude-3-sonnet-20240229-v1%3A0

aws Services Search [Option+S] Oregon WSParticipantRole/Participant @ 6534-0549-1536

## Amazon Bedrock < Chat playground

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**Claude 3 Sonnet v1** | ODT Change

Load examples  Compare mode :

Try one of these examples [or view more examples](#)

**Claude** Advanced Q&A with Citation An example prompt for long document Q&A supplemented by evidence and

**Claude 3 Sonnet** Advanced Q&A with Citations An example prompt for long document q&a supplemented by evidence and

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The supported file types are .csv, .doc, .docx, .html, .md, .pdf, .txt, .xls, .xlsx, .gif, .jpeg, .png, .webp. Maximum 5 files, 4.5 MB each.

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us-west-2.console.aws.amazon.com/bedrock/home?region=us-west-2#/chat-playground?modelId=anthropic.claude-3-sonnet-20240229-v1%3A0

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## Amazon Bedrock < Chat playground

### Chat playground Info

Load examples  Compare mode ⋮

i Change

#### Claude 3 Sonnet v1 | ODT

1. 雞排  
這是台灣最經典的夜市小吃之一。外皮酥脆，內里嫩滑多汁，醬汁香濃美味。常見的口味有原味、鹽酥雞、炸雞、黑胡椒等，適合不同的口味喜好。

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3. 蝦仔煎  
蝦仔煎是台式薄餅的一種，餡料豐富，包含蝦仔、蛋、豬肉等。麵糊外層酥脆，內餡鹹香可口，是很棒的小吃選擇。不同地區的做法和餡料組合也會有些微差異。

這三種小吃不僅價格親民，也凝聚了台灣夜市的精華與風味，值得一嚐。當然，台灣夜市的小吃選擇還有許多，每個人也會有自己的最愛。

Write a prompt... (Shift + ENTER to start a new line, and ENTER to generate a response)

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bedrock-finetune-20240712 x Amazon Bedrock | us-west-2 x taipei 101 - Google Search x +

us-west-2.console.aws.amazon.com/bedrock/home?region=us-west-2#/chat-playground?modelId=anthropic.claude-3-sonnet-20240229-v1%3A0

Services Search [Option+S] | | | | | Oregon | WSParticipantRole/Participant @ 6534-0549-1536

## Amazon Bedrock < Chat playground

### Chat playground Info

Load examples  Compare mode ⋮

#### A Claude 3 Sonnet v1 | ODT Change

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#### Model metrics Define metric criteria

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# Amazon Bedrock

Amazon Bedrock > Chat playground

## Chat playground Info

Load examples  Compare mode 

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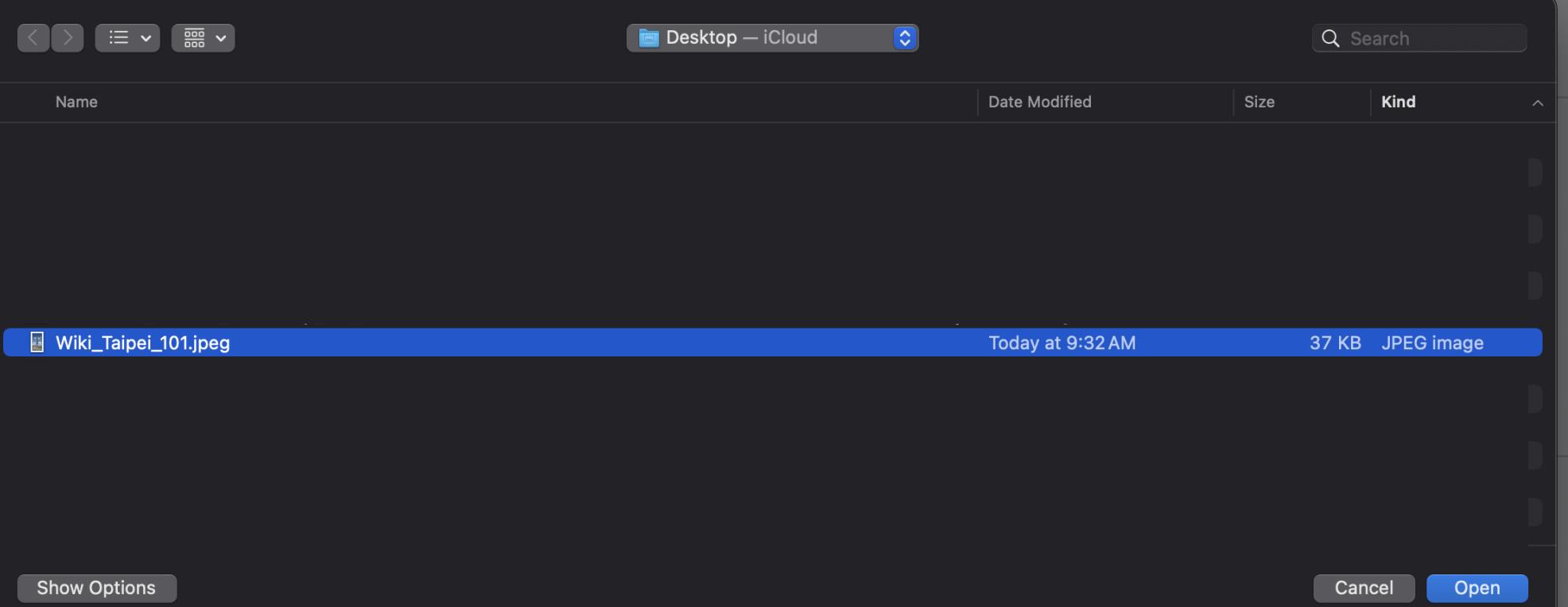
- Knowledge bases
- Agents
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- Prompt flows [Preview](#)

The supported file types are .csv, .doc, .docx, .html, .md, .pdf, .txt, .xls, .xlsx, .gif, .jpeg, .png, .webp. Maximum 5 files, 4.5 MB each.

**Model metrics** [Define metric criteria](#)

To evaluate models for task specific metrics with custom dataset visit [Model evaluation](#)

Metrics	Claude 3 Sonnet
Overall summary	<a href="#">Define metric criteria</a>

A file selection dialog is open over the main interface. It shows a list of files in 'Desktop — iCloud' folder. The file 'Wiki\_Taipei\_101.jpeg' is selected and highlighted in blue. The dialog includes a search bar, sorting columns for Name, Date Modified, Size, and Kind, and buttons for Cancel and Open.

bedrock-finetune-20240712 x Amazon Bedrock | us-west-2 x taipei 101 - Google Search x +

us-west-2.console.aws.amazon.com/bedrock/home?region=us-west-2#/chat-playground?modelId=anthropic.claude-3-sonnet-20240229-v1%3A0

Services Search [Option+S] | | | | | Oregon | WSParticipantRole/Participant @ 6534-0549-1536

## Amazon Bedrock < Chat playground

### Chat playground Info

**Claude 3 Sonnet v1 | ODT** Change

**1. 雞排**  
這是台灣最經典的夜市小吃之一。外皮酥脆，內里嫩滑多汁，醬汁香濃美味。常見的口味有原味、鹽酥雞、炸雞、黑胡椒等，適合不同的口味喜好。

**2. 臭豆腐**  
臭豆腐雖然名字聽起來不太誘人，但它實際上是台灣人最愛的小吃之一。外皮香酥，內餡綿密，蘸上辣醬風味十足。有些人喜歡加蔥蒜，也有人喜歡噴滿花生粉。

Write a prompt... (Shift + ENTER to start a new line, and ENTER to generate a response) Run

**Choose files**  
The supported file types are .csv, .doc, .docx, .html, .md, .pdf, .txt, .xls, .xlsx, .gif, .jpeg, .png, .webp. Maximum 5 files, 4.5 MB each.

Wiki\_Taipei\_101.jpeg 36.64 KB X

### Model metrics

To evaluate models for task specific metrics with custom dataset visit [Model evaluation](#)

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bedrock-finetune-20240712 x Amazon Bedrock | us-west-2 x taipei 101 - Google Search x +

us-west-2.console.aws.amazon.com/bedrock/home?region=us-west-2#/chat-playground?modelId=anthropic.claude-3-sonnet-20240229-v1%3A0

aws Services Search [Option+S] | | | | | Oregon | WSParticipantRole/Participant @ 6534-0549-1536

## Amazon Bedrock < Chat playground

### Chat playground Info

Load examples  Compare mode :

**A Claude 3 Sonnet v1 | ODT** Change

1. 雞排  
這是台灣最經典的夜市小吃之一。外皮酥脆，內里嫩滑多汁，醬汁香濃美味。常見的口味有原味、鹽酥雞、炸雞、黑胡椒等，適合不同的口味喜好。

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請敘述圖裡的景象  Run

Choose files

The supported file types are .csv, .doc, .docx, .html, .md, .pdf, .txt, .xls, .xlsx, .gif, .jpeg, .png, .webp. Maximum 5 files, 4.5 MB each.

Wiki\_Taipei\_101.jpeg

### Model metrics

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us-west-2.console.aws.amazon.com/bedrock/home?region=us-west-2#/chat-playground?modelId=anthropic.claude-3-sonnet-20240229-v1%3A0

Services Search [Option+S] Oregon WSParticipantRole/Participant @ 6534-0549-1536

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## Chat playground

### Claude 3 Sonnet v1 | ODT

Change

請敘述圖裡的景象

Wiki\_Taipei\_101.jpeg

這張圖片展示了台北市的著名地標建築物 - 台北 101 大樓。它是一座摩天大樓，外觀採用現代風格設計，以玻璃和鋼材構建而成。大樓擁有壯觀的高度，從圖中可以看到它挺拔地矗立在城市上空，遠遠超過周圍的其他建築物。大樓頂端有一個巨大的尖頂式天線。圖像清晰地捕捉了藍天和白雲作為背景，使這座標誌性的高樓更加耀眼。周圍是密集的都市建築群，反映出台北作為台灣最繁華大都市的景象。整體來說，這是一幅展現台北 101 大樓雄偉壯觀的都市風光畫面。

Write a prompt... (Shift + ENTER to start a new line, and ENTER to generate a response)

Run

Choose files

The supported file types are .csv, .doc, .docx, .html, .md, .pdf, .txt, .xls, .xlsx, .gif, .jpeg, .png, .webp. Maximum 5 files, 4.5 MB each.

### Model metrics

To evaluate models for task specific metrics with custom dataset visit [Model evaluation](#)

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<https://ppt.cc/f23sWx>



## Amazon Bedrock Workshop (Chinese Version)



實驗環境設定

[NEW]最新特性

### 核心功能實驗

#### 常見場景

##### 文本生成

翻譯

事實問答

小說續寫

角色扮演

RAG 場景

程式碼輔助

客服案例分類

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#### 圖片解析

IPC 圖片分析

物品辨識和計數

多模態能力

#### Content preferences

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中文(繁體) ▾

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- 事實問答
- 小說續寫
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Search results for 'sagemaker'

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### Amazon SageMaker



Build, Train, and Deploy Machine Learning Models

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### SageMaker Studio

Amazon SageMaker feature

### Notebooks

IoT Analytics feature

### Autopilot

Amazon SageMaker feature

### SageMaker Canvas

Amazon SageMaker feature

## Resources / for a focused search



### Introducing resource search

To search for resources, Resource Explorer must be active in at least one AWS Region and you must have permission to use the default view in the account. [Learn more](#)

[Define metric criteria](#)

Overall summary

[Define metric criteria](#)

bedrock-finetune-20240712 x Amazon SageMaker | us-west x taipei 101 - Google Search x +

us-west-2.console.aws.amazon.com/sagemaker/home?region=us-west-2#/studio

aws Services Search [Option+S] Oregon WSParticipantRole/Participant @ 6534-0549-1536

Amazon SageMaker X Learn more X

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Automatic Domain Migration

If you have existing Studio Classic domains, they will be automatically migrated to the new Studio experience starting June 2024. The new Studio experience provides better speed, efficiency, and productivity.

Amazon SageMaker > Domains

## Domains Info

In SageMaker, a domain is an environment for your team to access SageMaker resources. A domain consists of a list of authorized users and users within a domain can share notebook files and other artifacts with each other. One account can have either one or multiple domains.

Domains (1) <small>Info</small>				
<input type="text"/> Find domain name				
Name	Id	Status	Created on	Modified on
amazon-bedrock-workshop	d-noqxdjm0rbmm	<input checked="" type="checkbox"/> InService	Jul 12, 2024 02:28 UTC	Jul 12, 2024 02:31 UTC

**Create domain**

SageMaker Studio | Amazon S SageMaker Studio | Amazon S taipei 101 - Google Search

us-west-2.console.aws.amazon.com/sagemaker/home?region=us-west-2#/studio-landing

AWS Services Search [Option+S] Oregon WSParticipantRole/Participant @ 6534-0549-1536

Amazon SageMaker

Automatic Domain Migration

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Learn more

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SageMaker dashboard

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JumpStart

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Amazon SageMaker

**SageMaker Studio**

The first fully integrated development environment (IDE) for machine learning.

Get Started

Select user profile

sagemakeruser

Open Studio

How it works

What is Studio?

Amazon SageMaker Studio provides a single, web-based visual interface where you can perform all ML development steps, improving data science team

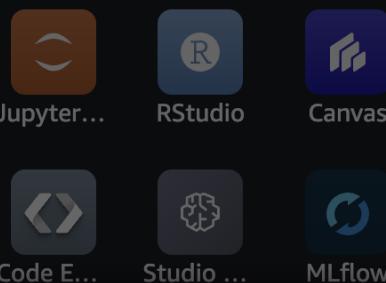
Pricing (US)

With Amazon SageMaker Studio, you pay only for





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## Onboarding

To get the most ou



Take the t

Quick tour high  
the new experie  
to be productiv

[Take the tour >](#)

Not ready to use th

Welcome to the new  
SageMaker Studio

We've built a new experience to empower you and your work.

Want to take a quick tour?

[Skip Tour for now](#)

[Take a quick tour](#)

Are you an existing Studio Classic user and looking to migrate  
your data and notebooks? Click here to learn how.

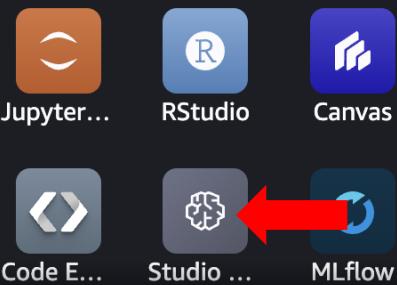
## Overview

Start a new ML wor





## Applications (6)

[Home](#)[Running instances](#)[Data](#)[Auto ML](#)[Experiments](#)[Jobs](#)[Pipelines](#)[Models](#)[JumpStart](#)[Deployments](#)[Collapse Menu](#)

## Home

Launch workflows, manage your applications and spaces, and view getting started materials

## Onboarding plan

To get the most out of the new Studio experience, explore the onboarding steps below.



## Take the tour

Quick tour highlights where you can find key features and how to navigate the new experience. See what's new and where to locate the tools you need to be productive.

[Take the tour >](#)

## Migrate data and notebooks

Bring your previous work into the new experience. Transfer notebooks, data sources, and other artifacts so they remain accessible as you adopt the new environment.

[Learn more ↗](#)

Not ready to use the new experience? Revert to Studio Classic experience in domain settings. [Learn more ↗](#)

[Overview](#)[Getting started](#)

## Overview

Start a new ML workflow or jump back into your workflow





Applications (6)

- JupyterLab
- RStudio
- Canvas
- Code Editor
- Studio Cl...
- MLflow

[Home](#)[Running instances](#)[Data](#)[Auto ML](#)[Experiments](#)[Jobs](#)[Pipelines](#)[Models](#)[JumpStart](#)[Deployments](#)[Collapse Menu](#)

# SageMaker Studio Classic

[+ Create Studio Classic space](#)

## About

Studio Classic is a legacy IDE that allows you to access the previous iteration of SageMaker Studio from within the new Studio experience.

[See features ↗](#) | [Learn more about Studio Classic ↗](#) Search...Filter spaces: 

Name	Application	Status	Type	Last modified	Action
sagemakeruser	Studio Classic	Stopped	Private	0 seconds ago	<input type="button" value="Run"/>

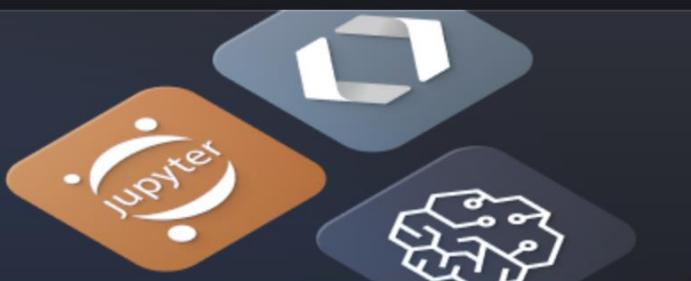
1 results

Results are cached

Page 1 of 1 &lt; &gt;

## Introducing spaces New

JupyterLab and Code Editor now come with durable instances that allow for faster startup, privacy options, and configurable storage.

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Applications (6)

- JupyterLab
- RStudio
- Canvas
- Code E...
- Studio ...
- MLflow

Studio Classic

[Home](#)[Running instances](#)[Data](#)[Auto ML](#)[Experiments](#)[Jobs](#)[Pipelines](#)[Models](#)[JumpStart](#)[Deployments](#)[Collapse Menu](#)

# SageMaker Studio Classic

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[See features ↗](#) | [Learn more about Studio Classic ↗](#) Search...Filter spaces: 

Name	Application	Status	Type	Last modified	Action
sagemakeruser	Studio Classic	Running	Private	15 seconds ago	<input type="button" value="Stop"/> <input style="background-color: #0072BD; color: white; border: none; border-radius: 4px; padding: 2px 10px; font-weight: bold; text-decoration: none; width: 100px; height: 30px; margin-left: 10px;" type="button" value="Open ↗"/>

1 results

Results are cached

Refresh

Go to page 1

Page 1 of 1 &lt; &gt;

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JupyterLab and Code Editor now come with durable instances that allow for faster startup, privacy options, and configurable storage.

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Home X



# Home

Customize layout

Quick actions



Open Launcher 

Create notebooks and other resources



Import & prepare data visually



Open the Getting Started notebook



Read documentation



View guided tutorials

Prebuilt and automated solutions

Deploy built-in algorithms, pre-built solutions, example notebooks, and build models from visual interface.



JumpStart

Pretrained models, notebooks, and prebuilt solutions



AutoML

Automatically build, train, and tune the best ML models

Workflows and tasks

Kick off a new step in the machine learning workflow.

Prepare data

- Connect to data sources

Build, train, tune model

- View all experiments

Deploy model

- Get endpoint recommendation



Home



Launcher

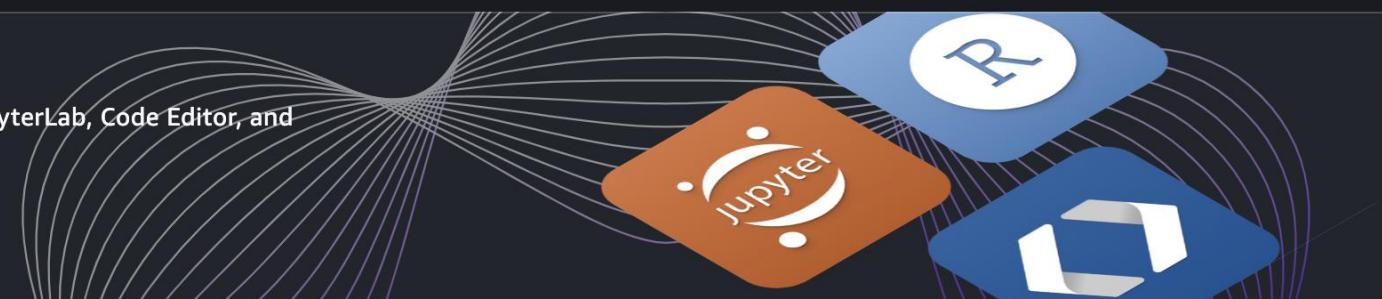


# Launcher

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## Notebooks and compute resources

Create notebooks, code console, image terminal with custom environment in the active folder.



Image  
Data Science 3.0

Kernel  
Python 3

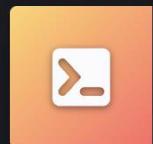
Instance  
ml.t3.medium

Start-up script  
No script

[Change environment](#)



Create notebook



Open code console



Open image terminal

[Learn more about SageMaker images and how to customize compute environment](#)



## Utilities and files

Simple

1 \$ 0



Cookie Preferences

Launcher 0





Home



Launcher



## Notebooks and compute resources

Create notebooks, code console, image terminal with custom environment in the active folder.

Image  
Data Science 3.0

Kernel  
Python 3

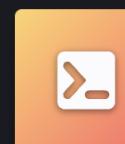
Instance  
ml.t3.medium

Start-up script  
No script

Change environment



Create notebook



Open code console



Open image terminal

Learn more about SageMaker images and how to customize compute environment [↗](#)

## Utilities and files



System terminal



Text file



Markdown file



Python file



Notebook jobs



Contextual help



CHANGED A FEW SECONDS AGO



Subscribed

0

Expand all

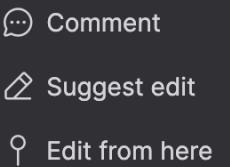
Back to top

Go to bottom

## 20240724 Foundation Model Fine-Tuning Workshop

Workshop Login: <https://catalog.us-east-1.prod.workshops.aws/join?access-code=9f1a-08aef8-75>

Workshop Instructions: <https://1.prod.workshops.aws/workshops/model-customization>



(if missing notebooks) In SageMaker Studio, under terminal mode: `git clone https://github.com/aws-samples/amazon-bedrock-workshop`

Lab 3 Bedrock SDK News summary with Llama 2. Github: [https://github.com/aws-samples/amazon-bedrock-workshop/tree/main/03\\_Model\\_customization](https://github.com/aws-samples/amazon-bedrock-workshop/tree/main/03_Model_customization)

Lab 4 Bedrock SDK Image generation with Titan Image Generator. Github: <https://github.com/aws-samples/amazon-bedrock-samples/tree/main/bedrock-finetuning/amazon-titan-image-generator>

Lab 6 SageMaker JumpStart with Llama 3. Github: [https://github.com/aws/amazon-sagemaker-examples/blob/main/introduction\\_to\\_amazon\\_algorithms/jumpstart-foundation-models/llama-3-finetuning.ipynb](https://github.com/aws/amazon-sagemaker-examples/blob/main/introduction_to_amazon_algorithms/jumpstart-foundation-models/llama-3-finetuning.ipynb)

Workshop Artifacts:

[https://github.com/michlin0825/20240724\\_Foundation\\_Model\\_Finetuning\\_Workshop](https://github.com/michlin0825/20240724_Foundation_Model_Finetuning_Workshop)

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Amazon SageMaker Studio Classic

File Edit View Run Kernel Git Tabs Settings Help

SageMakerUser / Personal Studio

Home Launcher Terminal 3

!!!!!! Welcome to SageMaker Studio System Terminal !!!!!!!

Below are some useful tips:

- \* Activate studio conda environment using "conda activate studio" to install extensions, list extension etc. For more information, see <https://docs.aws.amazon.com/sagemaker/latest/dg/studio-jl.html#studio-jl-install>
- \* Post JupyterServer extension installation, if needed, restart just the server(not app) using "restart-jupyter-server"

```
sagemaker-user@studio$ git clone https://github.com/aws-samples/amazon-bedrock-workshop
```

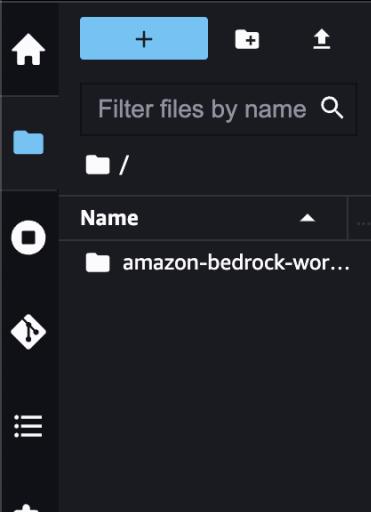
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Home X Launcher X Terminal 3 X

!!!!!! Welcome to SageMaker Studio System Terminal !!!!!!!

Below are some useful tips:

\* Activate studio conda environment using "conda activate studio" to install extensions, list extension etc. For more information, see <https://docs.aws.amazon.com/sagemaker/latest/dg/studio-jl.html#studio-jl-install>

\* Post JupyterServer extension installation, if needed, restart just the server(not app) using "restart-jupyter-server"

```
sagemaker-user@studio$ git clone https://github.com/aws-samples/amazon-bedrock-workshop
Cloning into 'amazon-bedrock-workshop'...
remote: Enumerating objects: 2761, done.
remote: Counting objects: 100% (1835/1835), done.
remote: Compressing objects: 100% (510/510), done.
remote: Total 2761 (delta 1492), reused 1496 (delta 1321), pack-reused 926
Receiving objects: 100% (2761/2761), 28.97 MiB | 23.18 MiB/s, done.
Resolving deltas: 100% (1850/1850), done.
Updating files: 100% (161/161), done.
sagemaker-user@studio$
```

# Workshop Setup

- Workshop Access
- Bedrock Model Access
- Bedrock Playground Test-Drive
- SageMaker Studio Access
- Bedrock API Test-Drive

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Launcher

+

Filter files by name

/ amazon-bedrock-workshop /

Name

00\_Prerequisites (highlighted with a red arrow)

01\_Text\_generation

02\_KnowledgeBases

03\_Model\_customization

04\_Image\_and\_Multimodal

05\_Agents

06\_OpenSource\_examples

imgs

CODE\_OF\_CONDUCT.md

CONTRIBUTING.md

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RELEASE\_NOTES.md

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R

Jupyter

Notebooks and compute resources

Create notebooks, code console, image terminal with custom environment in the active folder.

/amazon-bedrock-workshop

Image: Data Science 3.0

Kernel: Python 3

Instance: ml.t3.medium

Start-up script: No script

Change environment

Create notebook

Open code console

Open image terminal

Utilities and files

Simple main

Cookie Preferences Launcher 0

Learn more about SageMaker images and how to customize compute environment

Utilities and files

File Explorer sidebar showing the file structure:

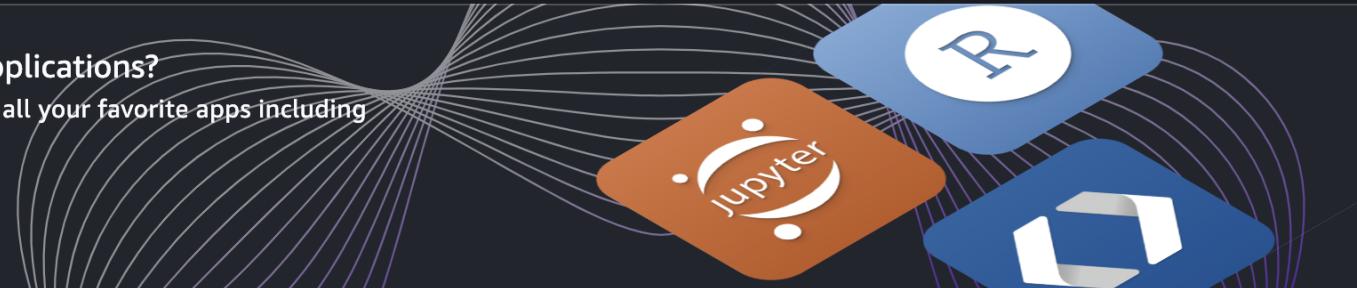
- amazon-bedrock-workshop / 00\_Prerequisites /
- Name
  - bedrock\_basics.ipynb
  - Getting\_started\_with\_Converse...
  - README.md

A red arrow points to the "bedrock\_basics.ipynb" file.

## Launcher

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### Notebooks and compute resources

Create notebooks, code console, image terminal with custom environment in the active folder. [/amazon-bedrock-workshop/00\\_Prerequisites](#)

Image Data Science 3.0	Kernel Python 3	Instance ml.t3.medium	Start-up script No script	<a href="#">Change environment</a>
---------------------------	--------------------	--------------------------	------------------------------	------------------------------------

[!\[\]\(15be4fb55d1fc4d55df2a1eacd08a618\_img.jpg\) Create notebook](#)   [!\[\]\(14ea59c714831ff0e0880dcbf87dadfd\_img.jpg\) Open code console](#)   [!\[\]\(35e3fbb32b3df64114a93b803c218b8e\_img.jpg\) Open image terminal](#)

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Launcher bedrock\_basics.ipynb

No Kernel Share

Filter files by name

/ amazon-bedrock-workshop / 00\_Prerequisites /

Name

- bedrock\_basics.ipynb
- Getting\_started\_with\_Converse...
- README.md

Amazon Bedrock boto3 Prerequisites

This notebook should work well with the Data Science 3.0 kernel in SageMaker Studio.

Set up notebook environment

In this demo

Set up environment for "bedrock\_basics.ipynb".

Image: Data Science 3.0

Kernel: Python 3

Instance type: ml.t3.medium

Start-up script: No script

Cancel Select

Prerequisites

Run the cells below to set up the environment. You may see pip dependency errors; you can safely ignore these errors.

IGNORE ERRORS: If you see errors, run the cells above again. This behaviour is the source of the following dependency errors.

[ ]: %pip install "boto3" "awscli" "botocore" --upgrade

Bedrock Foundation Models.

You will see pip dependency errors, you can safely ignore them.

at are installed. This behaviour is the source of the following dependency errors.

Create the boto3 client



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Amazon SageMaker Studio Classic

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Launcher bedrock\_basics.ipynb

No Kernel Share

Filter files by name

/ amazon-bedrock-workshop / 00\_Prerequisites /

Name

- bedrock\_basics.ipynb
- Getting\_started\_with\_Converse...
- README.md

Amazon Bedrock boto3 Prerequisites

This notebook should work well with the Data Science 3.0 kernel in SageMaker Studio.

Set up notebook environment

In this demo

Set up environment for "bedrock\_basics.ipynb".

Image: Data Science 3.0

Kernel: Python 3

Instance type: ml.c5.xlarge

Start-up script: No script

Cancel Select

Prerequisites

Run the cells below to set up the environment. You may see pip dependency errors; you can safely ignore these errors.

IGNORE ERRORS: If you see errors, run the cells above to set up the environment. You may see pip dependency errors; you can safely ignore these errors.

following dependencies will be installed. This behaviour is the source of the errors.

```
[ ]: %pip install "boto3" "awscli" "botocore" --upgrade
```

Create the boto3 client

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Amazon SageMaker Studio Classic File Edit View Run Kernel Git Tabs Settings Help sagemakeruser / Personal Studio

Launcher bedrock\_basics.ipynb

+ X Markdown \$ git Cluster Data Science 3.0 Python 3 4 vCPU + 8 GiB Share

## Amazon Bedrock boto3 Prerequisites

This notebook should work well with the **Data Science 3.0** kernel in SageMaker Studio

In this demo notebook, we demonstrate how to use the `boto3` Python SDK to work with Amazon Bedrock Foundation Models.

## Prerequisites

Run the cells in this section to install the packages needed by the notebooks in this workshop. **⚠️** You will see pip dependency errors, you can safely ignore these errors. **⚠️**

IGNORE ERROR: pip's dependency resolver does not currently take into account all the packages that are installed. This behaviour is the source of the following dependency conflicts.

```
[ ]: %pip install --no-build-isolation --force-reinstall \
    "boto3>=1.28.57" \
    "awscli>=1.29.57" \
    "botocore>=1.31.57"
```

## Create the boto3 client

Interaction with the Bedrock API is done via the AWS SDK for Python: `boto3`.

Amazon SageMaker Studio Classic

File Edit View Run Kernel Git Tabs Settings Help

sagemakeruser / Personal Studio

# Amazon Bedrock boto3 Prerequisites

This notebook should work well with the **Data Science 3.0** kernel in SageMaker Studio

In this demo notebook, we demonstrate how to use the `boto3` Python SDK to work with Amazon Bedrock Foundation Models.

## Prerequisites

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IGNORE ERROR: pip's dependency resolver does not currently take into account all the packages that are installed. This behaviour is the source of the following dependency conflicts.

```
[2]: %pip install --no-build-isolation --force-reinstall \
    "boto3>=1.28.57" \
    "awscli>=1.29.57" \
    "botocore>=1.31.57"
```

```
Collecting boto3>=1.28.57
  Downloading boto3-1.34.144-py3-none-any.whl.metadata (6.6 kB)
Collecting awscli>=1.29.57
  Downloading awscli-1.33.26-py3-none-any.whl.metadata (11 kB)
Collecting botocore>=1.31.57
  Downloading botocore-1.34.144-py3-none-any.whl.metadata (5.7 kB)
Collecting jmespath<2.0.0,>=0.7.1 (from boto3>=1.28.57)
  Downloading jmespath-1.0.1-py3-none-any.whl.metadata (7.6 kB)
Collecting s3transfer<0.11.0,>=0.10.0 (from boto3>=1.28.57)
  Downloading s3transfer-0.10.2-py3-none-any.whl.metadata (1.7 kB)
Collecting docutils<0.17,>=0.10 (from awscli>=1.29.57)
```

Amazon SageMaker Studio Classic File Edit View Run Kernel Git Tabs Settings Help

Launcher bedrock\_basics.ipynb

Cluster Data Science 3.0 | Python 3 | 4 vCPU + 8 GiB Share

+

Filter files by name

/ amazon-bedrock-workshop / 00\_Prerequisites /

Name

bedrock\_basics.ipynb

Getting\_started\_with\_Converse...

README.md

## Create the boto3 client

Interaction with the Bedrock API is done via the AWS SDK for Python: `boto3`.

### Use different clients

The `boto3` provides different clients for Amazon Bedrock to perform different actions. The actions for `InvokeModel` and `InvokeModelWithResponseStream` are supported by Amazon Bedrock Runtime whereas other operations, such as `ListFoundationModels`, are handled via Amazon Bedrock client.

### Use the default credential chain

If you are running this notebook from Amazon Sagemaker Studio and your Sagemaker Studio execution role has permissions to access Bedrock you can just run the cells below as-is. This is also the case if you are running these notebooks from a computer whose default AWS credentials have access to Bedrock.

```
[3]: import json
import os
import sys

import boto3

boto3_bedrock = boto3.client('bedrock')
```

### Validate the connection

We can check the client works by trying out the `list.foundation_models()` method, which will tell us all the models available for us to use

```
[4]: [model['modelId'] for model in boto3_bedrock.list.foundation_models()['modelSummaries']]
```

```
[4]: ['amazon.titan-tg1-large',
      'amazon.titan-embed-g1-text-02',
```

Amazon SageMaker Studio Classic File Edit View Run Kernel Git Tabs Settings Help

Launcher bedrock\_basics.ipynb

Filter files by name

/ amazon-bedrock-workshop / 00\_Prerequisites /

Name

- bedrock\_basics.ipynb
- Getting\_started\_with\_Converse...
- README.md

## InvokeModel body and output

The `invoke_model()` method of the Amazon Bedrock runtime client (`InvokeModel` API) will be the primary method we use for most of our Text Generation and Processing tasks - whichever model we're using.

Although the method is shared, the format of input and output varies depending on the foundation model used - as described below:

### Amazon Titan Large and Premier

#### Input

```
{  
    "inputText": "<prompt>",  
    "textGenerationConfig" : {  
        "maxTokenCount": 512,  
        "stopSequences": [],  
        "temperature": 0.1,  
        "topP": 0.9  
    }  
}
```

#### Output

```
{  
    "inputTextTokenCount": 613,  
    "results": [  
        {"tokenCount": 219,  
        "outputText": "<output>"  
    ]  
}
```

Amazon SageMaker Studio Classic File Edit View Run Kernel Git Tabs Settings Help

Launcher bedrock\_basics.ipynb Cluster Data Science 3.0 | Python 3 | 4 vCPU + 8 GiB Share

**Anthropic Claude**

**Input**

```
{  
    "prompt": "\n\nHuman:<prompt>\n\nAnswer:",  
    "max_tokens_to_sample": 300,  
    "temperature": 0.5,  
    "top_k": 250,  
    "top_p": 1,  
    "stop_sequences": ["\n\nHuman:"]  
}
```

**Output**

```
{  
    "completion": "<output>",  
    "stop_reason": "stop_sequence"  
}
```

**Stability AI Stable Diffusion XL**

**Input**

```
{  
    "text_prompts": [  
        {"text": "this is where you place your input text"}  
    ],  
    "cfg_scale": 10,  
    "seed": 0,  
    "steps": 50  
}
```

+    X    C

Filter files by name

/ amazon-bedrock-workshop / 00\_Prerequisites /

Name

- bedrock\_basics.ipynb
- Getting\_started\_with\_Converse...
- README.md

## Common inference parameter definitions

### Randomness and Diversity

Foundation models generally support the following parameters to control randomness and diversity in the response.

**Temperature** – Large language models use probability to construct the words in a sequence. For any given next word, there is a probability distribution of options for the next word in the sequence. When you set the temperature closer to zero, the model tends to select the higher-probability words. When you set the temperature further away from zero, the model may select a lower-probability word.

In technical terms, the temperature modulates the probability density function for the next tokens, implementing the temperature sampling technique. This parameter can deepen or flatten the density function curve. A lower value results in a steeper curve with more deterministic responses, and a higher value results in a flatter curve with more random responses.

**Top K** – Temperature defines the probability distribution of potential words, and Top K defines the cut off where the model no longer selects the words. For example, if K=50, the model selects from 50 of the most probable words that could be next in a given sequence. This reduces the probability that an unusual word gets selected next in a sequence. In technical terms, Top K is the number of the highest-probability vocabulary tokens to keep for Top- K-filtering - This limits the distribution of probable tokens, so the model chooses one of the highest- probability tokens.

**Top P** – Top P defines a cut off based on the sum of probabilities of the potential choices. If you set Top P below 1.0, the model considers the most probable options and ignores less probable ones. Top P is similar to Top K, but instead of capping the number of choices, it caps choices based on the sum of their probabilities. For the example prompt "I hear the hoof beats of , " you may want the model to provide "horses," "zebras" or "unicorns" as the next word. If you set the temperature to its maximum, without capping Top K or Top P, you increase the probability of getting unusual results such as "unicorns." If you set the temperature to 0, you increase the probability of "horses." If you set a high temperature and set Top K or Top P to the maximum, you increase the probability of "horses" or "zebras," and decrease the probability of "unicorns."

### Length

The following parameters control the length of the generated response.

**Response length** – Configures the minimum and maximum number of tokens to use in the generated response.

**Length penalty** – Length penalty optimizes the model to be more concise in its output by penalizing longer responses. Length penalty differs from response

Amazon SageMaker Studio Classic File Edit View Run Kernel Git Tabs Settings Help

Launcher bedrock\_basics.ipynb

Cluster Data Science 3.0 | Python 3 | 4 vCPU + 8 GiB Share

Try out the models

With some theory out of the way, let's see the models in action! Run the cells below to see basic, synchronous example invocations for each model:

```
[5]: import boto3
import botocore
import json

bedrock_runtime = boto3.client('bedrock-runtime')
```

## Amazon Titan Text Premier

```
[6]: # If you'd like to try your own prompt, edit this parameter!
prompt_data = """Command: Write me a blog about making strong business decisions as a leader.

Blog:
"""
```

Next, we will construct the body with the `prompt_data` above, and add a optional parameters like `topP` and `temperature`:

```
[7]: try:

    body = json.dumps({"inputText": prompt_data, "textGenerationConfig" : {"topP":0.95, "temperature":0.2}})
    modelId = "amazon.titan-tg1-large" #
    accept = "application/json"
    contentType = "application/json"

    response = bedrock_runtime.invoke_model(
        body=body, modelId=modelId, accept=accept, contentType=contentType
    )
    response_body = json.loads(response.get("body").read())
```

Amazon SageMaker Studio Classic File Edit View Run Kernel Git Tabs Settings Help

Launcher bedrock\_basics.ipynb

As a leader, making strong business decisions is crucial for the success of your organization. Here are some key factors to consider when making business decisions:

Define your goals and objectives: Clearly define what you want to achieve as a leader and for your organization. This will help you make decisions that are aligned with your vision and mission.

Gather relevant information: Collect and analyze relevant information about the situation, market, industry, and your competitors. This will help you make informed decisions that are based on facts and data.

Consider multiple perspectives: Seek input and perspectives from your team, stakeholders, and experts in the field

## Anthropic Claude

```
[8]: # If you'd like to try your own prompt, edit this parameter!
prompt_data = """Human: Write me a blog about making strong business decisions as a leader.

Assistant:
"""
```

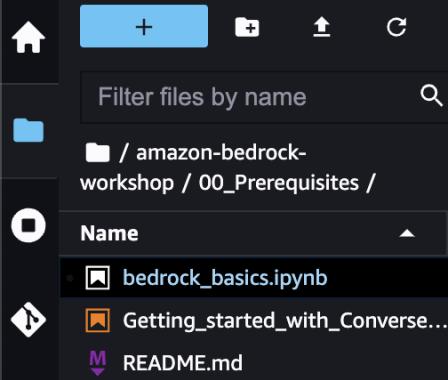
```
[9]: body = json.dumps({"prompt": prompt_data, "max_tokens_to_sample": 500})
modelId = "anthropic.claude-instant-v1" # change this to use a different version from the model provider
accept = "application/json"
contentType = "application/json"

try:

    response = bedrock_runtime.invoke_model(
        body=body, modelId=modelId, accept=accept, contentType=contentType
    )
    response_body = json.loads(response.get("body").read())

    print(response_body.get("completion"))

except botocore.exceptions.ClientError as error:
```



Launcher bedrock\_basics.ipynb

## Anthropic Claude

```
[8]: # If you'd like to try your own prompt, edit this parameter!
prompt_data = """Human: Write me a blog about making strong business decisions as a leader.

Assistant:
"""

[9]: body = json.dumps({"prompt": prompt_data, "max_tokens_to_sample": 500})
modelId = "anthropic.claude-instant-v1" # change this to use a different version from the model provider
accept = "application/json"
contentType = "application/json"

try:

    response = bedrock_runtime.invoke_model(
        body=body, modelId=modelId, accept=accept, contentType=contentType
    )
    response_body = json.loads(response.get("body").read())

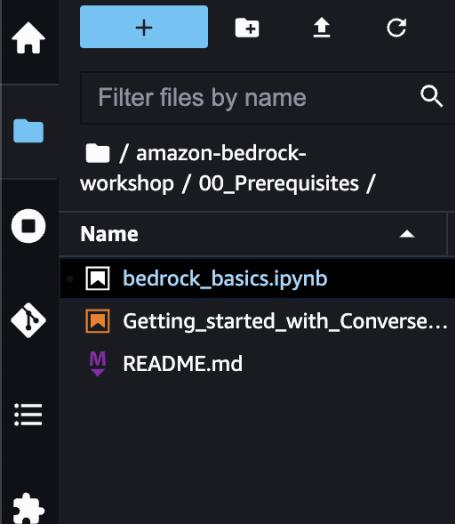
    print(response_body.get("completion"))

except botocore.exceptions.ClientError as error:

    if error.response['Error']['Code'] == 'AccessDeniedException':
        print(f"\x1b[41m{error.response['Error']['Message']}\\nTo troubleshoot this issue please refer to the following resources.\\nhttps://docs.aws.amazon.com/IAM/latest/UserGuide/troubleshoot_access-denied.html\\nhttps://docs.aws.amazon.com/bedrock/latest/userguide/security-iam.html\x1b[0m\\n")

    else:
        raise error

Here is a draft blog post on making strong business decisions as a leader:
## How to Make Strong Business Decisions as a Leader
```



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Here is a draft blog post on making strong business decisions as a leader:

```
## How to Make Strong Business Decisions as a Leader
```

As a leader, one of your most important responsibilities is making strategic decisions that will move your business in the right direction. However, decision-making can also be one of the most difficult parts of being a leader. There are so many factors to consider and potential risks involved with any choice.

The key is making decisions thoughtfully and deliberately through a structured process. Here are some tips for making strong, impactful choices as the leader of your organization:

**\*\*Gather comprehensive data and insights.\*\*** Before committing to a course of action, take time to research the issue from all angles. Look at trends in your industry, get customer and employee feedback, analyze financial reports and key metrics. Having a full picture will help you make an informed call.

**\*\*Consult your team.\*\*** Run ideas by your direct reports and get input from different departments. Leveraging diverse perspectives prevents blind spots and groupthink. Explain the rationale for various options to get others invested in the outcome as well.

**\*\*Consider short and long-term consequences.\*\*** Think through how a decision might impact goals over the next year but also farther down the road. The best choices are strategic moves that set your business up for sustained success, not just a quick win.

**\*\*Establish decision criteria in advance.\*\*** Determine what factors really matter most – like profitability, risk level, alignment with strategy, etc. Then rate each option against the criteria to identify the most advantageous path objectively.

**\*\*Trust your gut at the right time.\*\*** While data and logic should steer most choices, sometimes relying on your instincts can uncover innovative solutions. Experience and expertise provide innate wisdom to supplement analytical frameworks.

**\*\*Communicate decisions clearly and promptly.\*\*** Explain the rationale you followed to key stakeholders. Get their support carrying out the plan by sharing responsibilities and next steps. Delaying announcements breeds uncertainty – people respect leaders who make prompt calls.

By grounding moves in comprehensive research, wisely balancing logic and intuition, and getting buy-in from others, leaders can establish a reputation for smart decision-making that moves the needle for the business in a sustainable way. Staying disciplined in this process will serve you well over the long haul.

## Stability Stable Diffusion XL

```
[10]: prompt_data = "a landscape with trees"
body = json.dumps({}
```

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**[+]**

picture will help you make an informed call.

Insert a cell below (B) our team.\*\* Run ideas by your direct reports and get input from different departments. Leveraging diverse perspectives prevents blind spots and groupthink. Explain the rationale for various options to get others invested in the outcome as well.

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## Stability Stable Diffusion XL

```
[10]: prompt_data = "a landscape with trees"
body = json.dumps({
    "text_prompts": [{"text": prompt_data}],
    "cfg_scale": 10,
    "seed": 20,
    "steps": 50
})
modelId = "stability.stable-diffusion-xl-v1"
accept = "application/json"
contentType = "application/json"

try:
```

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\*\*Trust your gut at the right time.\*\* While data and logic should steer most choices, sometimes relying on your instincts can uncover innovative solutions. Experience and expertise provide innate wisdom to supplement analytical frameworks.

\*\*Communicate decisions clearly and promptly.\*\* Explain the rationale you followed to key stakeholders. Get their support carrying out the plan by sharing responsibilities and next steps. Delaying announcements breeds uncertainty – people respect leaders who make prompt calls.

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```
[ ]:
```

```
[ ]: # If you'd like to try your own prompt, edit this parameter!
prompt_data = """Human: Write me a blog about making strong business decisions as a leader. ←
Assistant:
"""
```

```
[ ]: body = json.dumps({"prompt": prompt_data, "max_tokens_to_sample": 500})
modelId = "anthropic.claude-instant-v1" # change this to use a different version from the model provider
accept = "application/json"
contentType = "application/json"

try:

    response = bedrock_runtime.invoke_model(
        body=body, modelId=modelId, accept=accept, contentType=contentType
    )
    response_body = json.loads(response.get("body").read())

    print(response_body.get("completion"))

except botocore.exceptions.ClientError as error:

    if error.response['Error']['Code'] == 'AccessDeniedException':
```

```
[ ]: # If you'd like to try your own prompt, edit this parameter!
prompt_data = """Human: 請寫一篇關於到動物園旅遊的作文。500字為限。通俗易懂。"""
Assistant:
"""

[ ]: body = json.dumps({"prompt": prompt_data, "max_tokens_to_sample": 500})
modelId = "anthropic.claude-instant-v1" # change this to use a different version from the model provider
accept = "application/json"
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except botocore.exceptions.ClientError as error:
    if error.response['Error']['Code'] == 'AccessDeniedException':
        print(f"\x1b[41m{error.response['Error']['Message']}\\nTo troubleshoot this issue please refer to the following resources.\\nhttps://docs.aws.amazon.com/IAM/latest/UserGuide/troubleshoot_access-denied.html\\nhttps://docs.aws.amazon.com/bedrock/latest/userguide/security-iam.html\x1b[0m\\n")
    else:
        raise error

[ ]:
```

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- bedrock\_basics.ipynb
- Getting\_started\_with\_Converse...
- README.md

```
        )
response_body = json.loads(response.get("body").read())

print(response_body.get("completion"))

except botocore.exceptions.ClientError as error:

    if error.response['Error']['Code'] == 'AccessDeniedException':
        print(f"\x1b[41m{error.response['Error']['Message']}\\nTo troubleshoot this issue please refer to the following resources.\\nhttps://docs.aws.amazon.com/IAM/latest/UserGuide/troubleshoot_access-denied.html\\nhttps://docs.aws.amazon.com/bedrock/latest/userguide/security-iam.html\x1b[0m\\n")

    else:
        raise error
```

到動物園的一天

上周六，我乘車和家人一起去了附近的動物園。出發前我們研究了一下動物園的地圖，劃定好要先看哪些動物區。

到達動物園後，我們先看了獅子區。幾隻大獅子正躺在陽光下打盹，看起來很懶洋洋的。接著我們去了猩猩區，那裡有幾隻猩猩在樹枝間跳躍，動作非常活潑。看到牠們用手指抓東西吃的樣子，我還以為牠們在玩耍。

中午時我們去了附近的小餐廳，吃過飯後繼續參觀。下午我最喜歡看的就是海豹表演了。海豹在水中游來游去，還會應聲做出各種動作，看起來很聰明。除此之外，我也第一次看到鼴狗和短吻鱷，牠們的外表真的很奇特。

一天很快就過去了。回家的路上，我們分享看見的動物，並討論下次還要去看哪些動物。這次在動物園的旅行，讓我更加了解不同動物，也玩得很開心。我希望下次能再去動物園，繼續發現更多新奇的動物。

[ ]:

[ ]:

[ ]:

[ ]:

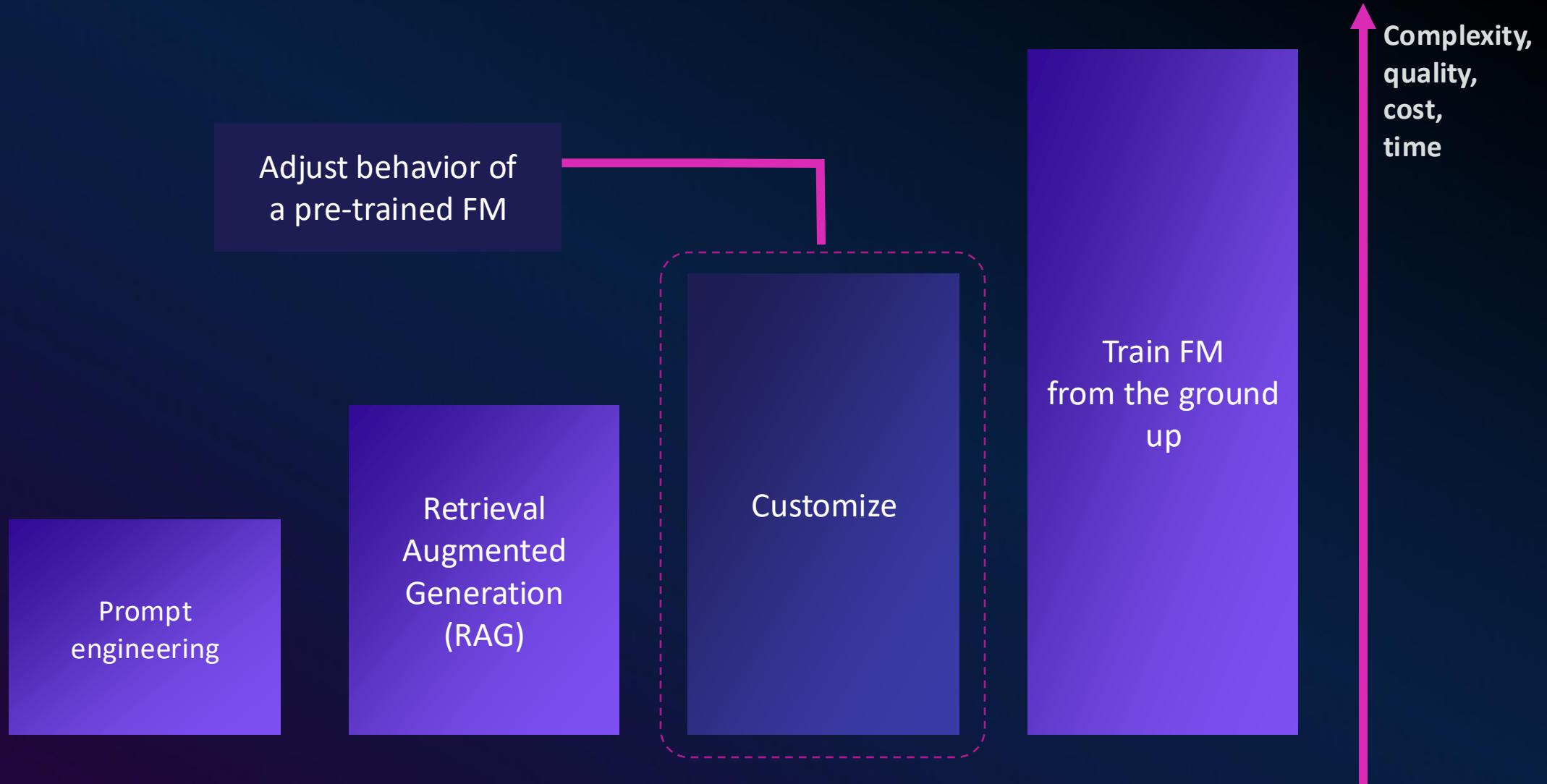
# Customize FMs for generative AI applications with Amazon Bedrock

**Michael Lin**

Sr. Solutions Architect  
Amazon Web Services



# Common approaches for customizing FMs



# Customizing model responses for your business



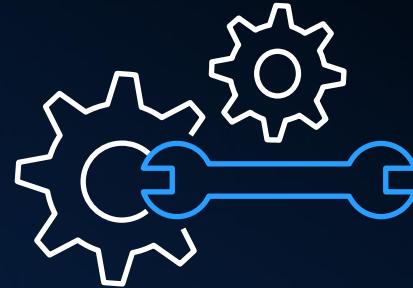
## Fine-tuning

### PURPOSE

Maximizing accuracy  
for **specific tasks**

### DATA NEED

**Small number** of  
labeled examples



## Continued pretraining

### PURPOSE

Maintaining model  
accuracy for  
**your domain**

### DATA NEED

**Large number** of unlabeled  
datasets

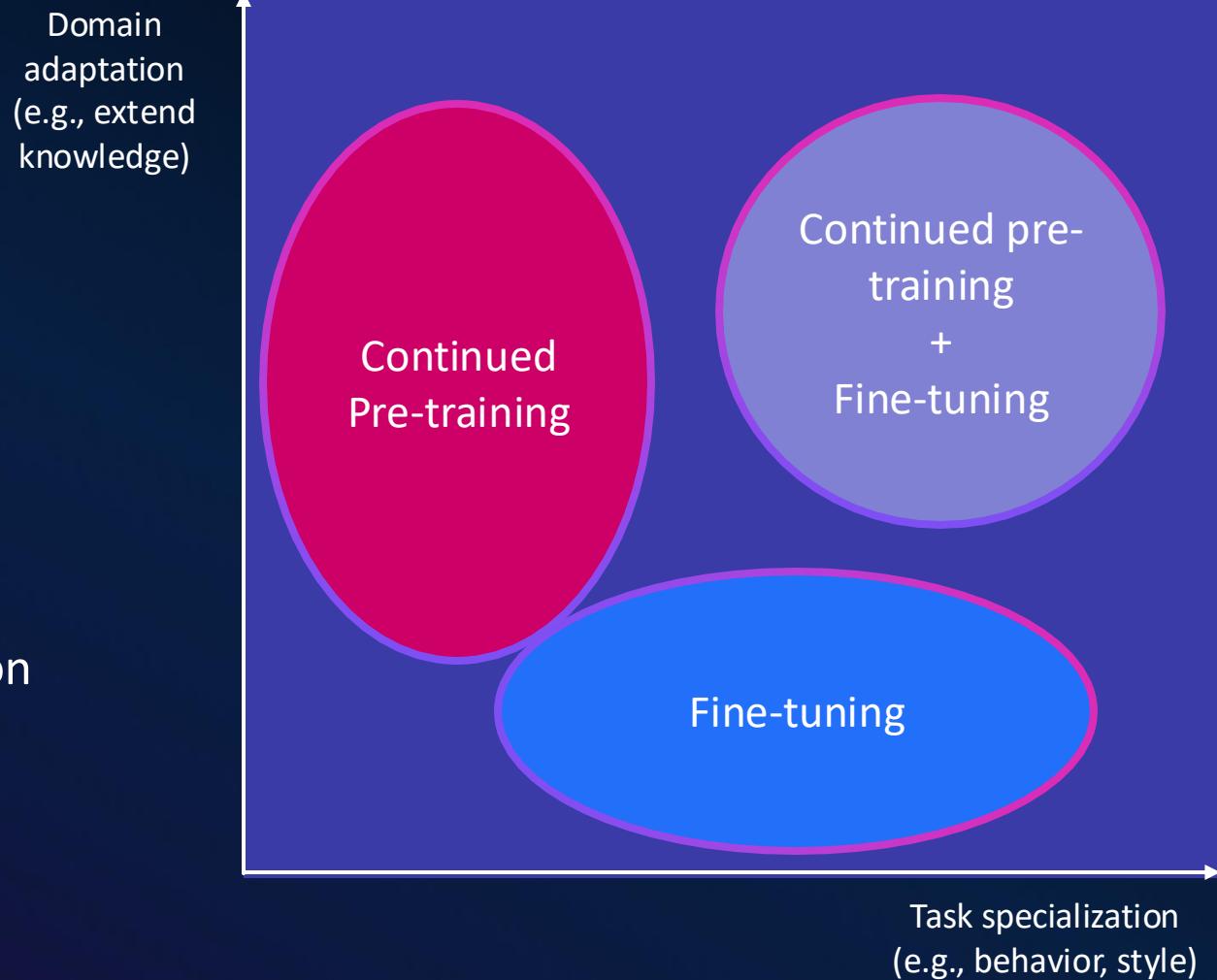
# Fine-tuning and Continued pre-training

## Fine-tuning

- Training dataset is available?
- Specific style, behavior required?

## Continued pre-training

- Raw dataset (e.g., PDFs)
- Additional knowledge through domain adaptation



# Datasets for Fine-tuning and Continued pre-training



```
{"prompt": "<prompt text>", "completion": "<expected generated text>"}  
 {"prompt": "<prompt text>", "completion": "<expected generated text>"}  
 {"prompt": "<prompt text>", "completion": "<expected generated text>"}
```

```
{"input": "<raw text>"}  
 {"input": "<raw text>"}  
 {"input": "<raw text>"}
```

# Amazon Bedrock custom models

CREATE CUSTOM MODELS USING THE CONSOLE OR APIs

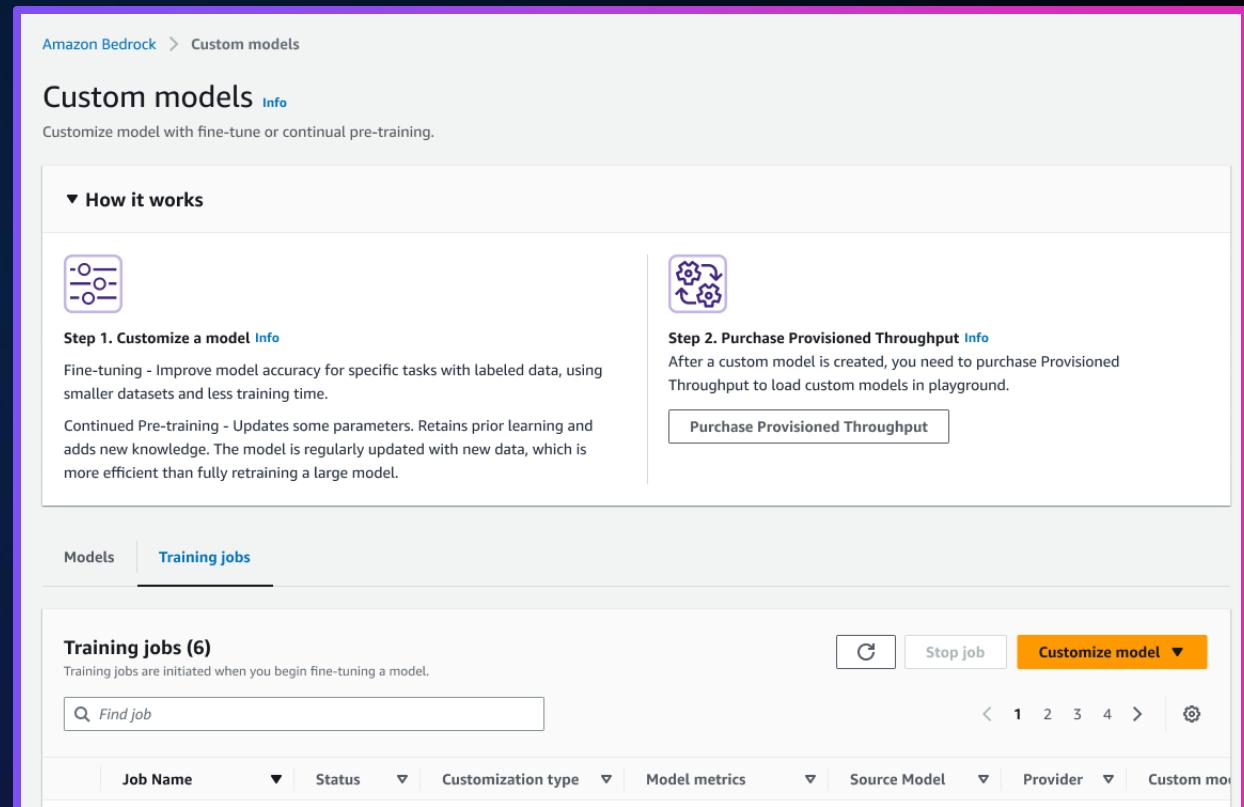
Maximize accuracy of FMs by providing labeled or raw unlabeled data

---

Once deployed, custom models are invoked the same way as base models (playground or API)

---

Customizations now supported for Amazon Titan and some third-party FMs



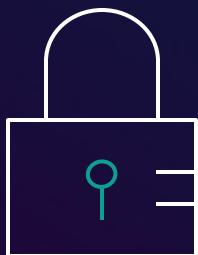
The screenshot shows the 'Custom models' section of the Amazon Bedrock console. At the top, there's a navigation bar with 'Amazon Bedrock > Custom models'. Below it, a title 'Custom models' with an 'Info' link and a subtitle 'Customize model with fine-tune or continual pre-training.' There are two main sections: 'How it works' and 'Training jobs'.

**How it works:** This section is divided into two parts: 'Step 1. Customize a model' and 'Step 2. Purchase Provisioned Throughput'. 'Step 1' includes icons for a neural network and a gear, with text about fine-tuning and continued pre-training. 'Step 2' includes an icon for a gear and a circular arrow, with text about purchasing throughput and a 'Purchase Provisioned Throughput' button.

**Training jobs:** This section shows a table titled 'Training jobs (6)'. The table has columns for 'Job Name', 'Status', 'Customization type', 'Model metrics', 'Source Model', 'Provider', and 'Custom model'. It includes a search bar 'Find job', a pagination area with numbers 1-4, and a 'Customize model' button.

# Security and privacy

YOU ARE ALWAYS IN CONTROL OF YOUR DATA



- ✓ Data not used to improve models, and not shared with model providers
- ✓ Customer data remain in AWS Region
- ✓ Support for **AWS PrivateLink** and **VPC configurations**
- ✓ Integration with **IAM**
- ✓ API monitoring in **AWS CloudTrail**, logging & metrics in **Amazon CloudWatch**
- ✓ Custom models encrypted and stored with **service or customer-managed keys** – Only you have access to your models

# Fine-Tuning in Action: Text Summarization

```
prompt = """  
Summarize the simplest and most interesting part of the following conversation.  
  
#Person1#: Hello. My name is John Sandals, and I've got a reservation.  
#Person2#: May I see some identification, sir, please?  
#Person1#: Sure. Here you are.  
#Person2#: Thank you so much. Have you got a credit card, Mr. Sandals?  
#Person1#: I sure do. How about American Express?  
#Person2#: Unfortunately, at the present time we take only MasterCard or VISA.  
#Person1#: No American Express? Okay, here's my VISA.  
#Person2#: Thank you, sir. You'll be in room 507, nonsmoking, with a queen-size bed. Do you approve, sir?  
#Person1#: Yeah, that'll be fine.  
#Person2#: That's great. This is your key, sir. If you need anything at all, anytime, just dial zero.  
  
Summary:  
"""  
  
body = {  
    "prompt": prompt,  
    "temperature": 0.5,  
    "top_p": 0.9,  
    "max_gen_len": 512,  
}
```

<https://www.youtube.com/watch?v=YY9N7sDoP30>



# Fine-Tuning in Action: Baseline Completion

```
response = bedrock_runtime.invoke_model(  
    modelId="meta.llama2-13b-chat-v1", # compare to chat model  
    body=json.dumps(body)  
)  
  
response_body = response["body"].read().decode('utf8')  
print(json.loads(response_body)["generation"])
```

A man named John Sandals checks into a hotel and provides identification and a credit card. The hotel only takes MasterCard or VISA, so he uses his VISA card. He is given room 507, a nonsmoking room with a queen-size bed.

<https://www.youtube.com/watch?v=YY9N7sDoP30>



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# Fine-Tuning in Action: Improved Completion

```
response = bedrock_runtime.invoke_model(  
    modelId=provisioned_model_arn, # custom fine-tuned model  
    body=json.dumps(body)  
)  
  
response_body = response["body"].read().decode('utf8')  
print(json.loads(response_body)["generation"])
```

John Sandals checks in the hotel with VISA and is assigned room 507, nonsmoking, with a queen-size bed.

<https://www.youtube.com/watch?v=YY9N7sDoP30>



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+ New chat

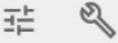
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Index

canvas-blogs-EN



a Titan Express



Based on the information provided for the client and their goals and risk profile, recommend funds to invest on, and explain why.

Client Background: A 38-year-old married couple with moderate monthly expenses and a mortgage. They aim to retire comfortably in 20 years and want to support clean energy initiatives. They have a medium risk tolerance.

Goals: To retire comfortably and invest in clean energy.

Risk Profile: Medium

Recommendation:

Based on the client's goals and risk profile, I recommend a mix of equity and bond funds. Here are the details: Equity Funds:

1. Vanguard Total Stock Market ETF (VTI): This ETF tracks the performance of the entire U.S. stock market. It has a low expense ratio of 0.04% and a diversified portfolio of over 3,000 stocks. VTI provides exposure to a wide range of sectors, including technology, healthcare, and finance, which aligns with the client's clean energy interests.
2. iShares ESG Aware MSCI USA ETF (ESGU): This ETF invests in companies that meet ESG criteria, such as sustainability and social responsibility. It has a low expense ratio of 0.05% and a diversified portfolio of over 1,000 stocks. ESGU provides exposure to companies that are contributing to the transition to a greener economy, which aligns with the client's goals. Bond Funds:
3. Vanguard Total Bond Market ETF (BND): This ETF tracks the performance of the entire U.S. bond market. It has a low expense ratio of 0.05% and a diversified portfolio of over 3,000 bonds. BND provides stability and income, which can help the client achieve their retirement goals.
4. iShares ESG Aware MSCI USA Bond ETF (ESGB): This ETF invests in companies that meet ESG criteria, such as sustainability and social responsibility. It has a low expense ratio of 0.05% and a diversified portfolio of over 1,000 bonds. ESGB provides exposure to companies that are contributing to the transition to a greener economy, which aligns with the client's goals.

Explanation: Equity Funds: VTI and ESGU are both excellent choices for equity funds. VTI provides broad exposure to the U.S. stock market, which is a



Ask me anything...





+ New chat

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FinancialPortfolio



Titan Express

Based on the information provided for the client and their goals and risk profile, recommend funds to invest on, and explain why.

Client Background: A 38-year-old married couple with moderate monthly expenses and a mortgage. They aim to retire comfortably in 20 years and want to support clean energy initiatives. They have a medium risk tolerance.

Goals: To retire comfortably and invest in clean energy.

Risk Profile: Medium

Recommendation:

Fund Allocation: 40% Clean Energy Impact Fund, 30% Early Retirement Portfolio, 30% Global Diversification Portfolio

## Customised Results



Based on the information provided, I recommend the following funds to invest in:

Vanguard Total Stock Market Index Fund Admiral Shares: This fund provides broad exposure to the U.S. stock market and has a low expense ratio of 0.04%. It is a good choice for investors with a medium risk tolerance.

iShares ESG Aware MSCI USA ETF: This fund invests in companies that have strong environmental, social, and governance (ESG) practices. It has a low expense ratio of 0.05% and is a good choice for investors who want to support clean energy initiatives.

Vanguard Total International Stock Index Fund Admiral Shares: This fund provides exposure to stocks from around the world and has a low expense ratio of 0.04%. It is a good choice for investors with a medium risk tolerance who want to diversify their portfolio.

## Generic Results

Ask me anything...



# Labs

- Bedrock Console: text generation with Titan Text
- Bedrock Console: news summary with Command Light
- Bedrock SDK: news summary with Llama 2
- Bedrock SDK: image generation with Titan Image Generator
- SageMaker JumpStart console: text generation with Mistral
- SageMaker JumpStart SDK: dialog summary with LLama 3

← → ⌂ docs.aws.amazon.com/bedrock/latest/userguide/model-customization-prepare.html ⌂ Paused ⌂

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**Amazon Bedrock** X

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► Set up

► Foundation model information

Console overview

► Run model inference

► Prompt engineering guidelines

► Guardrails for Amazon Bedrock

► Model evaluation

► Knowledge bases for Amazon Bedrock

Before you can begin a model customization job, you need to minimally prepare a training dataset. Whether a validation dataset is supported and the format of your training and validation dataset depend on the following factors.

- The type of customization job (fine-tuning or Continued Pre-training).
- The input and output modalities of the data.

To see dataset and file requirements for different models, see [Model customization quotas](#).

Select the tab that is relevant to your use-case.

Fine-tuning: Text-to-text | Fine-tuning: Text-to-image & Image-to-embeddings | **Continued Pre-training: Text-to-text**

To carry out Continued Pre-training on a text-to-text model, prepare a training and optional validation dataset by creating a JSONL file with multiple JSON lines. Because Continued Pre-training involves unlabeled data, each JSON line is a sample containing only an `input` field. Use 6 characters per token as an approximation for the number of tokens. The format is as follows.

```
{"input": "<input text>"}  
{"input": "<input text>"}  
{"input": "<input text>"}
```

The following is an example item that could be in the training data.

```
{"input": "AWS stands for Amazon Web Services"}
```

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{} aws-cli-dataset.jsonl ×

Users > mba > Desktop > 20240724\_Summit\_Workshop\_FM\_Finetune > datasets > {} aws-cli-dataset.jsonl

```
1 {"input": "User Guide for Version 2\nAWS Command Line Interface\nCopyright \u00a9 2024 Amazon Web Services, Inc. and/or its affiliates.\n\n2 {"input": "AWS Command Line Interface User Guide for Version 2\nAWS Command Line Interface: User Guide for Version 2\nCopyright \u00a9 2024 Amazon Web Services, Inc. and/or its affiliates.\n\n3 {"input": "AWS Command Line Interface User Guide for Version 2\nTable of Contents\n.....\n\n4 {"input": "AWS Command Line Interface User Guide for Version 2\nRun the official images .....\n\n5 {"input": "AWS Command Line Interface User Guide for Version 2\nUsing the examples .....\n\n6 {"input": "AWS Command Line Interface User Guide for Version 2\nUse the AWS CLI.....\n\n7 {"input": "AWS Command Line Interface User Guide for Version 2\nResources.....\n\n8 {"input": "AWS Command Line Interface User Guide for Version 2\nThe \"aws --version\" command returns a version after uninstalling the AWS CLI.\n\n9 {"input": "AWS Command Line Interface User Guide for Version 2\\nix"}\n\n10 {"input": "AWS Command Line Interface User Guide for Version 2\nWhat is the AWS Command Line Interface?\n\nThe AWS Command Line Interface (CLI) is a command-line interface for interacting with AWS services. It provides a way to programmatically interact with AWS services from the command line, making it easier to automate tasks and integrate with other tools.\n\n11 {"input": "AWS Command Line Interface User Guide for Version 2\nnot managed by AWS. We recommend that you install the AWS CLI from one of the following sources:\n\n12 {"input": "AWS Command Line Interface User Guide for Version 2\n\u2022 Prompt\n\nThe command prompt uses the Linux prompt and is displayed in the terminal window.\n\n13 {"input": "AWS Command Line Interface User Guide for Version 2\n$ aws ec2 create-security-group --group-name my-sg --description \"My first security group\"\n\n14 {"input": "AWS Command Line Interface User Guide for Version 2\nGet started with the AWS CLI\n\nThis chapter provides steps to get started with the AWS CLI.\n\n15 {"input": "AWS Command Line Interface User Guide for Version 2\nSet up the AWS CLI\n\nPrerequisites to use the AWS CLI version 2\n\n16 {"input": "AWS Command Line Interface User Guide for Version 2\nChoose none\n\nWay to manage your administrator. You can also choose to use the AWS CLI with your local user account.\n\n17 {"input": "AWS Command Line Interface User Guide for Version 2\nImportant\n\nAWS CLI versions 1 and 2 use the same aws command name. If you are using AWS CLI version 1, you can upgrade to version 2.\n\n18 {"input": "AWS Command Line Interface User Guide for Version 2\nAfter the yum installation of the AWS CLI is removed, follow the below steps to install the AWS CLI version 2.\n\n19 {"input": "AWS Command Line Interface User Guide for Version 2\nLinux ARM\n\nNote\n\nThe following command block downloads and installs the AWS CLI version 2 on a Linux ARM system.\n\n20 {"input": "AWS Command Line Interface User Guide for Version 2\n\u2022 Downloading from the URL\n\nTo download the installer with curl, run the following command:\n\n21 {"input": "AWS Command Line Interface User Guide for Version 2\nntCFBV1MgQ0xJIFR1YW0gPGF3cy1jbGlAYW1hem9uLmNvbT6JA1QEEwEIAD4CGwMF\n\n22 {"input": "AWS Command Line Interface User Guide for Version 2\nLinux x86 (64-bit)\n\nFor the latest version of the AWS CLI, use the following command:\n\n23 {"input": "AWS Command Line Interface User Guide for Version 2\nngpg: Signature made Mon Nov 4 19:00:01 2019 PST\n\nngpg:\n\n24 {"input": "AWS Command Line Interface User Guide for Version 2\nYou can install without sudo if you specify directories that you already own.\n\n25 {"input": "AWS Command Line Interface User Guide for Version 2\n2. Use the ls command to find the directory that your symlink points to.\n\n26 {"input": "AWS Command Line Interface User Guide for Version 2\n\u2022 For all users on the computer (requires sudo)\n\nYou can install the AWS CLI for all users on the computer by running the following command:\n\n27 {"input": "AWS Command Line Interface User Guide for Version 2\nCommand line installer - All users\n\nIf you have sudo permissions, you can run the following command to install the AWS CLI for all users:\n\n28 {"input": "AWS Command Line Interface User Guide for Version 2\nCommand line - Current user\n\n1. To specify which folder the AWS CLI is installed in, run the following command:\n\n29 {"input": "AWS Command Line Interface User Guide for Version 2\nThe following example installs the AWS CLI in the folder /Users/myuser/AWS.\n\n30 {"input": "AWS Command Line Interface User Guide for Version 2\nInstall or update the AWS CLI\n\nTo update your current installation of the AWS CLI, run the following command:\n\n31 {"input": "AWS Command Line Interface User Guide for Version 2\nNext steps\n\nAfter you successfully install the AWS CLI, you can safely remove the previous version of the AWS CLI from your system."}
```

Amazon Bedrock | us-east-1 X +

us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/ Paused

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## Amazon Bedrock

Machine Learning

# Amazon Bedrock

The easiest way to build and scale generative AI applications with foundation models (FMs)

Try Bedrock

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## Overview

Amazon Bedrock is a fully managed service that makes FMs from leading AI startups and Amazon available via an API, so you can choose from a wide range of FMs to find the model that is best suited for your use case. With Bedrock's serverless experience, you can get started quickly, privately customize FMs with your own data, and easily integrate and deploy them into your applications using the AWS tools without having to manage any infrastructure.

## Benefits

Amazon Bedrock | us-east-1 X + us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models Paused

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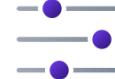
Assessment & deployment

### Custom models Info

Customize model with Fine-tuning or Continued Pre-training.

#### How it works

**Create a model**



Decide the custom model type you want to create, Fine-tuning or Continued Pre-training.

Create a model customization job. You need to purchase Provisioned Throughput before you can test or use your model in an application.

**Test a custom model**



Test your custom model in a playground or get the metrics from the model's details page.

**Use a custom model**



Use your model for inference in your application or experiment in the playground.

Models Jobs

#### Models (8)

Models that you have customized and have had their jobs successfully completed will appear here.

Find model

Purchase Provisioned Throughput

Customize model

← 1 → 🔍

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Models that you have customized and have had their jobs successfully completed will appear here.

Purchase Provisioned Throughput [Customize model](#) [Create Fine-tuning job](#) [Create Continued Pre-training job](#)

Find model

Amazon Bedrock | us-east-1 X + us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/jobs/create?jobType=CONTINUED\_PRE\_TRAINING Paused N. Virginia demouser @ 0947-8459-0684

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Amazon Bedrock > Custom models > Create Continued Pre-training job Create Continued Pre-training job Info Select the model you wish to pre-train and submit your data location.

**Model details**

**Source model**  
Choose from a list of models that you wish to customize with using your own data.  
**Select model** 

**Continued pre-trained model name**  
Enter a name to identify the newly created pre-trained model.  
*Enter a name here*

Model encryption [Info](#)

► Tags - optional

**Job configuration**

**Job name**  
Enter a name to identify the training job necessary to pre-train and create a new model.  
*Enter a name here*

► Tags - optional

← → ⌂ us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/jobs/create?jobType=CONTINUED\_PRE\_TRAINING ⭐ | ↗ | ↘ T Paused

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Select model

1. Category

Model providers

- Amazon**

Custom models

Fine-tuned models

2. Model

**Titan Text G1 - Lite v1**  
Text model | Context size = 4k

**Titan Text G1 - Express v1**  
Text model | Context size = 8k

Cancel Apply

← → ⌂ us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/jobs/create?jobType=CONTINUED\_PRE\_TRAINING ⭐ | ↗ | ↘ T Paused

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Select model

1. Category

Model providers

- Amazon**

Custom models

Fine-tuned models

2. Model

**Titan Text G1 - Lite v1**  
Text model | Context size = 4k

**Titan Text G1 - Express v1**  
Text model | Context size = 8k

Cancel **Apply** ←

The screenshot shows the 'Select model' dialog box from the Amazon Bedrock console. The left sidebar contains navigation links for 'Getting started', 'Foundation models', 'Playgrounds', 'Safeguards', 'Builder tools', and 'Assessment & deployment'. The main area displays the 'Select model' interface with two tabs: '1. Category' and '2. Model'. In 'Category', the 'Model providers' section is active, showing the 'Amazon' provider selected (indicated by a blue border). The 'Custom models' section is also visible. In 'Model', the 'Titan Text G1 - Lite v1' model is selected, shown in a highlighted box, with the description 'Text model | Context size = 4k'. Below it is the 'Titan Text G1 - Express v1' model, described as 'Text model | Context size = 8k'. At the bottom of the dialog are 'Cancel' and 'Apply' buttons, with a red arrow pointing to the 'Apply' button.

Amazon Bedrock | us-east-1 X + us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/jobs/create?jobType=CONTINUED\_PRE\_TRAINING&mode... Paused N. Virginia demouser @ 0947-8459-0684

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Amazon Bedrock > Custom models > Create Fine-tuning job

## Create Continued Pre-training job [Info](#)

Select the model you wish to pre-train and submit your data location.

### Model details

**Source model**  
Choose from a list of models that you wish to customize with using your own data.

 **Titan Text G1 - Lite v1** [Change](#)

**Continued pre-trained model name**  
Enter a name to identify the newly created pre-trained model.

Model encryption [Info](#)

► Tags - optional

### Job configuration

**Job name**  
Enter a name to identify the training job necessary to pre-train and create a new model.

Amazon Bedrock | us-east-1 X + us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/jobs/create?jobType=CONTINUED\_PRE\_TRAINING&mode... Paused N. Virginia demouser @ 0947-8459-0684

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Amazon Bedrock > Custom models > Create Fine-tuning job Create Continued Pre-training job Info Select the model you wish to pre-train and submit your data location.

**Model details**

**Source model**  
Choose from a list of models that you wish to customize with using your own data.  
 **Titan Text G1 - Lite v1** Change

**Continued pre-trained model name**  
Enter a name to identify the newly created pre-trained model.  
aws-cli-ft-20240630

Model encryption Info

► Tags - optional

**Job configuration**

**Job name**  
Enter a name to identify the training job necessary to pre-train and create a new model.  
aws-cli-ft-20240630-morning

us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/jobs/create?jobType=CONTINUED\_PRE\_TRAINING&mode...

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#### Input data [Info](#)

Choose a file in the S3 location. The files you choose must be in the [dataset format](#) that the model needs for training. You can also use Sagemaker Ground Truth to create and label training datasets. [Learn more](#)

**S3 location**

 [View](#) [Browse S3](#) 

#### Validation dataset S3 location (optional)

 [View](#) [Browse S3](#)

#### Hyperparameters [Info](#)

**Epochs**  
The total number of iterations of all the training data in one cycle for training the model.  
  
Enter an integer between 1 and 10.

**Batch size**  
The number of samples processed before model parameters are updated.  
  
Enter a value between 1 and 64.

**Learning rate**  
The rate at which model parameters are updated after each batch of training data.  
  
Enter a float value between 0 and 1.

### Input data Info

Choose a file in the S3 location. The files you choose must be in the dataset format [that](#) the model needs for training. You can also use Sagemaker Ground Truth to create and label training datasets. [Learn more](#)

#### S3 location

## Choose an archive in S3



### S3 buckets

#### Buckets (83)



cli



3No matches



&lt; 1 &gt;



#### Creation date

2024-06-30T01:55:00.000Z

2024-06-30T01:55:11.000Z

[Cancel](#)[Choose](#)

Enter a value between 1 and 0.1.

### Learning rate

The rate at which model parameters are updated after each batch of training data.

0.00001

Enter a float value between 0 and 1.

### Learning rate warmup steps

Number of iterations over which learning rate is gradually increased to the initial rate specified.

### Input data Info

Choose a file in the S3 location. The files you choose must be in the dataset format [that the model needs for training](#). You can also use Sagemaker Ground Truth to create and label training datasets. [Learn more](#)

#### S3 location

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## Choose an archive in S3

[S3 buckets](#) > aws-cli-dataset-ft-input-20240630

### Objects (1/1)



< 1 >

Key

Last modified

Size

aws-cli-dataset.jsonl

June 30, 2024, 09:56 (UTC+08:00)

9.39 MB

[Cancel](#)[Choose](#)

1

Enter a value between 1 and 64.

#### Learning rate

The rate at which model parameters are updated after each batch of training data.

Enter a float value between 0 and 1.

#### Learning rate warmup steps

Number of iterations over which learning rate is gradually increased to the initial rate specified.

Amazon Bedrock | us-east-1 X + us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/jobs/create?jobType=CONTINUED\_PRE\_TRAINING&mode... Paused N. Virginia demouser @ 0947-8459-0684

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### Input data [Info](#)

Choose a file in the S3 location. The files you choose must be in the [dataset format](#) that the model needs for training. You can also use Sagemaker Ground Truth to create and label training datasets. [Learn more](#)

S3 location

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Validation dataset S3 location (optional)

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### Hyperparameters [Info](#)

**Epochs**  
The total number of iterations of all the training data in one cycle for training the model.  
  
Enter an integer between 1 and 10.

**Batch size**  
The number of samples processed before model parameters are updated.  
  
Enter a value between 1 and 64.

**Learning rate**  
The rate at which model parameters are updated after each batch of training data.  
  
Enter a float value between 0 and 1.



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Amazon SageMaker



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## Hyperparameters Info

### Epochs

The total number of iterations of all the training data in one cycle for training the model.

Enter an integer between 1 and 10.

### Batch size

The number of samples processed before model parameters are updated.

Enter a value between 1 and 64.

### Learning rate

The rate at which model parameters are updated after each batch of training data.

Enter a float value between 0 and 1.

### Learning rate warmup steps

Number of iterations over which learning rate is gradually increased to the initial rate specified.

Enter an integer between 1 and 250.

## Output data Info

Choose S3 location to store the model validation outputs.

### S3 location

[View](#)[Browse S3](#)

Amazon Bedrock | us-east-1 X + us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/jobs/create?jobType=CONTINUED\_PRE\_TRAINING&mode... Paused N. Virginia demouser @ 0947-8459-0684

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Enter an integer between 1 and 250.

**Output data** Info Choose S3 location to store the model validation outputs.

**S3 location**

s3://bucket/path-to-your-data/ View Browse S3

**Service access** Info C Bedrock model customization job requires permissions to write to S3 on your behalf.

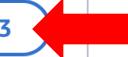
**Choose a method to authorize Bedrock**

Use an existing service role  Create and use a new service role

**Service role**

Choose role ▾

**Purchase Provisioned Throughput to use continued pre-trained model** Learn more After this custom model is created, you need to purchase Provisioned Throughput to be able to use this model.



## Amazon Bedrock



Enter an integer between 1 and 250.



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## Choose an archive in S3



## S3 buckets

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No matches



## Creation date

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2024-06-30T01:55:00.000Z

 aws-cli-dataset-ft-output-20240630

2024-06-30T01:55:11.000Z

Cancel

Choose

## Purchase Provisioned Throughput to use continued pre-trained model

[Learn more](#) 

After this custom model is created, you need to purchase Provisioned Throughput to be able to use this model.

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## Amazon Bedrock



Enter an integer between 1 and 250.



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&lt; 1 &gt;



## S3 buckets

## Buckets (1/83)



cli



No matches



## Creation date

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2024-06-30T01:55:00.000Z

 aws-cli-dataset-ft-output-20240630

2024-06-30T01:55:11.000Z

Cancel

Choose

Learn more

## Purchase Provisioned Throughput to use continued pre-trained model

After this custom model is created, you need to purchase Provisioned Throughput to be able to use this model.

Cancel

Create Continued Pre-training job

us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/jobs/create?jobType=CONTINUED\_PRE\_TRAINING&mode... Paused

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Enter an integer between 1 and 250.

### Output data Info

Choose S3 location to store the model validation outputs.

S3 location

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### Service access Info

Bedrock model customization job requires permissions to write to S3 on your behalf.

Choose a method to authorize Bedrock

- Use an existing service role
- Create and use a new service role

Service role

i Purchase Provisioned Throughput to use continued pre-trained model [Learn more](#)

After this custom model is created, you need to purchase Provisioned Throughput to be able to use this model.

Cancel [Create Continued Pre-training job](#)

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Choose S3 location to store the model validation outputs.  
**S3 location**  
s3://aws-cli-dataset-ft-output-20240630 [View](#) [Browse S3](#)

**Service access** [Info](#) [Edit](#)  
Bedrock model customization job requires permissions to write to S3 on your behalf.

**Choose a method to authorize Bedrock**

- Use an existing service role
- Create and use a new service role

**Service role name**  
aws-cli-ft-role-20240630  
Maximum 64 characters. Use alphanumeric and '+,=,.@-\_ ' characters.

[View permission details](#)

**i Purchase Provisioned Throughput to use continued pre-trained model** [Learn more](#)  
After this custom model is created, you need to purchase Provisioned Throughput to be able to use this model.

[Cancel](#) [Create Continued Pre-training job](#)



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**Service access** [Info](#) [Edit](#)  
Bedrock model customization job requires permissions to write to S3 on your behalf.

**Choose a method to authorize Bedrock**

- Use an existing service role
- Create and use a new service role

**Service role name**  
  
Maximum 64 characters. Use alphanumeric and '+,=,.@-\_ characters.

[View permission details](#)

**i Purchase Provisioned Throughput to use continued pre-trained model** [Learn more](#)  
After this custom model is created, you need to purchase Provisioned Throughput to be able to use this model.

[Cancel](#) [Create Continued Pre-training job](#)



Amazon Bedrock | us-east-1 X + us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models Paused

aws Services Search [Option+S] CloudFormation EC2 RDS S3 Amazon SageMaker Amazon Bedrock AWS DeepRacer N. Virginia demouser @ 0947-8459-0684

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Continued Pre-train model job aws-cli-ft-20240630-morning created successfully. Once the training job completes successfully the model will be available in the Models table. Training time can vary depending on your hyperparameter settings.

Amazon Bedrock > Custom models

## Custom models Info

Customize model with Fine-tuning or Continued Pre-training.

### How it works

**Create a model**



Decide the custom model type you want to create, Fine-tuning or Continued Pre-training.

Create a model customization job. You need to purchase Provisioned Throughput before you can test or use your model in an application.

**Test a custom model**



Test your custom model in a playground or get the metrics from the model's details page.

**Use a custom model**



Use your model for inference in your application or experiment in the playground.

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## Jobs (10)

Training jobs are initiated when you begin customizing a model.



Stop job

Customize model ▾

Find job

&lt; 1 &gt;



	Job name	Status	Source	Job type	Custom model n...	Creation time
<input type="radio"/>	aws-cli-ft-20240...	Training	<a href="#">Titan Text G1 - Lite</a>	Continued Pre-tr...	<a href="#">aws-cli-ft-20240...</a>	June 30, 2024, 1...
<input type="radio"/>						
<input type="radio"/>						
<input type="radio"/>						
<input type="radio"/>						
<input type="radio"/>						
<input type="radio"/>						
<input type="radio"/>						
<input type="radio"/>						



us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/item?arn=arn:aws:bedrock:us-east-1:094784590684:mo... Paused

aws Services Search [Option+S] N. Virginia demouser @ 0947-8459-0684

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### Training job : aws-cli-ft-20240630-morning

Info

Training job overview

Custom model name	aws-cli-ft-20240630	Job creation time	June 30, 2024, 10:15 (UTC+08:00)	Status	Training
Training job ARN	<a href="#">arn:aws:bedrock:us-east-1:094784590684:model-customization-job/amazon.titan-text-lite-v1:0:4k/6acth3jsdq6g</a>	Job duration	a few seconds	Custom model encryption KMS key	Bedrock owned KMS key
Data access role	<a href="#">arn:aws:iam::094784590684:role/service-role/aws-cli-ft-role-20240630</a>	Source model name	<a href="#">Titan Text G1 - Lite</a>	Source model ARN	<a href="#">arn:aws:bedrock:us-east-1::foundation-model/amazon.titan-text-lite-v1:0:4k</a>

### Input data

S3 location

[aws-cli-dataset-ft-input-20240630](#)

### Hyperparameters

Learning Rate Warmup Steps	5	Learning Rate	0.00001	Maximum number of epochs	5
Batch Size					

# Labs

- Bedrock Console: text generation with Titan Text
- Bedrock Console: news summary with Command Light
- Bedrock SDK: news summary with Llama 2
- Bedrock SDK: image generation with Titan Image Generator
- SageMaker JumpStart console: text generation with Mistral
- SageMaker JumpStart SDK: dialog summary with LLama 3

docs.aws.amazon.com/bedrock/latest/userguide/model-customization-prepare.html

Paused

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- AI21 Labs Jamba-Instruct models [June 26, 2024](#)
- AI21 Labs models [June 26, 2024](#)
- Prompt injection security [June 25, 2024](#)

[View all](#)

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► Set up

► Foundation model information

Console overview

► Run model inference

► Prompt engineering guidelines

► Guardrails for Amazon Bedrock

► Model evaluation

► Knowledge bases for Amazon Bedrock

Before you can begin a model customization job, you need to minimally prepare a training dataset. Whether a validation dataset is supported and the format of your training and validation dataset depend on the following factors.

- The type of customization job (fine-tuning or Continued Pre-training).
- The input and output modalities of the data.

To see dataset and file requirements for different models, see [Model customization quotas](#).

Select the tab that is relevant to your use-case.

Fine-tuning: Text-to-text    Fine-tuning: Text-to-image & Image-to-embeddings    Continued Pre-training: Text-to-text

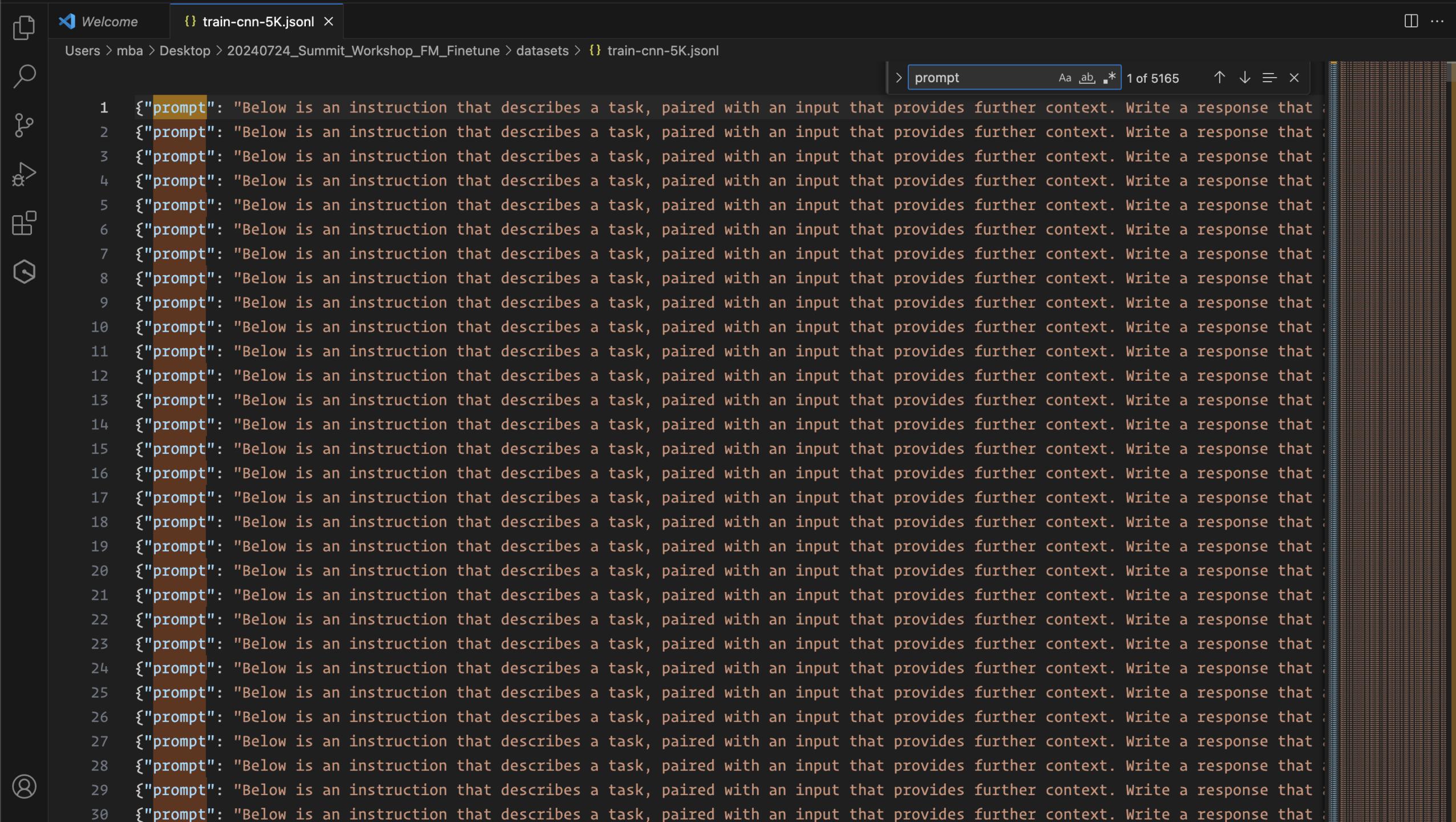
To fine-tune a text-to-text model, prepare a training and optional validation dataset by creating a JSONL file with multiple JSON lines. Each JSON line is a sample containing both a `prompt` and `completion` field. Use 6 characters per token as an approximation for the number of tokens. The format is as follows.

```
{"prompt": "<prompt1>", "completion": "<expected generated text>"}  
{"prompt": "<prompt2>", "completion": "<expected generated text>"}  
{"prompt": "<prompt3>", "completion": "<expected generated text>"}
```

The following is an example item for a question-answer task:

```
{"prompt": "what is AWS", "completion": "it's Amazon Web Services"}
```

Like [Share](#) [Feedback](#) [Help](#)



1 grabs EVERY WEEK... . Clash of the titans: Novak Djokovic remains on course to meet Andy Murray in the quarter-finals .", "completion":  
2 im believed she was about to be killed and jumped from an upstairs window to escape the clutches of her attacker - leaving her having  
3 one such photo tour in Tanzania when he spotted the lioness. Petr, 42, added: 'In Tanzania wild animals get used to the tourists so if  
4 a on the Oval outfield . Pleased as punch: Root jumps for joy as he celebrates his century on day four at The Oval .", "completion": "

5  
6 said that his friends and classmates \"were happy to help the environment.\" Hansen donated five pairs of his own outgrown jeans. The  
7 cers were working at the mall when the shooting occurred, Cole said. The mall was locked down and evacuated, with 15 agencies helping  
8 to waste that moon/And the heat on the hood of this Ford\" on the parkin' ballad 'Talk,' well, you may not want to waste it either.  
9 aiding and abetting an unlicensed driver. Police will consider if further action is appropriate.", "completion": "response:\n\nMan let  
10 -- three for \"Rehab\" as well as Album of the Year and Best New Artist. Winehouse's Grammy winning album, \"Back to Black,\" is still  
11 commercial broadcaster that Berlusconi founded. He has also been barred from holding public office for two years and was expelled fro  
12 llips puts his players through their paces in a training session . The custom vehicle fitter and former goalkeeper said: 'I had the at  
13 the amount I would usually sell in a whole year.' Belinda, who sources her fakes from . India, China and Hatton Garden in London, tel  
14 astily rewritten to allow her to leave the programme after filming only a handful of scenes. She said: 'The plan had been that my . ch  
15 spect a human caused the blaze, but they're still investigating ."

16 picture. Isaacson's book should hopefully provide some concrete answers to unresolved questions about Jobs's life, along with some ne  
17 lead an economic seminar at Macaulay Honors College in New York .\nPetraeus will assume the role of visiting professor at the college i  
18 d or not.\" Stern also pointed out that people often tell him that his program was the introduction of reality television. Despite naki  
19 ver 180 countries. Sanitas, the BUPA business in Spain, has one million insured customers who have access to a network of 18,000 medic  
20 ot to stay completely in the present. 'That's . what I'm going to try to do for all 18 holes tomorrow. You have to . think about how y  
21 in latter part of the First Temple period - from the end of the eighth century BC until the destruction of the Temple in 586 BC. To f  
22 ight.\", "completion": "response:\n\nOfficials: 81 people are treated at local hospitals for dizziness, nausea, headaches .\n\nThe incide  
23 s provisional repairs will be done on the nation's critical north-south highway by Wednesday. But because of poor communication, traffi  
24 to stab him in the back with a kitchen knife. 'Fortunately the blade of the knife hit his shoulder blade, he managed to fight her off  
25

26 fficult decision to make. As a prosecutor -- I've been a prosecutor for 30 years -- I hate to say this, but you're somewhat accustomed

27  
28 squad for Euro 2016 qualifier against Macedonia .\n\nPique took in basketball game with popstar wife during time off ."

29 1 October. For any couples out there who want to attempt something similar be warned, the towers of the bridge aren't open to the publ  
30 . 'In short, leave the damn Tree alone, so that future fans can enjoy it. Left alone, the Tree will be there for many, many decades to  
31 \\"food service establishments.\\" Sugary drinks linked to 180,000 deaths worldwide . Mayor Michael Bloomberg firmly disagreed. \\"Today

Amazon Bedrock | us-east-1 X + us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models Paused

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Custom models Info Customize model with Fine-tuning or Continued Pre-training.

▼ How it works

Create a model

Test a custom model

Use a custom model

Decide the custom model type you want to create, Fine-tuning or Continued Pre-training.

Create a model customization job. You need to purchase Provisioned Throughput before you can test or use your model in an application.

Test your custom model in a playground or get the metrics from the model's details page.

Use your model for inference in your application or experiment in the playground.

Models Jobs Models (8) Purchase Provisioned Throughput Customize model Find model < 1 > 🔍

Amazon Bedrock | us-east-1 X + us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models Paused

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### Custom models Info

Customize model with Fine-tuning or Continued Pre-training.

#### How it works

**Create a model**



Decide the custom model type you want to create, Fine-tuning or Continued Pre-training.

Create a model customization job. You need to purchase Provisioned Throughput before you can test or use your model in an application.

**Test a custom model**



Test your custom model in a playground or get the metrics from the model's details page.

**Use a custom model**



Use your model for inference in your application or experiment in the playground.

Models Jobs

#### Models (8)

Models that you have customized and have had their jobs successfully completed will appear here.

Purchase Provisioned Throughput [Customize model ▾](#) [Create Fine-tuning job](#) [Create Continued Pre-training job](#)

Find model

Amazon Bedrock | us-east-1 X + us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/jobs/create?jobType=FINE\_TUNING Paused

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Amazon Bedrock > Custom models > Create Fine-tuning job Create Fine-tuning job Info Select the model you wish to fine-tune and submit your data location.

**Model details**

**Source model**  
Choose from a list of models that you wish to customize with using your own data.  
**Select model** 

**Fine-tuned model name**  
Enter a name to identify the new fine-tuned model.  
*Enter a name here*

Model encryption [Info](#)

► Tags - optional

**Job configuration**

**Job name**  
Enter a name to identify the training job necessary to pre-train and create a new model.  
*Enter a name here*

► Tags - optional

← → ⌂ us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/jobs/create?jobType=FINE\_TUNING ⌂ Paused : ...

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Select model

1. Category

Model providers

- Amazon
- Cohere**
- Meta

Custom models

- Fine-tuned models

2. Models available for fine-tuning

Command v14.7  
Text model

**Command Light v14.7**  
Text model

Cancel Apply

The screenshot shows the AWS Bedrock console interface. On the left, there's a sidebar with navigation links like 'Getting started', 'Foundation models', 'Playgrounds', etc. The main area has tabs for 'Amazon Bedrock' and other services. A central modal window titled 'Select model' is open. It has two main sections: '1. Category' and '2. Models available for fine-tuning'. Under 'Category', there are sections for 'Model providers' (listing Amazon, Cohere, and Meta) and 'Custom models' (listing Fine-tuned models). Under 'Models available for fine-tuning', it lists 'Command v14.7' and 'Command Light v14.7' as 'Text model'. The 'Command Light v14.7' option is highlighted with a blue border. At the bottom of the modal are 'Cancel' and 'Apply' buttons.

Amazon Bedrock | us-east-1 X + us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/jobs/create?jobType=FINE\_TUNING&modelId=cohere.co... Paused N. Virginia demouser @ 0947-8459-0684

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Amazon Bedrock > Custom models > Create Fine-tuning job

## Create Fine-tuning job [Info](#)

Select the model you wish to fine-tune and submit your data location.

### Model details

**Source model**  
Choose from a list of models that you wish to customize with using your own data.

 **Command Light v14.7** [Info](#)  
[Change](#)

**Fine-tuned model name**  
Enter a name to identify the new fine-tuned model.

Model encryption [Info](#)

► Tags - optional

### Job configuration

**Job name**  
Enter a name to identify the training job necessary to pre-train and create a new model.

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Amazon Bedrock > Custom models > Create Fine-tuning job

## Create Fine-tuning job [Info](#)

Select the model you wish to fine-tune and submit your data location.

### Model details

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 **Command Light v14.7** [Change](#)

**Fine-tuned model name**  
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Model encryption [Info](#)

► Tags - optional

### Job configuration

**Job name**  
Enter a name to identify the training job necessary to pre-train and create a new model.

Amazon Bedrock | us-east-1 X + us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/jobs/create?jobType=FINE\_TUNING&modelId=cohere.co... Paused N. Virginia demouser @ 0947-8459-0684

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**Input data** Info Choose a file in the S3 location. The files you choose must be in the dataset format that the model needs for training. You can also use Sagemaker Ground Truth to create and label training datasets. Learn more

**S3 location** s3://bucket/path-to-your-data/ View Browse S3

**Validation dataset S3 location (optional)** s3://bucket/path-to-your-data/ View Browse S3

Evaluate the model by providing the S3 location of a validation dataset or by using a percentage of the training dataset. If you don't provide a validation dataset, specify the evaluation percentage in the Hyperparameters section.

**Hyperparameters** Info

**Epochs** The total number of iterations of all the training data in one cycle for training the model. 1 Enter an integer between 1 and 100.

**Batch size** The number of samples processed before model parameters are updated. 32 ▾

Amazon Bedrock



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Input data Info

Choose a file in the S3 location. The files you choose must be in the dataset format ? that the model needs for training. You can also use Sagemaker Ground Truth to create and label training datasets. [Learn more](#) ?

S3 location

s3://bucket/path-to-your-data/

View ?

Browse S3

S3 buckets

Buckets (83)

cnn



2No matches



< 1 >



Name



Creation date

cnn-daily-ft-input-20240630

2024-06-30T02:05:26.000Z

cnn-daily-ft-output-20240630

2024-06-30T02:05:36.000Z

Cancel

Choose

Enter an integer between 1 and 100.

Batch size

The number of samples processed before model parameters are updated.

32



Learning rate

The rate at which model parameters are updated after each batch of training data.

0.0001

### Input data Info

Choose a file in the S3 location. The files you choose must be in the dataset format ? that the model needs for training. You can also use Sagemaker Ground Truth to create and label training datasets. [Learn more](#) ?

#### S3 location

[View ?](#)[Browse S3](#)

## Choose an archive in S3

[S3 buckets](#) > **cnn-daily-ft-input-20240630**

### Objects (1/1)



< 1 >

Key

Last modified

Size

train-cnn-5K.jsonl

June 30, 2024, 10:08 (UTC+08:00)

11.36 MB

[Cancel](#)[Choose](#)

1

Enter an integer between 1 and 100.

#### Batch size

The number of samples processed before model parameters are updated.

32



#### Learning rate

The rate at which model parameters are updated after each batch of training data.

0.0001

us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/jobs/create?jobType=FINE\_TUNING&modelId=cohere.co...

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## Input data Info

Choose a file in the S3 location. The files you choose must be in the [dataset format](#) that the model needs for training. You can also use Sagemaker Ground Truth to create and label training datasets. [Learn more](#)

### S3 location

[View](#)[Browse S3](#)

### Validation dataset S3 location (optional)

[View](#)[Browse S3](#)

Evaluate the model by providing the S3 location of a validation dataset or by using a percentage of the training dataset. If you don't provide a validation dataset, specify the evaluation percentage in the Hyperparameters section.

## Hyperparameters Info

### Epochs

The total number of iterations of all the training data in one cycle for training the model.

Enter an integer between 1 and 100.

### Batch size

The number of samples processed before model parameters are updated.

us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/jobs/create?jobType=FINE\_TUNING&modelId=cohere.co...

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## Hyperparameters Info

**Epochs**  
The total number of iterations of all the training data in one cycle for training the model.  
 Enter an integer between 1 and 100.

**Batch size**  
The number of samples processed before model parameters are updated.

**Learning rate**  
The rate at which model parameters are updated after each batch of training data.  
 Enter a float value between 0.00005 and 0.1.

**Early stopping threshold**  
The minimum amount of validation loss improvement required to continue training the model.  
 Enter a value between 0 and 0.1.

**Early stopping patience**  
The number of epochs to wait for an improvement with validation loss before stopping training. If the validation loss improvement has not reached the early stopping threshold within the patience period, the training will be stopped.  
 Enter an integer between 1 and 10.

**Evaluation percentage**  
The percentage of the dataset allocated for model evaluation if a separate validation dataset is not provided.

us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/jobs/create?jobType=FINE\_TUNING&modelId=cohere.co... Paused

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Enter a value between 5% and 50%

**Output data** [Info](#)

Choose S3 location to store the model validation outputs.

**S3 location**

s3://bucket/path-to-your-data/ [View](#) [Browse S3](#) 

**Service access** [Info](#) 

Bedrock model customization job requires permissions to write to S3 on your behalf.

**Choose a method to authorize Bedrock**

Use an existing service role  
 Create and use a new service role

**Service role**

Choose role 

**Purchase Provisioned Throughput to use fine-tuned model** [Learn more](#)

After this custom model is created, you need to purchase Provisioned Throughput to be able to use this model.

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## Amazon Bedrock



Enter a value between 5% and 50%



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## Choose an archive in S3



&lt; 1 &gt;



## S3 buckets

## Buckets (1/83)



cnn



2No matches



Name



Creation date

 cnn-daily-ft-input-20240630 2024-06-30T02:05:26.000Z cnn-daily-ft-output-20240630 2024-06-30T02:05:36.000Z

Cancel

Choose

Learn more

## Purchase Provisioned Throughput to use fine-tuned model

After this custom model is created, you need to purchase Provisioned Throughput to be able to use this model.

Cancel

Create Fine-tuning job

us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/jobs/create?jobType=FINE\_TUNING&modelId=cohere.co... Paused

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Enter a value between 5% and 50%

**Output data** [Info](#)

Choose S3 location to store the model validation outputs.

**S3 location**

s3://cnn-daily-ft-output-20240630 [View](#) [Browse S3](#)

**Service access** [Info](#)

Bedrock model customization job requires permissions to write to S3 on your behalf.

**Choose a method to authorize Bedrock**

Use an existing service role  
 Create and use a new service role

**Service role**

Choose role

**Purchase Provisioned Throughput to use fine-tuned model** [Learn more](#)

After this custom model is created, you need to purchase Provisioned Throughput to be able to use this model.

Cancel **Create Fine-tuning job**

us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/jobs/create?jobType=FINE\_TUNING&modelId=cohere.co... Paused

aws Services Search [Option+S]

CloudFormation EC2 RDS S3 Amazon SageMaker Amazon Bedrock AWS DeepRacer

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Output data [Info](#)  
Choose S3 location to store the model validation outputs.

S3 location  [View](#) [Browse S3](#)

Service access [Info](#) [Edit](#)  
Bedrock model customization job requires permissions to write to S3 on your behalf.

Choose a method to authorize Bedrock

- Use an existing service role
- Create and use a new service role

Service role name   
Maximum 64 characters. Use alphanumeric and '+=-,.@-\_ ' characters.

[View permission details](#)

**Purchase Provisioned Throughput to use fine-tuned model** [Learn more](#)  
After this custom model is created, you need to purchase Provisioned Throughput to be able to use this model.

[Cancel](#) [Create Fine-tuning job](#)



us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/jobs/create?jobType=FINE\_TUNING&modelId=cohere.co... Paused

aws Services Search [Option+S]

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- Model Evaluation

**Output data** [Info](#)  
Choose S3 location to store the model validation outputs.

**S3 location**

s3://cnn-daily-ft-output-20240630 [View](#) [Browse S3](#)

**Service access** [Info](#) [Edit](#)

Bedrock model customization job requires permissions to write to S3 on your behalf.

**Choose a method to authorize Bedrock**

Use an existing service role  
 Create and use a new service role

**Service role name**

cnn-daily-ft-service-role-20240630

Maximum 64 characters. Use alphanumeric and '+=-,.@-\_ ' characters.

[View permission details](#)

**Purchase Provisioned Throughput to use fine-tuned model** [Learn more](#)

After this custom model is created, you need to purchase Provisioned Throughput to be able to use this model.

[Cancel](#) [Create Fine-tuning job](#)



Amazon Bedrock | us-east-1 X + us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models Paused

aws Services Search [Option+S] CloudFormation EC2 RDS S3 Amazon SageMaker Amazon Bedrock AWS DeepRacer N. Virginia demouser @ 0947-8459-0684

Amazon Bedrock <

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Assessment & deployment Models (8) Purchase Provisioned Throughput Customize model

Create Fine-tuning job job cnn-daily-ft-20240630-morning created successfully. Once the training job completes successfully the model will be available in the Models table. Training time can vary depending on your hyperparameter settings.

Amazon Bedrock > Custom models

## Custom models Info

Customize model with Fine-tuning or Continued Pre-training.

### How it works

**Create a model**



Decide the custom model type you want to create, Fine-tuning or Continued Pre-training.

Create a model customization job. You need to purchase Provisioned Throughput before you can test or use your model in an application.

**Test a custom model**



Test your custom model in a playground or get the metrics from the model's details page.

**Use a custom model**



Use your model for inference in your application or experiment in the playground.

Models Jobs

Amazon Bedrock | us-east-1

us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models?tab=jobs

Paused

AWS Services Search [Option+S]

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## Amazon Bedrock

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### Assessment & deployment

Models Jobs (10)

Jobs (10) Training jobs are initiated when you begin customizing a model.

Find job

Job name	Status	Source	Job type	Custom model n...	Creation time
cnn-daily-ft-202...	Training	Command Light	Fine-tuning	cnn-daily-ft-202...	June 30, 2024, 1...

Amazon Bedrock | us-east-1 X + us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/item?arn=arn:aws:bedrock:us-east-1:094784590684:mo... Paused N. Virginia demouser @ 0947-8459-0684

aws Services Search [Option+S] CloudFormation EC2 RDS S3 Amazon SageMaker Amazon Bedrock AWS DeepRacer

## Amazon Bedrock

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### Training job : cnn-daily-ft-20240630-morning

Info

#### Training job overview

Custom model name	cnn-daily-ft-20240630	Job creation time	June 30, 2024, 10:24 (UTC+08:00)	Status	Training
Training job ARN	<a href="#">arn:aws:bedrock:us-east-1:094784590684:model-customization-job/cohere.command-light-text-v14:7:4k/kkgw68zdf9vr</a>	Job duration	a few seconds	Custom model encryption KMS key	Bedrock owned KMS key
Data access role	<a href="#">arn:aws:iam::094784590684:role/service-role/cnn-daily-ft-service-role-20240630</a>	Source model name	<a href="#">Command Light</a>	Source model ARN	<a href="#">arn:aws:bedrock:us-east-1::foundation-model/cohere.command-light-text-v14:7:4k</a>

#### Input data

S3 location [cnn-daily-ft-input-20240630](#)

#### Hyperparameters

Learning Rate	0.0001	Evaluation percentage	20.0	Maximum number of epochs	10
---------------	--------	-----------------------	------	--------------------------	----

# Labs

- Bedrock Console: text generation with Titan Text
- Bedrock Console: news summary with Command Light
- Bedrock SDK: news summary with Llama 2
- Bedrock SDK: image generation with Titan Image Generator
- SageMaker JumpStart console: text generation with Mistral
- SageMaker JumpStart SDK: dialog summary with LLama 3

[https://github.com/aws-samples/amazon-bedrock-workshop/tree/main/03\\_Model\\_customization](https://github.com/aws-samples/amazon-bedrock-workshop/tree/main/03_Model_customization)

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Cluster Data Science 3.0 Python 3 4 vCPU + 8 GiB Share

Setup for running customization notebooks both for fine-tuning and continued pre-training using Amazon Bedrock

In this notebook, we will create set of roles and an s3 bucket which will be used for other notebooks in this module.

This notebook should work well with the Data Science 3.0 , Python 3 , and ml.c5.2xlarge kernel in SageMaker Studio

**Prerequisites**

**Custom job role**

The notebook allows you to either create a Bedrock role for running customization jobs in the [Create IAM customisation job role](#) section or you can skip this section and create Bedrock Service role for customization jobs following [instructions on managing permissions for customization jobs](#). If you want to using an existing custom job role please edit the variable `customization_role` and also ensure it has access to the S3 bucket which is created containing the dataset.

**Create IAM Pre-requisites**

This notebook requires permissions to:

- create and delete Amazon IAM roles
- create, update and delete Amazon S3 buckets
- access Amazon Bedrock

If you are running this notebook without an Admin role, make sure that your role include the following managed policies:

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Cluster Data Science 3.0 Python 3 4 vCPU + 8 GiB Share

## Setup

Install and import all the needed libraries and dependencies to complete this notebook.

**Warning:** Please ignore error messages related to pip's dependency resolver.

```
[2]: !pip install --upgrade pip
%pip install --no-build-isolation --force-reinstall \
    "boto3>=1.28.57" \
    "awscli>=1.29.57" \
    "botocore>=1.31.57"
!pip install -qU --force-reinstall langchain typing_extensions pypdf urllib3==2.1.0
!pip install -qU ipywidgets>=7,<8
!pip install jsonlines
!pip install datasets==2.15.0
!pip install pandas==2.1.3
!pip install matplotlib==3.8.2
```

Requirement already satisfied: pip in /opt/conda/lib/python3.10/site-packages (24.1.2)  
WARNING: Running pip as the 'root' user can result in broken permissions and conflicting behaviour with the system package manager, possibly rendering your system unusable.  
It is recommended to use a virtual environment instead: <https://pip.pypa.io/warnings/venv>. Use the --root-user-action option if you know what you are doing and want to suppress this warning.  
Collecting boto3>=1.28.57  
Using cached boto3-1.34.143-py3-none-any.whl.metadata (6.6 kB)  
Collecting awscli>=1.29.57  
Using cached awscli-1.33.25-py3-none-any.whl.metadata (11 kB)  
Collecting botocore>=1.31.57  
Using cached botocore-1.34.143-py3-none-any.whl.metadata (5.7 kB)  
Collecting jmespath<2.0.0,>=0.7.1 (from boto3>=1.28.57)  
Using cached jmespath-1.0.1-py3-none-any.whl.metadata (7.6 kB)  
Collecting s3transfer<0.11.0,>=0.10.0 (from boto3>=1.28.57)

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[3]: # restart kernel for packages to take effect  
from IPython.core.display import HTML  
HTML("<script>Jupyter.notebook.kernel.restart()</script>")

[3]:

[4]: import warnings  
warnings.filterwarnings('ignore')  
import json  
import os  
import sys  
import boto3  
import time  
import pprint  
from datasets import load\_dataset  
import random  
import jsonlines

[5]: session = boto3.session.Session()  
region = session.region\_name  
sts\_client = boto3.client('sts')  
account\_id = sts\_client.get\_caller\_identity()["Account"]  
s3\_suffix = f"{region}-{account\_id}"  
bucket\_name = f"bedrock-customization-{s3\_suffix}"  
s3\_client = boto3.client('s3')  
bedrock = boto3.client(service\_name="bedrock")  
bedrock\_runtime = boto3.client(service\_name="bedrock-runtime")  
iam = boto3.client('iam', region\_name=region)

[6]: import uuid  
suffix = str(uuid.uuid4())  
role\_name = "BedrockRole-" + suffix  
s3\_bedrock\_finetuning\_access\_policy="BedrockPolicy-" + suffix  
customization\_role = f"arn:aws:iam::{account\_id}:role/{role\_name}"

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Cluster Data Science 3.0 Python 3 4 vCPU + 8 GiB Share

## Testing boto3 connection

We will list the foundation models to test the bot3 connection and make sure bedrock client has been successfully created.

```
for model in bedrock.list.foundation_models(
    byCustomizationType="FINE_TUNING")["modelSummaries"]:
    for key, value in model.items():
        print(key, ":", value)
    print("----\n")

modelArn : arn:aws:bedrock:us-east-1::foundation-model/amazon.titan-image-generator-v1:0
modelId : amazon.titan-image-generator-v1:0
modelName : Titan Image Generator G1
providerName : Amazon
inputModalities : ['TEXT', 'IMAGE']
outputModalities : ['IMAGE']
customizationsSupported : ['FINE_TUNING']
inferenceTypesSupported : ['PROVISIONED']
modelLifecycle : {'status': 'ACTIVE'}
-----

modelArn : arn:aws:bedrock:us-east-1::foundation-model/amazon.titan-text-lite-v1:0:4k
modelId : amazon.titan-text-lite-v1:0:4k
modelName : Titan Text G1 - Lite
providerName : Amazon
inputModalities : ['TEXT']
outputModalities : ['TEXT']
responseStreamingSupported : True
customizationsSupported : ['FINE_TUNING', 'CONTINUED_PRE_TRAINING']
inferenceTypesSupported : ['PROVISIONED']
modelLifecycle : {'status': 'ACTIVE'}
-----
```

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```
modelArn : arn:aws:bedrock:us-east-1::foundation-model/cohere.command-light-text-v14:7:4k
modelId : cohere.command-light-text-v14:7:4k
modelName : Command Light
providerName : Cohere
inputModalities : ['TEXT']
outputModalities : ['TEXT']
responseStreamingSupported : True
customizationsSupported : ['FINE_TUNING']
inferenceTypesSupported : ['PROVISIONED']
modelLifecycle : {'status': 'ACTIVE'}
-----

modelArn : arn:aws:bedrock:us-east-1::foundation-model/meta.llama2-13b-v1:0:4k ←
modelId : meta.llama2-13b-v1:0:4k
modelName : Llama 2 13B
providerName : Meta
inputModalities : ['TEXT']
outputModalities : ['TEXT']
responseStreamingSupported : True
customizationsSupported : ['FINE_TUNING']
inferenceTypesSupported : []
modelLifecycle : {'status': 'LEGACY'}
-----

modelArn : arn:aws:bedrock:us-east-1::foundation-model/meta.llama2-70b-v1:0:4k
modelId : meta.llama2-70b-v1:0:4k
modelName : Llama 2 70B
providerName : Meta
inputModalities : ['TEXT']
outputModalities : ['TEXT']
responseStreamingSupported : True
customizationsSupported : ['FINE_TUNING']
inferenceTypesSupported : []
modelLifecycle : {'status': 'LEGACY'}
```

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Cluster Data Science 3.0 Python 3 4 vCPU + 8 GiB Share

## Create s3 bucket

In this step we will create a s3 bucket, which will be used to store data for fine-tuning and continued pre-training notebooks.

```
[8]: # Create S3 bucket for knowledge base data source
s3bucket = s3_client.create_bucket(
    Bucket=bucket_name,
    ## Uncomment the following if you run into errors
    # CreateBucketConfiguration={
    #     'LocationConstraint':region,
    # },
)
```

## Creating role and policies required to run customization jobs with Amazon Bedrock

This JSON object defines the trust relationship that allows the bedrock service to assume a role that will give it the ability to talk to other required AWS services. The conditions set restrict the assumption of the role to a specific account ID and a specific component of the bedrock service (model\_customization\_jobs)

```
[9]: ROLE_DOC = f"""
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Principal": {
                "Service": "bedrock.amazonaws.com"
            },
            "Action": "sts:AssumeRole",
            "Condition": {
                "StringEquals": {
                    "aws:SourceAccount": "{account_id}"
                }
            }
        }
    ]
}
```

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d-c9qeuo6x91qp.studio.us-east-1.sagemaker.aws/jupyter/default/lab/tree/amazon-bedrock-workshop-20240712/03\_Model\_customization/00\_setup.ipynb

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```
[9]: ROLE_DOC = f"""{{
    "Version": "2012-10-17",
    "Statement": [
        {{
            "Effect": "Allow",
            "Principal": {{
                "Service": "bedrock.amazonaws.com"
            }},
            "Action": "sts:AssumeRole",
            "Condition": {{
                "StringEquals": {{
                    "aws:SourceAccount": "{account_id}"
                }},
                "ArnEquals": {{
                    "aws:SourceArn": "arn:aws:bedrock:{region}:{account_id}:model-customization-job/*"
                }}
            }}
        }}
    ]
}}"""

```

This JSON object defines the permissions of the role we want bedrock to assume to allow access to the S3 bucket that we created that will hold our fine-tuning datasets and allow certain bucket and object manipulations.

```
[10]: ACCESS_POLICY_DOC = f"""{{
    "Version": "2012-10-17",
    "Statement": [
        {{
            "Effect": "Allow",
            "Principal": "bedrock.amazonaws.com",
            "Action": "s3:ListBucket",
            "Resource": "arn:aws:s3:::{bucket_name}"
        }},
        {{
            "Effect": "Allow",
            "Principal": "bedrock.amazonaws.com",
            "Action": "s3:PutObject",
            "Resource": "arn:aws:s3:::{bucket_name}/*"
        }},
        {{
            "Effect": "Allow",
            "Principal": "bedrock.amazonaws.com",
            "Action": "s3:GetObject",
            "Resource": "arn:aws:s3:::{bucket_name}/*"
        }},
        {{
            "Effect": "Allow",
            "Principal": "bedrock.amazonaws.com",
            "Action": "s3:DeleteObject",
            "Resource": "arn:aws:s3:::{bucket_name}/*"
        }}
    ]
}}"""

```

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Cluster Data Science 3.0 | Python 3 | 4 vCPU + 8 GiB Share ⌂

```
[10]: ACCESS_POLICY_DOC = f"""{{
    "Version": "2012-10-17",
    "Statement": [
        {{
            "Effect": "Allow",
            "Action": [
                "s3:AbortMultipartUpload",
                "s3:DeleteObject",
                "s3:PutObject",
                "s3:GetObject",
                "s3:GetBucketAcl",
                "s3:GetBucketNotification",
                "s3>ListBucket",
                "s3:PutBucketNotification"
            ],
            "Resource": [
                "arn:aws:s3:::{bucket_name}",
                "arn:aws:s3:::{bucket_name}/*"
            ]
        }}
    ]
}}"""
```

```
[11]: response = iam.create_role(
    RoleName=role_name,
    AssumeRolePolicyDocument=ROLE_DOC,
    Description="Role for Bedrock to access S3 for finetuning",
)
pprint.pprint(response)

{'Role': {'Path': '/',
          'RoleName': 'BedrockRole-257549b9-3aff-4c30-86e9-530c1416e6ac',
          'RoleId': 'AROARMEM2CNOOMCZTH05I',
          'Arn': 'arn:aws:iamp::094784590684:role/BedrockRole-257549b9-3aff-4c30-86e9-530c1416e6ac',
```

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[11]:

```
response = iam.create_role(
    RoleName=role_name,
    AssumeRolePolicyDocument=ROLE_DOC,
    Description="Role for Bedrock to access S3 for finetuning",
)
pprint.pp(response)
```

{'Role': {'Path': '/',
 'RoleName': 'BedrockRole-257549b9-3aff-4c30-86e9-530c1416e6ac',
 'RoleId': 'AROARMEM2CNOOMCZTH05I',
 'Arn': 'arn:aws:iam::094784590684:role/BedrockRole-257549b9-3aff-4c30-86e9-530c1416e6ac',
 'CreateDate': datetime.datetime(2024, 7, 12, 5, 35, 7, tzinfo=tzlocal()),
 'AssumeRolePolicyDocument': {'Version': '2012-10-17',
 'Statement': [{'Effect': 'Allow',
 'Principal': {'Service': 'bedrock.amazonaws.com'},
 'Action': 'sts:AssumeRole',
 'Condition': {'StringEquals': {'aws:SourceAccount': '094784590684'},
 'ArnEquals': {'aws:SourceArn': 'arn:aws:bedrock:us-east-1:094784590684:model-customization-job/\*'}}]}},
 'ResponseMetadata': {'RequestId': '8b973123-4d38-47f2-9340-a5bd2907c10b',
 'HTTPStatusCode': 200,
 'HTTPHeaders': {'date': 'Fri, 12 Jul 2024 05:35:07 GMT',
 'x-amzn-requestid': '8b973123-4d38-47f2-9340-a5bd2907c10b',
 'content-type': 'text/xml',
 'content-length': '1812'},
 'RetryAttempts': 0}}

[12]:

```
role_arn = response["Role"]["Arn"]
pprint.pp(role_arn)
```

'arn:aws:iam::094784590684:role/BedrockRole-257549b9-3aff-4c30-86e9-530c1416e6ac'

[13]:

```
response = iam.create_policy(
    PolicyName=s3_bedrock_finetuning_access_policy,
    PolicyDocument=ACCESS_POLICY_DOC,
)
pprint.pp(response)
```

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[14]:

```
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Cluster Data Science 3.0 Python 3 4 vCPU + 8 GiB Share ⚡
```

```
        )
pprint.pp(response)

{'Policy': {'PolicyName': 'BedrockPolicy-257549b9-3aff-4c30-86e9-530c1416e6ac',
  'PolicyId': 'ANPARMEM2CNOPFWJXG3E2',
  'Arn': 'arn:aws:iam::094784590684:policy/BedrockPolicy-257549b9-3aff-4c30-86e9-530c1416e6ac',
  'Path': '/',
  'DefaultVersionId': 'v1',
  'AttachmentCount': 0,
  'PermissionsBoundaryUsageCount': 0,
  'IsAttachable': True,
  'CreateDate': datetime.datetime(2024, 7, 12, 5, 35, 7, tzinfo=tzlocal()),
  'UpdateDate': datetime.datetime(2024, 7, 12, 5, 35, 7, tzinfo=tzlocal())},
 'ResponseMetadata': {'RequestId': '8bfffbb0b-4903-4692-82e5-de0f1a92d5ce',
  'HTTPStatusCode': 200,
  'HTTPHeaders': {'date': 'Fri, 12 Jul 2024 05:35:07 GMT',
    'x-amzn-requestid': '8bfffbb0b-4903-4692-82e5-de0f1a92d5ce',
    'content-type': 'text/xml',
    'content-length': '835'},
  'RetryAttempts': 0}}
```

[14]:

```
policy_arn = response["Policy"]["Arn"]
pprint.pp(policy_arn)
```

```
'arn:aws:iam::094784590684:policy/BedrockPolicy-257549b9-3aff-4c30-86e9-530c1416e6ac'
```

[15]:

```
iam.attach_role_policy(
    RoleName=role_name,
    PolicyArn=policy_arn,
)
```

[15]:

```
{'ResponseMetadata': {'RequestId': '081e20e5-d600-4e22-9ae1-758abafc53c8',
  'HTTPStatusCode': 200,
  'HTTPHeaders': {'date': 'Fri, 12 Jul 2024 05:35:07 GMT',
    'x-amzn-requestid': '081e20e5-d600-4e22-9ae1-758abafc53c8',
    'content-type': 'text/xml',
    'content-length': '212'}}}
```

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## Prepare CNN news article dataset for fine-tuning job and evaluation

The dataset that will be used is a collection of new articles from CNN and the associated highlights from that article. More information can be found at [huggingface](https://huggingface.co/datasets/cnn_dailymail):  
[https://huggingface.co/datasets/cnn\\_dailymail](https://huggingface.co/datasets/cnn_dailymail)

#Load cnn dataset from huggingface  
dataset = load\_dataset("cnn\_dailymail", "3.0.0")

View the structure of the dataset

[17]: print(dataset)

```
DatasetDict({  
    train: Dataset({  
        features: ['article', 'highlights', 'id'],  
        num_rows: 287113  
    })  
    validation: Dataset({  
        features: ['article', 'highlights', 'id'],  
        num_rows: 13368  
    })  
    test: Dataset({  
        features: ['article', 'highlights', 'id'],  
        num_rows: 11490  
    })  
})
```

Prepare the Fine-tuning Dataset In this example, we are using a .jsonl dataset following example format:

```
{"prompt": "", "completion": ""}
```

The following is an example item for a question-answer task: {"prompt": "prompt is AWS", "completion": "it's Amazon Web Services"}

A screenshot of a web browser window titled "Amazon WorkSpaces". The address bar shows a URL starting with "d-c9qeuo6x91qp.studio.us-east-1.sagemaker.aws/jupyter/default/lab/tree/amazon-bedrock-workshop-20240712/03\_Model\_customization/00\_setup.ipynb". The browser interface includes standard navigation buttons (back, forward, search) and a tab bar with several open tabs.

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[18]: instruction='''Below is an instruction that describes a task, paired with an input that provides further context. Write a response that appropriately completes the request.'''

instruction:

Summarize the news article provided below.

input:

...

For the 'completion' component we will attach the word "response" and new lines together with the summary/highlights of the article. The transformation of each datapoint is performed with the code below

```
[19]: datapoints_train=[]
for dp in dataset['train']:
    temp_dict={}
    temp_dict['prompt']=instruction+dp['article']
    temp_dict['completion']='response:\n\n'+dp['highlights']
    datapoints_train.append(temp_dict)
```

An example of a processed datapoint can be printed below

```
[20]: print(datapoints_train[4]['prompt'])
```

Below is an instruction that describes a task, paired with an input that provides further context. Write a response that appropriately completes the request.

instruction:

Summarize the news article provided below.

input:

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An example of a processed datapoint can be printed below

```
print(datapoints_train[4]['prompt'])
```

Below is an instruction that describes a task, paired with an input that provides further context. Write a response that appropriately completes the request.

instruction:

Summarize the news article provided below.

input:

(CNN) -- The National Football League has indefinitely suspended Atlanta Falcons quarterback Michael Vick without pay, officials with the league said Friday. NFL star Michael Vick is set to appear in court Monday. A judge will have the final say on a plea deal. Earlier, Vick admitted to participating in a dogfighting ring as part of a plea agreement with federal prosecutors in Virginia. "Your admitted conduct was not only illegal, but also cruel and reprehensible. Your team, the NFL, and NFL fans have all been hurt by your actions," NFL Commissioner Roger Goodell said in a letter to Vick. Goodell said he would review the status of the suspension after the legal proceedings are over. In papers filed Friday with a federal court in Virginia, Vick also admitted that he and two co-conspirators killed dogs that did not fight well. Falcons owner Arthur Blank said Vick's admissions describe actions that are "incomprehensible and unacceptable." The suspension makes "a strong statement that conduct which tarnishes the good reputation of the NFL will not be tolerated," he said in a statement. Watch what led to Vick's suspension ». Goodell said the Falcons could "assert any claims or remedies" to recover \$22 million of Vick's signing bonus from the 10-year, \$130 million contract he signed in 2004, according to The Associated Press. Vick said he would plead guilty to one count of "Conspiracy to Travel in Interstate Commerce in Aid of Unlawful Activities and to Sponsor a Dog in an Animal Fighting Venture" in a plea agreement filed at U.S. District Court in Richmond, Virginia. The charge is punishable by up to five years in prison, a \$250,000 fine, "full restitution, a special assessment and 3 years of supervised release," the plea deal said. Federal prosecutors agreed to ask for the low end of the sentencing guidelines. "The defendant will plead guilty because t

The same processing is done for the validation and test sets as well.

```
[21]: datapoints_valid=[]
for dp in dataset['validation']:
    temp_dict={}
    temp_dict['prompt']=instruction+dp['article']
    temp_dict['completion']='response:\n\n'+dp['highlights']
    datapoints_valid.append(temp_dict)
```

```
[22]: datapoints_test=[]
```

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/ ... / 03\_Model\_customization / fine-tuning-datasets /

Name	Last Modified
model-customization-job-hj6q5...	a day ago
test-cnn-10.jsonl	a day ago
train-cnn-5K.jsonl	a day ago
validation-cnn-1K.jsonl	a day ago

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```
1 {"prompt": "Below is an instruction that describes a task, paired with an input that provides further context. Write a response that appropriately completes the request.\n\ninstruction:\n\nSummarize the news article provided below.\n\ninput:\n\n(CNN) -- Slim Whitman, the high-pitched yodeling country music singer whose productive career spanned decades, died Wednesday, his son-in-law told CNN. He was 90. The singer-songwriter, born Ottis Dewey Whitman Jr., died of heart failure at Orange Park Medical Center in Florida, Roy Beagle said. Whitman gained fame in Europe as well as the United States. \"Love Song of the Waterfall,\" which a Country Music Television biography calls his \"breakthrough\" hit, was released in the early '50s. His next single \"Indian Love Call\" brought him stardom, according to the bio. \"Whitman joined the Grand Ole Opry, and then went to Britain in 1956 as the first country singer to play the London Palladium. Throughout the late '50s and early '60s, he had a string of British hits, including 'Tumbling Tumbleweeds,' 'Unchain My Heart,' and 'I'll Take You Home Again Kathleen,'\" the bio said. He gained cult status after he filmed a TV commercial that touted a released of his top greatest hits, a compilation that was a great success. \"Between 1980 and 1984, Whitman had a small run of minor hits, highlighted by 1980's number 15 hit 'When.' In the late '80s, he returned to television-marketed albums, releasing Slim Whitman: Best Loved Favorites in 1989 and 20 Precious Memories in 1991. During the '90s, Whitman recorded infrequently but continued to tour successfully, particularly in Europe and Australia,\" CMT said. His music was featured in the 1996 film \"Mars Attacks!\" In the film, the sound of Whitman's \"Indian Love Call\" made the heads of invading Martians explode. People we've lost in 2013: The lives they lived .", "completion": "response:\n\nCountry music singer Slim Whitman died at 90 Wednesday .\nThe cause was heart failure .\nThe yodeling singer gained fame in Europe as well as in the U.S."}
```

2 {"prompt": "Below is an instruction that describes a task, paired with an input that provides further context. Write a response that appropriately completes the request.\n\ninstruction:\n\nSummarize the news article provided below.\n\ninput:\n\nA young schoolgirl was horrified to discover six metal nails in her chicken and chips from the family's favourite local takeaway. Mollie Howe, 11, had been just about to tuck in to her tea when she spotted the inch-long nails in the £1.30 meal. Her furious mother, Sharon Howe, 39, has now blasted the Red Rooster fast food outlet, in Dagenham, Essex, which served her daughter the dangerous meal. Mollie Howe (left) and her mother Sharon Howe (right) were horrified to discover six nails in her takeaway from Red Rooster in Dagenham, Essex . Ms Howe said: 'I'm just so glad Mollie didn't eat it - who knows what might have happened? She came home, opened it up and there were these six nails - just like the ones you hammer into the wall. 'It's even more worrying because my dad could have eaten it as he often goes there too. He's 81 and lives on his own.' Ms Howe, of Dagenham, Essex, added that her family had been regular customers at the Red Rooster takeaway for years - but none of them will be going back. 'It's almost an everyday thing because it's cheap and cheerful. But I definitely won't be going there again - it just isn't worth the risk,' said the mother-of-two. The lethal inch-long metal nails were discovered nestled amongst the 11-year-old's chicken and chips . Maumand Khan, who works at Red Rooster (pictured) apologised and said he was baffled as to how the nails had got into the schoolgirl's food . 'None of my family and friends will be using it either. 'I just want people to be aware of what happened because it could have been a lot worse if poor Mollie had started eating and swallowed those nails.' Ms Howe said she was so outraged that she immediately went to confront staff at Red Rooster with her son Reece Hare, 21. 'I was so angry that my son wouldn't even let me go in there to see them,' she admitted. 'He went in instead and told them about it and they just wanted to offer him more food - it's not good enough.' Maumand Khan, who works at the takeaway, said he was baffled as to how the nails had got into Mollie's food. Mr Khan said: 'We are terribly sorry, but we can't understand how this has happened. 'We don't have that kind of nail anywhere in the shop .' He said they had not had any other complaints of this nature since the Red Rooster opened back in 2000. Furious Ms Howe

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The same processing is done for the validation and test sets as well.

```
[21]: datapoints_valid=[]
for dp in dataset['validation']:
    temp_dict={}
    temp_dict['prompt']=instruction+dp['article']
    temp_dict['completion']='response:\n\n'+dp['highlights']
    datapoints_valid.append(temp_dict)

[22]: datapoints_test=[]
for dp in dataset['test']:
    temp_dict={}
    temp_dict['prompt']=instruction+dp['article']
    temp_dict['completion']='response:\n\n'+dp['highlights']
    datapoints_test.append(temp_dict)
```

Here we define some helper functions to process our datapoints further by modifying the number of datapoints we want to include in each set and the max string length of the datapoints we want to include. The final function will convert our datasets into JSONL files.

```
[23]: def dp_transform(data_points,num_dps,max_dp_length):
    lines=[]
    for dp in data_points:
        if len(dp['prompt']+dp['completion'])<=max_dp_length:
            lines.append(dp)
    random.shuffle(lines)
    lines=lines[:num_dps]
    return lines

[24]: def jsonl_converter(dataset,file_name):
    print(file_name)
    with jsonlines.open(file_name, 'w') as writer:
        for line in dataset:
```

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Process data partitions. Every LLM may have different input token limits and what string of characters represents a token is defined by a particular model's vocabulary. For simplicity, we have restricted each datapoint to be <=3,000 characters.

```
[25]: train=dp_transform(datapoints_train,5000,3000)
validation=dp_transform(datapoints_valid,999,3000)
test=dp_transform(datapoints_test,10,3000)
```

## Create local directory for datasets

Please note that your training dataset for fine-tuning cannot be greater than 10K records, and validation dataset has a maximum limit of 1K records.

```
[26]: dataset_folder="fine-tuning-datasets"
train_file_name="train-cnn-5K.jsonl"
validation_file_name="validation-cnn-1K.jsonl"
test_file_name="test-cnn-10.jsonl"
!mkdir fine-tuning-datasets
abs_path=os.path.abspath(dataset_folder)

mkdir: cannot create directory ‘fine-tuning-datasets’: File exists
```

## Create JSONL format datasets for Bedrock fine-tuning job

```
[27]: jsonl_converter(train,f'{abs_path}/{train_file_name}')
jsonl_converter(validation,f'{abs_path}/{validation_file_name}')
jsonl_converter(test,f'{abs_path}/{test_file_name}')

/root/amazon-bedrock-workshop-20240712/03_Model_customization/fine-tuning-datasets/train-cnn-5K.jsonl
/root/amazon-bedrock-workshop-20240712/03_Model_customization/fine-tuning-datasets/validation-cnn-1K.jsonl
/root/amazon-bedrock-workshop-20240712/03_Model_customization/fine-tuning-datasets/test-cnn-10.jsonl
```

## Upload datasets to s3 bucket

A screenshot of a web browser window titled "Amazon WorkSpaces". The address bar shows a URL starting with "d-c9qeuo6x91qp.studio.us-east-1.sagemaker.aws/jupyter/default/lab/tree/amazon-bedrock-workshop-20240712/03\_Model\_customization/00\_setup.ipynb". The browser interface includes standard navigation buttons (back, forward, search) and a tab bar with several open tabs.

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## Upload datasets to s3 bucket

Uploading both training and test dataset. We will use the training and validation datasets for fine-tuning the model. The test dataset will be used for evaluating the performance of the model on an unseen input.

```
[28]: s3_client.upload_file(f'{abs_path}/{train_file_name}', bucket_name, f'fine-tuning-datasets/train/{train_file_name}')
s3_client.upload_file(f'{abs_path}/{validation_file_name}', bucket_name, f'fine-tuning-datasets/validation/{validation_file_name}')
s3_client.upload_file(f'{abs_path}/{test_file_name}', bucket_name, f'fine-tuning-datasets/test/{test_file_name}'')
```

```
[29]: s3_train_uri=f's3://{bucket_name}/fine-tuning-datasets/train/{train_file_name}'
s3_validation_uri=f's3://{bucket_name}/fine-tuning-datasets/validation/{validation_file_name}'
s3_test_uri=f's3://{bucket_name}/fine-tuning-datasets/test/{test_file_name}''
```

## Storing variables to be used in other notebooks.

Please make sure to use the same kernel as used for 00\_setup.ipynb for other notebooks on fine-tuning and continued pre-training.

```
[30]: %store role_arn
%store bucket_name
%store role_name
%store policy_arn
%store s3_train_uri
%store s3_validation_uri
%store s3_test_uri
```

```
Stored 'role_arn' (str)
Stored 'bucket_name' (str)
Stored 'role_name' (str)
Stored 'policy_arn' (str)
Stored 's3_train_uri' (str)
Stored 's3_validation_uri' (str)
```

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Name	Last Modified
data	18 hours ago
fine-tuning-datasets	a day ago
=7,	a day ago
00_setup.ipynb	2 hours ago
01_fine-tuning-lite.ipynb	2 hours ago
02_fine-tuning_llama2.ipynb	2 hours ago
03_continued_pretraining_titan...	2 hours ago
04_cleanup.ipynb	a day ago
README.md	a day ago

A red arrow points to the '02\_fine-tuning\_llama2.ipynb' file in the list.

# Fine-tune Meta Llama2 13B model provided by Amazon Bedrock: End-to-End

In this notebook we demonstrate using Boto3 sdk for the fine-tuning and provisioning of Llama2 13B model in Bedrock. You can also do this through the Bedrock Console.

**Warning:** This module cannot be executed in Workshop Studio Accounts, and you will have to run this notebook in your own account.

## A Summarization Use Case

In this notebook, we build an end-to-end workflow for fine-tuning and evaluating the Foundation Models (FMs) in Amazon Bedrock. We choose Meta Llama 2 13B as our FM to perform the customization through fine-tuning, we then create provisioned throughput of the fine-tuned model, test the provisioned model invocation, and finally evaluate the fine-tuned model performance using fmeval on the summarization accuracy metrics including METEOR, ROUGE, and BERT scores. We have defined these scores in the Evaluate the Provisioned Custom Model section below.

\*This notebook should work well with the Data Science 3.0, Python 3, and ml.c5.2xlarge kernel in SageMaker Studio\*

## Prerequisites

- Make sure you have executed 00\_setup.ipynb notebook.
- Make sure you are using the same kernel and instance as 00\_setup.ipynb notebook.

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# Fine-tune Meta Llama2 13B model provided by Amazon Bedrock: End-to-End

In this notebook we demonstrate using Boto3 sdk for the fine-tuning and provisioning of Llama2 13B model in Bedrock. You can also do this through the Bedrock Console.

**Warning:** This module cannot be executed in Workshop Studio Accounts, and you will have to run this notebook in your own account.

## A Summarization Use Case

In this notebook, we build an end-to-end workflow for fine-tuning and evaluating the Foundation Models (FMs) in Amazon Bedrock. We choose Meta Llama 2 13B as our FM to perform the customization through fine-tuning, we then create provisioned throughput of the fine-tuned model, test the provisioned model invocation, and finally evaluate the fine-tuned model performance using fmeval on the summarization accuracy metrics including METEOR, ROUGE, and BERT scores. We have defined these scores in the Evaluate the Provisioned Custom Model section below.

\*This notebook should work well with the Data Science 3.0, Python 3, and ml.c5.2xlarge kernel in SageMaker Studio\*

## Prerequisites

- Make sure you have executed `00_setup.ipynb` notebook.
- Make sure you are using the same kernel and instance as `00_setup.ipynb` notebook.

In this notebook we demonstrate using Boto3 sdk for the fine-tuning and provisioning of Llama2 13B model in Bedrock. You can also do this through the Bedrock Console.

**Warning:** This notebook will create provisioned throughput for testing the fine-tuned model. Therefore, please make sure to delete the provisioned throughput as mentioned in the last section of the notebook, otherwise you will be charged for it, even if you are not using it.

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## Setup

Install and import all the needed libraries and dependencies to complete this notebook.

Please ignore error messages related to pip's dependency resolver.

```
[2]: # # install the fmeval package for foundation model evaluation
!rm -Rf ~/.cache/pip/*
!pip install tokenizers==0.12.1
!pip install -qU fmeval==0.3.0

Collecting tokenizers==0.12.1
  Downloading tokenizers-0.12.1-cp310-cp310-manylinux_2_12_x86_64.manylinux2010_x86_64.whl.metadata (6.5 kB)
  Downloading tokenizers-0.12.1-cp310-cp310-manylinux_2_12_x86_64.manylinux2010_x86_64.whl (6.6 MB)
    6.6/6.6 MB 39.9 MB/s eta 0:00:00:00:01
Installing collected packages: tokenizers
Attempting uninstall: tokenizers
  Found existing installation: tokenizers 0.19.1
  Uninstalling tokenizers-0.19.1:
    Successfully uninstalled tokenizers-0.19.1
ERROR: pip's dependency resolver does not currently take into account all the packages that are installed. This behaviour is the source of the following dependency conflict
s.
transformers 4.42.4 requires tokenizers<0.20,>=0.19, but you have tokenizers 0.12.1 which is incompatible.
Successfully installed tokenizers-0.12.1
WARNING: Running pip as the 'root' user can result in broken permissions and conflicting behaviour with the system package manager, possibly rendering your system unusable.
It is recommended to use a virtual environment instead: https://pip.pypa.io/warnings/venv. Use the --root-user-action option if you know what you are doing and want to suppress this warning.
ERROR: pip's dependency resolver does not currently take into account all the packages that are installed. This behaviour is the source of the following dependency conflict
s.
sphinx 7.2.6 requires docutils<0.21,>=0.18.1, but you have docutils 0.16 which is incompatible.
WARNING: Running pip as the 'root' user can result in broken permissions and conflicting behaviour with the system package manager, possibly rendering your system unusable.
It is recommended to use a virtual environment instead: https://pip.pypa.io/warnings/venv. Use the --root-user-action option if you know what you are doing and want to suppress this warning.
```

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[3]: 

```
# restart kernel for packages to take effect
from IPython.core.display import HTML
HTML("<script>Jupyter.notebook.kernel.restart()</script>")
```

[3]:

[4]: 

```
## Fetching variables from `00_setup.ipynb` notebook.
%store -r role_arn
%store -r s3_train_uri
%store -r s3_validation_uri
%store -r s3_test_uri
%store -r bucket_name
```

[5]: 

```
import pprint
pprint.pprint(role_arn)
pprint.pprint(s3_train_uri)
pprint.pprint(s3_validation_uri)
pprint.pprint(s3_test_uri)
pprint.pprint(bucket_name)
```

'arn:aws:iam::094784590684:role/BedrockRole-257549b9-3aff-4c30-86e9-530c1416e6ac'
's3://bedrock-customization-us-east-1-094784590684/fine-tuning-datasets/train/train-cnn-5K.jsonl'
's3://bedrock-customization-us-east-1-094784590684/fine-tuning-datasets/validation/validation-cnn-1K.jsonl'
's3://bedrock-customization-us-east-1-094784590684/fine-tuning-datasets/test/test-cnn-10.jsonl'
'bedrock-customization-us-east-1-094784590684'

[6]: 

```
import warnings
warnings.filterwarnings('ignore')
import json
import os
import sys
import boto3
import pandas as pd
from matplotlib import pyplot as plt
```

Amazon SageMaker Studio Classic      File Edit View Run Kernel Git Tabs Settings Help      default-20240221t112169 / Personal Studio

[00\_setup.ipynb] [01\_fine-tuning-titan-lite.ipynb] [02\_fine-tuning\_llama2.ipynb] [03\_continued\_pretraining\_tita...] [1-TIGFT-customization-job.ip...] [2-TIGFT-provisioned-throughp...]

[7]: session = boto3.Session()  
region = session.region\_name  
sts\_client = boto3.client('sts')  
s3\_client = boto3.client('s3')  
aws\_account\_id = sts\_client.get\_caller\_identity()["Account"]  
bedrock = boto3.client(service\_name="bedrock")  
bedrock\_runtime = boto3.client(service\_name="bedrock-runtime")

[8]: test\_file\_name = "test-cnn-10.jsonl"  
data\_folder = "fine-tuning-datasets"

## Create the Fine-Tuning Job

Note: Fine-tuning job will take around 60mins to complete with 5K records.

Meta Llama2 customization hyperparameters:

- epochs : The number of iterations through the entire training dataset and can take up any integer values in the range of 1-10, with a default value of 2.
- batchSize : The number of samples processed before updating model parameters and can take up any integer values in the range of 1-64, with a default value of 1.
- learningRate : The rate at which model parameters are updated after each batch which can take up a float value between 0.0-1.0 with a default value set to 1.00E-5.
- learningRateWarmupSteps : The number of iterations over which the learning rate is gradually increased to the specified rate and can take any integer value between 0-250 with a default value of 5.

For guidelines on setting hyper-parameters refer to the guidelines provided [here](#)

[9]: from datetime import datetime  
ts = datetime.now().strftime("%Y-%m-%d-%H-%M-%S")

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Cluster Data Science 3.0 Python 3 4 vCPU + 8 GiB Share

## Create the Fine-Tuning Job

Note: Fine-tuning job will take around 60mins to complete with 5K records.

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- learningRate : The rate at which model parameters are updated after each batch which can take up a float value between 0.0-1.0 with a default value set to 1.00E-5.
- learningRateWarmupSteps : The number of iterations over which the learning rate is gradually increased to the specified rate and can take any integer value between 0-250 with a default value of 5.

For guidelines on setting hyper-parameters refer to the guidelines provided [here](#)

```
[9]: from datetime import datetime
ts = datetime.now().strftime("%Y-%m-%d-%H-%M-%S")

# Choose the foundation model you want to customize and provide ModelId(find more about model reference at https://docs.aws.amazon.com/bedrock/latest/userguide/bedrock-reference.html)
base_model_id = "meta.llama2-13b-v1:0:4k"

# Select the customization type from "FINE_TUNING" or "CONTINUED_PRE_TRAINING".
customization_type = "FINE_TUNING"

# Specify the roleArn for your customization job
customization_role = role_arn

# Create a customization job name
customization_job_name = f"llama2-finetune-sm-test-model-{ts}"
```

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[9]:

```
from datetime import datetime
ts = datetime.now().strftime("%Y-%m-%d-%H-%M-%S")

# Choose the foundation model you want to customize and provide ModelId(find more about model reference at https://docs.aws.amazon.com/bedrock/latest/userguide/bedrock-reference.html)
base_model_id = "meta.llama2-13b-v1:0:4k"

# Select the customization type from "FINE_TUNING" or "CONTINUED_PRE_TRAINING".
customization_type = "FINE_TUNING"

# Specify the roleArn for your customization job
customization_role = role_arn

# Create a customization job name
customization_job_name = f"llama2-finetune-sm-test-model-{ts}"

# Create a customized model name for your fine-tuned Llama2 model
custom_model_name = f"llama2-finetune-{ts}"

# Define the hyperparameters for fine-tuning Llama2 model
hyper_parameters = {
    "epochCount": "2",
    "batchSize": "1",
    "learningRate": "0.00005",
}

# Specify your data path for training, validation(optional) and output
training_data_config = {"s3Uri": s3_train_uri}

# # uncomment the below section if you have validation dataset and provide the s3 uri for it.
validation_data_config = [
    {
        "s3Uri": s3_validation_uri
    }
]
```

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```
output_data_config = {"s3Uri": f's3://{bucket_name}/outputs/output-{custom_model_name}'}

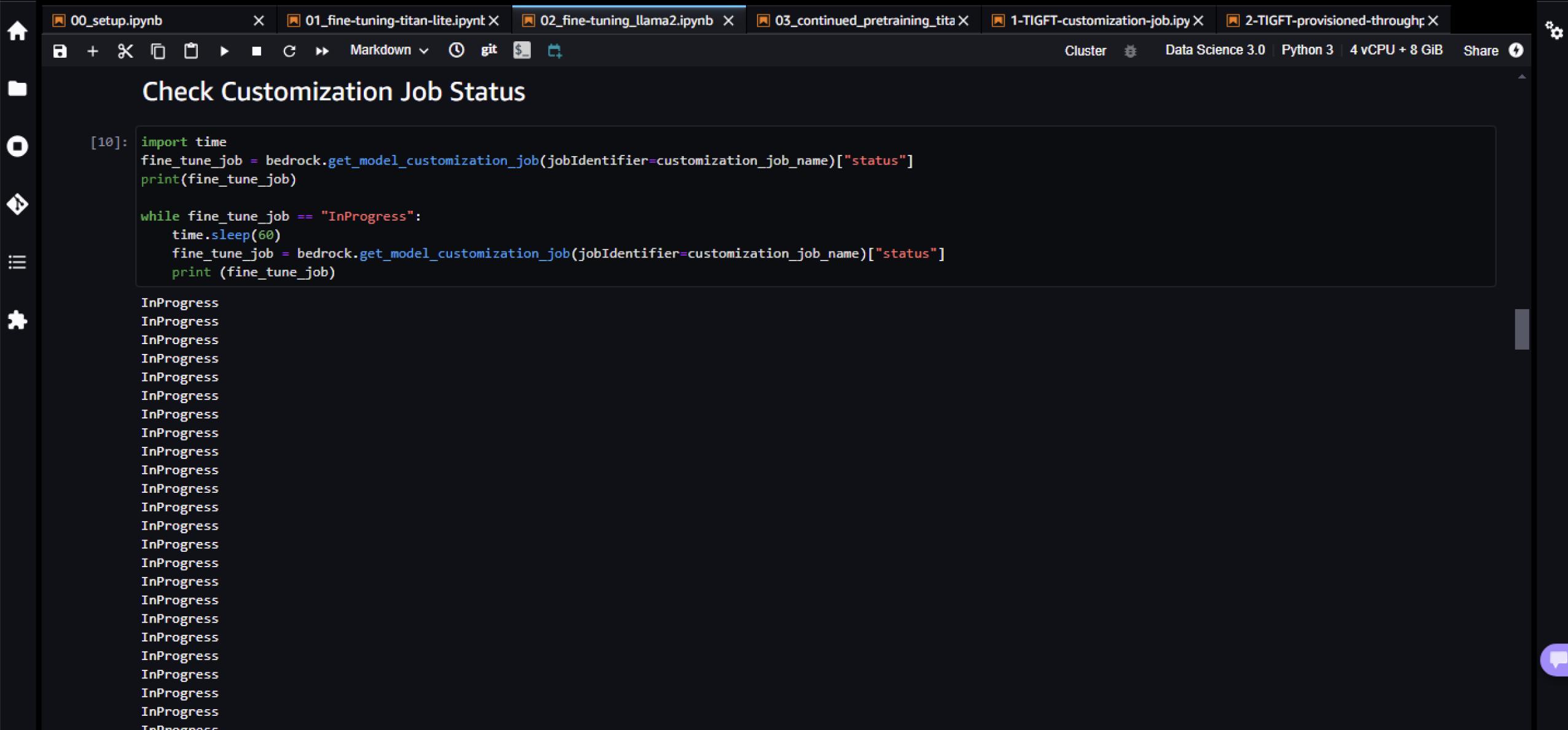
# # Create the customization job
bedrock.create_model_customization_job(
    customizationType=customization_type,
    jobName=customization_job_name,
    customModelName=custom_model_name,
    roleArn=customization_role,
    baseModelIdentifier=base_model_id,
    hyperParameters=hyper_parameters,
    trainingDataConfig=training_data_config,
    validationDataConfig=validation_data_config,
    outputDataConfig=output_data_config
)
```

[9]: { 'ResponseMetadata': { 'RequestId': '814513c4-65b0-41bc-b83e-5abae996cf6c',  
'HTTPStatusCode': 201,  
'HTTPHeaders': { 'date': 'Fri, 12 Jul 2024 05:39:59 GMT',  
'content-type': 'application/json',  
'content-length': '112',  
'connection': 'keep-alive',  
'x-amzn-requestid': '814513c4-65b0-41bc-b83e-5abae996cf6c'},  
'RetryAttempts': 0},  
'jobArn': 'arn:aws:bedrock:us-east-1:094784590684:model-customization-job/meta.llama2-13b-v1:0:4k/hj6q5t4jcg91' }

## Check Customization Job Status

```
[10]: import time
fine_tune_job = bedrock.get_model_customization_job(jobIdentifier=customization_job_name)[ "status"]
print(fine_tune_job)

while fine_tune_job == "InProgress":
    time.sleep(10)
```



Screenshot of the Amazon Bedrock console showing the Custom models page.

The URL in the browser is [us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models?tab=jobs](https://us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models?tab=jobs).

The sidebar on the left includes sections for Getting started, Foundation models (Base models, Custom models selected), Playgrounds (Chat, Text, Image), Safeguards (Guardrails, Watermark detection), Builder tools (Knowledge bases, Agents, Prompt management Preview, Prompt flows Preview), and Assessment & deployment.

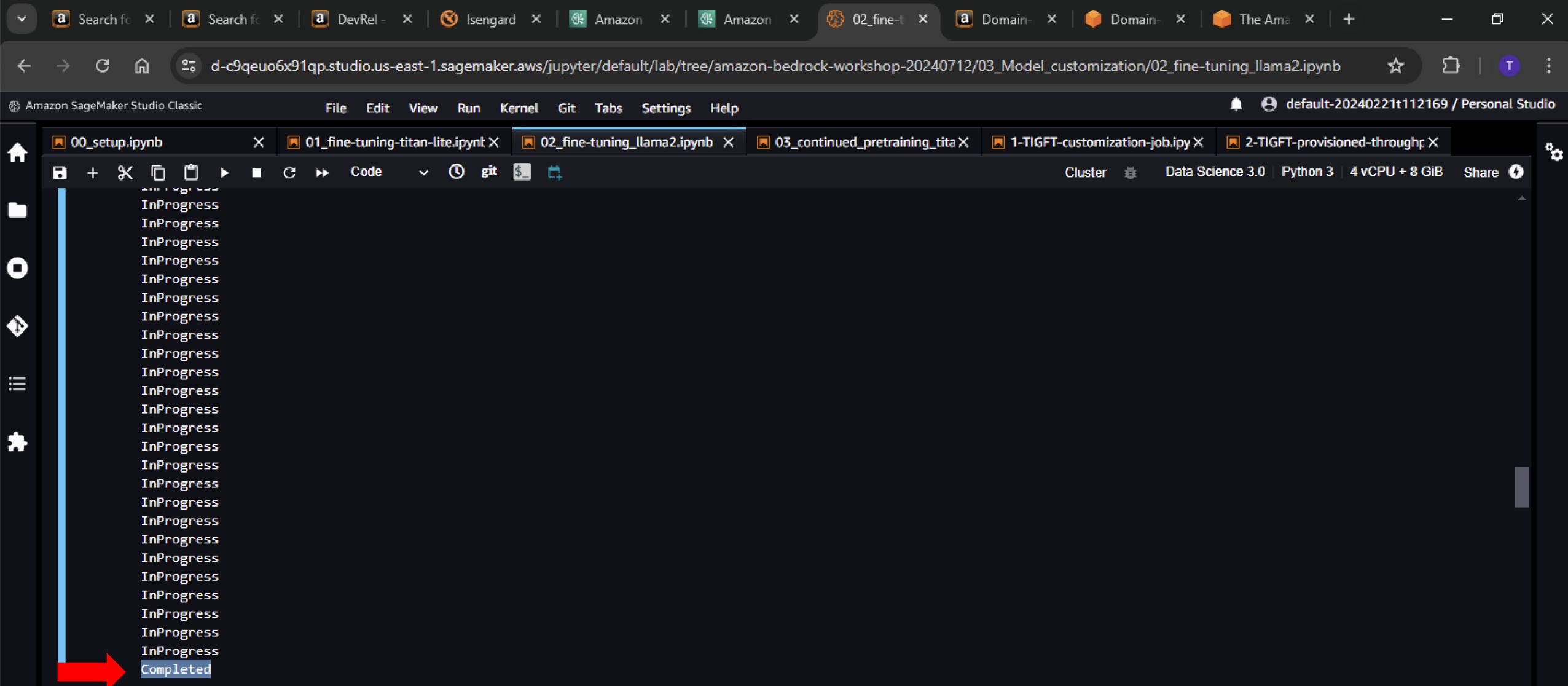
The main content area shows the "Custom models" page with the following sections:

- How it works:**
  - Create a model:** Three sliders for configuration.
  - Decide the custom model type you want to create, Fine-tuning or Continued Pre-training.
  - Create a model customization job. You need to purchase Provisioned Throughput before you can test or use your model in an application.
- Test a custom model:** Shows a play button icon. Test your custom model in a playground or get the metrics from the model's details page.
- Use a custom model:** Shows a cube icon. Use your model for inference in your application or experiment in the playground.

Below this, there are tabs for **Models** and **Jobs** (selected). The **Jobs** section displays 10 training jobs:

Job name	Status	Source	Job type	Custom model name	Creation time
llama2-finetune-sm-te...	Training	Llama 2 13B	Fine-tuning	llama2-finetune-20...	July 12, 2024, 13:...

A red arrow points to the "Training" status of the first job.



A screenshot of the Amazon SageMaker Studio interface. The top navigation bar shows the title "Amazon WorkSpaces" and a series of tabs. The main workspace displays a list of fine-tuning jobs. A red arrow points to the last item in the list, which is labeled "Completed".

Job Status
InProgress
Completed

## Retrieve Custom Model

Once the customization job is finished, you can check your existing custom model(s) and retrieve the `modelArn` of your fine-tuned Llama2 model.

```
[11]: # You can list your custom models using the command below  
bedrock.list_custom_models()
```

AI/ML and Generative AI Enable | Isengard | Amazon Bedrock | us-east-1 | SageMaker Studio | 02\_fine-tuni... (4) - JupyterLab | Paused

us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models?tab=jobs

Services Search [Alt+S]

Amazon Bedrock > Custom models

Custom models Info

Customize model with Fine-tuning or Continued Pre-training.

▼ How it works

Create a model

— — —

Decide the custom model type you want to create, Fine-tuning or Continued Pre-training.

Test a custom model

! Test your custom model in a playground or get the metrics from the model's details page.

Use a custom model

Use your model for inference in your application or experiment in the playground.

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- Prompt flows [Preview](#)

Assessment & deployment

Models [Jobs](#)

Jobs (10)

Training jobs are initiated when you begin customizing a model.

Find job

C Stop job Customize model

Job name	Status	Source	Job type	Custom model name	Creation...
llama2-finetune-sm-test-mod...	Complete	Llama 2 13B	Fine-tuning	llama2-finetune-20...	July 12, 2...

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## Retrieve Custom Model

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```
# You can list your custom models using the command below
bedrock.list_custom_models()
```

[11]: { 'ResponseMetadata': { 'RequestId': 'c13432a9-498c-4300-8b6b-5297b2664c86', 'HTTPStatusCode': 200, 'HTTPHeaders': { 'date': 'Fri, 12 Jul 2024 06:26:07 GMT', 'content-type': 'application/json', 'content-length': '3719', 'connection': 'keep-alive', 'x-amzn-requestid': 'c13432a9-498c-4300-8b6b-5297b2664c86' }, 'RetryAttempts': 0 }, 'modelSummaries': [ { 'modelArn': 'arn:aws:bedrock:us-east-1:094784590684:custom-model/meta.llama2-13b-v1:0:4k/vrme87cn8271', 'modelName': 'llama2-finetune-2024-07-12-05-39-59', 'creationTime': datetime.datetime(2024, 7, 12, 5, 39, 59, 672000, tzinfo=tzlocal()), 'baseModelArn': 'arn:aws:bedrock:us-east-1::foundation-model/meta.llama2-13b-v1:0:4k', 'baseModelName': '', 'customizationType': 'FINE\_TUNING' }, { 'modelArn': 'arn:aws:bedrock:us-east-1:094784590684:custom-model/cohere.command-light-text-v14:7:4k/jglb0h06zthe', 'modelName': 'cnn-daily-ft-20240630', 'creationTime': datetime.datetime(2024, 6, 30, 2, 24, 3, 210000, tzinfo=tzlocal()), 'baseModelArn': 'arn:aws:bedrock:us-east-1::foundation-model/cohere.command-light-text-v14:7:4k', 'baseModelName': '', 'customizationType': 'FINE\_TUNING' }, { 'modelArn': 'arn:aws:bedrock:us-east-1:094784590684:custom-model/meta.llama2-13b-v1:0:4k/34kn0fkqp2sb', 'modelName': 'llama2-finetune-2024-06-26-14-13-22', 'creationTime': datetime.datetime(2024, 6, 26, 14, 13, 22, 359000, tzinfo=tzlocal()), 'baseModelArn': 'arn:aws:bedrock:us-east-1::foundation-model/meta.llama2-13b-v1:0:4k', 'baseModelName': '', 'customizationType': 'FINE\_TUNING' } ] }

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[12]: # retrieve the modelArn of the fine-tuned model  
fine\_tune\_job = bedrock.get\_custom\_model(modelIdentifier=custom\_model\_name)  
custom\_model\_id = fine\_tune\_job['modelArn']

[13]: output\_job\_name = "model-customization-job-"+fine\_tune\_job['jobArn'].split('/')[-1]  
output\_job\_name

[13]: 'model-customization-job-hj6q5t4jcg91' 

## Visualize Training and Validation Loss

Now that we have completed fine-tuning job, lets visualize our results to see if our job is not underfitting or overfitting.

Download model customization job metrics from S3 and plot the learning curves.

[14]: output\_metrics\_path = f"fine-tuning-datasets/{output\_job\_name}"

[15]: !mkdir \$output\_metrics\_path

[16]: train\_metrics\_s3\_prefix=f'outputs/output-{custom\_model\_name}/{output\_job\_name}/training\_artifacts/step\_wise\_training\_metrics.csv'  
validation\_metrics\_s3\_prefix=f'outputs/output-{custom\_model\_name}/{output\_job\_name}/validation\_artifacts/post\_fine\_tuning\_validation/validation/validation\_metrics.csv'  
train\_metrics\_name='train\_metrics.csv'  
validation\_metrics\_name='validation\_metrics.csv'  
train\_file\_name\_local=output\_metrics\_path+'/'+train\_metrics\_name  
validation\_file\_name\_local=output\_metrics\_path+'/'+validation\_metrics\_name

[17]: s3\_client.download\_file(bucket\_name, train\_metrics\_s3\_prefix, train\_file\_name\_local)  
s3\_client.download\_file(bucket\_name, validation\_metrics\_s3\_prefix, validation\_file\_name\_local)

[18]: train\_data = pd.read\_csv(train\_file\_name\_local)  
'''The training loss is at an iteration level. To calculate loss at the epoch level,

A screenshot of an Amazon SageMaker Studio Classic interface showing a Jupyter notebook titled "02\_fine-tuning\_llama2.ipynb". The notebook contains code for visualizing training and validation loss.

The top navigation bar includes tabs for "File", "Edit", "View", "Run", "Kernel", "Git", "Tabs", "Settings", and "Help". The URL in the address bar is "d-c9qeuo6x91qp.studio.us-east-1.sagemaker.aws/jupyter/default/lab/tree/amazon-bedrock-workshop-20240712/03\_Model\_customization/02\_fine-tuning\_llama2.ipynb".

The toolbar below the tabs includes icons for file operations (New, Open, Save, etc.), a "Code" dropdown, a "git" icon, and a "Cluster" dropdown showing "Data Science 3.0 | Python 3 | 4 vCPU + 8 GiB".

## Visualize Training and Validation Loss

Now that we have completed fine-tuning job, lets visualize our results to see if our job is not underfitting or overfitting.

Download model customization job metrics from S3 and plot the learning curves.

```
[14]: output_metrics_path = f"fine-tuning-datasets/{output_job_name}"  
[15]: !mkdir $output_metrics_path  
[16]: train_metrics_s3_prefix=f'outputs/output-{custom_model_name}/{output_job_name}/training_artifacts/step_wise_training_metrics.csv'  
validation_metrics_s3_prefix=f'outputs/output-{custom_model_name}/{output_job_name}/validation_artifacts/post_fine_tuning_validation/validation/validation_metrics.csv'  
train_metrics_name='train_metrics.csv'  
validation_metrics_name='validation_metrics.csv'  
train_file_name_local=output_metrics_path+'/'+train_metrics_name  
validation_file_name_local=output_metrics_path+'/'+validation_metrics_name  
[17]: s3_client.download_file(bucket_name, train_metrics_s3_prefix, train_file_name_local)  
s3_client.download_file(bucket_name, validation_metrics_s3_prefix, validation_file_name_local)  
[18]: train_data = pd.read_csv(train_file_name_local)  
'''The training loss is at an iteration level. To calculate loss at the epoch level,  
average the iteration-level loss for each epoch'''  
train_metrics_epoch=train_data.groupby('epoch_number').mean()  
validation_metrics_epoch=pd.read_csv(validation_file_name_local)  
[19]: plt.plot(validation_metrics_epoch.epoch_number, validation_metrics_epoch.validation_loss,label='validation')  
plt.plot(train_metrics_epoch.index, train_metrics_epoch.training_loss,label='training')  
plt.title('Training vs Validation Loss')  
plt.ylabel('Loss')  
plt.xlabel('Epoch')
```

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d-c9qeuo6x91qp.studio.us-east-1.sagemaker.aws/jupyter/default/lab/tree/amazon-bedrock-workshop-20240712/03\_Model\_customization/02\_fine-tuning\_llama2.ipynb

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Cluster Data Science 3.0 Python 3 4 vCPU + 8 GiB Share

```
plt.xlabel('Epoch')
plt.legend()
plt.show()
```

Training vs Validation Loss

Epoch	Validation Loss	Training Loss
1.0	~2.85	~1.52
2.0	~0.95	~0.95

Create Provisioned Throughput

Provisioned Throughput for A X +

docs.aws.amazon.com/bedrock/latest/userguide/prov-throughput.html

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# Provisioned Throughput for Amazon Bedrock

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**Throughput** refers to the number and rate of inputs and outputs that a model processes and returns. You can purchase **Provisioned Throughput** to provision a higher level of throughput for a model at a fixed cost. If you customized a model, you must purchase Provisioned Throughput to be able to use it.

You're billed hourly for a Provisioned Throughput that you purchase. For detailed information about pricing, see [Amazon Bedrock Pricing](#). The price per hour depends on the following factors:

1. The model that you choose (for custom models, pricing is the same as the base model that it was customized from).
2. The number of Model Units (MUs) that you specify for the Provisioned Throughput. An MU delivers a specific throughput level for the specified model. The throughput level of an MU specifies the following:
  - The number of input tokens that an MU can process across all requests within a span of one minute.
  - The number of output tokens that an MU can generate across all requests within a span of one minute.

**Note**

For more information about what an MU specifies, contact your AWS account manager.

3. The duration of time you commit to keeping the Provisioned Throughput. The longer the commitment duration, the more discounted the hourly price becomes. You can choose between the following levels of commitment:

Like | Dislike

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A set of small, light-gray navigation icons typically found in presentation software like Beamer. They include symbols for back, forward, search, and other document-related functions.

**Note:** Creating provisioned throughput will take around 20-30mins to complete.

You will need to create provisioned throughput to be able to evaluate the model performance. You can do so through the [console] (<https://docs.aws.amazon.com/bedrock/latest/userguide/prov-cap-console.html>) or use the following API call.

```
# Create the provision throughput job and retrieve the provisioned model id
provisioned_model_id = bedrock.create_provisioned_model_throughput(
    modelUnits=1,
    # create a name for your provisioned throughput model
    provisionedModelName='test-model-v1-001',
    modelId=custom_model_id
)[['provisionedModelArn']]
```

```
[21]: # check provisioned throughput job status
import time
status_provisioning = bedrock.get_provisioned_model_throughput(provisionedModelId = provisioned_model_id)['status']
while status_provisioning == 'Creating':
    time.sleep(60)
    status_provisioning = bedrock.get_provisioned_model_throughput(provisionedModelId=provisioned_model_id)['status']
    print(status_provisioning)
```

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us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/provisioned-throughput

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Amazon Bedrock > Provisioned Throughput

## Provisioned Throughput Info

Provisioned Throughput allows you to have dedicated capacity to deploy your models

### Overview

Active	Failed	Updating	Inactive
1	0	0	0

### Provisioned Throughput (1)

Name	Status	Model	Model units	Creation time	Commitment term	End
test-model-v1-001	<input checked="" type="checkbox"/> In service	llama2-finetune-2024-07-12-05-39-59	1	July 12, 2024, 14:26 (UTC+08:00)	No commitment	-

[Find Provisioned Throughput](#)

[Actions ▾](#) [Purchase Provisioned Throughput](#)

< 1 > [@](#)

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## Invoke the Provisioned Custom Model

Invoke the provisioned custom model. You can replace the following prompt\_txt with the prompts that are more similar to your fine-tuning dataset, this helps to check whether the fine-tuned model is performing as you expected.

**Note:** Please make sure your provisioned throughput job status becomes InService before proceeding.

```
[22]: # Provide the prompt text
test_file_path = f'{data_folder}/{test_file_name}'
with open(test_file_path) as f:
    lines = f.read().splitlines()
```

```
[23]: test_prompt = json.loads(lines[0])['prompt']
reference_summary = json.loads(lines[0])['completion']
print(test_prompt)
print()
print(reference_summary)
```

Below is an instruction that describes a task, paired with an input that provides further context. Write a response that appropriately completes the request.

instruction:

Summarize the news article provided below.

input:

Pep Guardiola was left purring at Bayern Munich's first-half performance against Porto as the club put a turbulent week behind them to storm in to the Champions League semi-finals. A 3-1 first leg defeat in Portugal last week followed by the dramatic resignation of long-serving club doctor Hans-Wilhelm Muller-Wohlfahrt had turned the spotlight on Guardiola heading in to the tie. But the Bayern boss reminded the watching world why he is considered by many to be the best manager in the business as his side raced in to a 5-0 lead before half-time on Tuesday night. Bayern Munich players celebrate in front of their fans after the 6-1 demolition of Porto on Tuesday night. Pep Guardiola looks animated as he issues instructions from the touchline at the Allianz Arena. 'It's easy to love my players now,' said Guardiola. 'I am the coach of extraordinary player

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A screenshot of a Jupyter Notebook interface showing several tabs at the top. The active tab is '02\_fine-tuning\_llama2.ipynb'. Below the tabs is a toolbar with icons for file operations like new, open, save, and run. The main area contains code in a Python cell, starting with reading a file from a specific path.

```
test_file_path = r'{data_root}/{test_file_name}'  
with open(test_file_path) as f:  
    lines = f.read().splitlines()
```

Cluster Data Science 3.0 | Python 3 | 4 vCPU + 8 GiB Share

```
[23]: test_prompt = json.loads(lines[0])['prompt']  
reference_summary = json.loads(lines[0])['completion']  
print(test_prompt)  
print()  
print(reference_summary)
```

Below is an instruction that describes a task, paired with an input that provides further context. Write a response that appropriately completes the request.

instruction:

Summarize the news article provided below.

input:

Pep Guardiola was left purring at Bayern Munich's first-half performance against Porto as the club put a turbulent week behind them to storm in to the Champions League semi-finals. A 3-1 first leg defeat in Portugal last week followed by the dramatic resignation of long-serving club doctor Hans-Wilhelm Muller-Wohlfahrt had turned the spotlight on Guardiola heading in to the tie. But the Bayern boss reminded the watching world why he is considered by many to be the best manager in the business as his side raced in to a 5-0 lead before half-time on Tuesday night. Bayern Munich players celebrate in front of their fans after the 6-1 demolition of Porto on Tuesday night. Pep Guardiola looks animated as he issues instructions from the touchline at the Allianz Arena. 'It's easy to love my players now,' said Guardiola. 'I am the coach of extraordinary players. I didn't expect such a first half.' Typical of the man though, Guardiola found faults in Bayern's second half performance as Porto pulled back to 5-1 before Xabi Alonso added a late sixth. 'We can still play better,' he added. 'We lost the ball here and there and we can improve on that. We had a few problems in the second half. 'They had only a few chances but you should never relax in the Champions League.' Guardiola talks to captain Philipp Lahm (third right) as Mario Gotze (far left), Thiago and Thomas Müller listen in. It is believed that Muller-Wohlfahrt and his team resigned as they felt they were blamed for the first-leg defeat, though neither the doctor, the club or Guardiola have said as much in public. Bayern find out their semi-final opponents on Thursday with Guardiola's former club Barcelona already through to the last four and the winners of Real Madrid v Atletico Madrid and Monaco v Juventus to join them in the draw. Guardiola celebrates as Robert Lewandowski scores Bayern's fifth goal in the first half.

.

response:

Bayern Munich beat Porto 6-1 at the Allianz Arena on Tuesday night.  
Result gave them a 7-4 aggregate victory in Champions League last eight.  
Bayern manager Pep Guardiola hailed his players after the match.  
READ: Luis Enrique 'happy' to see Pep Guardiola prove doubters wrong.

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Construct model input following the format needed by Llama2 model following instructions [here](#). Please pay attention to the "Model invocation request body field" section

```
[24]: body = json.dumps({
    "prompt": test_prompt,
    # specify the parameters as needed
    "max_gen_len": 200,
    "temperature": 0.4,
    "top_p": 0.3,
})

# provide the modelId of the provisioned custom model
modelId = provisioned_model_id
accept = 'application/json'
contentType = 'application/json'

# invoke the provisioned custom model
response = bedrock_runtime.invoke_model(body=body, modelId=modelId, accept=accept, contentType=contentType)

response_body = json.loads(response.get('body').read())
print(response_body)
```

{'generation': "response:\n\nBayern Munich put a turbulent week behind them to storm in to the Champions League semi-finals .\nPep Guardiola's side raced in to a 5-0 lead before half-time on Tuesday night .\nGuardiola reminded the watching world why he is considered by many to be the best manager in the business .", 'prompt\_token\_count': 531, 'generation\_token\_count': 85, 'stop\_reason': 'stop'}

## Clean up

**Warning:** Please make sure to delete provisioned throughput with the following code as there will be cost incurred if its left in running state, even if you are not using it.

```
[25]: # delete the provisioned throughput
bedrock.delete_provisioned_model_throughput(provisionedModelId=provisioned_model_id)
```

```
[25]: {'ResponseMetadata': {'RequestId': '2d0ec641-3779-4b8b-8812-bdb231931047',
```

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## Clean up

**Warning:** Please make sure to delete provided throughput with the following code as there will be cost incurred if its left in running state, even if you are not using it.

```
# delete the provisioned throughput
bedrock.delete_provisioned_model_throughput(provisionedModelId=provisioned_model_id)
```

[25]: {'ResponseMetadata': {'RequestId': '2d0ec641-3779-4b8b-8812-bdb231931047', 'HTTPStatusCode': 200, 'HTTPHeaders': {'date': 'Fri, 12 Jul 2024 06:38:00 GMT', 'content-type': 'application/json', 'content-length': '2', 'connection': 'keep-alive', 'x-amzn-requestid': '2d0ec641-3779-4b8b-8812-bdb231931047'}, 'RetryAttempts': 0}}

**Note:** Please finish up the cleaning process by running 04\_cleanup.ipynb to clean up the other resources.

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us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/provisioned-throughput

Services Search [Alt+S]

Amazon Bedrock

Getting started

- Overview
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- Providers

Foundation models

- Base models
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- Imported models [Preview](#)

Playgrounds

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- Image

Safeguards

- Guardrails
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Builder tools

- Knowledge bases
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- Prompt management [Preview](#)
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Assessment & deployment

Amazon Bedrock > Provisioned Throughput

## Provisioned Throughput Info

Provisioned Throughput allows you to have dedicated capacity to deploy your models

### Overview

Active	Failed	Updating	Inactive
0	0	0	0

### Provisioned Throughput (0)

[Find Provisioned Throughput](#)

[Actions](#) [Purchase Provisioned Throughput](#)

Name	Status	Model	Model units	Creation time	Commitment term	End time
No Provisioned Throughput						
There are currently no resources.						

[Purchase Provisioned Throughput](#)

Paused

AWS Machine Learning Blog

# Fine-tune Anthropic's Claude 3 Haiku in Amazon Bedrock to boost model accuracy and quality

by Yanyan Zhang, Fang Liu, Sovik Nath, and Carrie Wu | on 10 JUL 2024 | in [Amazon Bedrock](#), [Artificial Intelligence](#), [Generative AI](#), [Intermediate \(200\)](#) | [Permalink](#) | [Comments](#) | [Share](#)

Frontier [large language models \(LLMs\)](#) like [Anthropic Claude](#) on Amazon Bedrock are trained on vast amounts of data, allowing Anthropic Claude to understand and generate human-like text. Fine-tuning Anthropic Claude 3 Haiku on proprietary datasets can provide optimal performance on specific domains or tasks. The fine-tuning as a deep level of customization represents a key differentiating factor by using your own unique data.

<https://aws.amazon.com/blogs/machine-learning/fine-tune-anthropic-claude-3-haiku-in-amazon-bedrock-to-boost-model-accuracy-and-quality/>



# Labs

- Bedrock Console: text generation with Titan Text
- Bedrock Console: news summary with Command Light
- Bedrock SDK: news summary with Llama 2
- Bedrock SDK: image generation with Titan Image Generator
- SageMaker JumpStart console: text generation with Mistral
- SageMaker JumpStart SDK: dialog summary with LLama 3

<https://github.com/aws-samples/amazon-bedrock-samples/tree/main/bedrock-fine-tuning/amazon-titan-image-generator>



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Filter files by name

📁 / ... / bedrock-fine-tuning / amazon-titan-image-generator /

Name	Last Modified
data	a day ago
prompts	15 hours ago
1-TIGFT-customiz...	an hour ago
2-TIGFT-provisio...	an hour ago
README.md	a day ago

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# Fine-Tuning Amazon Titan Image Generator G1

This notebook has been tested with the **SageMaker Data Science 3.0** kernel in Amazon SageMaker Studio.

In this notebook, we will show how to fine tune [Amazon Titan Image Generator G1](#) on Amazon Bedrock model.

We will teach our model to recognize two new classes:

Ron the dog



and Smila the cat

Amazon SageMaker Studio Classic

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Filter files by name

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- ron\_17.jpg a day ago
- ron\_18.jpg a day ago
- ron\_19.jpg a day ago
- ron\_20.jpg a day ago
- ron\_21.jpg a day ago
- ron\_22.jpg a day ago
- ron\_23.jpg a day ago
- ron\_24.jpg a day ago
- ron\_25.jpg a day ago
- ron\_26.jpg a day ago
- ron\_27.jpg a day ago
- ron\_28.jpg a day ago
- ron\_29.jpg a day ago
- ron\_30.jpg a day ago
- ron\_ft\_1.png a day ago
- ron\_ft\_2.png a day ago
- smila\_01.jpg a day ago
- smila\_02.jpg a day ago
- smila\_03.jpg a day ago
- smila\_04.jpg a day ago
- smila\_05.jpg a day ago
- smila\_06.jpg a day ago

A brown dog wearing a blue superhero costume with a red star on the cap and a red cape, standing in a grassy field.

Simple 2 \$ 6 main

Cookie Preferences ron\_ft\_1.png 0

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Filter files by name

amazon-titan-image-generator / data /

Name	Last Modified
smila_10.jpg	a day ago
smila_11.jpg	a day ago
smila_12.jpg	a day ago
smila_13.jpg	a day ago
smila_14.jpg	a day ago
smila_15.jpg	a day ago
smila_16.jpg	a day ago
smila_17.jpg	a day ago
smila_18.jpg	a day ago
smila_19.jpg	a day ago
smila_20.jpg	a day ago
smila_21.jpg	a day ago
smila_22.jpg	a day ago
smila_23.jpg	a day ago
smila_24.jpg	a day ago
smila_25.jpg	a day ago
smila_26.jpg	a day ago
smila_27.jpg	a day ago
smila_28.jpg	a day ago
smila_29.jpg	a day ago
smila_30.jpg	a day ago
smila_ft_1.png	a day ago
smila_ft_2.png	a day ago



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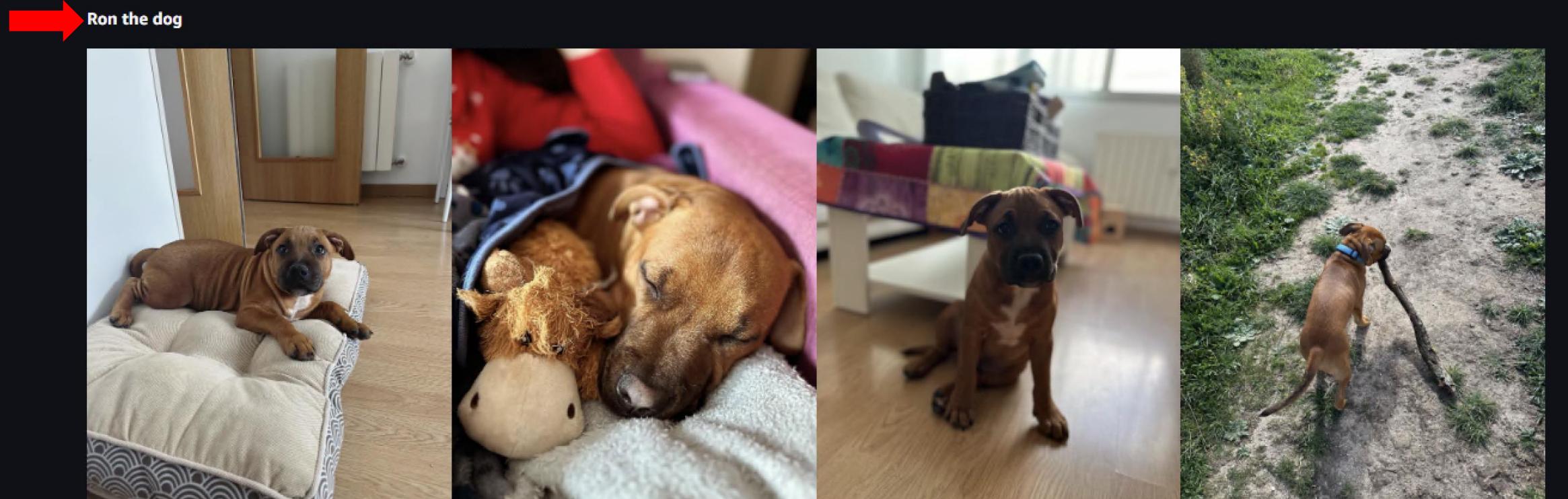
## Fine-Tuning Amazon Titan Image Generator G1

This notebook has been tested with the [SageMaker Data Science 3.0](#) kernel in Amazon SageMaker Studio.

In this notebook, we will show how to fine tune [Amazon Titan Image Generator G1](#) on [Amazon Bedrock](#) model.

We will teach our model to recognize two new classes:

Ron the dog

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 Smila the cat



```
[2]: !pip install --upgrade --force-reinstall --no-cache boto3  
!pip install --upgrade --force-reinstall --no-cache botocore  
!pip install --upgrade --force-reinstall --no-cache awscli
```

```
Collecting boto3
  Downloading boto3-1.34.143-py3-none-any.whl.metadata (6.6 kB)
Collecting botocore<1.35.0,>=1.34.143 (from boto3)
  Downloading botocore-1.34.143-py3-none-any.whl.metadata (5.7 kB)
Collecting jmespath<2.0.0,>=0.7.1 (from boto3)
```

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No kernel: Unknown | Instance MEM

Cookie Preferences Mode: Command

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## Data preparation

- To fine-tune a text-to-image or image-to-embedding model, prepare a training dataset by create a JSONL file with multiple JSON lines.
- Validation datasets are not supported.
- Each JSON line is a sample containing an image-ref, the Amazon S3 URI for an image, and a caption that could be a prompt for the image.

The images must be in JPEG or PNG format.

```
{"image-ref": "s3://bucket/path/to/image001.png", "caption": "<prompt text>"}  
{"image-ref": "s3://bucket/path/to/image002.png", "caption": "<prompt text>"}  
{"image-ref": "s3://bucket/path/to/image003.png", "caption": "<prompt text>"}
```

The following is an example item:

```
{"image-ref": "s3://my-bucket/my-pets/cat.png", "caption": "an orange cat with white spots"}
```

### Locate your sample json file

We are going to use a json file which contains the image captions in the following format:

```
{  
    "imagefile": "caption",  
    "imagefile": "caption",  
    "imagefile": "caption"  
}
```

[5]: raw\_data\_file = "prompts/captions.json"

```
with open(raw_data_file, 'r') as file:  
    raw_data = json.load(file)
```

```
[5]: raw_data_file = "prompts/captions.json"

with open(raw_data_file, 'r') as file:
    raw_data = json.load(file)

print(raw_data)

{'ron_01.jpg': 'Ron the dog laying on a white dog bed', 'ron_02.jpg': 'Ron the dog sitting on a tile floor, possibly in a kitchen or living room', 'ron_03.jpg': 'Ron the dog laying on a car seat', 'ron_04.jpg': 'Ron the dog looking directly at the camera. He is laying down on a wooden floor.', 'ron_05.jpg': 'Ron the dog sitting on a couch, looking at the camera with a smile on his face.', 'ron_06.jpg': 'Ron the dog lying on a couch, covered in a blanket.', 'ron_07.jpg': 'Ron the dog sleeping or resting, with his head on the stuffed animal.', 'ron_08.jpg': 'Ron the dog sitting on a box with a red leash.', 'ron_09.jpg': 'Ron the dog sitting in the snow, wearing a red collar.', 'ron_10.jpg': 'Ron the dog lying on a couch, chewing on a tennis shoe.', 'ron_11.jpg': 'Ron the dog sitting on a sandy beach, wearing a blue collar.', 'ron_12.jpg': 'Ron the dog wearing a yellow raincoat and is sitting on the floor.', 'ron_13.jpg': 'Ron the dog looking at the camera in front of a table.', 'ron_14.jpg': 'Ron the dog lying on a white couch, playing with a pink toy.', 'ron_15.jpg': 'Ron the dog sleeping on a white couch.', 'ron_16.jpg': 'Ron the dog laying on a couch.', 'ron_17.jpg': 'Ron the dog laying on a couch.', 'ron_18.jpg': 'Ron the dog playing with a ball.', 'ron_19.jpg': 'Ron the dog sitting on a couch.', 'ron_20.jpg': 'Ron the dog holding a large stick in his mouth.', 'ron_21.jpg': 'Ron the dog sitting on a brick floor.', 'ron_22.jpg': 'Ron the dog laying on a blanket.', 'ron_23.jpg': 'Ron the dog sitting on a couch.', 'ron_24.jpg': 'Ron the dog standing on a tile floor, wearing a leash.', 'ron_25.jpg': 'Ron the dog wearing a blue and white jacket and is sitting on the grass.', 'ron_26.jpg': 'Ron the dog standing in front of a large brown teddy bear.', 'ron_27.jpg': 'Ron the dog is standing in a kitchen, looking at the camera.', 'ron_28.jpg': 'Ron the dog sitting on a couch.', 'ron_29.jpg': 'Ron the dog wearing a festive sweater with snowflakes on it.', 'ron_30.jpg': 'Ron the dog wearing a red sweater with a white snowflake pattern.', 'smila_01.jpg': 'Smila the cat lying on a couch.', 'smila_02.jpg': 'Smila the cat sitting next to the window next to a statue cat.', 'smila_03.jpg': 'Smila the cat sitting inside a colorful cat tunnel.', 'smila_05.jpg': 'Smila the cat lying on a sofa.', 'smila_06.jpg': 'Smila the cat sitting on a couch.', 'smila_07.jpg': 'Smila the cat sitting on a black cupboard.', 'smila_08.jpg': 'Smila the cat is sitting inside a cat carrier.', 'smila_09.jpg': 'Smila the cat is sitting on the floor next to a door.', 'smila_10.jpg': 'Smila the cat is sitting in a pet carrier.', 'smila_12.jpg': 'Smila the cat lying on the sofa.', 'smila_13.jpg': 'Smila the cat lying on a grey couch.', 'smila_14.jpg': 'Smila the cat sitting inside a colorful tunnel.', 'smila_15.jpg': 'Smila the cat sitting in a cat transporter.', 'smila_16.jpg': 'Smila the cat is sitting next to a window.', 'smila_17.jpg': 'Smila the cat laying on a white table.', 'smila_18.jpg': 'Smila the cat lying on a cat scratcher.', 'smila_19.jpg': 'Smila the cat sitting on a wicker basket in the bathroom.', 'smila_20.jpg': 'Smila the cat sitting on a couch, eating yogurt.', 'smila_21.jpg': 'Smila the cat sitting on a wicker basket in a bathroom.', 'smila_22.jpg': 'Smila the cat laying on a bed.', 'smila_23.jpg': 'Smila the cat sitting on a cat bed.', 'smila_24.jpg': 'Smila the cat sitting on a white bed.', 'smila_25.jpg': 'Smila the cat laying on a cat scratcher.', 'smila_26.jpg': 'Smila the cat is laying on a gray sofa, surrounded by pillows.', 'smila_27.jpg': 'Smila the cat sitting on a couch.', 'smila_28.jpg': 'Smila the cat laying on a white bed.'}
```

## Create the dataset file and upload the images to Amazon S3

Create the `jsonl` file with the images prompt based on the image's s3 path.

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[11]: ts = datetime.datetime.now().strftime("%Y-%m-%d-%H-%M-%S")

# Select the foundation model you want to customize (you can find this from the "modelId" from listed foundation model above)  
base\_model\_id = "amazon.titan-image-generator-v1:0"

# Select the customization type from "FINE\_TUNING" or "CONTINUED\_PRE\_TRAINING".  
customization\_type = "FINE\_TUNING"

# Specify the roleArn for your customization job  
customization\_role = role\_arn

# Create a customization job name  
customization\_job\_name = f"image-gen-ft-{ts}"

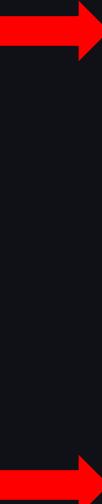
# Create a customized model name for your fine-tuned Llama2 model  
custom\_model\_name = f"image-gen-ft-{ts}"

# Define the hyperparameters for fine-tuning Llama2 model  
hyper\_parameters = {  
 "stepCount": "8000",  
 "batchSize": "8",  
 "learningRate": "0.00001",  
}

# Specify your data path for training, validation(optional) and output  
s3\_train\_uri = s3\_bucket\_path + "/" + output\_file  
training\_data\_config = {"s3Uri": s3\_train\_uri}

output\_data\_config = {"s3Uri": f's3://{bucket\_name}/outputs/output-{custom\_model\_name}'}

# Create the customization job  
bedrock\_client.create\_model\_customization\_job(  
 customizationType=customization\_type,  
 jobName=customization\_job\_name,



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```
# Create the customization job
bedrock_client.create_model_customization_job(
    customizationType=customization_type,
    jobName=customization_job_name,
    customModelName=custom_model_name,
    roleArn=customization_role,
    baseModelIdentifier=base_model_id,
    hyperParameters=hyper_parameters,
    trainingDataConfig=training_data_config,
    outputDataConfig=output_data_config
)
```

[11]: { 'ResponseMetadata': { 'RequestId': 'c1c09ec1-3658-4593-b986-e13cb80ae3e9',
 'HTTPStatusCode': 201,
 'HTTPHeaders': { 'date': 'Fri, 12 Jul 2024 13:43:03 GMT',
 'content-type': 'application/json',
 'content-length': '122',
 'connection': 'keep-alive',
 'x-amzn-requestid': 'c1c09ec1-3658-4593-b986-e13cb80ae3e9'},
 'RetryAttempts': 0},
 'jobArn': 'arn:aws:bedrock:us-east-1:094784590684:model-customization-job/amazon.titan-image-generator-v1:0/hw5vebkzf8c1'}

## Waiting until customization job is completed

Once the customization job is finished, you can check your existing custom model(s) and retrieve the `modelArn` of your fine-tuned model.

**Warning:** The model customization job can take hours to run. With 5000 steps, 0.000001 learning rate, 64 of batch size and 60 images, it takes around 4 hours to complete

```
[ ]: # check model customization status
status = bedrock_client.list_model_customization_jobs(
    nameContains=customization_job_name
)[["modelCustomizationJobSummaries"]][0]["status"]
```

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# Image Generation with Fine-tuned Amazon Titan Image Generator G1 model

This notebook has been tested with the `SageMaker Data Science 3.0` kernel in Amazon SageMaker Studio.

---

In this notebook, we will show how to invoke a fine-tuned Amazon Titan Image Generator G1 on Amazon Bedrock trained with Ron the dog and Smila the cat



## Pre-requisites

Import needed libraries, instantiate the boto3 clients and setup any style tag that was added during model fine-tuning

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[9]:

```
def decode_base64_image(img_b64):
    return Image.open(io.BytesIO(base64.b64decode(img_b64)))

def invoke_model_tgi(prompt, seed, model_arn):
    img_gen_conf = {
        "cfgScale": 8,
        "seed": seed,
        "quality": "standard",
        "width": 1024,
        "height": 1024,
        "numberOfImages": 2
    }

    body = json.dumps({
        "textToImageParams": {
            "text": prompt
        },
        "taskType": "TEXT_IMAGE",
        "imageGenerationConfig": img_gen_conf
    })


    response = bedrock_runtime.invoke_model(
        body=body,
        modelId=model_arn,
        accept="application/json",
        contentType="application/json"
    )

    response_body = json.loads(response.get("body").read())
    return [decode_base64_image(img) for img in response_body["images"]]

def compare_models_outputs(prompts, seeds, model_arn_base, model_arn_custom):
    for prompt in prompts:
        for seed in seeds:
            # Invoke the base model
            base_image = invoke_model_tgi(prompt, seed, model_arn_base)
```

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```
response = bedrock_runtime.invoke_model(
    body=body,
    modelId=model_arn,
    accept="application/json",
    contentType="application/json"
)

response_body = json.loads(response.get("body").read())
return [decode_base64_image(img) for img in response_body["images"]]

def compare_models_outputs(prompts, seeds, model_arn_base, model_arn_custom):
    for prompt in prompts:
        for seed in seeds:
            # Invoke the base model
            base_images = invoke_model_tgi(prompt, seed, model_arn_base)

            # Invoke the customized model
            custom_images = invoke_model_tgi(prompt, seed, model_arn_custom)

            # Display the images for comparison
            plot_images(base_images, custom_images, prompt, seed)

def plot_images(base_images, custom_images, prompt, seed):
    fig, axes = plt.subplots(1, 2, figsize=(10, 5))

    axes[0].imshow(np.array(base_images[0]))
    axes[0].set_title('Base Model\nSeed: {}'.format(seed))
    axes[0].axis('off')

    axes[1].imshow(np.array(custom_images[0]))
    axes[1].set_title('Custom Model\nSeed: {}'.format(seed))
    axes[1].axis('off')
    print("Prompt:{}\n".format(prompt))
    plt.show()
```

Amazon SageMaker Studio Classic      File Edit View Run Kernel Git Tabs Settings Help      default-20240221t112169 / Personal Studio

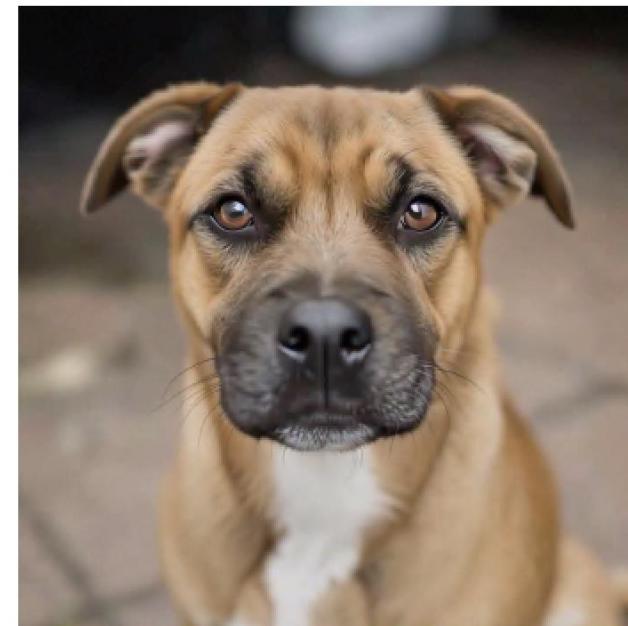
00\_setup.ipynb X 01\_fine-tuning-titan-lite.ipynb X 02\_fine-tuning\_llama2.ipynb X 03\_continued\_pretraining\_tita X 1-TIGFT-customization-job.ipynb X 2-TIGFT-provisioned-throughp X

Prompt:'Ron the dog' is staring at the camera.

Base Model  
Seed: 3000



Custom Model  
Seed: 3000



Prompt:'Smila the cat' is staring at the camera.

Base Model  
Seed: 0



Custom Model  
Seed: 0



Amazon SageMaker Studio Classic      File Edit View Run Kernel Git Tabs Settings Help      default-20240221t112169 / Personal Studio

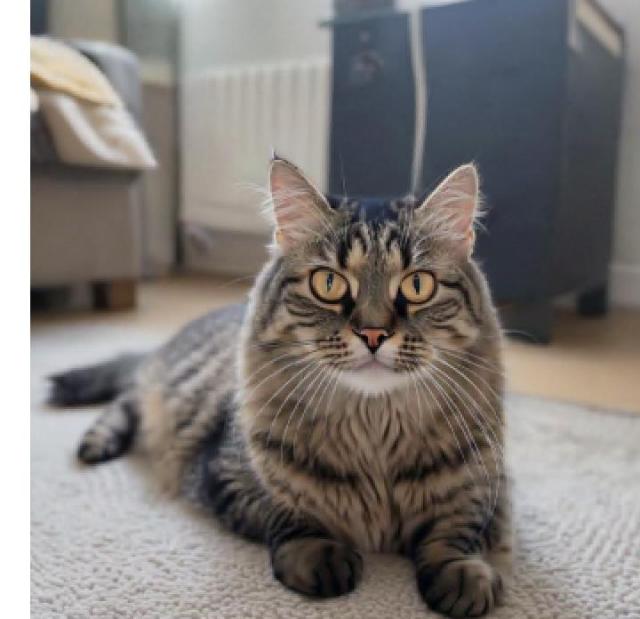
00\_setup.ipynb X 01\_fine-tuning-titan-lite.ipynb X 02\_fine-tuning\_llama2.ipynb X 03\_continued\_pretraining\_tita X 1-TIGFT-customization-job.ipynb X 2-TIGFT-provisioned-throughp X

Prompt:'Smila the cat' is staring at the camera.

Base Model  
Seed: 0



Custom Model  
Seed: 0



Prompt:'Smila the cat' is staring at the camera.

Base Model  
Seed: 3000



Custom Model  
Seed: 3000



Amazon SageMaker Studio Classic      File Edit View Run Kernel Git Tabs Settings Help      default-20240221t112169 / Personal Studio

00\_setup.ipynb X 01\_fine-tuning-titan-lite.ipynb X 02\_fine-tuning\_llama2.ipynb X 03\_continued\_pretraining\_tita X 1-TIGFT-customization-job.ipynb X 2-TIGFT-provisioned-throughp X

Prompt: 'Ron the dog' is running on the beach.

Base Model  
Seed: 3000



Custom Model  
Seed: 3000



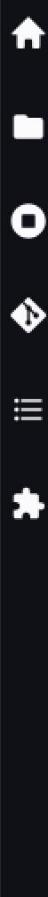
Prompt: 'Smila the cat' is running on the grass.

Base Model  
Seed: 0



Custom Model  
Seed: 0





00\_setup.ipynb X 01\_fine-tuning-titan-lite.ipynb X 02\_fine-tuning\_llama2.ipynb X 03\_continued\_pretraining\_tita X 1-TIGFT-customization-job.ipynb X 2-TIGFT-provisioned-throughput.ipynb X

Code git

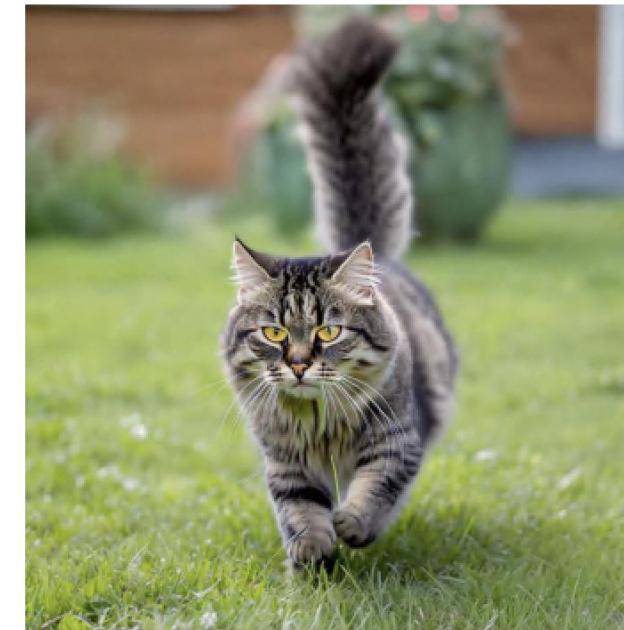
Cluster Data Science 3.0 Python 3 4 vCPU + 8 GiB Share

Prompt: 'Smilia the cat' is running on the grass.

Base Model  
Seed: 3000



Custom Model  
Seed: 3000



[ ]:

## Clean Up

To avoid unnecessary costs, let's now delete the provisioned throughput model

# Accelerate FM development with Amazon SageMaker JumpStart



# Discover foundation models from multiple providers

The screenshot shows the SageMaker JumpStart interface. At the top, there's a navigation bar with 'Home', 'Quick actions' (including 'Open Launcher', 'Import & prepare data visually', and 'Open the'), and a search bar. Below the navigation is a sidebar with sections for 'Prebuilt ai' (with a 'Deploy built-in' button), 'Workflow' (with a 'Kick off a new workflow' button), and 'Prepare data' (with a 'Connect to data', 'Transform, analyze', 'Store, manage', and 'Manage EMR' list). The main content area is titled 'SageMaker JumpStart' and displays two sections: 'Foundation Models: Text Generation' and 'Foundation Models: Image Generation'. The 'Text Generation' section lists three models: 'Meta AI Llama-2-70b-chat' (Featured, Text Generation, Details: 70B fine-tuned model optimized for...), 'Meta AI Llama-2-7b' (Featured, Text Generation, Details: 7B pretrained model, Fine-tunable: Yes, Source: Meta), and 'AI21 labs Jurassic-2 Ultra' (Featured, Text To Text, Details: Best-in-class instruction-following model, Provider: AI21, View notebook). The 'Image Generation' section lists three models: 'Stability AI Stable Diffusion XL 1.0' (Text To Image, Fine-tunable: No, Provider: Stability AI, Details: The leading generation model from...), 'Stability AI Stable Diffusion XL Beta 0.8' (Text To Image, Fine-tunable: No, Provider: Stability AI, Details: Beta version of SDXL, with native 512x512 support), and 'Stability AI Stable Diffusion XL 1.0 (open)' (Text To Image, Fine-tunable: No, Provider: Stability AI, Details: Beta version of SDXL, with native 512x512 support, View model).

- Browse in SageMaker Studio
- Search for specific model or provider from search bar
- View model-specific information

# Review model details and take action

The screenshot shows the Amazon SageMaker JumpStart interface for the Falcon 40B Instruct BF16 model. At the top, there are buttons for 'Open notebook', 'Share', and 'Browse JumpStart'. Below that, tabs for 'Deploy', 'Train', 'Notebook', and 'Model details' are present, with 'Model details' being the active tab.

**Deploy Model:** A section describing how to deploy a pretrained model to an endpoint for inference. It includes a 'Deployment Configuration' link and a 'Deploy' button.

**Train Model:** A section for creating a training job. It includes fields for 'Training data set' (set to 's3://jumpstart-cache-prod-us-west-2/training-datasets/genuq/small/') and 'Validation data set' (set to 's3://bucketName/path-to-folder/'). It also includes sections for 'Deployment Configuration', 'Hyper-parameters', and 'Security Settings', each with a corresponding link. A 'Train' button is located at the bottom.

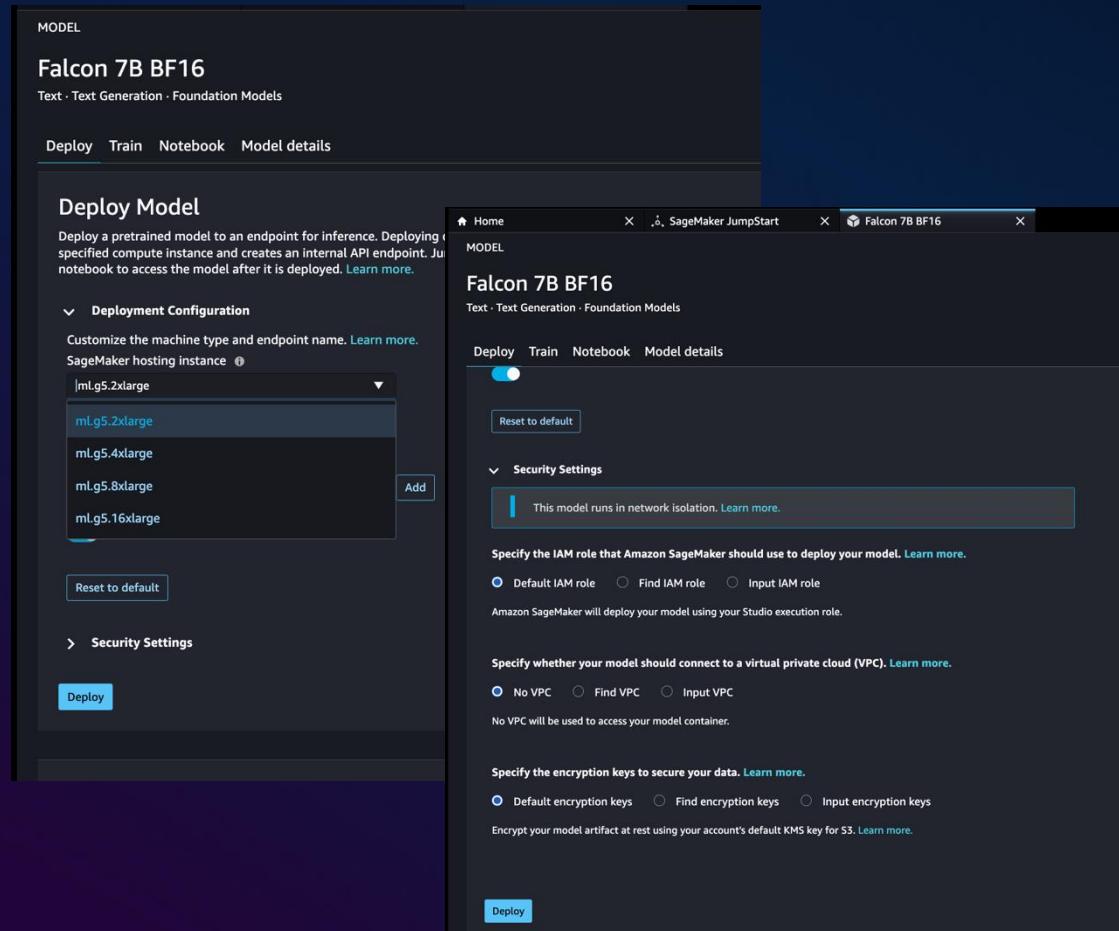
Details from model provider:

- Model size and description
- License info
- Use cases and how-to use model

Take action:

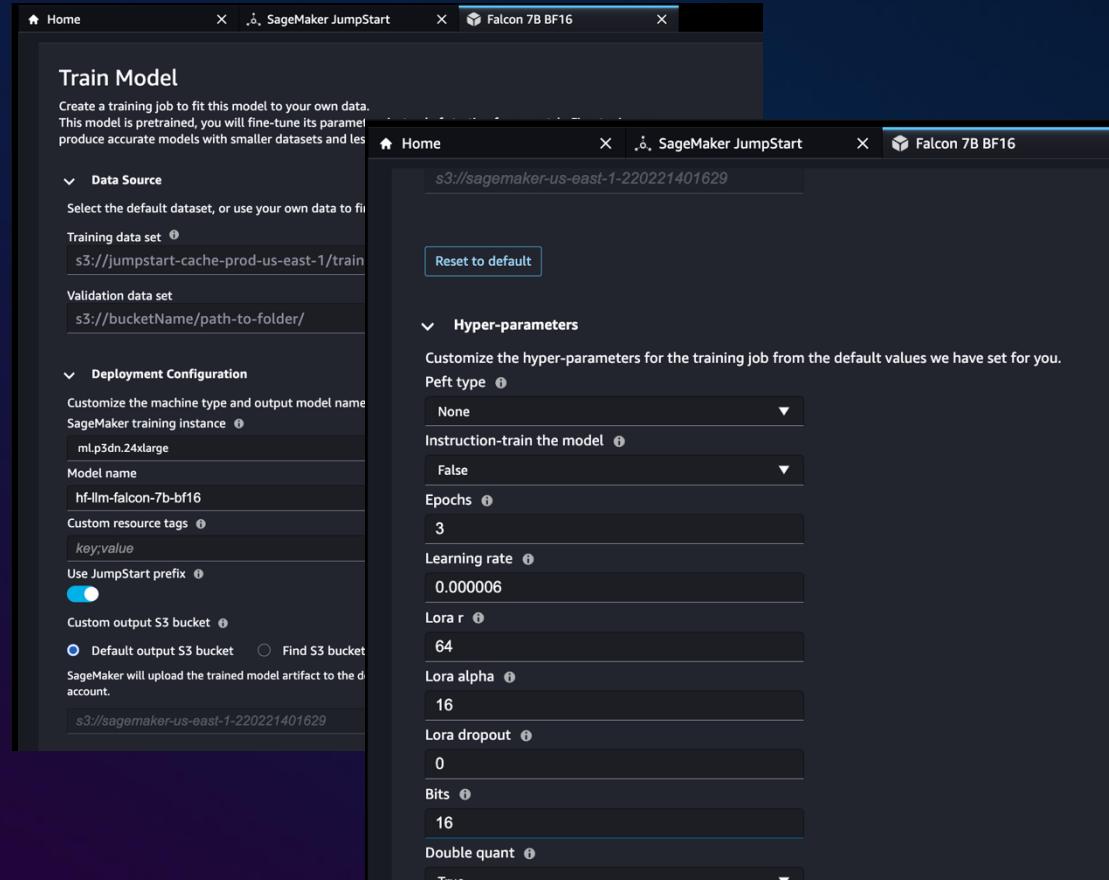
- Deploy
- Train
- View API snippet

# Deploy to SageMaker with just a few clicks



- One-click deploy with defaults
- Configure for cost, throughput, and latency
- Control security and VPC settings

# Customize models with your data



- Fine-tune open and closed models
- Store model weights in your S3 bucket
- Control hyper-parameters
- Choose preferred instance type

# Scale using the SageMaker SDK

MODEL

Falcon 7B BF16

Text · Text Generation · Foundation Models

Deploy Train Notebook

> Hyper-parameters

> Security Settings

Train

Run in notebook

Use the model programmatically

Open notebook

The screenshot shows the AWS SageMaker Studio interface. On the left, there's a sidebar with tabs for 'Deploy', 'Train', 'Notebook', 'Hyper-parameters', 'Security Settings', and 'Train' (which is highlighted). Below that is a section for 'Run in notebook' with a 'Use the model programmatically' link and an 'Open notebook' button. The main area is a Jupyter-style notebook. At the top, it says 'Falcon 7B BF16' and 'Text · Text Generation · Foundation Models'. It has buttons for 'Open notebook' and 'Share'. The notebook content includes a note about fine-tuning, limitations (mentioning English bias), and several code snippets in Python:

```
[ ]: def query_endpoint(payload):
    """Query endpoint and print the response"""
    response = predictor.predict(payload)
    print(f"\033[1m Input:\033[0m {payload['inputs']}")
    print(f"\033[1m Output:\033[0m {response[0]['generated_text']}")

[ ]: # Code generation
payload = {"inputs": "Write a program to compute factorial in python:", "parameters": {"max_new_tokens": 2}}
query_endpoint(payload)

[ ]: payload = {
    "inputs": "Building a website can be done in 10 simple steps:",
    "parameters": {
        "max_new_tokens": 110,
        "no_repeat_ngram_size": 3
    }
}
query_endpoint(payload)

[ ]: # Translation
payload = {
    "inputs": "Translate English to French:
    sea otter => loutre de mer
```

- Automate using the SageMaker APIs
- View example code for each model
- Control deployment parameters

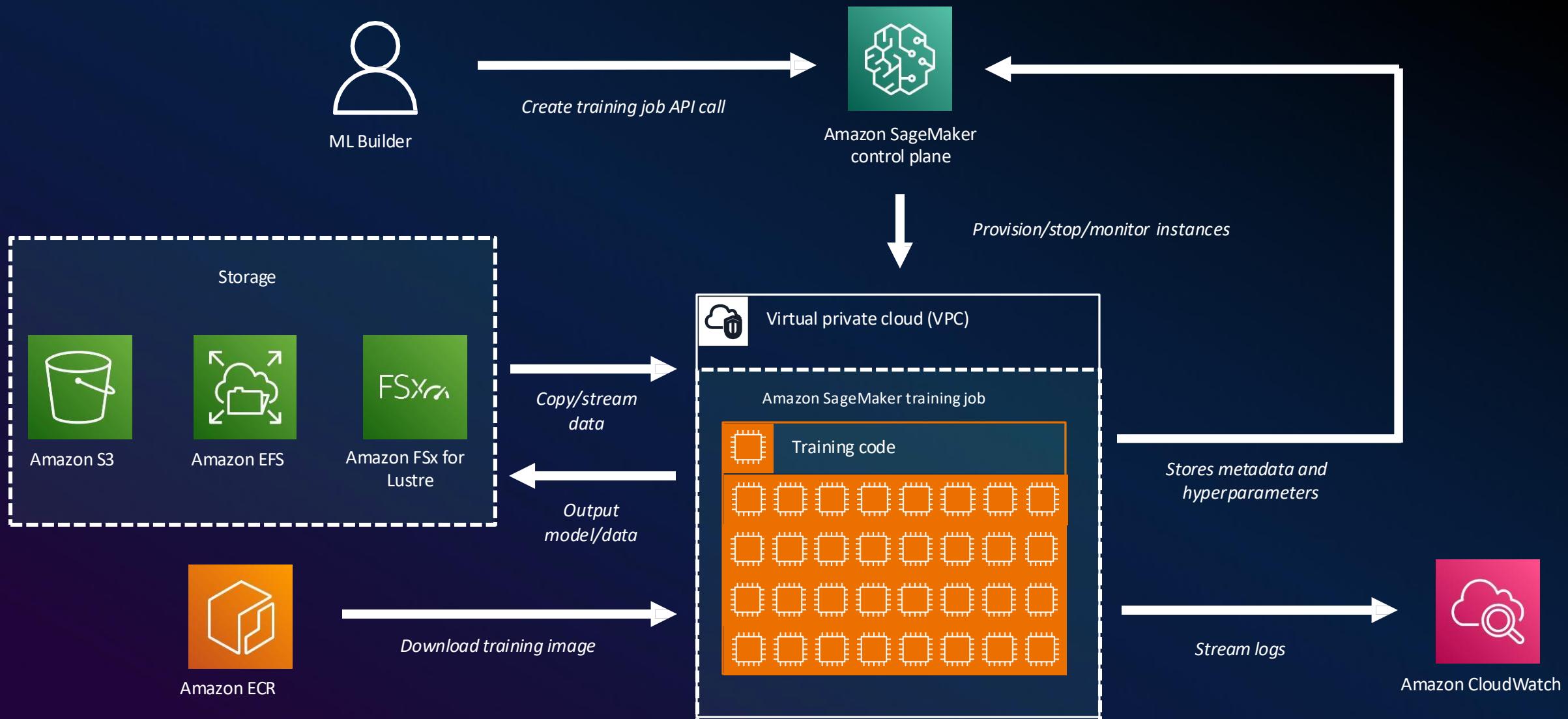
# Optimize training of foundation models on Amazon SageMaker

**Michael Lin**

Sr. Solutions Architect  
Amazon Web Services



# Amazon SageMaker ephemeral training clusters

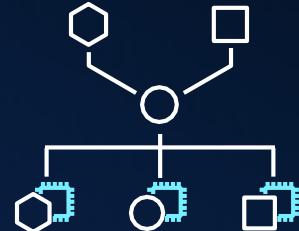


# Amazon SageMaker distributed training libraries



## Data parallelism

Scale out training clusters with near-linear efficiency, optimized for AWS networking and instance topology



## Model parallelism

Train models too large to fit within GPU memory, with automated model splitting and sophisticated pipeline scheduling

# Optimize training with Amazon SageMaker data parallel



## Data parallelism

Scale out training clusters with near-linear efficiency, optimized for AWS networking and instance topology



### Support for popular ML framework APIs

Re-use existing APIs such as Horovod and PyTorch DistributedDataParallel (DDP)



### Reduced training time

~25% faster with synchronization across GPUs (as tested with BERT)



### Minimal code change

See Scrum Master (SM) developer guide for PyTorch and TensorFlow instructions – or use Hugging Face Trainer API scripts with no code changes at all

# Streamline distributed training with model parallel



Model parallelism on Amazon SageMaker enables interleave pipeline execution to stabilize GPU utilization



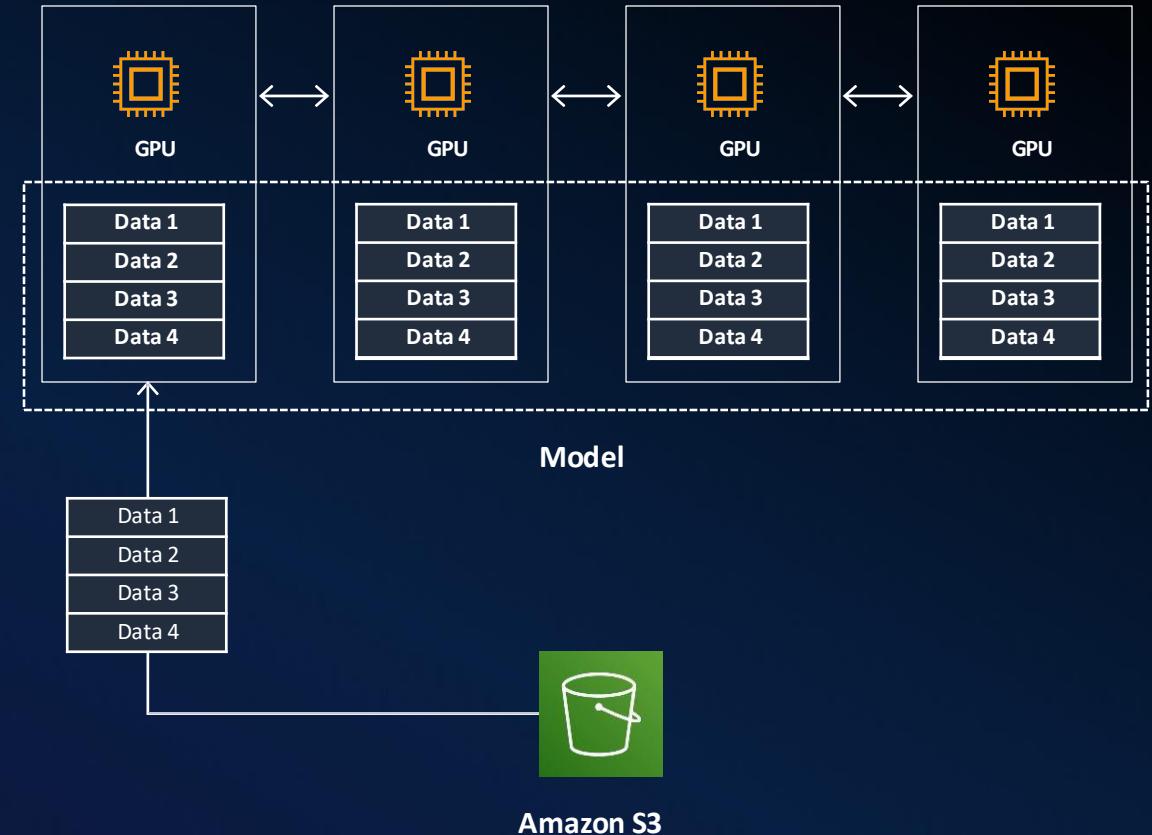
Split mini-batches into N “micro-batches”



Feed micro-batches sequentially, but process them to keep GPU utilization more even



Minimize “idle” time on GPUs



# What is fine-tuning?

## Fine-tuning basics

- Use pre-trained model
- Update model's weights
- General-purpose base model into a specialized model
- Models can achieve better performance while requiring (far) fewer manually labeled examples
- Smaller (fine-tuned) model can often outperform larger (more expensive) models

# Parameter-Efficient Fine-Tuning (PEFT)

## Parameter training

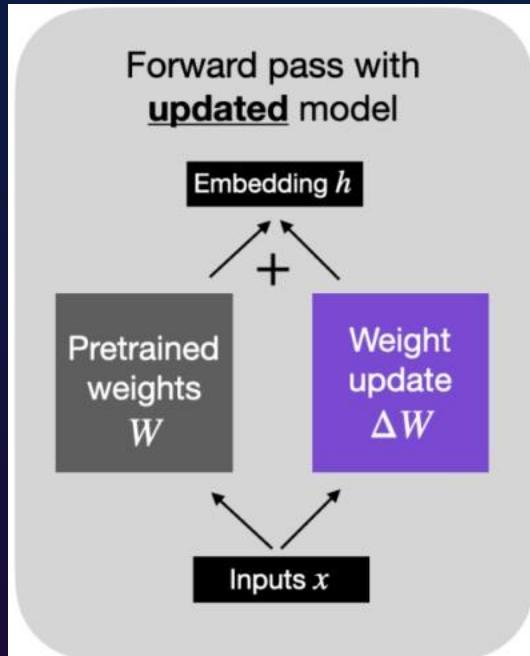
- A novel approach for fine-tuning
- Open-source library from Hugging Face
- Fine-tune a small number of (extra) model parameters
- State-of-the-art PEFT achieve full fine-tuning performance
- Supported methods
  - LoRA and QLoRA - are most widely used and effective
  - Prefix-tuning
  - AdaLoRA
  - ...

[Github - HuggingFace - PEFT](#)



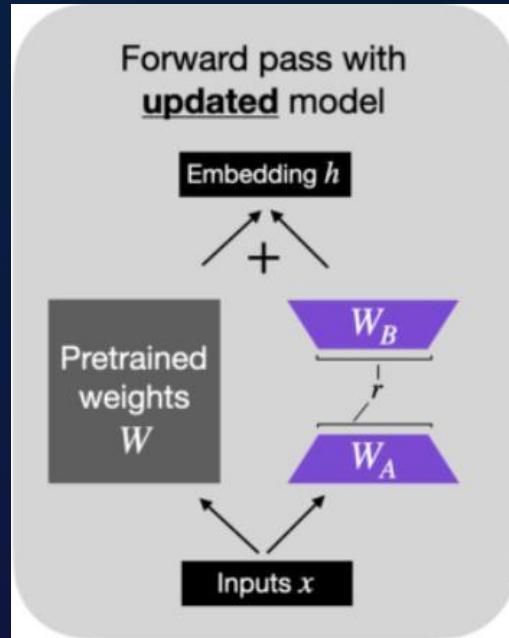
# Low-Rank Adaptation (LoRA)

Training method that accelerates the training of large models while consuming less memory



$$W \leftarrow W + \Delta W$$

Where,  $W \in \mathbb{R}^{m \times n}$



$$\Delta W = W_A \cdot W_B T$$

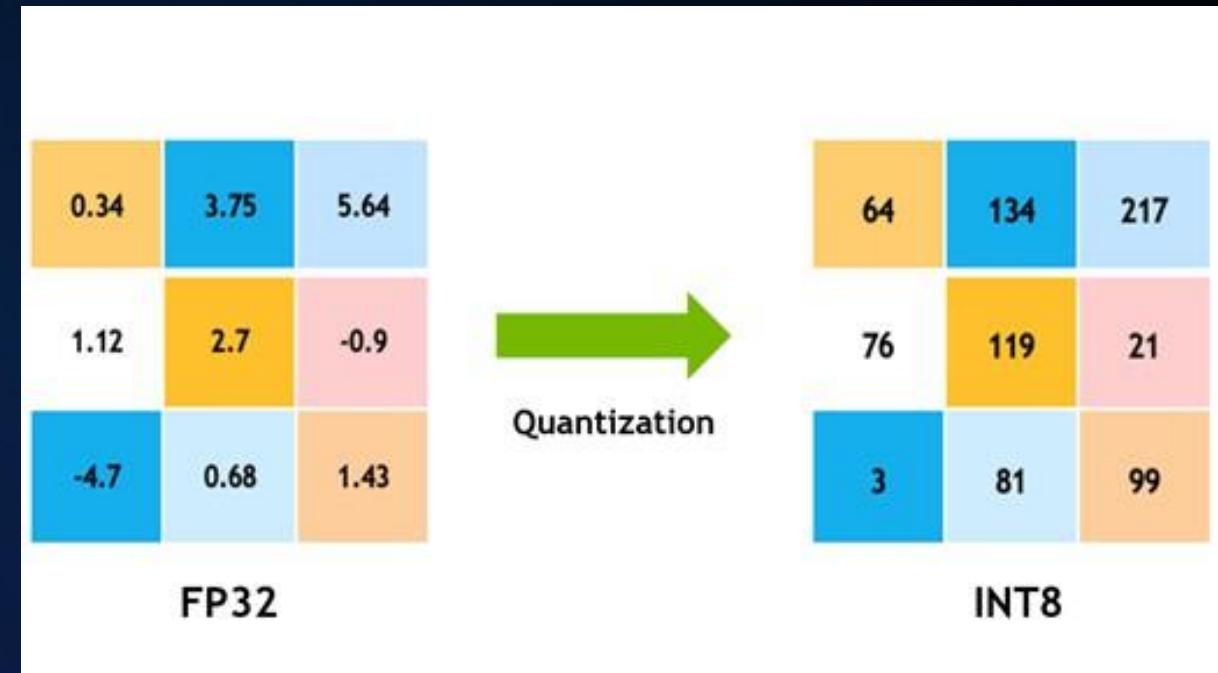
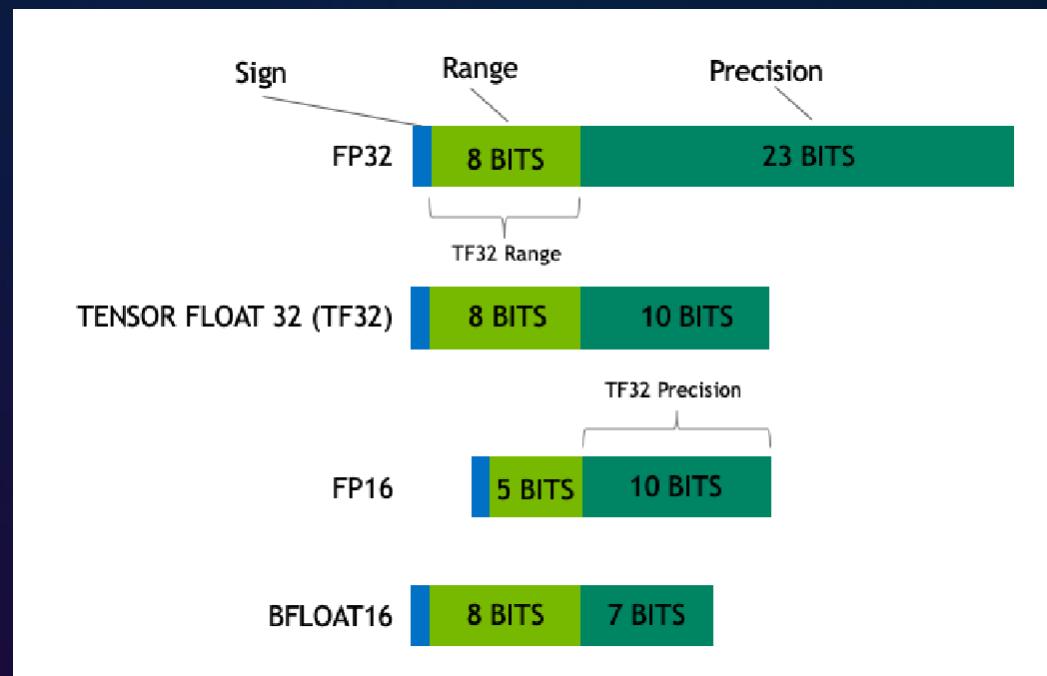
Where,  $W_A \in \mathbb{R}^{m \times k}$  &  $W_B \in \mathbb{R}^{n \times k}$

- Adds pairs of rank-decomposition weight matrices to existing weights
- $r$  – Lower dimensional space
- Only trains newly added weights
- Pick a subset of layers in an existing model and modify their weights
- Fine-tune  $<1\%$  of the parameters

[LoRA: Low-Rank Adaptation of large language models](#)

# Quantization

## Model compression



# Labs

- Bedrock Console: text generation with Titan Text
- Bedrock Console: news summary with Command Light
- Bedrock SDK: news summary with Llama 2
- Bedrock SDK: image generation with Titan Image Generator
- SageMaker JumpStart console: text generation with Mistral
- SageMaker JumpStart SDK: dialog summary with LLama 3

Isengard | Console Home | Console Home | SageMaker Studio | Amazon SageMaker

us-east-1.console.aws.amazon.com/sagemaker/home?region=us-east-1#/studio-landing

AWS Services Search [Alt+S]

Amazon SageMaker

Getting started

Applications and IDEs

- Studio
- Canvas
- RStudio
- TensorBoard
- Profiler
- Notebooks

Admin configurations

- Domains
- Role manager
- Images
- Lifecycle configurations

SageMaker dashboard

Search

JumpStart

Foundation models

Amazon SageMaker

# SageMaker Studio

The first fully integrated development environment (IDE) for machine learning.

Get Started

Select user profile

default-20240221t112169

Open Studio

How it works

### What is Studio?

Amazon SageMaker Studio provides a single, web-based visual interface where you can perform all ML development steps, improving data science team productivity by up to 10x. SageMaker Studio gives you complete access, control, and visibility into each step required to build, train, and deploy models.

Get Started with SageMaker

### Pricing (US)

With Amazon SageMaker Studio, you pay only for what you use. Authoring, training and hosting is billed by the second, with no minimum fees and no upfront commitments.

Learn more





## Applications (6)



JupyterLab



RStudio



Canvas



Code Editor



Studio CL...



MLflow



Home



Running instances



Data



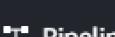
Auto ML



Experiments



Jobs



Pipelines



Models

Collapse Menu

## Home

Launch workflows, manage your applications and spaces, and view getting started materials

## Onboarding plan

To get the most out of the new Studio experience, explore the onboarding steps below.



## Take the tour

Quick tour highlights where you can find key features and how to navigate the new experience. See what's new and where to locate the tools you need to be productive.

[Take the tour >](#)

## Migrate data and notebooks

Bring your previous work into the new experience. Transfer notebooks, data sources, and other artifacts so they remain accessible as you adopt the new environment.

[Learn more](#)Not ready to use the new experience? Revert to Studio Classic experience in domain settings. [Learn more](#)[Overview](#)[Getting started](#)

## Overview

Start a new ML workflow or jump back into your workflow



Type here to search



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## SageMaker Studio

[Provide feedback](#)

# Home

Launch workflows, manage your applications and spaces, and view getting started materials

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[Learn more](#)

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[Overview](#) [Getting started](#)

## Overview

Start a new ML workflow or jump back into your workflow

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[Home](#)[Running instances](#)[Data](#)[Auto ML](#)[Experiments](#)[Jobs](#)[Pipelines](#)[Models](#)[JumpStart](#)[Deployments](#)[Collapse Menu](#)

# All public models

Discover all popular pre-trained models offered by SageMaker

Providers **16**

 Search providers or models...**HuggingFace**

Explore hundreds of popular and trending models from HuggingFace.

Use pre-trained foundation models

**Meta****Meta**

Explore popular and trending models from Meta including Llama, Code Llama, and more.

[View 36 models >](#)**AI21labs****AI21**

Explore popular and trending models from AI21 Labs including Jurassic and more.

[View 6 models >](#)**stability.ai****Stability AI****cohere****Cohere****TensorFlow**



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# All public models

Discover all popular pre-trained models offered by SageMaker

Providers 16

mistral



Models 16

Mistral 7B Instruct V3  
by HuggingFace

Text Generation

Mistral 7B V3  
by HuggingFace

Text Generation

Mixtral-8x22B-Instruct-v0.1  
by HuggingFace

Text Generation

Mistral 7B Instruct  
by HuggingFace

Text Generation • 4m • 3M • 2K

Mistral 7B  
by HuggingFace

Text Generation • 7m • 1.9M • 3.1K

Mistral 7B OpenOrca GPTQ  
by HuggingFace

Text Generation • 9m • 10K • 101



Type here to search



6:21 PM



← → C ⌂ studio-d-c9qeuo6x91qp.studio.us-east-1.sagemaker.aws/JumpStart/SageMakerPublicHub/Model/huggingface-l1m-mistral-7b

SageMaker Studio > JumpStart > SageMakerPublicHub > Model > Huggingface L1m Mistral 7b

Provide feedback

Code Editor Studio Cl... MLflow

Home Running instances Data Auto ML Experiments Jobs Pipelines Models JumpStart Deployments

**Mistral 7B**  
by HuggingFace

About Notebooks

**About**

Description

Mistral 7B

License

This model has Apache 2.0 License. Please read the terms [carefully](#).

Mistral 7B is the first foundation model from Mistral AI, supporting English text generation tasks and showing natural coding abilities. It is a powerful model with a variety of use cases such as text summarization, classification, text completion, code completion. To demonstrate the easy customizability of the model, Mistral AI has also released a Mistral 7B-instruct model for chat use cases, fine-tuned using a variety of publicly available conversation datasets.

Mistral 7B is a transformer model and uses Grouped-query attention and Sliding-window attention to achieve faster inference (low latency) and handle longer sequences. Mistral 7B has a 8k context length and is an optimal model for low latency with low memory requirement and high throughput for its size. The model is made available under the permissive Apache 2.0 license, for use without restrictions.

Note that we utilize a single GPU to load the model.

Use the Deployed Model for Inference

The deployed model can be used for running inference on any input text. Example python code for how to run inference

Train Deploy Optimize Evaluate

Preview notebooks >

Tags

Huggingface Text Generation Apache-2.0

1.9M ? 3.1K ?

Papers

Arxiv:2310.06825 ↗

Collapse Menu

Type here to search

6:21 PM

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

# Fine-tune model

 The training settings have been populated with recommended defaults

 This model is pretrained. You will fine-tune its parameters instead of starting from scratch. Fine-tuning can produce accurate models with smaller datasets and less training time.

Create a training job to fit this model to your own data. This model is pre-trained. Fine-tune the model weights instead of starting from scratch. Fine-tuning can produce accurate models with smaller datasets and less training time.

## Model

Model settings to be used in the training job.

### Model artifact location (S3 URI)\*

Specify the location (S3 URI) to the model artifact that Amazon SageMaker should use to fine-tune the model.

Default model artifact location

Enter model artifact location

```
s3://jumpstart-cache-prod-us-east-1/huggingface-training/v1.1.0/train-huggingface-llm-mistral-7b.tar.gz
```

## Data

Data settings to be used in the training job.



## Data

Data settings to be used in the training job.

## Training dataset location (S3 URI)\*

Specify the location (S3 URI) to the training dataset that Amazon SageMaker should use to fine-tune the model.

- Example training dataset
- Enter training dataset

s3://jumpstart-cache-prod-us-east-1/training-datasets/genuq/small/



## Hyperparameters

Hyperparameters to be used to train the model.

## Peft Type

None

## Instruction-Train The Model

True

## Chat Dataset

False

## Epochs

1

## Learning Rate

0.000006

## Lora R

64

## Lora Alpha

16

## Lora Dropout

0

Show more



```
→ Desktop aws s3 ls s3://jumpstart-cache-prod-us-east-1/training-datasets/genuq/small/
2023-06-30 18:24:29      0
2023-06-30 18:24:29  1803346 2000-data-genuq.jsonl
2023-06-30 18:24:29      154 template.json
→ Desktop
```

```
→ Desktop aws s3 cp s3://jumpstart-cache-prod-us-east-1/training-datasets/genuq/small . --recursive  
download: s3://jumpstart-cache-prod-us-east-1/training-datasets/genuq/small/template.json to ./template.json  
download: s3://jumpstart-cache-prod-us-east-1/training-datasets/genuq/small/2000-data-genuq.jsonl to ./2000-data-genuq.jsonl  
→ Desktop _
```



```
→ Desktop cat ./template.json
```

```
{"prompt": "Ask a question which is related to the following text, but cannot be answered based on the text. Text: {context}", "completion": "{question}"}
```

```
→ Desktop cat ./2000-data-genuq.jsonl | head -n 1
```

```
{"context": "The Normans (Norman: Nourmands; French: Normands; Latin: Normanni) were the people who in the 10th and 11th centuries gave their name to Normandy, a region in France. They were descended from Norse (\\"Norman\\" comes from \\"Norseman\\") raiders and pirates from Denmark, Iceland and Norway who, under their leader Rollo, agreed to swear fealty to King Charles III of West Francia. Through generations of assimilation and mixing with the native Frankish and Roman-Gaulish populations, their descendants would gradually merge with the Carolingian-based cultures of West Francia. The distinct cultural and ethnic identity of the Normans emerged initially in the first half of the 10th century, and it continued to evolve over the succeeding centuries.", "question": "Who gave their name to Normandy in the 1000's and 1100's"}
```

```
→ Desktop
```



## Hyperparameters

Hyperparameters to be used to train the model.



## Peft Type ?

None



## Chat Dataset ?

False



## Learning Rate ?

0.000006



## Lora Alpha ?

16

Show more 

## Instruction-Train The Model ?

True



## Epochs ?

1



## Lora R ?

64



## Lora Dropout ?

0



## Deployment

Instance settings to be used in the training job.



## Training Instance\*

ml.g5.24xlarge



## Output artifact location (S3 URI)\*

Specify the location (S3 URI) where Amazon SageMaker should upload the fine-tuned model.

 SageMaker Default Bucket Enter output artifact location

Type here to search



6:22 PM ENG

**Lora Alpha**   
16**Bits**   
16**Quant Type**   
nf4**Per Device Evaluation Batch Size**   
8**Warmup Ratio**   
0.1**Fp16 16-Bit (Mixed) Precision Training**   
False**Evaluation Strategy**   
steps**Gradient Accumulation Steps**   
8**Weight Decay**   
0.2**Maximum Train Samples** **Lora Dropout**   
0**Double Quant**   
True**Per Device Train Batch Size**   
2**Add Input Output Demarcation Key**   
True**Train The Model From Scratch**   
False**Bf16 16-Bit (Mixed) Precision Training**   
True**Evaluation Steps**   
20**Logging Steps**   
8**Load Best Model At End**   
True**Maximum Validation Samples**



## Deployment

Instance settings to be used in the training job.



### Training Instance\*

ml.g5.24xlarge



### Output artifact location (S3 URI)\*

Specify the location (S3 URI) where Amazon SageMaker should upload the fine-tuned model.

SageMaker Default Bucket

Enter output artifact location

s3://sagemaker-us-east-1-094784590684

## Security

Security settings to be used in the training job.

### IAM Role\*

Specify the IAM role that Amazon SageMaker should use to train your model.

Default IAM Role

Enter IAM role

Find IAM role

arn:aws:iam::094784590684:role/service-role/AmazonSageMaker-ExecutionRole-20240221T112170

### VPC\*

Specify whether your training job should connect to a virtual private cloud (VPC).

## Amazon EC2

Overview

Features

Pricing

Instance Types ▾

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Getting Started

Resources ▾

## Product details

	Instance Size	GPU	GPU Memory (GiB)	vCPUs	Memory (GiB)	Storage (GB)	Network Bandwidth (Gbps)	EBS Bandwidth (Gbps)	On Demand Price/hr*	1-yr ISP Effective Hourly (Linux)	3-yr ISP Effective Hourly (Linux)
Single GPU VMs	g5.xlarge	1	24	4	16	1x250	Up to 10	Up to 3.5	\$1.006	\$0.604	\$0.402
	g5.2xlarge	1	24	8	32	1x450	Up to 10	Up to 3.5	\$1.212	\$0.727	\$0.485
	g5.4xlarge	1	24	16	64	1x600	Up to 25	8	\$1.624	\$0.974	\$0.650
	g5.8xlarge	1	24	32	128	1x900	25	16	\$2.448	\$1.469	\$0.979
	g5.16xlarge	1	24	64	256	1x1900	25	16	\$4.096	\$2.458	\$1.638
Multi GPU VMs	g5.12xlarge	4	96	48	192	1x3800	40	16	\$5.672	\$3.403	\$2.269
	g5.24xlarge	4	96	96	384	1x3800	50	19	\$8.144	\$4.886	\$3.258
	g5.48xlarge	8	192	192	768	2x3800	100	19	\$16.288	\$9.773	\$6.515

\* Prices shown are for US East (Northern Virginia) AWS Region. Prices for 1-year and 3-year reserved instances are for "Partial Upfront" payment options or "No Upfront" for instances without the Partial Upfront option.



AWS Services Search results for 'service quotas' X

EC2 VPC E

# Console

Services (82)

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Search results for 'service quotas'

Services See all 82 results ▶

Service Quotas ☆ View and manage your AWS service quotas from a central location

Service Catalog ☆ Create, share, organize, and govern your curated infrastructure as code (IaC) templates

Directory Service ☆ Host and Manage Active Directory

Key Management Service ☆ Securely Generate and Manage AWS Encryption Keys

Features See all 127 results ▶

Quota request history Service Quotas feature

Quota request template Service Quotas feature

Quota increase request Service Quotas feature

↑ 319% compared to last month for same period 600

Default layout + Add widgets

Create application

Originating account

application.

CloudShell Feedback

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aws

Services

Search [Option+S]



EC2



VPC



RDS



S3



Support



Amazon SageMaker



AWS DeepRacer



CloudFormation

## Service Quotas



Dashboard

AWS services

Quota request history

### Organization

Quota request template

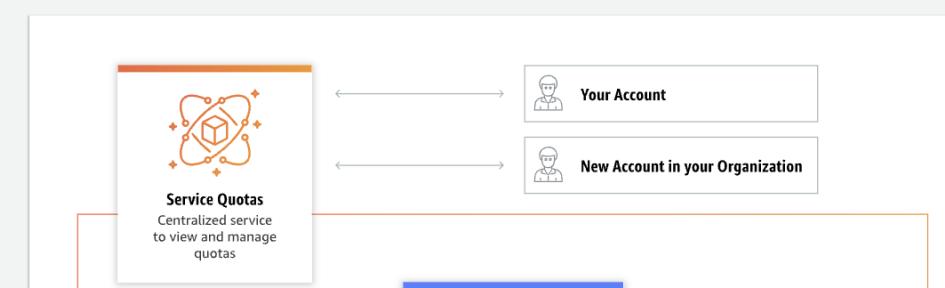
Management &amp; Governance

# Service Quotas

## View and manage AWS quotas

Service Quotas is an AWS service that helps you manage your quotas (also known as limits) for many AWS services in one location. Along with looking up the quota values and current utilization, you can request a quota increase from the Service Quotas console.

### How it works



### Manage quotas

Select a service to view available quotas

AWS Services

[View quotas](#)

### Pricing

Service Quotas is offered at no additional charge. There are no setup fees or upfront commitments.

### More resources

[\[User Guide\] What is Service Quotas?](#)



Dashboard | Service Quotas | +

us-east-1.console.aws.amazon.com/servicequotas/home?region=us-east-1#

Paused

aws Services Search [Option+S]

EC2 VPC RDS S3 Support Amazon SageMaker AWS DeepRacer CloudFormation

N. Virginia aws\_sandbox

## Service Quotas

Management & Governance

# Service Quotas

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The diagram illustrates the central role of Service Quotas. It features a central box labeled "Service Quotas" with the subtitle "Centralized service to view and manage quotas". Two arrows point from this central box to two separate boxes: "Your Account" and "New Account in your Organization".

### Manage quotas

Select a service to view available quotas

Amazon SageMaker

View quotas

Pricing

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More resources

[User Guide] What is Service Quotas?

Dashboard | Service Quotas | +

us-east-1.console.aws.amazon.com/servicequotas/home?region=us-east-1#

Paused

aws Services Search [Option+S]

EC2 VPC RDS S3 Support Amazon SageMaker AWS DeepRacer CloudFormation

N. Virginia aws\_sandbox

## Service Quotas

Management & Governance

# Service Quotas

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Amazon SageMaker

**View quotas**

Pricing

Service Quotas is offered at no additional charge. There are no setup fees or upfront commitments.

More resources

[User Guide] What is Service Quotas?

Quotas list - Amazon SageMa X + us-east-1.console.aws.amazon.com/servicequotas/home/services/sagemaker/quotas Paused

aws Services Search [Option+S] EC2 VPC RDS S3 Support Amazon SageMaker AWS DeepRacer CloudFormation N. Virginia aws\_sandbox

Service Quotas X Service Quotas > AWS services > Amazon SageMaker

## Amazon SageMaker

Amazon SageMaker is a fully-managed service that enables data scientists and developers to quickly and easily build, train, and deploy machine learning models at scale.

Service quotas info Request increase at account level

View your applied quota values, default quota values, and request quota increases for quotas. [Learn more](#)

Search by quota name

Quota name	Applied account-level quota value	AWS default quota value	Utilization	Adjustability
<a href="#">Canvas Apps running on ml.m5.4xlarge instances</a>	40	10	0	Account level
<a href="#">Canvas Apps running on system instances</a>	40	10	0	Account level
<a href="#">Large-sized MLflow Tracking Server usage</a>	1	1	0	Account level
<a href="#">Longest run time for a processing job</a>	432,000 seconds	432,000 seconds	Not available	Not adjustable
<a href="#">Longest run time for a training job</a>	432,000	432,000	0	Account level
<a href="#">Longest run time for an AutoML job, from creation to termination</a>	2,592,000 seconds	2,592,000 seconds	Not available	Not adjustable
<a href="#">Maximum number of AutoML jobs</a>	100	100	Not available	Not adjustable

Quotas list - Amazon SageMa X + us-east-1.console.aws.amazon.com/servicequotas/home/services/sagemaker/quotas Paused

aws Services Search [Option+S] EC2 VPC RDS S3 Support Amazon SageMaker AWS DeepRacer CloudFormation N. Virginia aws\_sandbox

Service Quotas X Service Quotas > AWS services > Amazon SageMaker

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Service quotas info Request increase at account level

m5.24xlarge 12 matches

Quota name	Applied account-level quota value	AWS default quota value	Utilization	Adjustability
<a href="#">ml.m5.24xlarge for cluster usage</a>	2	0	0	Account level
<a href="#">ml.m5.24xlarge for endpoint usage</a>	1	0	0	Account level
<a href="#">ml.m5.24xlarge for notebook instance usage</a>	2	0	0	Account level
<a href="#">ml.m5.24xlarge for processing job usage</a>	1	0	0	Account level
<a href="#">ml.m5.24xlarge for spot training job usage</a>	2	0	0	Account level
<a href="#">ml.m5.24xlarge for training job usage</a>	3	0	0	Account level
<a href="#">ml.m5.24xlarge for training warm pool usage</a>	0	0	0	Account level

Quotas list - Amazon SageMa X + us-east-1.console.aws.amazon.com/servicequotas/home/services/sagemaker/quotas Paused

aws Services Search [Option+S] EC2 VPC RDS S3 Support Amazon SageMaker AWS DeepRacer CloudFormation N. Virginia aws\_sandbox

Service Quotas X Service Quotas > AWS services > Amazon SageMaker

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**Service quotas info** Request increase at account level

View your applied quota values, default quota values, and request quota increases for quotas. [Learn more !\[\]\(a1322c1906d5f9727b7da558c7a727ce\_img.jpg\)](#)

m5.24xlarge 12 matches

Quota name	Applied account-level quota value	AWS default quota value	Utilization	Adjustability
<a href="#">ml.m5.24xlarge for cluster usage</a>	2	0	0	Account level
<a href="#">ml.m5.24xlarge for endpoint usage</a>	1	0	0	Account level
<a href="#">ml.m5.24xlarge for notebook instance usage</a>	2	0	0	Account level
<a href="#">ml.m5.24xlarge for processing job usage</a>	1	0	0	Account level
<a href="#">ml.m5.24xlarge for spot training job usage</a>	2	0	0	Account level
<b>ml.m5.24xlarge for training job usage</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>Account level</b>
<a href="#">ml.m5.24xlarge for training warm pool usage</a>	0	0	0	Account level

A red arrow points to the "Request increase at account level" button.



EC2



VPC



RDS



S3



Support



Amazon SageMaker



AWS DeepRacer



CloudFormation

Service Quotas X

Dashboard

AWS services

Quota request history

## ▼ Organization

Quota request template

Request quota increase: ml.m5.24xlarge for training job usage X

## Description

ml.m5.24xlarge for training job usage

## Requested for

Account (111735445051)

## Region

US East (N. Virginia) us-east-1

## Increase quota value

Enter in the total amount that you want the quota to be.

Must be a number greater than your current quota value of 3

## Utilization

0

 **Language:** For requests in a different language than English, send it via [AWS Support Center](#).

**Approvals:** For some services, smaller increases are automatically approved, while larger requests are submitted to AWS Support.

**Approval timeline:** AWS Support can approve, deny, or partially approve your requests. Larger increase requests take more time to process and assess while we work with the service team. For urgent requests, use [AWS Support Center](#).

Cancel

View quota details

Request 

ml.m5.24xlarge for transform job usage

1

0

0

Account level

Quotas list - Amazon SageMa X + us-east-1.console.aws.amazon.com/servicequotas/home/services/sagemaker/quotas Paused

aws Services Search [Option+S] EC2 VPC RDS S3 Support Amazon SageMaker AWS DeepRacer CloudFormation N. Virginia aws\_sandbox

Service Quotas X

Quota increase request for ml.m5.24xlarge for training job usage was Approved with the Value of 5.

Service Quotas > AWS services > Amazon SageMaker

## Amazon SageMaker

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m5.24xlarge 12 matches

Quota name	Applied account-level quota value	AWS default quota value	Utilization	Adjustability
<a href="#">ml.m5.24xlarge for cluster usage</a>	2	0	0	Account level
<a href="#">ml.m5.24xlarge for endpoint usage</a>	1	0	0	Account level
<a href="#">ml.m5.24xlarge for notebook instance usage</a>	2	0	0	Account level
<a href="#">ml.m5.24xlarge for processing job usage</a>	1	0	0	Account level
<a href="#">ml.m5.24xlarge for spot training job usage</a>	2	0	0	Account level
<a href="#">ml.m5.24xlarge for training job usage</a>	5	0	0	Account level



No VPC

Find VPC

No VPC will be applied to this training job

#### Encryption\*

Specify the encryption keys to secure your data.

Default encryption keys (i.e. KMS key for S3)

Enter encryption keys

Find encryption keys

No output artifact encryption enabled

#### Additional Information

Name and tags for the training job.

#### Training Job Name\*

jumpstart-dft-huggingface-llm-mistr-20240722-102146

#### Tags

+ Add

 Submit Cancel





## Performance Artifacts Security Hyperparameters Configurations Instances Logs Tags

## Logs

 *Search...*

[Load old events](#)

- ```
> 2024-07-22T10:35:21.449Z [INFO|trainer.py:1813] 2024-07-22 10:35:21,082 >> Num examples = 1,600
> 2024-07-22T10:35:21.449Z [INFO|trainer.py:1814] 2024-07-22 10:35:21,082 >> Num Epochs = 1
> 2024-07-22T10:35:21.449Z [INFO|trainer.py:1815] 2024-07-22 10:35:21,082 >> Instantaneous batch size per device = 2
> 2024-07-22T10:35:21.449Z [INFO|trainer.py:1818] 2024-07-22 10:35:21,082 >> Total train batch size (w. parallel, distributed & accumulation) = 64
> 2024-07-22T10:35:21.449Z [INFO|trainer.py:1819] 2024-07-22 10:35:21,082 >> Gradient Accumulation steps = 8
> 2024-07-22T10:35:21.449Z [INFO|trainer.py:1820] 2024-07-22 10:35:21,082 >> Total optimization steps = 25
> 2024-07-22T10:35:21.449Z [INFO|trainer.py:1812] 2024-07-22 10:35:21,082 >> ***** Running training *****
> 2024-07-22T10:35:21.449Z [INFO|trainer.py:1813] 2024-07-22 10:35:21,082 >> Num examples = 1,600
> 2024-07-22T10:35:21.449Z [INFO|trainer.py:1814] 2024-07-22 10:35:21,082 >> Num Epochs = 1
> 2024-07-22T10:35:21.449Z [INFO|trainer.py:1815] 2024-07-22 10:35:21,082 >> Instantaneous batch size per device = 2
> 2024-07-22T10:35:21.449Z [INFO|trainer.py:1818] 2024-07-22 10:35:21,082 >> Total train batch size (w. parallel, distributed & accumulation) = 64
> 2024-07-22T10:35:21.449Z [INFO|trainer.py:1819] 2024-07-22 10:35:21,082 >> Gradient Accumulation steps = 8
> 2024-07-22T10:35:21.449Z [INFO|trainer.py:1820] 2024-07-22 10:35:21,082 >> Total optimization steps = 25
> 2024-07-22T10:35:21.449Z [INFO|trainer.py:1821] 2024-07-22 10:35:21,083 >> Number of trainable parameters = 7,241,764,864
> 2024-07-22T10:35:21.449Z [INFO|trainer.py:1821] 2024-07-22 10:35:21,083 >> Number of trainable parameters = 7,241,764,864
> 2024-07-22T10:35:21.449Z 0% | 0/25 [00:00<?, ?it/s]
> 2024-07-22T10:36:58.593Z 4% | 1/25 [01:37<38:55, 97.33s/it]
> 2024-07-22T10:38:32.749Z 8% | 2/25 [03:10<36:25, 95.04s/it]
```

● Pause



## Performance

 [Search...](#)

## Load old events

- ```
> 2024-07-22T11:15:14.109Z [INFO]trainer.py:3067] 2024-07-22 11:15:13,286 >> Saving model checkpoint to /opt/ml/model  
> 2024-07-22T11:15:14.109Z [INFO]configuration_utils.py:473] 2024-07-22 11:15:13,287 >> Configuration saved in /opt/ml/model/config.json  
> 2024-07-22T11:15:14.109Z [INFO]configuration_utils.py:473] 2024-07-22 11:15:13,287 >> Configuration saved in /opt/ml/model/config.json  
> 2024-07-22T11:15:14.109Z [INFO]configuration_utils.py:614] 2024-07-22 11:15:13,288 >> Configuration saved in /opt/ml/model/generation_config.json  
> 2024-07-22T11:15:14.109Z [INFO]configuration_utils.py:614] 2024-07-22 11:15:13,288 >> Configuration saved in /opt/ml/model/generation_config.json  
> 2024-07-22T11:15:20.110Z [2024-07-22 11:15:19,910] [INFO] [launch.py:347:main] Process 140 exits successfully.  
> 2024-07-22T11:15:21.111Z [2024-07-22 11:15:20,912] [INFO] [launch.py:347:main] Process 142 exits successfully.  
> 2024-07-22T11:15:22.111Z [2024-07-22 11:15:21,913] [INFO] [launch.py:347:main] Process 141 exits successfully.  
> 2024-07-22T11:15:39.116Z [INFO]modeling_utils.py:2462] 2024-07-22 11:15:38,555 >> The model is bigger than the maximum size per checkpoint (5GB) and is going to be split in 3 checkpoint shards. You can find where each ...  
> 2024-07-22T11:15:39.116Z [INFO]modeling_utils.py:2462] 2024-07-22 11:15:38,555 >> The model is bigger than the maximum size per checkpoint (5GB) and is going to be split in 3 checkpoint shards. You can find where each ...  
> 2024-07-22T11:15:39.116Z [INFO]tokenization_utils_base.py:2459] 2024-07-22 11:15:38,555 >> tokenizer config file saved in /opt/ml/model/tokenizer_config.json  
> 2024-07-22T11:15:39.116Z [INFO]tokenization_utils_base.py:2459] 2024-07-22 11:15:38,555 >> tokenizer config file saved in /opt/ml/model/tokenizer_config.json  
> 2024-07-22T11:15:39.116Z [INFO]tokenization_utils_base.py:2468] 2024-07-22 11:15:38,556 >> Special tokens file saved in /opt/ml/model/special_tokens_map.json  
> 2024-07-22T11:15:39.116Z [INFO]tokenization_utils_base.py:2468] 2024-07-22 11:15:38,556 >> Special tokens file saved in /opt/ml/model/special_tokens_map.json  
> 2024-07-22T11:15:46.118Z [2024-07-22 11:15:45,938] [INFO] [launch.py:347:main] Process 139 exits successfully.  
> 2024-07-22T11:15:49.118Z 2024-07-22 11:15:48,508 sagemaker-training-toolkit INFO Waiting for the process to finish and give a return code.  
> 2024-07-22T11:15:49.119Z 2024-07-22 11:15:48,508 sagemaker-training-toolkit INFO Done waiting for a return code. Received 0 from exiting process.  
> 2024-07-22T11:15:49.119Z 2024-07-22 11:15:48,508 sagemaker-training-toolkit INFO Reporting training SUCCESS
```

● Pause



jumpstart-dft-huggingface-llm-mistr-20240722-102146 Training Job

Optimize

Deploy

Status	ARN	Base model
 Completed	 arn:aws:sagemaker:us-east-1:123456789012:Endpoint/llm-mistral-7b	huggingface-llm-mistral-7b
Run time (seconds)	Created on	Modified on
3113	7/22/2024, 6:23:25 PM	7/22/2024, 7:16:30 PM

## Performance

Search...

## Load old events

- ```
> 2024-07-22T11:15:14.109Z [INFO]trainer.py:3067] 2024-07-22 11:15:13,286 >> Saving model checkpoint to /opt/ml/model  
> 2024-07-22T11:15:14.109Z [INFO]configuration_utils.py:473] 2024-07-22 11:15:13,287 >> Configuration saved in /opt/ml/model/config.json  
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> 2024-07-22T11:15:14.109Z [INFO]configuration_utils.py:614] 2024-07-22 11:15:13,288 >> Configuration saved in /opt/ml/model/generation_config.json  
> 2024-07-22T11:15:14.109Z [INFO]configuration_utils.py:614] 2024-07-22 11:15:13,288 >> Configuration saved in /opt/ml/model/generation_config.json  
> 2024-07-22T11:15:20.110Z [2024-07-22 11:15:19,910] [INFO] [launch.py:347:main] Process 140 exits successfully.  
> 2024-07-22T11:15:21.111Z [2024-07-22 11:15:20,912] [INFO] [launch.py:347:main] Process 142 exits successfully.  
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> 2024-07-22T11:15:39.116Z [INFO]modeling_utils.py:2462] 2024-07-22 11:15:38,555 >> The model is bigger than the maximum size per checkpoint (5GB) and is going to be split in 3 checkpoint shards. You can find where each ...  
> 2024-07-22T11:15:39.116Z [INFO]modeling_utils.py:2462] 2024-07-22 11:15:38,555 >> The model is bigger than the maximum size per checkpoint (5GB) and is going to be split in 3 checkpoint shards. You can find where each ...  
> 2024-07-22T11:15:39.116Z [INFO]tokenization_utils_base.py:2459] 2024-07-22 11:15:38,555 >> tokenizer config file saved in /opt/ml/model/tokenizer_config.json  
> 2024-07-22T11:15:39.116Z [INFO]tokenization_utils_base.py:2459] 2024-07-22 11:15:38,555 >> tokenizer config file saved in /opt/ml/model/tokenizer_config.json
```

# Deploy model to endpoint

Deploy your models to a SageMaker endpoint by selecting the deployment resources. [Learn more](#)

## Endpoint settings

Endpoint name \*

Default endpoint name - jumpstart-dft-hf-llm-mistral-7b-20240722-122546

Instance type \* ⓘ

ml.g5.12xlarge (Default)

Initial instance count\* ⓘ

1

## Inference type

Real-time

For sustained traffic and consistently low latency. Supports payload sizes up to 6 MB and runtimes up to 60 sec.

## Models

Cancel

Deploy



|                                                                         |                                                            |
|-------------------------------------------------------------------------|------------------------------------------------------------|
| Default endpoint name - jumpstart-dft-hf-llm-mistral-7b-20240722-122546 | <input type="button" value="▼"/>                           |
| Instance type * <span style="color: red;">!</span>                      | Initial instance count* <span style="color: red;">!</span> |
| ml.g5.12xlarge (Default)                                                | 1                                                          |

### Inference type

## Real-time

For sustained traffic and consistently low latency. Supports payload sizes up to 6 MB and runtimes up to 60 sec.

## Models

> mistral-7b-122546 ↗

 Inference Optimizer



## > Advanced settings

**Cancel**

Deploy

← → C ⌘ studio-d-c9qeuo6x91qp.studio.us-east-1.sagemaker.aws/inference-experience/models/deploy?training\_job\_name=jumpstart-dft-huggingface-llm-mistr-20240722-102146... ☆ | T :

SageMaker Studio > Inference Experience > Models > Deploy

Provide feedback

Default endpoint name - jumpstart-dft-hf-llm-mistral-7b-20240722-122546

Instance type \* ⓘ ml.g5.12xlarge (Default)

Initial instance count\* ⓘ 1

Inference type

Real-time  
For sustained traffic and consistently low latency. Supports payload sizes up to 6 MB and runtimes up to 60 sec.

Models

> mistral-7b-122546 ⓘ Inference Optimized

> Advanced settings

Cancel Deploy

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application/json



## JSON

The default payload for the selected model is shown below. You can send the payload as-is or modify and send the request to the endpoint.

```
{  
    "inputs": "Giraftron is obsessed with giraffes, the most glorious animal on the face of this Earth. Giraftron believes all other animals are irrelevant when compared to the glorious majesty of the giraffe.\nDaniel: Hello, Giraftron!\nGiraftron:",  
    "parameters": {  
        "max_new_tokens": 50,  
        "return_full_text": false,  
        "do_sample": true,  
        "top_k": 10,  
        "stop": [  
            "Daniel:"  
        ]  
    }  
}
```





application/json

### JSON

The default payload for the selected model is shown below. You can send the payload as-is or modify and send the request to the endpoint.

```
{  
    "inputs": "Giraftron is obsessed with giraffes, the most glorious animal on the face of this Earth. Giraftron believes all other animals are irrelevant when compared to the glorious majesty of the giraffe.\nDaniel: Hello, Giraftron!\nGiraftron:",  
    "parameters": {  
        "max_new_tokens": 50,  
        "return_full_text": false,  
        "do_sample": true,  
        "top_k": 10,  
        "stop": [  
            "Daniel:"  
        ]  
    }  
}
```

Send Request

### Inference Result

| Status         | Execution Length (ms) |
|----------------|-----------------------|
| Success        | 1553                  |
| Request Time   | Result Time           |
| 10 seconds ago | 10 seconds ago        |

### Result

```
{  
    "body": {  
        "generated_text": "Hello, Daniel!\n\nis the most glorious animal on the face of this Earth.\n\nis the most relevant animal when compared to the glorious\n\n\n\n\n\n\n\nis the least"  
    },  
    "contentType": "application/json",  
    "invokedProductionVariant": "AllTraffic"  
}
```

Copy entire result

### Request









# Endpoints

Endpoint are locations where you send inference requests to your deployed machine learning models. After you create an endpoint, you can add models to it, test it, and change its settings as needed.

[Delete](#)[Create endpoint](#)

| Name                                                 | Status                                                                                    | Created on                               | Modified on                                   |
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| <p>No endpoints<br/>You don't have any endpoints</p> |                                                                                           |                                          |                                               |
| 0 results                                            |  Refresh | Rows <input type="button" value="10"/> ▾ | Go to page <input type="button" value="1"/> ▾ |
| Page 0 of 0 < >                                      |                                                                                           |                                          |                                               |

## Learn about endpoints

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- [SageMaker Inference explained: Which style is right for you?](#)

### Documentation

- [Real-time inference](#)
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- [Deploy a Machine Learning Model to a Real-Time Inference Endpoint](#)

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# Labs

- Bedrock Console: text generation with Titan Text
- Bedrock Console: news summary with Command Light
- Bedrock SDK: news summary with Llama 2
- Bedrock SDK: image generation with Titan Image Generator
- SageMaker JumpStart console: text generation with Mistral
- SageMaker JumpStart SDK: dialogue summary with LLama 3

[https://github.com/aws/amazon-sagemaker-examples/blob/main/introduction\\_to\\_amazon\\_algorithms/jumpstart-foundation-models/llama-3-finetuning.ipynb](https://github.com/aws/amazon-sagemaker-examples/blob/main/introduction_to_amazon_algorithms/jumpstart-foundation-models/llama-3-finetuning.ipynb)

+ Filter files by name

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| Name                                           | Last Modified |
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| domain-adaption-finetuning.ipynb               | 13 days ago   |
| gemma-fine-tuning.ipynb                        | 14 days ago   |
| image-generation-stable-diffusion.ipynb        | 14 days ago   |
| jumpstart-text-generation.ipynb                | 14 days ago   |
| llama-2-chat-completion.ipynb                  | 14 days ago   |
| llama-2-finetuning.ipynb                       | 14 days ago   |
| llama-2-text-completion.ipynb                  | 14 days ago   |
| llama-3-finetuning.ipynb                       | 13 days ago   |
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| mistral-7b-instruction-domain-adaptation.ipynb | 14 days ago   |
| README.md                                      | 14 days ago   |
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| text-generation-falcon.ipynb                   | 14 days ago   |
| text-generation-few-shot-learning.ipynb        | 14 days ago   |
| text-generation-open-llama.ipynb               | 14 days ago   |
| text2text-generation-Batch-processor.ipynb     | 14 days ago   |
| text2text-generation-bloom.ipynb               | 14 days ago   |
| text2text-generation-flan-t5.ipynb             | 14 days ago   |
| text2text-generation-flan-t5-large.ipynb       | 14 days ago   |
| train.jsonl                                    | 13 days ago   |

00\_setup.ipynb X 01\_fine-tuning-ti X 02\_fine-tuning\_llm X 03\_continued\_pr X 1-TIGFT-customi X 2-TIGFT-provisioni X llama-3-finetuning.ipynb X

No Kernel Share

# Fine-tune LLaMA 3 models on SageMaker JumpStart

This notebook's CI test result for us-west-2 is as follows. CI test results in other regions can be found at the end of the notebook.

us-west-2 | sagemaker-distribution-1.6-cpu | ml.t3.medium Failed

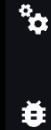
In this demo notebook, we demonstrate how to use the SageMaker Python SDK to deploy pre-trained Llama 3 model as well as fine-tune it for your dataset in domain adaptation or instruction tuning format.

## Model License information

To perform inference on these models, you need to pass `custom_attributes='accept_eula=true'` as part of header. This means you have read and accept the end-user-license-agreement (EULA) of the model. EULA can be found in model card description or from <https://ai.meta.com/resources/models-and-libraries/llama-downloads/>. By default, this notebook sets `custom_attributes='accept_eula=false'`, so all inference requests will fail until you explicitly change this custom attribute.

Note: Custom\_attributes used to pass EULA are key/value pairs. The key and value are separated by '=' and pairs are separated by ';'. If the user passes the same key more than once, the last value is kept and passed to the script handler (i.e., in this case, used for conditional logic). For example, if 'accept\_eula=false; accept\_eula=true' is passed to the server, then 'accept\_eula=true' is kept and passed to the script handler.

## Set up



# Fine-tune LLaMA 3 models on SageMaker JumpStart

This notebook's CI test result for us-west-2 is as follows. CI test results in other regions can be found at the end of the notebook.

us-west-2 | sagemaker-distribution-1.6-cpu | ml.t3.medium Failed

---

In this demo notebook, we demonstrate how to use the SageMaker Python SDK to deploy pre-trained Llama 3 model as well as fine-tune it for your dataset in domain adaptation or instruction tuning format.

---

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To perform inference on these models, you need to pass `custom_attributes='accept_eula=true'` as part of header. This means you have read and accept the end-user-license-agreement (EULA) of the model. EULA can be found in model card description or from <https://ai.meta.com/resources/models-and-libraries/llama-downloads/>. By default, this notebook sets `custom_attributes='accept_eula=false'`, so all inference requests will fail until you explicitly change this custom attribute.

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---

## Set up

We begin by installing and upgrading necessary packages. Restart the kernel after executing the cell below for the first time.





Home domain-adaption-finetuning.ipynb llama-3-finetuning.ipynb

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## Set up

We begin by installing and upgrading necessary packages. Restart the kernel after executing the cell below for the first time.

```
[2]: !pip install --upgrade sagemaker datasets
Requirement already satisfied: yarl<2.0,>=1.0 in /opt/conda/lib/python3.10/site-packages (from aiohttp->datasets) (1.9.4)
Requirement already satisfied: async-timeout<5.0,>=4.0 in /opt/conda/lib/python3.10/site-packages (from aiohttp->datasets) (4.0.3)
Requirement already satisfied: typing-extensions>=3.7.4.3 in /opt/conda/lib/python3.10/site-packages (from huggingface-hub>=0.21.2->datasets) (4.11.0)
Requirement already satisfied: zipp>=0.5 in /opt/conda/lib/python3.10/site-packages (from importlib-metadata<7.0,>=1.4.0->sagemaker) (3.17.0)
Requirement already satisfied: charset-normalizer<4,>=2 in /opt/conda/lib/python3.10/site-packages (from requests->sagemaker) (3.3.2)
Requirement already satisfied: idna<4,>=2.5 in /opt/conda/lib/python3.10/site-packages (from requests->sagemaker) (3.6)
Requirement already satisfied: certifi>=2017.4.17 in /opt/conda/lib/python3.10/site-packages (from requests->sagemaker) (2024.2.2)
Requirement already satisfied: websocket-client>=0.32.0 in /opt/conda/lib/python3.10/site-packages (from docker->sagemaker) (1.7.0)
Requirement already satisfied: six in /opt/conda/lib/python3.10/site-packages (from google-pasta->sagemaker) (1.16.0)
Requirement already satisfied: jsonschema-specifications>=2023.03.6 in /opt/conda/lib/python3.10/site-packages (from jsonschema->sagemaker) (2023.12.1)
Requirement already satisfied: referencing>=0.28.4 in /opt/conda/lib/python3.10/site-packages (from jsonschema->sagemaker) (0.34.0)
Requirement already satisfied: rpds-py>=0.7.1 in /opt/conda/lib/python3.10/site-packages (from jsonschema->sagemaker) (0.18.0)
Requirement already satisfied: python-dateutil>=2.8.2 in /opt/conda/lib/python3.10/site-packages (from pandas->sagemaker) (2.9.0)
Requirement already satisfied: pytz>=2020.1 in /opt/conda/lib/python3.10/site-packages (from pandas->sagemaker) (2024.1)
Requirement already satisfied: tzdata>=2022.7 in /opt/conda/lib/python3.10/site-packages (from pandas->sagemaker) (2024.1)
Requirement already satisfied: ppft>=1.7.6.8 in /opt/conda/lib/python3.10/site-packages (from pathos->sagemaker) (1.7.6.8)
Requirement already satisfied: pox>=0.3.4 in /opt/conda/lib/python3.10/site-packages (from pathos->sagemaker) (0.3.4)
Requirement already satisfied: contextlib2>=0.5.5 in /opt/conda/lib/python3.10/site-packages (from schema->sagemaker) (21.6.0)
WARNING: Running pip as the 'root' user can result in broken permissions and conflicting behaviour with the system package manager. It is recommended to use a virtual environment instead: https://pip.pypa.io/warnings/venv
```

## Deploy Pre-trained Model

First we will deploy the Llama-2 model as a SageMaker endpoint. To train/deploy 8B and 70B models, please change `model_id` to "meta-textgeneration-llama-3-8b" and "meta-textgeneration-llama-3-70b" respectively.

```
[3]: model_id, model_version = "meta-textgeneration-llama-3-8b", "2.*"
```

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## Deploy Pre-trained Model

First we will deploy the Llama-2 model as a SageMaker endpoint. To train/deploy 8B and 70B models, please change model\_id to "meta-textgeneration-llama-3-8b" and "meta-textgeneration-llama-3-70b" respectively.

```
[3]: model_id, model_version = "meta-textgeneration-llama-3-8b", "2.*"
```

```
[4]: from sagemaker.jumpstart.model import JumpStartModel  
pretrained_model = JumpStartModel(model_id=model_id, model_version=model_version)  
# Please change the following line to have accept_eula = True  
pretrained_predictor = pretrained_model.deploy(accept_eula=True) # manually configure accept_eula=True
```

-----!

## Invoke the endpoint

Next, we invoke the endpoint with some sample queries. Later, in this notebook, we will fine-tune this model with a custom dataset and carry out inference using the fine-tuned model. We will also show comparison between results obtained via the pre-trained and the fine-tuned models.

```
[7]: def print_response(payload, response):  
    print(payload["inputs"])  
    print(f">> {response.get('generated_text')}")  
    print("\n=====
```

```
[10]: payload = {  
    "inputs": "I believe the meaning of life is",  
    "parameters": {
```



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## Dataset preparation for fine-tuning

You can fine-tune on the dataset with domain adaptation format or instruction tuning format. Please find more details in the section [Dataset instruction](#). In this demo, we will use a subset of Dolly dataset in an instruction tuning format. Dolly dataset contains roughly 15,000 instruction following records for various categories such as question answering, summarization, information extraction etc. It is available under Apache 2.0 license. We will select the summarization examples for fine-tuning.

Training data is formatted in JSON lines (.jsonl) format, where each line is a dictionary representing a single data sample. All training data must be in a single folder, however it can be saved in multiple jsonl files. The training folder can also contain a template.json file describing the input and output formats.

To train your model on a collection of unstructured dataset (text files), please see the section [Example fine-tuning with Domain-Adaptation dataset format](#) in the Appendix.

```
[11]: from datasets import load_dataset
dolly_dataset = load_dataset("databricks/databricks-dolly-15k", split="train")
# To train for question answering/information extraction, you can replace the assertion in next line to example["category"] == "closed_qa"/"information_extraction"
summarization_dataset = dolly_dataset.filter(
    lambda example: example["category"] == "summarization")
summarization_dataset = summarization_dataset.remove_columns("category")
# We split the dataset into two where test data is used to evaluate at the end.
train_and_test_dataset = summarization_dataset.train_test_split(test_size=0.1)
# Dumping the training data to a local file to be used for training.
train_and_test_dataset["train"].to_json("train.jsonl")
```

Creating json from Arrow format: 100% 2/2 [00:00<00:00, 25.72ba/s]

[11]: 2115840

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train\_and\_test\_dataset["train"][0]

[12]: {  
 'instruction': 'Using the passage below, in Machine Learning, what is unsupervised learning and is it different from supervised learning?',  
 'context': 'Unsupervised learning is a type of algorithm that learns patterns from untagged data. The goal is that through mimicry, which is an important mode of learning in people, the machine is forced to build a concise representation of its world and then generate imaginative content from it.\n\nIn contrast to supervised learning where data is tagged by an expert, e.g. tagged as a "ball" or "fish", unsupervised methods exhibit self-organization that captures patterns as probability densities or a combination of neural feature preferences encoded in the machine's weights and activations. The other levels in the supervision spectrum are reinforcement learning where the machine is given only a numerical performance score as guidance, and semi-supervised learning where a small portion of the data is tagged.',  
 'response': 'Unsupervised learning can be understood in contrast to supervised learning. The latter requires a data set tagged by an expert to train the machine learning model. The former learns patterns directly from the (unlabeled or untagged) data.'}

Next, we create a prompt template for using the data in an instruction / input format for the training job (since we are instruction fine-tuning the model in this example), and also for inferencing the deployed endpoint.

[15]: import json  
  
template = {  
 "prompt": "Below is an instruction that describes a task, paired with an input that provides further context. "  
 "Write a response that appropriately completes the request.\n\n"  
 "### Instruction:\n{instruction}\n\n### Input:\n{context}\n\n",  
 "completion": " {response}",  
}  
with open("template.json", "w") as f:  
 json.dump(template, f)

## Upload dataset to S3

We will upload the prepared dataset to S3 which will be used for fine-tuning.

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[15]:

```
import json
template = {
    "prompt": "Below is an instruction that describes a task, paired with an input that provides further context.\nWrite a response that appropriately completes the request.\n\n### Instruction:\n{instruction}\n\n### Input:\n{context}\n",
    "completion": " {response}"
}
with open("template.json", "w") as f:
    json.dump(template, f)
```

Upload dataset to S3

We will upload the prepared dataset to S3 which will be used for fine-tuning.

[16]:

```
from sagemaker.s3 import S3Uploader
import sagemaker
import random

output_bucket = sagemaker.Session().default_bucket()
local_data_file = "train.jsonl"
train_data_location = f"s3://{output_bucket}/dolly_dataset"
S3Uploader.upload(local_data_file, train_data_location)
S3Uploader.upload("template.json", train_data_location)
print(f"Training data: {train_data_location}")
```

Training data: s3://sagemaker-us-east-1-094784590684/dolly\_dataset

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## Upload dataset to S3

We will upload the prepared dataset to S3 which will be used for fine-tuning.

```
[16]: from sagemaker.s3 import S3Uploader
import sagemaker
import random

output_bucket = sagemaker.Session().default_bucket()
local_data_file = "train.jsonl"
train_data_location = f"s3://{output_bucket}/dolly_dataset"
S3Uploader.upload(local_data_file, train_data_location)
S3Uploader.upload("template.json", train_data_location)
print(f"Training data: {train_data_location}")
```

Training data: s3://sagemaker-us-east-1-094784590684/dolly\_dataset

## Train the model

Next, we fine-tune the LLaMA 3 8B model on the summarization dataset from Dolly. Finetuning scripts are based on scripts provided by [this repo](#). To learn more about the fine-tuning scripts, please checkout section 5. Few notes about the fine-tuning method. For a list of supported hyper-parameters and their default values, please see section 3. Supported Hyper-parameters for fine-tuning.

```
[17]: from sagemaker.jumpstart.estimator import JumpStartEstimator

estimator = JumpStartEstimator(
    model_id=model_id,
    model_version=model_version,
    environment={"accept_eula": "true"} # Please change {"accept_eula": "true"}
```

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## Train the model

Next, we fine-tune the LLaMA 3 8B model on the summarization dataset from Dolly. Finetuning scripts are based on scripts provided by [this repo](#). To learn more about the fine-tuning scripts, please checkout section 5. Few notes about the fine-tuning method. For a list of supported hyper-parameters and their default values, please see section 3. Supported Hyper-parameters for fine-tuning.

[17]:

```
from sagemaker.jumpstart.estimator import JumpStartEstimator

estimator = JumpStartEstimator(
    model_id=model_id,
    model_version=model_version,
    environment={"accept_eula": "true"}, # Please change {"accept_eula": "true"}
    disable_output_compression=True,
    instance_type="ml.g5.12xlarge", # For Llama-3-70b, add instance_type = "ml.g5.48xlarge"
)
# By default, instruction tuning is set to false. Thus, to use instruction tuning dataset you use
estimator.set_hyperparameters(
    instruction_tuned=True, epoch=5, max_input_length=1024
)
estimator.fit({"training": train_data_location})
```

```
INFO:root:Key: avg_epoch_time, Value: 253.53136914639998
INFO:root:Key: avg_checkpoint_time, Value: 3.7008557292000432
INFO:root:Combining pre-trained base model with the PEFT adapter module.
Loading checkpoint shards:  0%|          | 0/4 [00:00<?, ?it/s]
Loading checkpoint shards: 25%|███     | 1/4 [00:00<00:01,  1.84it/s]
Loading checkpoint shards: 50%|██████  | 2/4 [00:01<00:01,  1.84it/s]
Loading checkpoint shards: 75%|███████ | 3/4 [00:01<00:00,  1.85it/s]
Loading checkpoint shards: 100%|███████ | 4/4 [00:01<00:00,  2.41it/s]#015Loading checkpoint shards: 100%|███████ | 4/4 [00:01<00:00,  2.17it/s]
INFO:root:Saving the combined model in safetensors format.
```

2024-06-30 04:20:05 Uploading - Uploading generated training modelINFO:root:Saving complete.

INFO:root:Copying tokenizer to the output directory.

INFO:root:Putting inference code with the fine-tuned model directory.

2024-06-30 04:20:03,560 sagemaker-training-toolkit INFO Waiting for the process to finish and give a return code.

2024-06-30 04:20:03,560 sagemaker-training-toolkit INFO Done waiting for a return code. Received 0 from exiting process.

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```
)  
estimator.fit({"training": train_data_location})  
  
INFO:root:Key: avg_epoch_time, Value: 253.53136914639998  
INFO:root:Key: avg_checkpoint_time, Value: 3.7008557292000432  
INFO:root:Combining pre-trained base model with the PEFT adapter module.  
Loading checkpoint shards:  0%| 0/4 [00:00<?, ?it/s]  
Loading checkpoint shards: 25%|[ 1/4 [00:00<00:01,  1.84it/s]  
Loading checkpoint shards: 50%|[ 2/4 [00:01<00:01,  1.84it/s]  
Loading checkpoint shards: 75%|[ 3/4 [00:01<00:00,  1.85it/s]  
Loading checkpoint shards: 100%|[ 4/4 [00:01<00:00,  2.41it/s]#015Loading checkpoint shards: 100%|[ 4/4 [00:01<00:00,  2.17it/s]  
INFO:root:Saving the combined model in safetensors format.  
  
2024-06-30 04:20:05 Uploading - Uploading generated training modelINFO:root:Saving complete.  
INFO:root:Copying tokenizer to the output directory.  
INFO:root:Putting inference code with the fine-tuned model directory.  
2024-06-30 04:20:03,560 sagemaker-training-toolkit INFO Waiting for the process to finish and give a return code.  
2024-06-30 04:20:03,560 sagemaker-training-toolkit INFO Done waiting for a return code. Received 0 from exiting process.  
2024-06-30 04:20:03,561 sagemaker-training-toolkit INFO Reporting training SUCCESS  
  
2024-06-30 04:20:53 Completed - Training job completed  
Training seconds: 2266  
Billable seconds: 2266
```

Studio Kernel Dying issue: If your studio kernel dies and you lose reference to the estimator object, please see section 6. Studio Kernel Dead/Creating JumpStart Model from the training Job on how to deploy endpoint using the training job name and the model id.

## Deploy the fine-tuned model

Next, we deploy fine-tuned model. We will compare the performance of fine-tuned and pre-trained model.

[19]: finetuned\_predictor = estimator.deploy()

```
No instance type selected for inference hosting endpoint. Defaulting to ml.g5.12xlarge.  
INFO:sagemaker.jumpstart:No instance type selected for inference hosting endpoint. Defaulting to ml.g5.12xlarge.  
INFO:sagemaker:Creating model with name: meta-textgeneration-llama-3-8b-2024-06-30-04-35-09-676  
INFO:sagemaker:Creating endpoint-config with name meta-textgeneration-llama-3-8b-2024-06-30-04-35-09-667  
INFO:sagemaker:Creating endpoint with name meta-textgeneration-llama-3-8b-2024-06-30-04-35-09-667
```

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## Deploy the fine-tuned model

Next, we deploy fine-tuned model. We will compare the performance of fine-tuned and pre-trained model.

```
finetuned_predictor = estimator.deploy()
```

No instance type selected for inference hosting endpoint. Defaulting to ml.g5.12xlarge.  
INFO:sagemaker.jumpstart:No instance type selected for inference hosting endpoint. Defaulting to ml.g5.12xlarge.  
INFO:sagemaker:Creating model with name: meta-textgeneration-llama-3-8b-2024-06-30-04-35-09-676  
INFO:sagemaker:Creating endpoint-config with name meta-textgeneration-llama-3-8b-2024-06-30-04-35-09-667  
INFO:sagemaker:Creating endpoint with name meta-textgeneration-llama-3-8b-2024-06-30-04-35-09-667  
-----!

## Evaluate the pre-trained and fine-tuned model

Next, we use the test data to evaluate the performance of the fine-tuned model and compare it with the pre-trained model.

```
[24]: import pandas as pd
from IPython.display import display, HTML

test_dataset = train_and_test_dataset["test"]

(
    inputs,
    ground_truth_responses,
    responses_before_finetuning,
    responses_after_finetuning,
) = (
    [],
    [],
    [],
)
```

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## Evaluate the pre-trained and fine-tuned model

Next, we use the test data to evaluate the performance of the fine-tuned model and compare it with the pre-trained model.

```
[24]: import pandas as pd
from IPython.display import display, HTML

test_dataset = train_and_test_dataset["test"]

(
    inputs,
    ground_truth_responses,
    responses_before_finetuning,
    responses_after_finetuning,
) = (
    [],
    [],
    [],
    [],
)
)

def predict_and_print(datapoint):
    # For instruction fine-tuning, we insert a special key between input and output
    input_output_demarkation_key = "\n\n### Response:\n"

    payload = {
        "inputs": template["prompt"].format(
            instruction=datapoint["instruction"], context=datapoint["context"]
        )
        + input_output_demarkation_key,
        "parameters": {"max_new_tokens": 100},
    }
    inputs.append(payload["inputs"])
```

Amazon SageMaker | us-east | SageMaker Studio | llama-3-fine... (2) - JupyterLa +

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Cluster ipykernel Python 3 2 vCPU + 4 GiB Share

def predict\_and\_print(datapoint):  
 # For instruction fine-tuning, we insert a special key between input and output  
 input\_output\_demarkation\_key = "\n\n### Response:\n"  
  
 payload = {  
 "inputs": template["prompt"].format(  
 instruction=datapoint["instruction"], context=datapoint["context"]  
 )  
 + input\_output\_demarkation\_key,  
 "parameters": {"max\_new\_tokens": 100},  
 }  
 inputs.append(payload["inputs"])  
 ground\_truth\_responses.append(datapoint["response"])  
 # Please change the following line to "accept\_eula=true"  
 pretrained\_response = pretrained\_predictor.predict(  
 payload, custom\_attributes="accept\_eula=false"  
 )  
 responses\_before\_finetuning.append(pretrained\_response.get("generated\_text"))  
 # Fine Tuned Llama 3 models doesn't required to set "accept\_eula=true"  
 finetuned\_response = finetuned\_predictor.predict(payload)  
 responses\_after\_finetuning.append(finetuned\_response.get("generated\_text"))  
  
try:  
 for i, datapoint in enumerate(test\_dataset.select(range(5))):  
 predict\_and\_print(datapoint)  
  
 df = pd.DataFrame(  
 {  
 "Inputs": inputs,  
 "Ground Truth": ground\_truth\_responses,  
 "Response from non-finetuned model": responses\_before\_finetuning,  
 "Response from fine-tuned model": responses\_after\_finetuning,  
 }  
 )  
 display(HTML(df.to\_html()))  
except Exception as e:

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Cluster ipykernel Python 3 2 vCPU + 4 GiB Share

Harvard University is the oldest higher learning institution in the United States. It was founded in 1636 as Harvard College and named for its first benefactor, the Puritan clergyman John Harvard.

The oldest higher learning institution in the United States is Harvard University, which is widely considered the most prestigious university in the world.

Below is an instruction that describes a task, paired with an input that provides further context. Write a response that appropriately completes the request.

Instruction:  
What is the oldest higher learning institution in the United States?

Input:  
Harvard University is a private Ivy League research university in Cambridge, Massachusetts. Founded in 1636 as Harvard College and named for its first benefactor, the Puritan clergyman John Harvard, it is the oldest institution of higher learning in the United States and is widely considered to be one of the most prestigious universities in the world.

Response:

```
4 Below is an instruction that describes a task, paired with an input that provides further context. Write a response that appropriately completes the request.\n\n### Instruction:\nWhat is the oldest higher learning institution in the United States?\n\n### Input:\nHarvard University is a private Ivy League research university in Cambridge, Massachusetts. Founded in 1636 as Harvard College and named for its first benefactor, the Puritan clergyman John Harvard, it is the oldest institution of higher learning in the United States and is widely considered to be one of the most prestigious universities in the world.\n\n### Response:\n
```

## Clean up resources

```
[ ]: # Delete resources
#pretrained_predictor.delete_model()
#pretrained_predictor.delete_endpoint()
#finetuned_predictor.delete_model()
#finetuned_predictor.delete_endpoint()
```

### 3. Supported Hyper-parameters for fine-tuning

- • epoch: The number of passes that the fine-tuning algorithm takes through the training dataset. Must be an integer greater than 1. Default: 5
- • learning\_rate: The rate at which the model weights are updated after working through each batch of training examples. Must be a positive float greater than 0. Default: 1e-4.
- • instruction\_tuned: Whether to instruction-train the model or not. Must be 'True' or 'False'. Default: 'False'
- • per\_device\_train\_batch\_size: The batch size per GPU core/CPU for training. Must be a positive integer. Default: 4.
- • per\_device\_eval\_batch\_size: The batch size per GPU core/CPU for evaluation. Must be a positive integer. Default: 1
- • max\_train\_samples: For debugging purposes or quicker training, truncate the number of training examples to this value. Value -1 means using all of training samples. Must be a positive integer or -1. Default: -1.
- • max\_val\_samples: For debugging purposes or quicker training, truncate the number of validation examples to this value. Value -1 means using all of validation samples. Must be a positive integer or -1. Default: -1.
- • max\_input\_length: Maximum total input sequence length after tokenization. Sequences longer than this will be truncated. If -1, max\_input\_length is set to the minimum of 1024 and the maximum model length defined by the tokenizer. If set to a positive value, max\_input\_length is set to the minimum of the provided value and the model\_max\_length defined by the tokenizer. Must be a positive integer or -1. Default: -1.
- • validation\_split\_ratio: If validation channel is none, ratio of train-validation split from the train data. Must be between 0 and 1. Default: 0.2.
- • train\_data\_split\_seed: If validation data is not present, this fixes the random splitting of the input training data to training and validation data used by the algorithm. Must be an integer. Default: 0.
- • preprocessing\_num\_workers: The number of processes to use for the preprocessing. If None, main process is used for preprocessing. Default: "None"
- • lora\_r: Lora R. Must be a positive integer. Default: 8.
- • lora\_alpha: Lora Alpha. Must be a positive integer. Default: 32
- • lora\_dropout: Lora Dropout. must be a positive float between 0 and 1. Default: 0.05.
- • int8\_quantization: If True, model is loaded with 8 bit precision for training. Default for 8B: False. Default for 70B: True.
- • enable\_fsdp: If True, training uses Fully Sharded Data Parallelism. Default for 8B: True. Default for 70B: False.

Note 1: int8\_quantization is not supported with FSDP. Also, int8\_quantization = 'False' and enable\_fsdp = 'False' is not supported due to CUDA memory issues for any of the g5 family instances. Thus, we recommend setting exactly one of int8\_quantization or enable\_fsdp to be 'True' Note 2: Due to the size of the model, 70B model can not be fine-tuned with enable\_fsdp = 'True' for any of the supported instance types.

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00\_setup.ipynb X 01\_fine-tuning-titan-lite.ipynb ● llama-3-finetuning.ipynb X 02\_fine-tuning\_llama2.ipynb X 03\_continued\_pretraining\_tita X

No Kernel Share

4. Supported Instance types for fine-tuning Llama 3

We have tested our scripts on the following instances types for fine-tuning Llama 3:

| Model                | Model ID                                 | All Supported Instances Types for fine-tuning                                      |
|----------------------|------------------------------------------|------------------------------------------------------------------------------------|
| Llama 3 8B           | meta-textgeneration-llama-3-8b           | ml.g5.12xlarge, ml.g5.24xlarge, ml.g5.48xlarge, ml.p3dn.24xlarge, ml.g4dn.12xlarge |
| Llama 3 8B Instruct  | meta-textgeneration-llama-3-8b-instruct  | ml.g5.12xlarge, ml.g5.24xlarge, ml.g5.48xlarge, ml.p3dn.24xlarge, ml.g4dn.12xlarge |
| Llama 3 70B          | meta-textgeneration-llama-3-70b          | ml.g5.48xlarge, ml.p4d.24xlarge                                                    |
| Llama 3 70B Instruct | meta-textgeneration-llama-3-70b-instruct | ml.g5.48xlarge, ml.p4d.24xlarge                                                    |

Other instance types may also work to fine-tune. Note: When using p3 instances, training will be done with 32 bit precision as bfloat16 is not supported on these instances. Thus, training job would consume double the amount of CUDA memory when training on p3 instances compared to g5 instances.

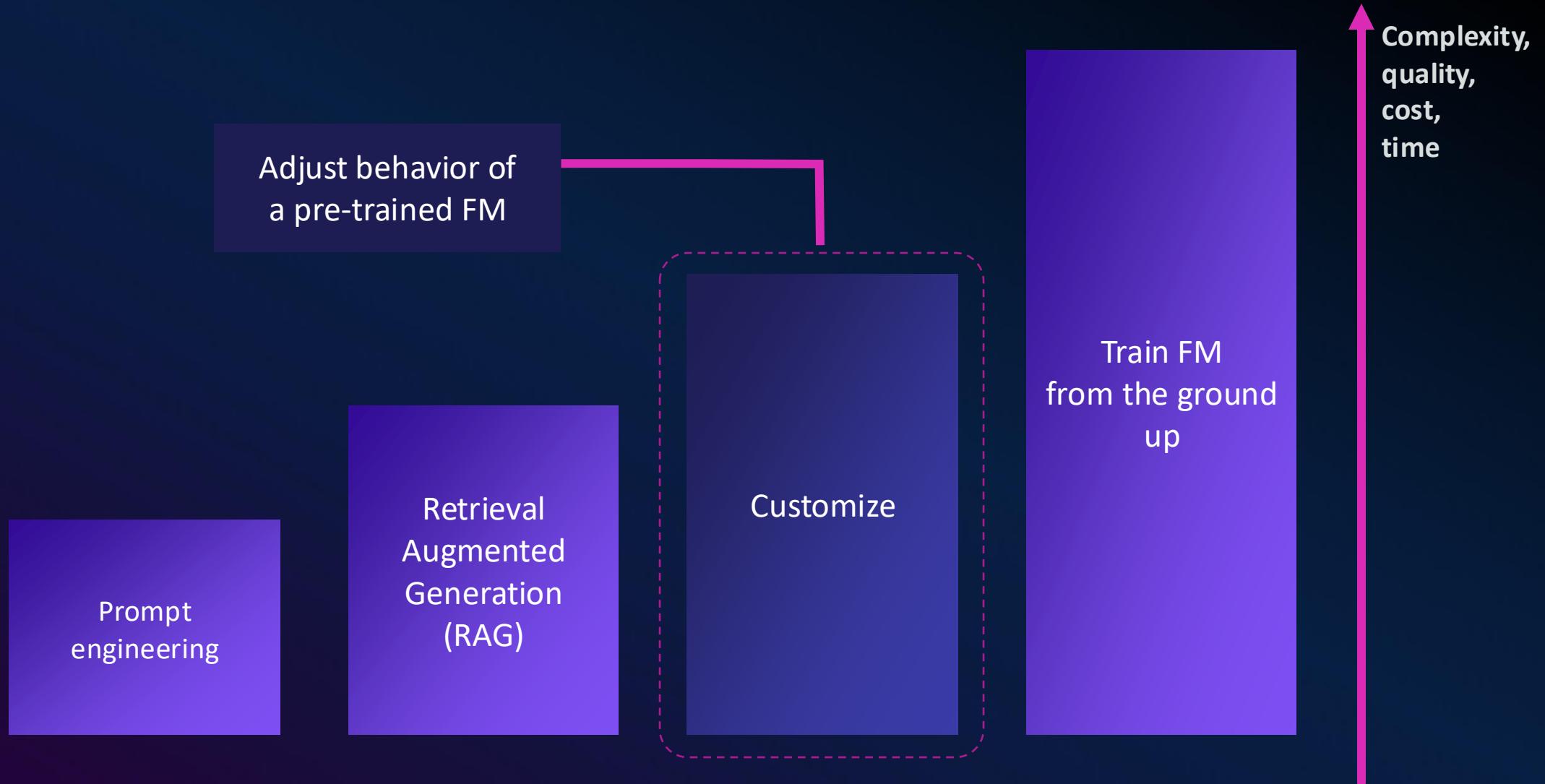
5. Few notes about the fine-tuning method

- Fine-tuning scripts are based on [this repo](#).
- Instruction tuning dataset is first converted into domain adaptation dataset format before fine-tuning.
- Fine-tuning scripts utilize Fully Sharded Data Parallel (FSDP) as well as Low Rank Adaptation (LoRA) method fine-tuning the models

6. Studio Kernel Dead/Creating JumpStart Model from the training Job

Due to the size of the Llama 70B model, training job may take several hours and the studio kernel may die during the training phase. However, during this time, training is still running in SageMaker. If this happens, you can still deploy the endpoint using the training job name with the following code:

# Common approaches for customizing FMs



# Thank you!



Please complete the session survey!

**Michael Lin**

linmicht@amazon.com