

Foundation Model Fine-Tuning Workshop

Michael Lin

Sr. Solutions Architect
Amazon Web Services



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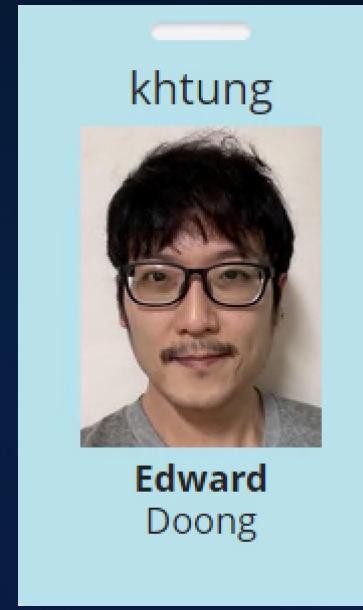
Facilitators



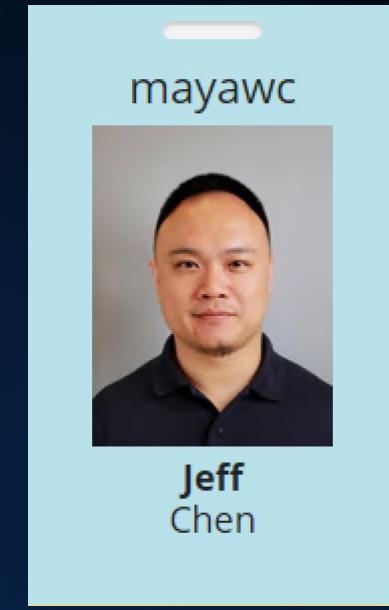
Sr. Solutions
Architect



Sr. AI/ML GTM
Specialist



Solutions Architect



Solutions Architect

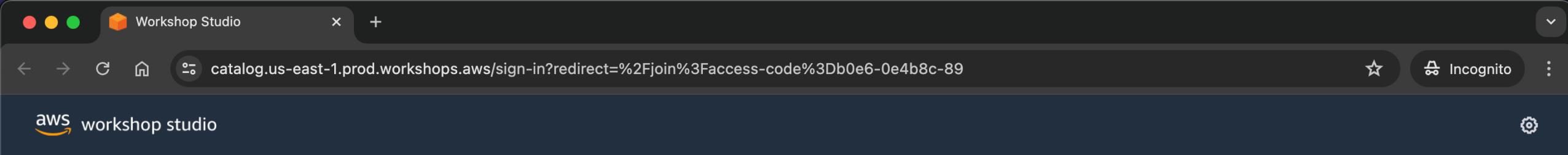
Labs

- 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
- SageMaker Studio Access



[Workshop Studio](#) > Sign in

Sign in

Choose a preferred sign-in method

Email one-time password (OTP)

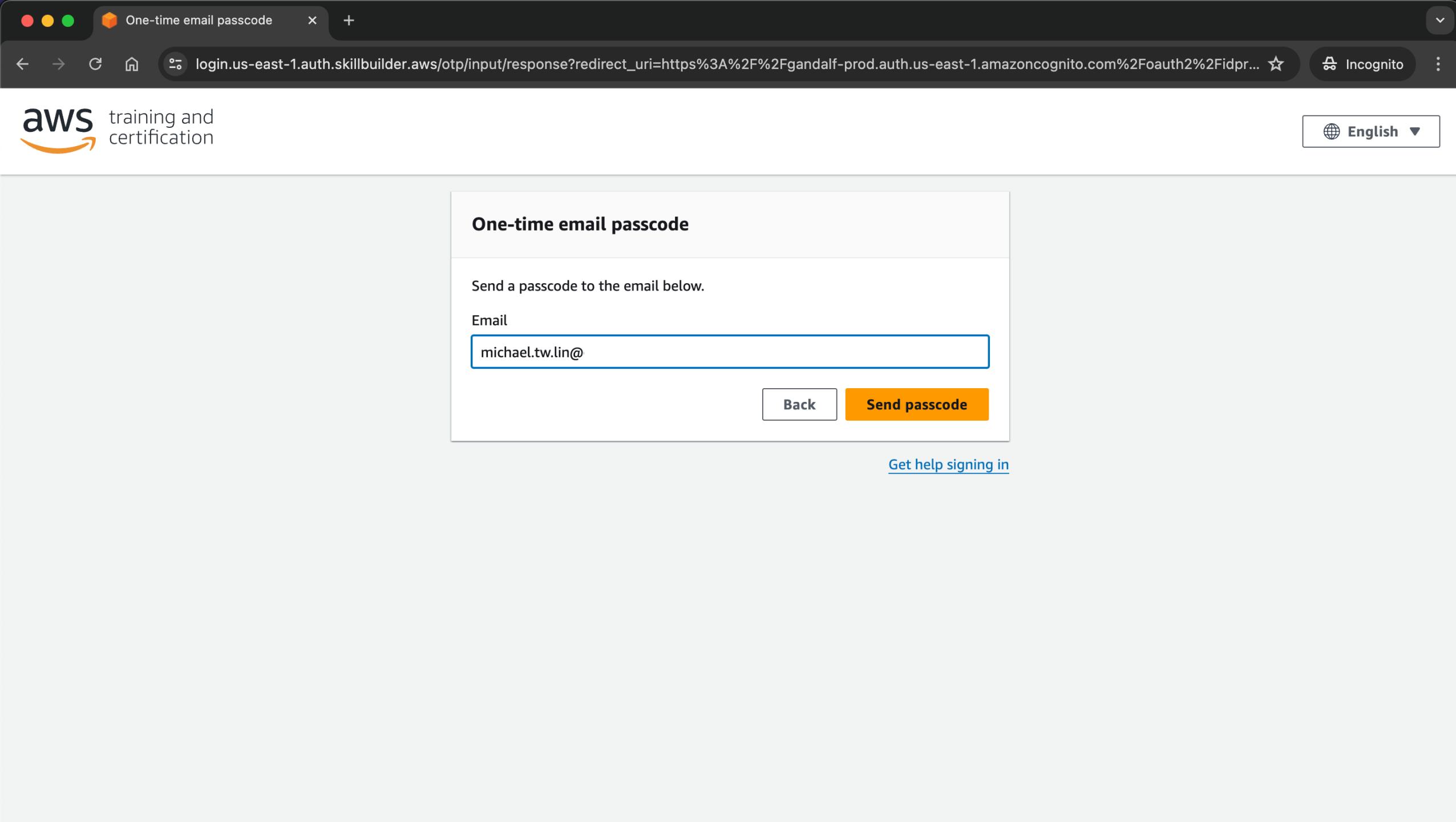
Enter your personal or corporate email to receive a one-time password

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.





Verify one-time email passcode

← → ⌛ ⌂ 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

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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



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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 i

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
----------------------------------	----------------------	--

Description
bedrock-finetune-20240712

Workshop

Title Amazon Bedrock Workshop	Complexity level 300	AWS services Amazon Bedrock	Topics Machine Learning (ML/AI), Generative AI
----------------------------------	-------------------------	--------------------------------	--

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 using AWS services.

AWS Health Info

Cost and usage Info

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

Workshop Setup

- Workshop Access
- Bedrock Model Access
- SageMaker Studio Access

AWS Services Search: bedrock

Services (1)

- Recent
- Resources **New**
- Documentation (2,575)
- Knowledge Articles (12)
- Marketplace (368)
- Blogs (217)
- Events (1)
- Amazon Bedrock
- IAM
- S3
- Amazon CloudWatch
- CloudFront
- 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 

User Guide

Default layout **+ Add widgets**

Create application **:**

1

Originating account

application.

40

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Services

Search [Option+S]



Oregon ▾

WSParticipantRole/Participant @ 6534-0549-1536 ▾



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#/

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](#)

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- 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 ▾

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- Model Evaluation

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Bedrock Studio [Preview](#)

Settings

User guide 

Machine Learning

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



Services

Search [Option+S]



Oregon ▾

WSParticipantRole/Participant @ 6534-0549-1536 ▾



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

[Cancel](#)[Previous](#)[Submit](#)



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

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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#/modelaccess

aws 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

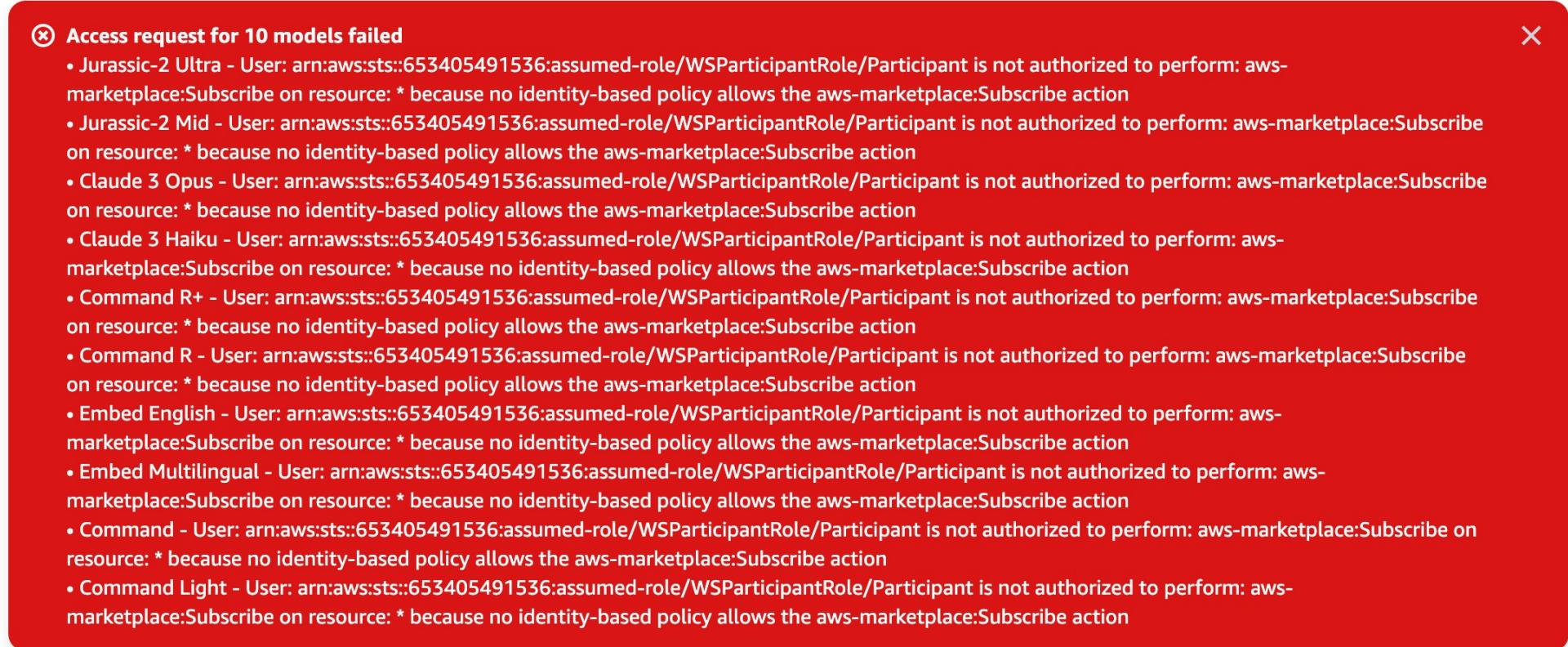
Amazon Bedrock > Model access

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- Bedrock Model Access
- SageMaker Studio Access

Amazon Bedrock

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Assessment & deployment

[Model Evaluation](#)

Search results for 'sagemaker'

Services



Amazon SageMaker



Build, Train, and Deploy Machine Learning Models

Features

[See all 5 results ▶](#)

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](#)[examples](#)[Compare mode](#)

等,適合不同的口味喜好。



▶ Run

[Define metric criteria](#)

Overall summary

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

Getting started

Applications and IDEs

- Studio ←
- Canvas
- RStudio
- TensorBoard
- Notebooks

Admin configurations

- Domains →
- Role manager
- Images
- Lifecycle configurations

SageMaker dashboard

Search

JumpStart

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) Info				
C View Create domain				
Find domain name				
Name	Id	Status	Created on	Modified on
amazon-bedrock-workshop	d-noqxdjm0rbmm	InService	Jul 12, 2024 02:28 UTC	Jul 12, 2024 02:31 UTC

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

Getting started

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SageMaker dashboard

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Foundation models

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.

Learn more

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

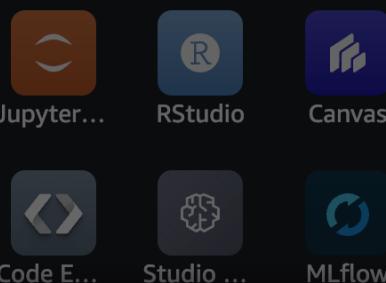
Pricing (US)

With Amazon SageMaker Studio, you pay only for





Applications (6)

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

Onboarding

To get the most ou

Take the 1

Quick tour high
the new experie
to be productiv

[Take the tour >](#)

Not ready to use th

[Overview](#)[Getti](#)

Overview

Start a new ML wor



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](#)

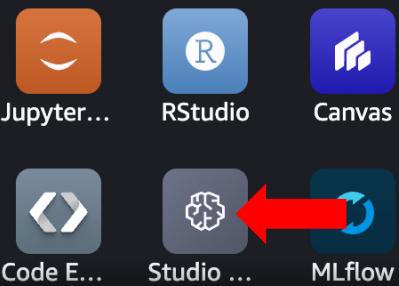
[Take a quick tour](#)

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





Applications (6)

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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

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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 ↗](#)

Filter spaces: Running

Name	Application	Status	Type	Last modified	Action
sagemakeruser	Studio Classic	Stopped	Private	0 seconds ago	Run

1 results

Results are cached

Refresh

Go to page 1

Page 1 of 1 < >

Introducing spaces New

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

[Learn more ↗](#)



Applications (6)

- JupyterLab
- RStudio
- Canvas
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Studio Classic

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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	Running	Private	15 seconds ago	<input type="button" value="Stop"/> <input style="background-color: #0072bc; color: white; border-radius: 5px; border: none; padding: 2px 10px; font-weight: bold; margin-left: 10px;" type="button" value="Open ↗"/>

1 results

Results are cached

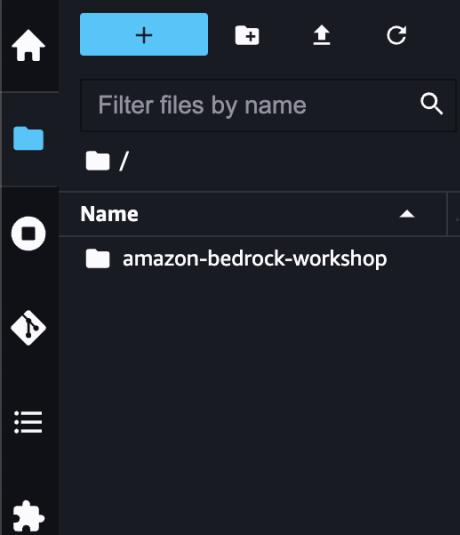
Go to page 1

Page 1 of 1 < >

Introducing spaces New

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

[Learn more ↗](#)



Launcher

Interested in launching different applications? Introducing a centralized hub for launching all your favorite apps including JupyterLab, Code Editor, and RStudio.

[Learn more](#)



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

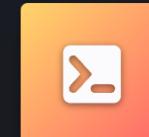
Start-up script

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

Customize FMs for generative AI applications with Amazon Bedrock

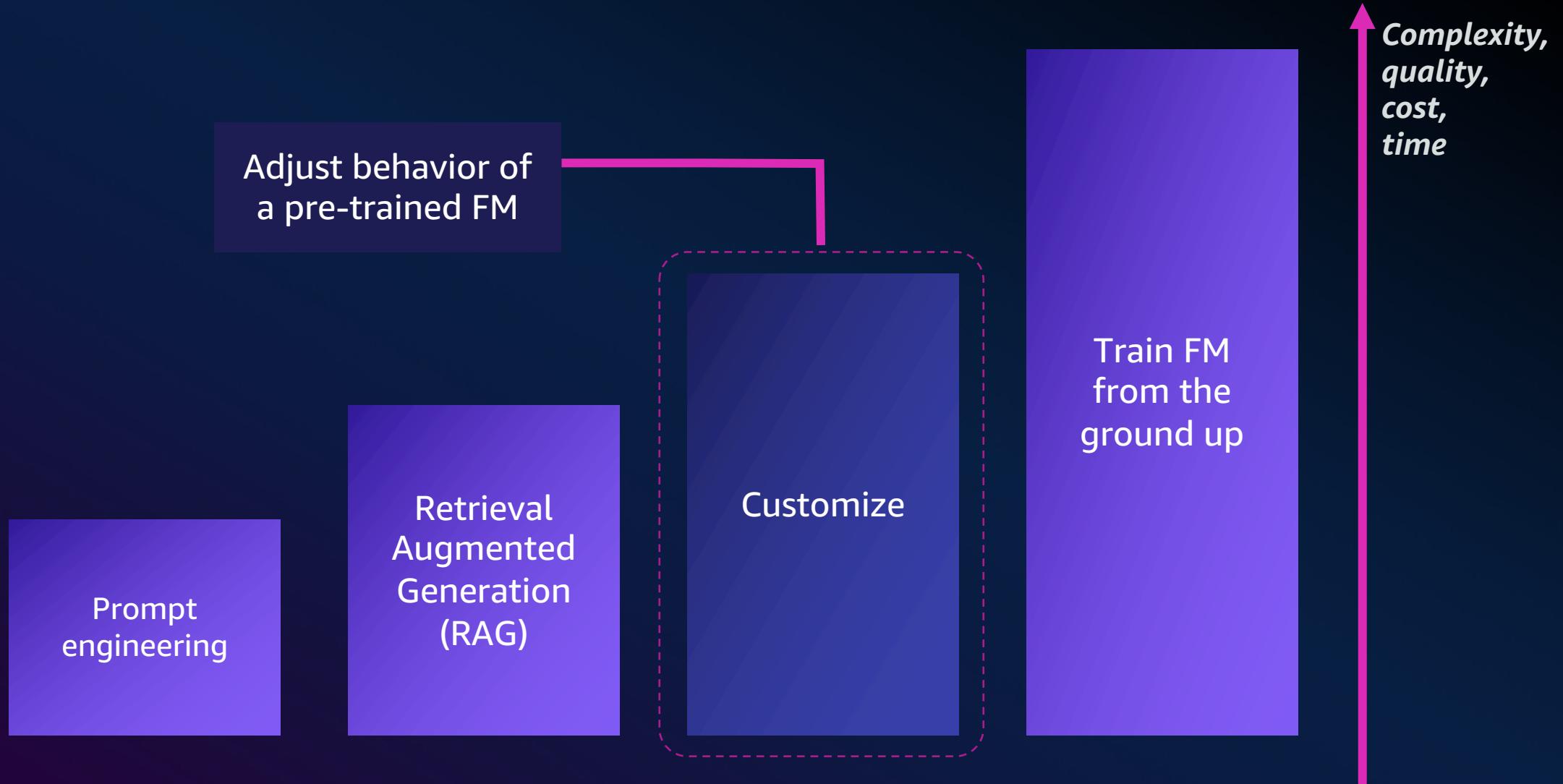
Michael Lin

Sr. Solutions Architect
Amazon Web Services



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Common approaches for customizing FMs



Customizing model responses for your business



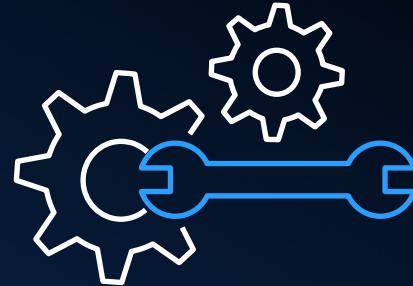
Fine-tuning

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

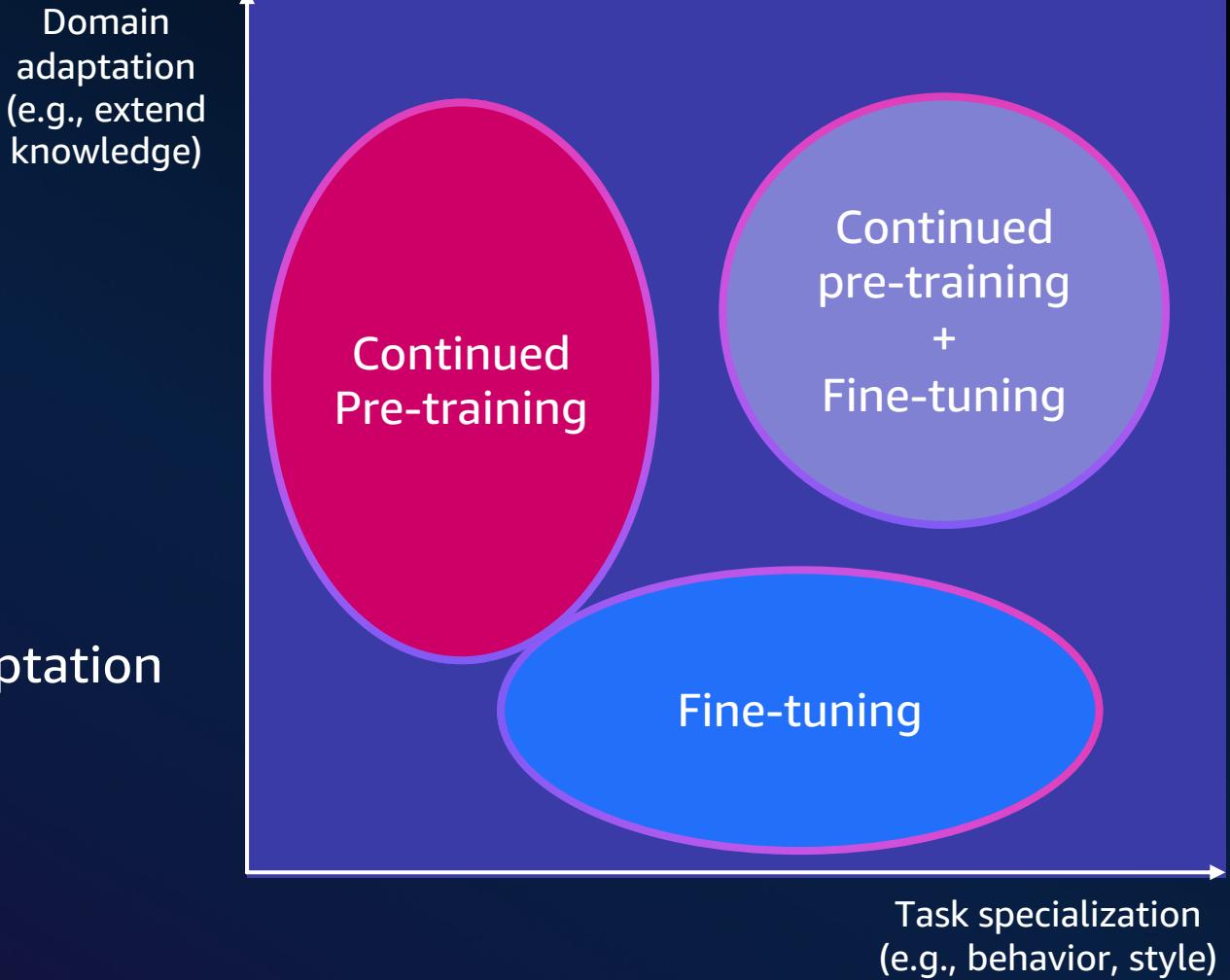
Fine-tuning and Continued pre-training

Fine-tuning

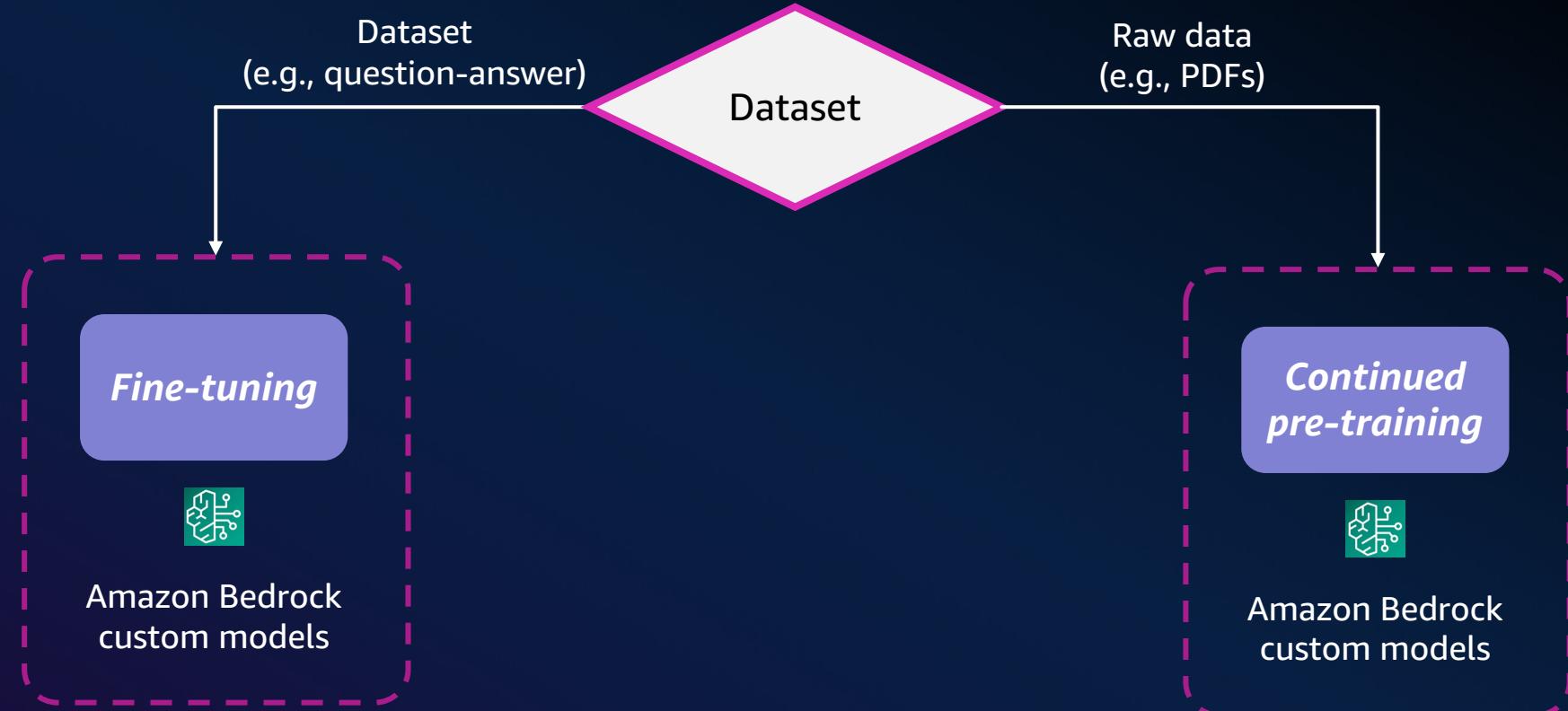
- Training dataset is available?
- Specific style, behavior required?

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 sub-instruction 'Customize model with fine-tune or continual pre-training.' There are two main sections: 'How it works' and 'Training jobs'. The 'How it works' section is divided into two steps: 'Step 1. Customize a model' (with a 'Fine-tuning' icon) and 'Step 2. Purchase Provisioned Throughput' (with a 'Purchase Provisioned Throughput' button). The 'Training jobs' section shows a table with 6 entries, each with a 'Find job' search bar. The table has columns for 'Job Name', 'Status', 'Customization type', 'Model metrics', 'Source Model', 'Provider', and 'Custom mod'. Navigation icons like back, forward, and search are at the bottom.

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>



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 ⌂

aws *Search in this guide*

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AWS > Documentation > Amazon Bedrock > User Guide Feedback Preferences

Amazon Bedrock X

User Guide

Recently added to this guide Preview

AI21 Labs Jamba-Instruct models June 26, 2024

AI21 Labs models June 26, 2024

Prompt injection security June 25, 2024

[View all](#)

► What is Amazon Bedrock?

► 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"}
```

Like Share Feedback Open in new window

{} 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.\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.\n3 {"input": "AWS Command Line Interface User Guide for Version 2\nTable of Contents\n4 {"input": "AWS Command Line Interface User Guide for Version 2\nRun the official images\n5 {"input": "AWS Command Line Interface User Guide for Version 2\nUsing the examples\n6 {"input": "AWS Command Line Interface User Guide for Version 2\nUse the AWS CLI\n7 {"input": "AWS Command Line Interface User Guide for Version 2\nResources\n8 {"input": "AWS Command Line Interface User Guide for Version 2\nThe \"aws --version\" command returns a version after uninstalling the AWS CLI\n9 {"input": "AWS Command Line Interface User Guide for Version 2\\nix"\n10 {"input": "AWS Command Line Interface User Guide for Version 2\nWhat is the AWS Command Line Interface?\nThe AWS Command Line Interface is a command-line interface for interacting with AWS services. It is a separate application from the AWS Management Console and the AWS Mobile SDKs. The AWS CLI provides a unified interface for performing common AWS tasks from the command line, such as creating and managing AWS resources, monitoring metrics, and retrieving logs.\n11 {"input": "AWS Command Line Interface User Guide for Version 2\nnor managed by AWS. We recommend that you install the AWS CLI from one of the supported platforms.\n12 {"input": "AWS Command Line Interface User Guide for Version 2\n\u2022 Prompt\n\u2022 The command prompt uses the Linux prompt and is displayed in the terminal window.\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\"\n14 {"input": "AWS Command Line Interface User Guide for Version 2\nGet started with the AWS CLI\nThis chapter provides steps to get started with the AWS CLI.\n15 {"input": "AWS Command Line Interface User Guide for Version 2\nSet up the AWS CLI\nPrerequisites to use the AWS CLI version 2\n16 {"input": "AWS Command Line Interface User Guide for Version 2\nChoose none\nway to manage your administrator. You can also choose to use the AWS CLI with your local user account.\n17 {"input": "AWS Command Line Interface User Guide for Version 2\nImportant\nAWS CLI versions 1 and 2 use the same aws command name. If you are using the AWS CLI version 1, you can upgrade to version 2.\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.\n19 {"input": "AWS Command Line Interface User Guide for Version 2\nLinux ARM\nNote\nThe following command block downloads and installs the AWS CLI version 2 on a Linux ARM system.\n20 {"input": "AWS Command Line Interface User Guide for Version 2\n\u2022 Downloading from the URL\n\u2022 To download the installer with curl, run the following command:\n21 {"input": "AWS Command Line Interface User Guide for Version 2\nntCFBV1MgQ0xJIFR1YW0gPGF3cy1jbGlAYW1hem9uLmNvbT6JA1QEEwEIAD4CGwMF\nCwk\n22 {"input": "AWS Command Line Interface User Guide for Version 2\nLinux x86 (64-bit)\nFor the latest version of the AWS CLI, use the following command:\n23 {"input": "AWS Command Line Interface User Guide for Version 2\nngpg: Signature made Mon Nov 4 19:00:01 2019 PST\nngpg:\n24 {"input": "AWS Command Line Interface User Guide for Version 2\nYou can install without sudo if you specify directories that you already own.\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.\n26 {"input": "AWS Command Line Interface User Guide for Version 2\n\u2022 For all users on the computer (requires sudo)\n\u2022 You can install the AWS CLI for a specific user by specifying the --user option.\n27 {"input": "AWS Command Line Interface User Guide for Version 2\nCommand line installer - All users\nIf you have sudo permissions, you can use the sudo command to install the AWS CLI for all users on the computer.\n28 {"input": "AWS Command Line Interface User Guide for Version 2\nCommand line - Current user\n1. To specify which folder the AWS CLI is installed in, use the --install-dir option.\n29 {"input": "AWS Command Line Interface User Guide for Version 2\nThe following example installs the AWS CLI in the folder /Users/myuser/AWS.\n30 {"input": "AWS Command Line Interface User Guide for Version 2\nInstall or update the AWS CLI\nTo update your current installation of the AWS CLI, run the following command:\n31 {"input": "AWS Command Line Interface User Guide for Version 2\nNext steps\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

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 Get started

Getting started Overview Examples Providers

Foundation models Base models Custom models **Imported models Preview**

Playgrounds Chat Text Image

Safeguards Guardrails Watermark detection

Builder tools Knowledge bases Agents

Assessment & deployment

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

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

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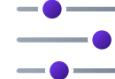
Assessment & deployment

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.

Purchase Provisioned Throughput

Customize model

Find model

< 1 > 

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

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Find model

Purchase Provisioned Throughput

Customize model

Create Fine-tuning job

Create Continued Pre-training job

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

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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.

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.

▶ 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

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Fine-tuned models

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Titan Text G1 - Lite v1

Text model | Context size = 4k

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Text model | Context size = 8k

Cancel Apply

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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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Assessment & deployment

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 +

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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Amazon Bedrock > Custom models > Create Fine-tuning job

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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

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Assessment & deployment

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.

Amazon Bedrock



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Model Evaluation

Provisioned Throughput

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



Creation date



Name	
aws-cli-dataset-ft-input-20240630	2024-06-30T01:55:00.000Z
aws-cli-dataset-ft-output-20240630	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.

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Assessment & deployment Model Evaluation Provisioned Throughput

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 > aws-cli-dataset-ft-input-20240630

Objects (1/1)

Find object by prefix

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.
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.

Amazon Bedrock | us-east-1

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

AWS Services Search [Option+S] 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

[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.

Amazon Bedrock | us-east-1 +

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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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 +

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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Enter an integer between 1 and 250.



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Provisioned Throughput

Output data Info

Choose S3 location to store the model validation outputs.

Choose an archive in S3



< 1 >



S3 buckets

Buckets (83)



cli



3No matches



Creation date



- | | Name | |
|-----------------------|------------------------------------|--------------------------|
| <input type="radio"/> | aws-cli-dataset-ft-input-20240630 | 2024-06-30T01:55:00.000Z |
| <input type="radio"/> | aws-cli-dataset-ft-output-20240630 | 2024-06-30T01:55:11.000Z |

Cancel

Choose

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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Enter an integer between 1 and 250.



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< 1 >



Choose an archive in S3

S3 buckets

Buckets (1/83)

Name	Creation date
aws-cli-dataset-ft-input-20240630	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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- Model Evaluation

Enter an integer between 1 and 250.

Output data Info

Choose S3 location to store the model validation outputs.

S3 location

 [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

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](#)

← → ⌂ us-east-1.console.aws.amazon.com/bedrock/home?region=us-east-1#/custom-models/jobs/create?jobType=CONTINUED_PRE_TRAINING&mode... ☆ | ↗ | ↘ | T Paused

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

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Assessment & deployment

- Model Evaluation
- Precision-Recall

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

S3 location

s3://aws-cli-dataset-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 name

aws-cli-ft-role-20240630

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

[View permission details](#)

ⓘ 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 +

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

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Custom models Info

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.

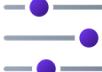
Amazon Bedrock > Custom models

Custom models

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)

Purchase Provisioned Throughput

Customize model

Amazon Bedrock | us-east-1

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

Paused

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Models Jobs

Jobs (10)

Training jobs are initiated when you begin customizing a model.

Job name	Status	Source	Job type	Custom model n...	Creation time
aws-cli-ft-20240...	Training	Titan Text G1 - Lite	Continued Pre-tr...	aws-cli-ft-20240...	June 30, 2024, 1...

Find job

C Stop job Customize model

Amazon Bedrock | us-east-1 +

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]

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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	arn:aws:bedrock:us-east-1:094784590684:model-customization-job/amazon.titan-text-lite-v1:0:4k/6acth3jsdq6g	Job duration	a few seconds	Custom model encryption KMS key	Bedrock owned KMS key
Data access role	arn:aws:iam::094784590684:role/service-role/aws-cli-ft-role-20240630	Source model name	Titan Text G1 - Lite	Source model ARN	arn:aws:bedrock:us-east-1::foundation-model/amazon.titan-text-lite-v1:0:4k

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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► Set up

► Foundation model information

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► 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 Copy

Users > mba > Desktop > 20240724_Summit_Workshop_FM_Finetune > datasets > {} train-cnn-5K.jsonl

> prompt Aa ab .* 1 of 5165 ↑ ↓ ≡ ×

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 siding 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 i 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 +

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

Paused

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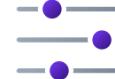
Assessment & deployment

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.

Purchase Provisioned Throughput

Customize model

Find model

< 1 > 1

Amazon Bedrock | us-east-1 +

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

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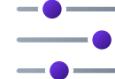
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Custom models Info

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.

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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 ▾ ⋮

Find model

Create Fine-tuning job ⋮

Create Continued Pre-training job ⋮

Amazon Bedrock | us-east-1 +

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

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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.

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.

▶ 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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- Model Evaluation

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 Amazon Bedrock console interface. A modal window titled 'Select model' is open, divided into two sections: '1. Category' and '2. Models available for fine-tuning'. In 'Category', under 'Model providers', the 'Cohere' option is selected, highlighted with a blue border. Under 'Custom models', the 'Fine-tuned models' option is shown. In '2. Models available for fine-tuning', the 'Command Light v14.7' model is selected, also highlighted with a blue border. At the bottom right of the modal are 'Cancel' and 'Apply' buttons. The background shows the main navigation menu on the left, including sections like 'Getting started', 'Foundation models', 'Playgrounds', 'Safeguards', 'Builder tools', and 'Assessment & deployment'.

Amazon Bedrock | us-east-1 +

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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Assessment & deployment

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.

Amazon Bedrock | us-east-1 +

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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Assessment & deployment

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** [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.

Amazon Bedrock | us-east-1

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](#)

i 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.

Amazon Bedrock <

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Choose an archive in S3

S3 buckets

Buckets (83)

 cnn X

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



Paused

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

Services [Option+S]

CloudFormation EC2 RDS S3 Amazon SageMaker Amazon Bedrock AWS DeepRacer

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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](#)

Info 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.

10

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

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.

0.01

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.

6

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

aws Services Search [Option+S]

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- Model Evaluation

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 ▾

i 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 <

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Model Evaluation

Provisioned Throughput



Enter a value between 5% and 50%

Output data Info

Choose S3 location to store the model validation outputs.

S3 location

Choose an archive in S3 X

S3 buckets

Buckets (1/83) (C) cnn X2No 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](#)

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

S3 location [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

i 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

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- Precision-Recall

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](#)

i 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 +

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

Paused

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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.

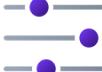
Amazon Bedrock > Custom models

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

Models (8)

Purchase Provisioned Throughput

Customize model

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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Jobs

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 +

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]

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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	arn:aws:bedrock:us-east-1:094784590684:model-customization-job/cohere.command-light-text-v14:7:4k/kkgw68zdf9vr	Job duration	a few seconds	Custom model encryption KMS key	Bedrock owned KMS key
Data access role	arn:aws:iam::094784590684:role/service-role/cnn-daily-ft-service-role-20240630	Source model name	Command Light	Source model ARN	arn:aws:bedrock:us-east-1::foundation-model/cohere.command-light-text-v14:7:4k

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

Amazon SageMaker Studio Classic

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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

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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

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

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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)

The screenshot shows a Jupyter notebook interface within the Amazon SageMaker Studio Classic environment. The top navigation bar includes 'File', 'Edit', 'View', 'Run', 'Kernel', 'Git', 'Tabs', 'Settings', and 'Help'. The top right shows the cluster configuration: 'Cluster' (Data Science 3.0 | Python 3 | 4 vCPU + 8 GiB) and 'Share'.

The left sidebar features icons for Home, Files, Folders, Data Sources, and Help.

The main area displays six code cells:

- [3]:

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

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

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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.

```
[7]: 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'}
-----
```

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

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

```
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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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.py X 2-TIGFT-provisioned-throughp X

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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}"
                }},
                "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}/*"
        }}
    ]
}}"""

```

A tab bar at the top shows various browser windows, including "Search fo", "DevRel -", "Isengard", "Amazon", "Amazon", "00_setup", "Domain-", "Domain-", "The Ama", and a new tab indicator.

The main interface is Amazon SageMaker Studio Classic, showing a Jupyter notebook titled "00_setup.ipynb". The notebook has several tabs open, including "01_fine-tuning-titan-lite.ipynb", "02_fine-tuning_llama2.ipynb", "03_continued_pretraining_tita", "1-TIGFT-customization-job.ipynb", and "2-TIGFT-provisioned-throughp.ipynb".

The toolbar includes icons for file operations (New, Open, Save, Print, Copy, Paste, Find, Refresh), Git integration, and cluster management (Cluster, Data Science 3.0, Python 3, 4 vCPU + 8 GiB, Share).

The code editor displays two cells:

```
[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',
```

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

[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)
```

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.py X 2-TIGFT-provisioned-throughp X

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```
        )
pprint.pprint(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.pprint(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'}}

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.py X 2-TIGFT-provisioned-throughp X

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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

```
[16]: #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"}

← → ⌂ d-c9qeuo6x91qp.studio.us-east-1.sagemaker.aws/jupyter/default/lab/tree/amazon-bedrock-workshop-20240712/03_Model_customization/00_setup.ipynb ⌂ ★ ⌂ T ⌂ :

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.py X 2-TIGFT-provisioned-throughp X

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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:
```



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:

```
(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=[]
```

Filter files by name

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

00_setup.ipyr X | 01_fine-tunin X | 02_fine-tunin X | test-cnn-10.js X | train-cnn-5K.j X | 03_continued X | 1-TIGFT-custc X | 2-TIGFT-provi X

```
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:
```

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

[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

Search fo X | Search fo X | DevRel - X | Isengard X | Amazon X | Amazon X | 00_setup X | Domain- X | Domain- X | The Ama X | +

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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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.py X 2-TIGFT-provisioned-throughp X

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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)
Stored 's3_test_uri' (str)
```

Amazon SageMaker Studio Classic

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00_setup.ipynb X 01_fine-tuning-titan-X 02_fine-tuning_llama X 03_continued_pretrain X 1-TIGFT-customizatio X 2-TIGFT-provisioned-X

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+

Filter files by name

/ amazon-bedrock-workshop-20240712 / 03_Model_customization /

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

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 m1.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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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.ip X 2-TIGFT-provisioned-throughput.ip X

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

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.

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_titan.ipynb X 1-TIGFT-customization-job.ipynb X 2-TIGFT-provisioned-throughput.ipynb X

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.

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.
```

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

[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.py] [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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File Edit View Run Kernel Git Tabs Settings Help

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

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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}"
```

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

[9]:

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

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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 = {
    "validators": [
        {"s3Uri": s3_validation_uri
    ]
}
```

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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.py X 2-TIGFT-provisioned-throughp X

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

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

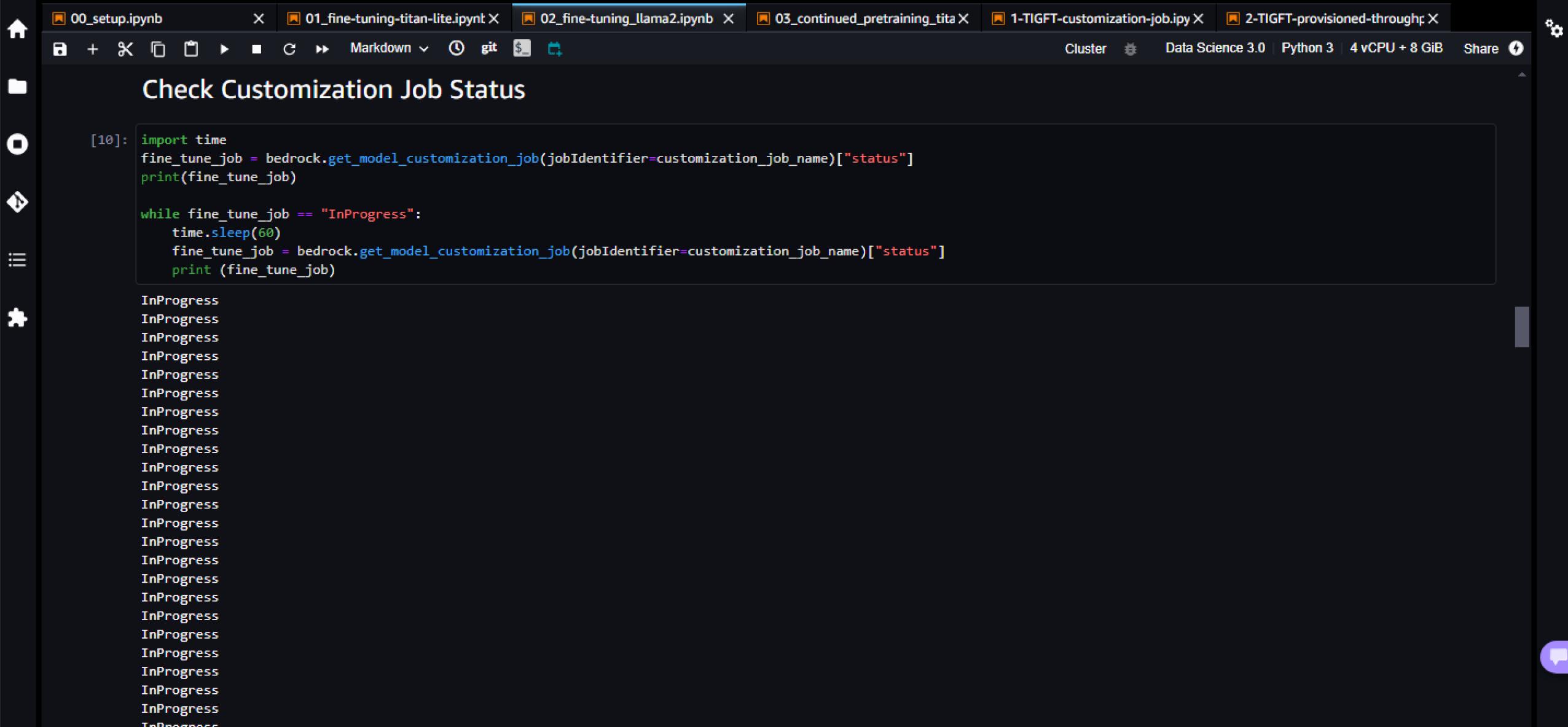
# # Create the customization job
bedrock.create_model_customization_job(
    customizationType=customization_type,
    jobName=customization_job_name,
    customModelName=custom_model_name,
    roleArn=customization_role,
    baseModelIdentifier=base_model_id,
    hyperParameters=hyper_parameters,
    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.

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" section with three cards:

- 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.

Below this, there is a "Jobs" tab selected in a navigation bar, showing a list of 10 training jobs. A red arrow points to the status column of the first job, which is labeled "Training".

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 screenshot of the Amazon SageMaker Studio interface. The top navigation bar shows multiple tabs, including "02_fine-tuning_llama2.ipynb". The main workspace displays a list of files in a tab bar: "00_setup.ipynb", "01_fine-tuning-titan-lite.ipynb", "02_fine-tuning_llama2.ipynb" (which is currently selected), "03_continued_pretraining_tita", "1-TIGFT-customization-job.py", and "2-TIGFT-provisioned-throughg". Below the tabs, there are icons for file operations like Create, Open, Save, and Delete. The central area shows a list of items, all of which are labeled "InProgress" except for one at the bottom labeled "Completed". A large red arrow points from the bottom left towards the "Completed" item. On the far right, there are buttons for "Cluster", "Data Science 3.0", "Python 3", "4 vCPU + 8 GiB", and "Share".

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()
```

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

Services Search [Alt+S]

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Getting started

- Overview
- Examples
- Providers

Foundation models

- Base models
- Custom 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

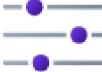
Amazon Bedrock > Custom models

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**

Jobs (10)

Training jobs are initiated when you begin customizing a model.

Find job

< 1 > | [@](#)

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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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.py X 2-TIGFT-provisioned-throughp X

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

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```
[11]: # 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'}]}
```

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

[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,

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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

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

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

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

Training vs Validation Loss

Epoch	validation	training
1.0	0.95	1.52
2.0	0.95	0.95

Create Provisioned Throughput

Create Provisioned Throughput

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.

```
[20]: # 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)
```

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

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

Services Search [Alt+S]

Amazon Bedrock

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Paused

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)

[Find Provisioned Throughput](#)

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	-

C Actions Purchase Provisioned Throughput

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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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```
test_file_path = f'{data_root_dir}/{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:

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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',
```

AWS Sagemaker Studio Classic Jupyter Notebook - 02_fine-tuning_llama2.ipynb

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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',
 '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

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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
0	0	0	0

Provisioned Throughput (0)

[Find Provisioned Throughput](#)

Name	Status	Model	Model units	Creation time	Commitment term	End time
No Provisioned Throughput						

There are currently no resources.

[Purchase Provisioned Throughput](#)

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>

Amazon SageMaker Studio Classic

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Filter files by name

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

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

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Filter files by name

File / ... / amazon-titan-image-generator / data /

Name	Last Modified
ron_16.jpg	a day ago
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



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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



Simple 2 6 main Python 3 (Data Science 3.0) | Disconnected

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



and 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)
```

Simple 0 \$ 0 main No Kernel | Unknown

No kernel: Unknown | Instance MEM

Cookie Preferences Mode: Command

Ln 1, Col 1 1-TIGFT-customization-job.ipynb 0 3:46 PM 7/13/2024



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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)
```

Amazon SageMaker Studio Classic

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

```
[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 gray sofa, looking at the camera.', 'smila_29.jpg': 'Smila the cat sitting on a bench, staring at the camera.', 'smila_30.jpg': 'Smila the cat lying 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.

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

[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}'

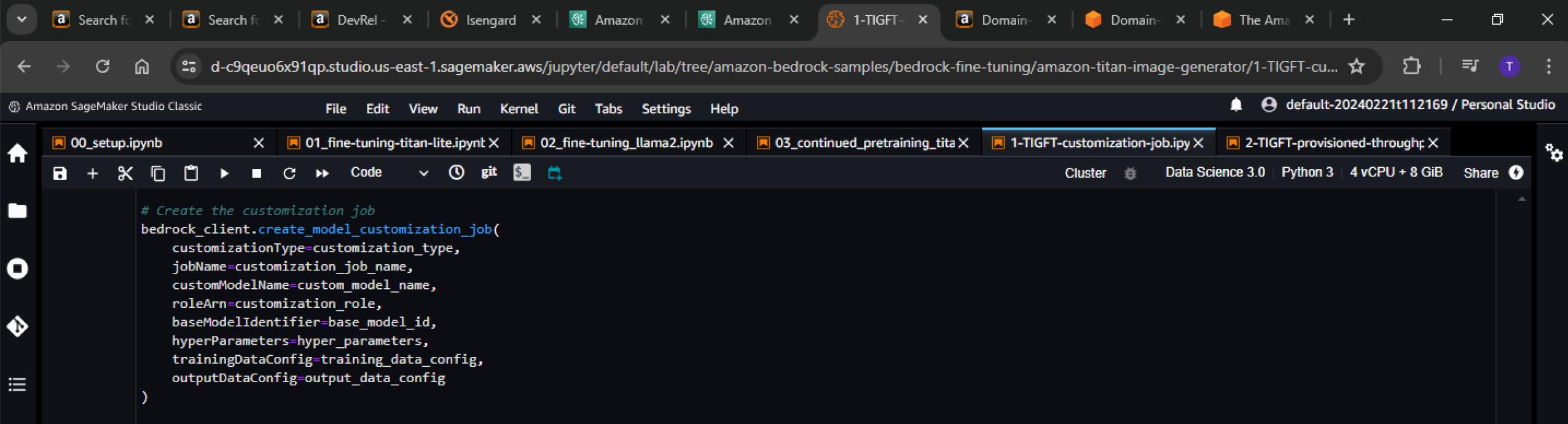
# Create a customized model name for your fine-tuned Llama2 model
custom_model_name = f'image-gen-ft-{ts}'

# 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,
```



The screenshot shows a Jupyter notebook titled "1-TIGFT-customization-job.ipynb" running on a Data Science 3.0 cluster. The code cell contains Python code to create a customization job using the Bedrock client. The output cell shows the response metadata for the job creation, including the job ARN.

```
# 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"]]
```

A tab bar at the top shows various browser windows, including "Search fo", "DevRel", "Isengard", "Amazon", "Amazon", "2-TIGFT", "Domain-", "Domain-", and "The Ama". The main content area is titled "Amazon SageMaker Studio Classic" and "default-20240221t112169 / Personal Studio". The tabs in the notebook include "00_setup.ipynb", "01_fine-tuning-titan-lite.ipynb", "02_fine-tuning_llama2.ipynb", "03_continued_pretraining_tita", "1-TIGFT-customization-job.ipynb", and "2-TIGFT-provisioned-throughp". The interface includes a toolbar with icons for file operations, a cluster configuration section, and a sidebar with navigation icons.

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

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

[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)
```

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.py X 2-TIGFT-provisioned-throughp X

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

```
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

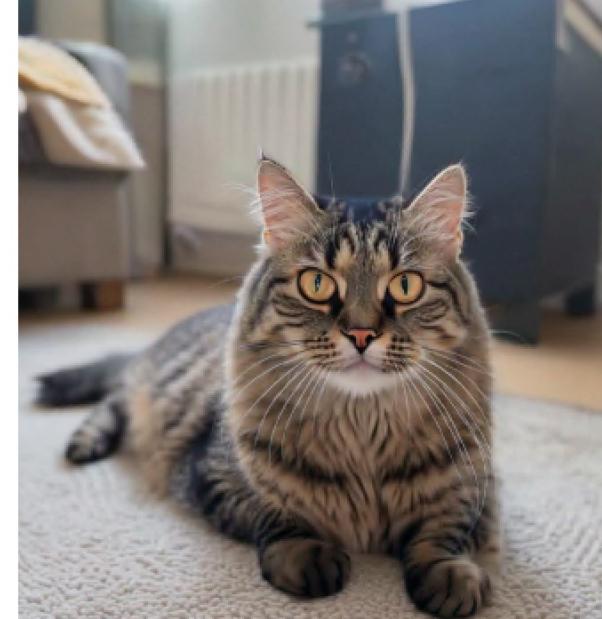
00_setup.ipynb X 01_fine-tuning-titan-lite.ipynb X 02_fine-tuning_llama2.ipynb X 03_continued_pretraining_tita X 1-TIGFT-customization-job.ipynb X 2-TIGFT-provisioned-throughp X

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

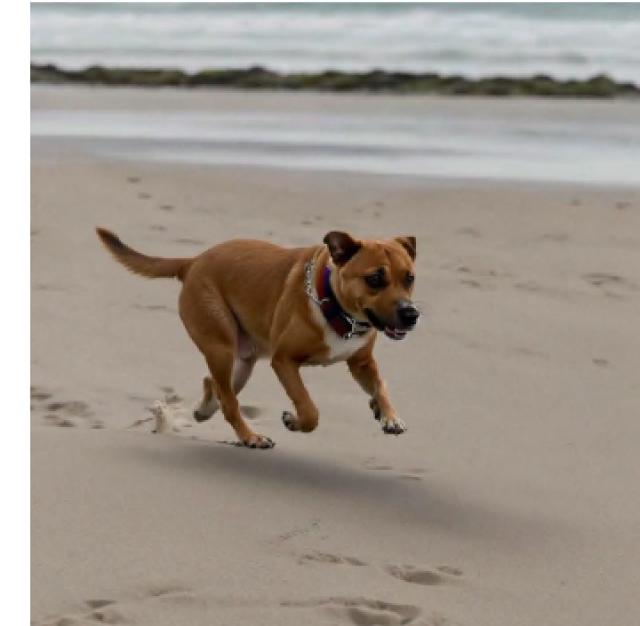
00_setup.ipynb X 01_fine-tuning-titan-lite.ipynb X 02_fine-tuning_llama2.ipynb X 03_continued_pretraining_tita X 1-TIGFT-customization-job.ipynb X 2-TIGFT-provisioned-throughp X

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



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 Studio Home page. At the top, there's a navigation bar with 'Home' and 'Quick actions' (Open Launcher, Import & prepare data visually, Open the). Below the navigation is a search bar labeled 'SageMaker JumpStart'. The main content area is divided into two sections: 'Foundation Models: Text Generation' and 'Foundation Models: Image Generation'.
Foundation Models: Text Generation: This section displays three models:

- Llama-2-70b-chat** (Meta AI) - Featured, Text Generation. Details: 70B fine-tuned model optimized for... Fine-tunable: Yes. Source: Meta. Buttons: View model >, View notebook >.
- Llama-2-7b** (Meta AI) - Featured, Text Generation. Details: 7B pretrained model. Fine-tunable: Yes. Source: Meta. Buttons: View model >, View notebook >.
- Jurassic-2 Ultra** (AI21 lab) - Featured, Text To Text. Details: Best-in-class instruction-following model. Fine-tunable: No. Provider: AI21. Buttons: View notebook >.

Foundation Models: Image Generation: This section displays three models:

- Stable Diffusion XL 1.0** (Stability AI) - Text To Image. Fine-tunable: No. Provider: Stability AI. Details: The leading generation model from... Buttons: View notebook >, View model >.
- Stable Diffusion XL Beta 0.8** (Stability AI) - Text To Image. Fine-tunable: No. Provider: Stability AI. Details: Beta version of SDXL, with native 512... Buttons: View notebook >, View model >.
- Stable Diffusion XL 1.0 (open)** (Stability AI) - Text To Image. Fine-tunable: No. Provider: Stability AI. Details: Beta version of SDXL, with native 512... Buttons: View notebook >, 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 visible, 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 to fit the model to your own data. 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 'Deployment Configuration', 'Hyper-parameters', and 'Security Settings' links, and a 'Train' button.

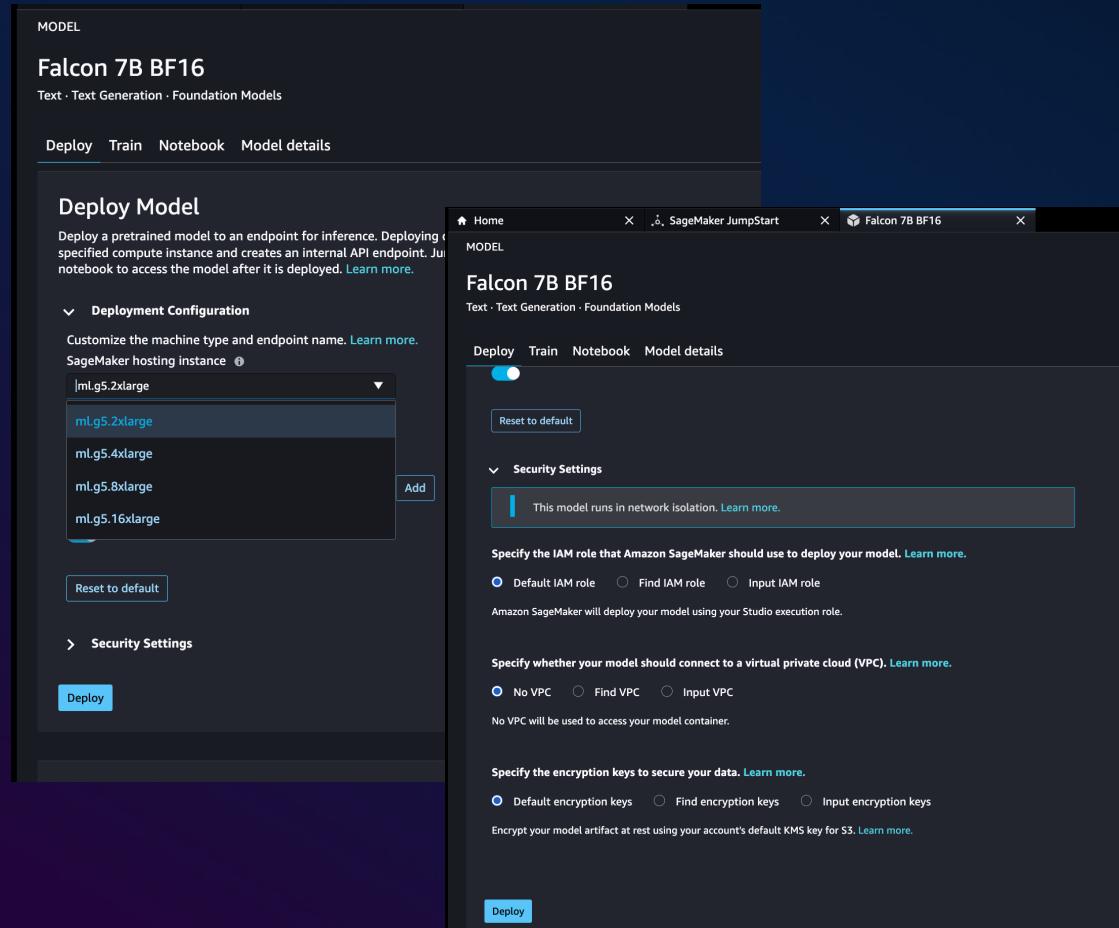
Details from model provider:

- Model size and description
- License info
- Use cases and how-to use model

Take action:

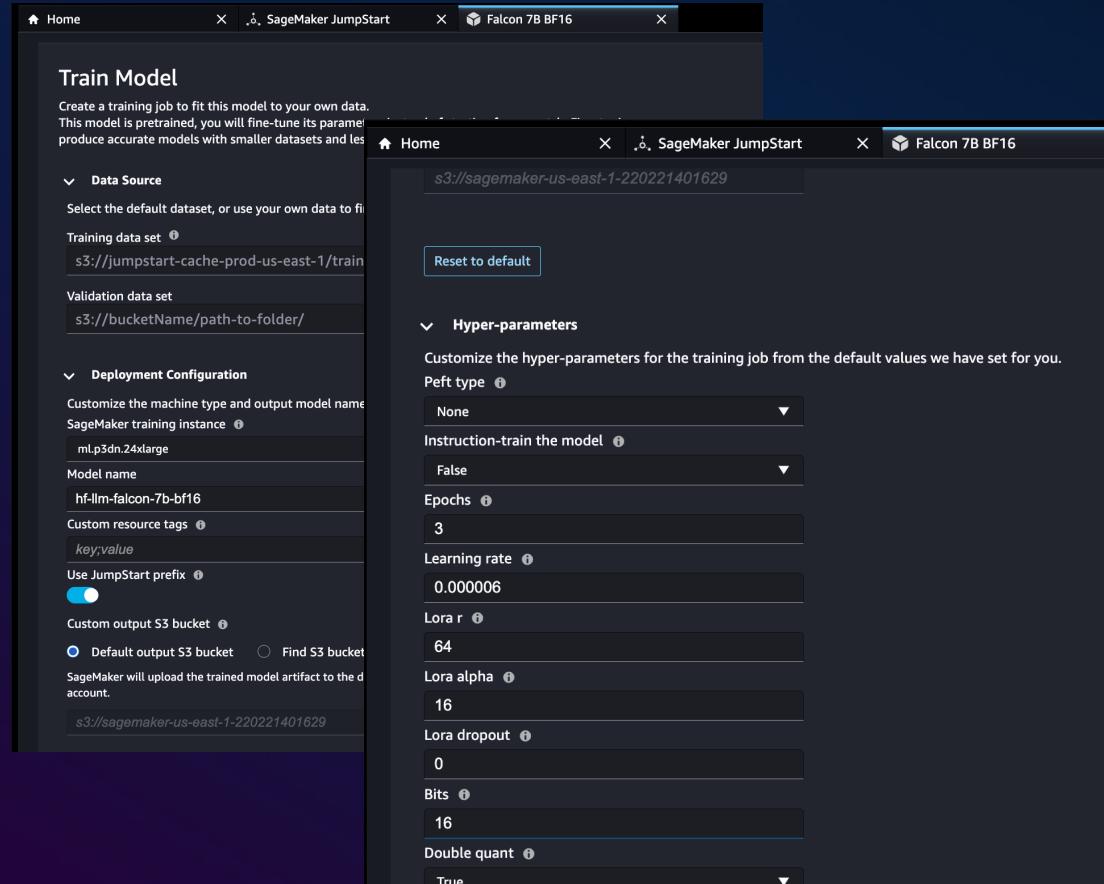
- Deploy
- Train
- View API snippet

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

```
[ ]: 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": 110}}
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

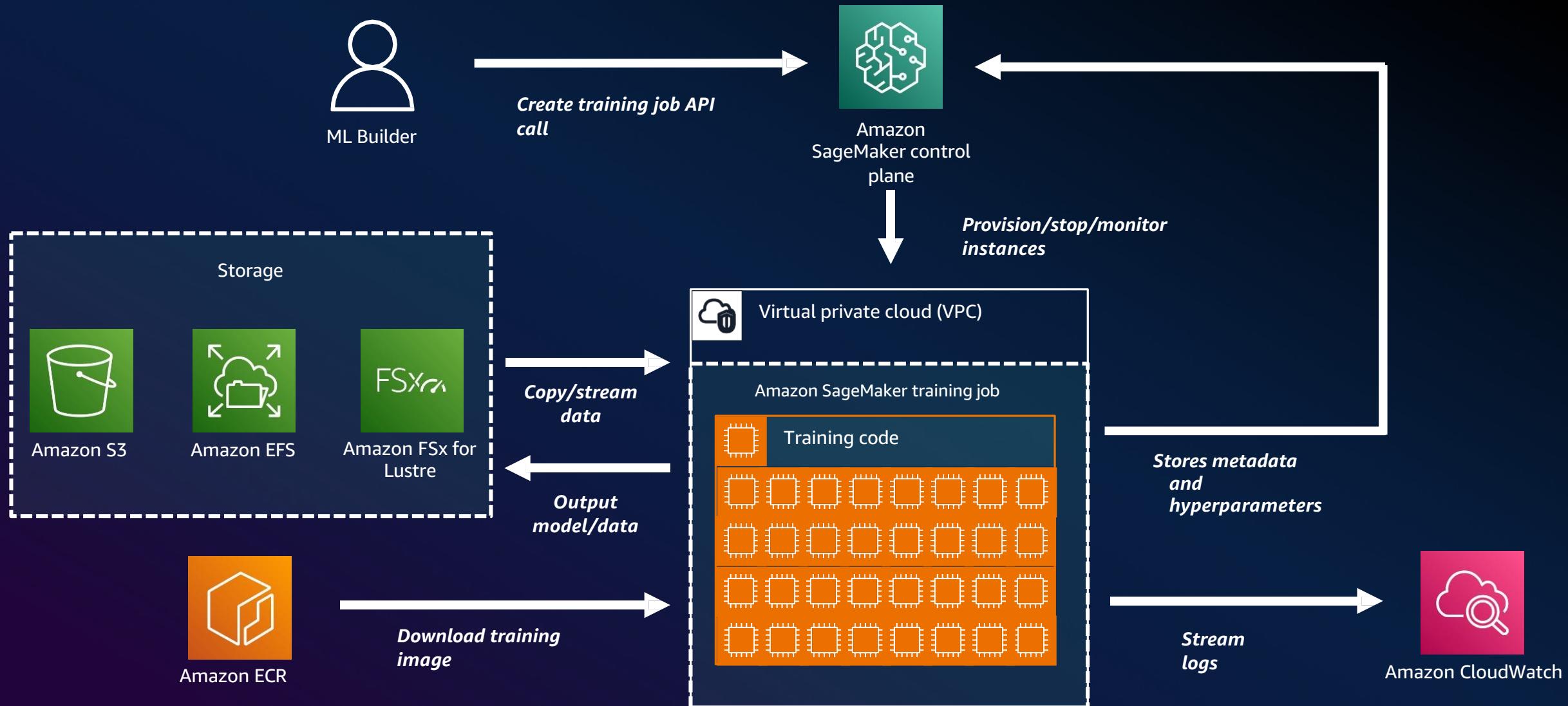
Michael Lin

Sr. Solutions Architect
Amazon Web Services



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Amazon SageMaker ephemeral training clusters

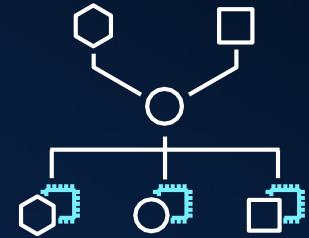


Amazon SageMaker distributed training libraries



Data parallelism

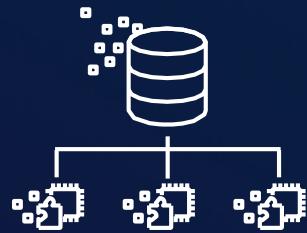
Scale out training clusters with near-linear efficiency, optimized for AWS networking and instance topology



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



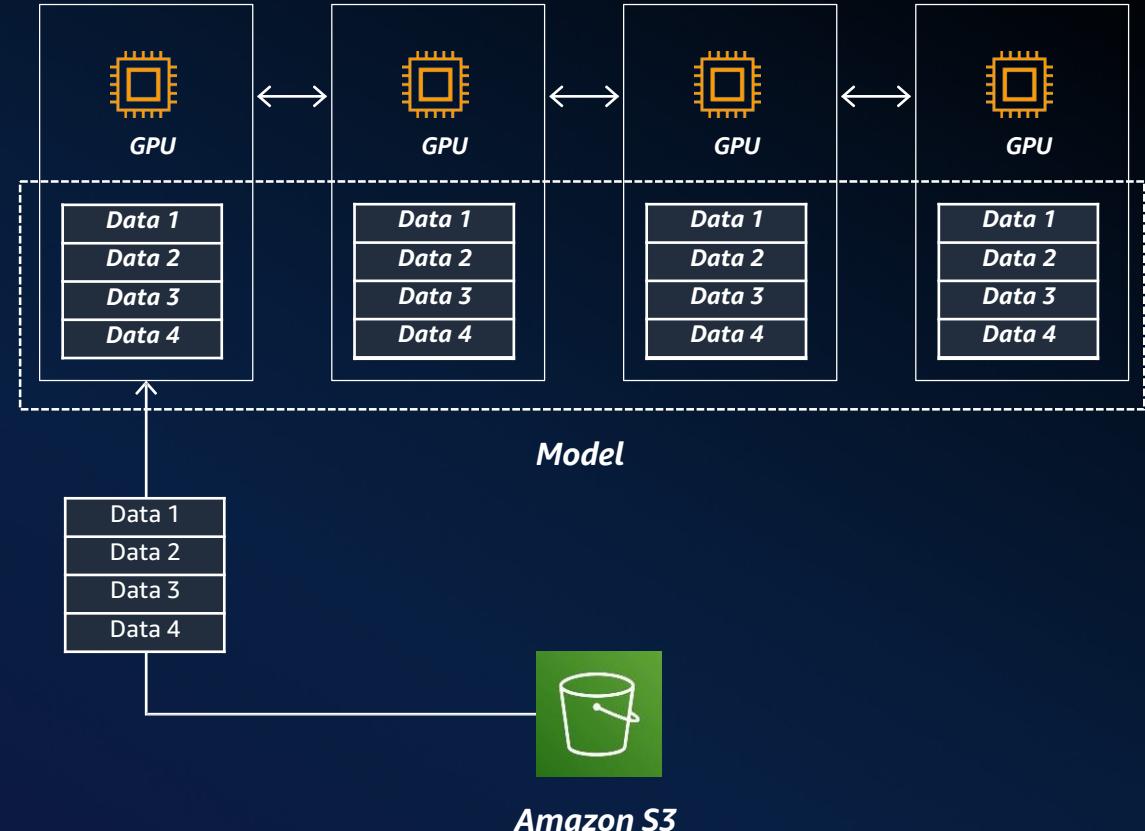
Split mini-batches into N “micro-batches”



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)

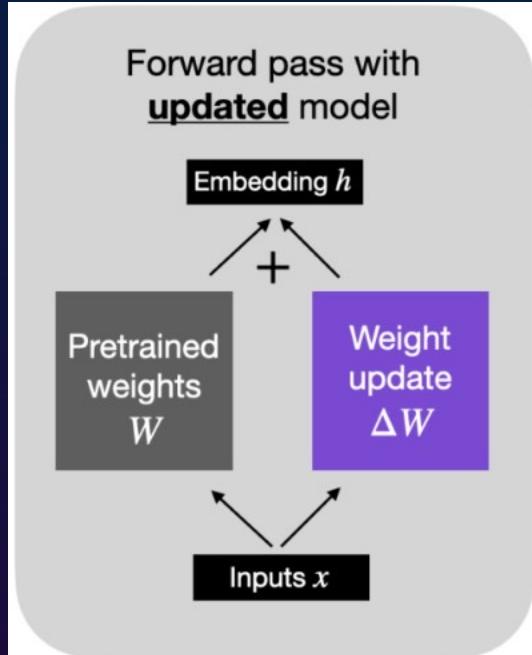
Parameter training

- 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](#)

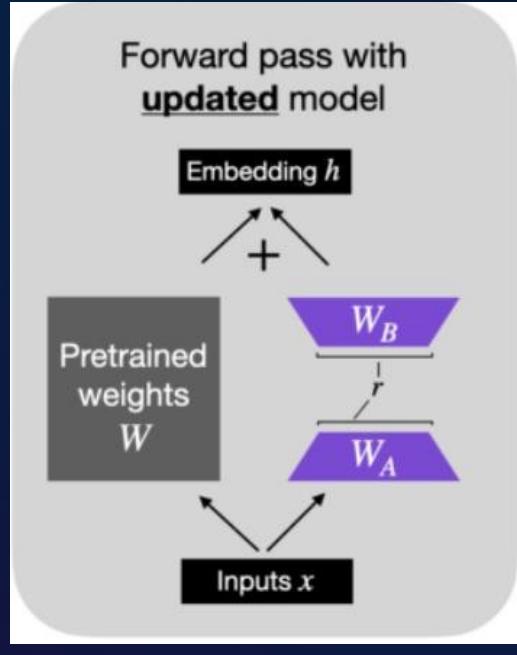
Low-Rank Adaptation (LoRA)

Training method that accelerates the training of large models while consuming less memory



$$W \leftarrow W + \Delta W$$

Where, $W \in \mathbb{R}^{m \times n}$



$$\Delta W = WA \cdot WBT$$

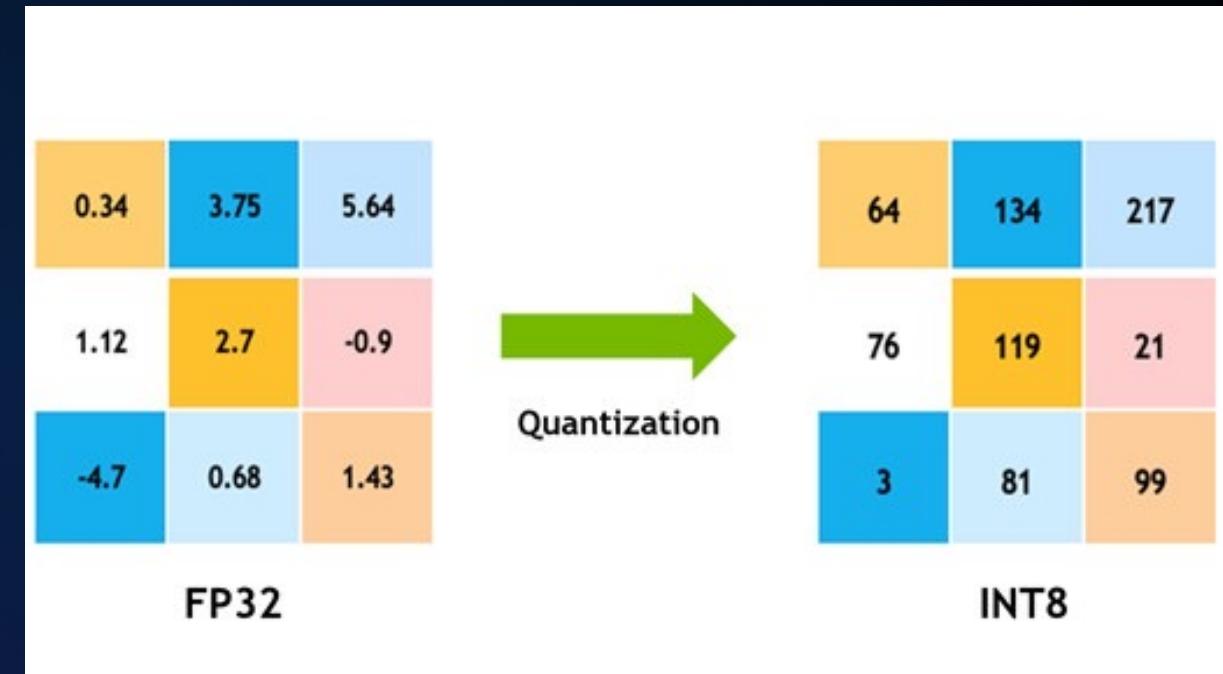
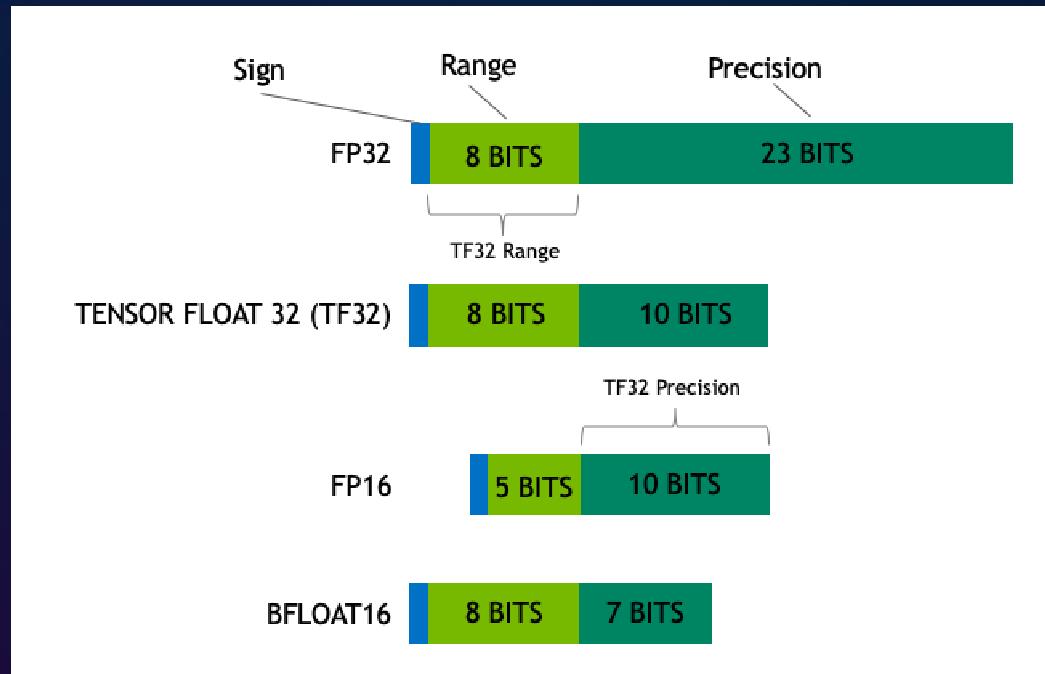
Where, $WA \in \mathbb{R}^{m \times k}$ & $WB \in \mathbb{R}^{n \times k}$

- 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

Services

Search [Alt+S]

N. Virginia Admin/linmicht-Isengard @ 0947-8459-0684

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

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 ↗



studio-a-c9qeu06x9 | qp.studio.us-east-1.sagemaker.aws/home?tab=Overview

SageMaker Studio

Provide feedback

Applications (6)

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

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

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23



studio-a-c9qeu06x91qp.studio.us-east-1.sagemaker.aws/home?tab=Overview

SageMaker Studio

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Code Editor Studio Cl... MLflow

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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

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23

studio-a-c9qeu06x9.tqp.studio.us-east-1.sagemaker.aws/JumpStart/SageMakerPublicHub

SageMaker Studio > JumpStart > SageMakerPublicHub

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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

Use pre-trained foundation models

stability.ai

Stability AI

Meta

Explore popular and trending models from Meta including Llama, Code Llama, and more.

View 36 models >

AI21

Explore popular and trending models from AI21 Labs including Jurassic and more.

View 6 models >

cohere

Cohere

TensorFlow

TensorFlow

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studio-a-c9qeu00x9 | qp.studio.us-east-1.sagemaker.aws/JumpStart/SageMakerPublicHub

SageMaker Studio > JumpStart > SageMakerPublicHub

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All public models

Discover all popular pre-trained models offered by SageMaker

Providers 16

Search bar: mistral (highlighted with a red arrow)

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

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SageMaker Studio | Amazon SageMaker Studio

Isengard

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

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Deployments

Mistral 7B by HuggingFace

Train Deploy Optimize Evaluate

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

Preview notebooks >

Tags

Huggingface Text Generation

Apache-2.0

1.9M ?

3.1K ?

Papers

Arxiv:2310.06825 ↗

A red arrow points to the "Train" button in the top right corner of the main content area.

SageMaker Studio | Amazon SageMaker Studio

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

studio-a-c9qeu06x9 | qp.studio.us-east-1.sagemaker.aws/jobs/create/train?jumpstart_model_id=huggingface-hf-mistral-7b&jumpstart_model_version=2.9.1&jumpstart_nu...  

SageMaker Studio > Jobs > Create > Train 

 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 

Type here to search

6:22 PM
7/22/2024



```
→ 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
```

← → C ⌂ studio-d-c9qeuo6x91qp.studio.us-east-1.sagemaker.aws/jobs/create/train?jumpstart_model_id=huggingface-llm-mistral-7b&jumpstart_model_version=2.9.1&jumpstart_hu... ☆ ⌂ | T : ⌂

SageMaker Studio > Jobs > Create > Train ⌂ Provide feedback ⌂

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

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

6:22 PM

SageMaker Studio > Jobs > Create > Train

Provide feedback

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 ?

6:22 PM
7/22/2024

← → C ⌂ studio-d-c9qeuo6x91qp.studio.us-east-1.sagemaker.aws/jobs/create/train?jumpstart_model_id=huggingface-llm-mistral-7b&jumpstart_model_version=2.9.1&jumpstart_hu... ☆ ⌂ T :

SageMaker Studio > Jobs > Create > Train

Provide feedback

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).

6:23 PM

Amazon EC2

Overview Features Pricing Instance Types ▾ FAQs 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' N. Virginia aws_sandbox

EC2 VPC

Console

Services (82)

Features (127)

Resources New

Documentation (488,562)

Knowledge Articles (1,241)

Marketplace (56)

Blogs (11,255)

Tutorials (33)

Events (296)

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

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

Create application

Default layout + Add widgets

Originating account

CloudShell Feedback

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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

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

The diagram illustrates the central role of Service Quotas. It features a central box labeled "Service Quotas: 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

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

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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

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Amazon SageMaker

View quotas

Pricing

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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

Dashboard AWS services Quota request history

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

View your applied quota values, default quota values, and request quota increases for quotas. [Learn more](#)

Request increase at account level

Search by quota name

Quota name	Applied account-level quota value	AWS default quota value	Utilization	Adjustability
Canvas Apps running on ml.m5.4xlarge instances	40	10	0	Account level
Canvas Apps running on system instances	40	10	0	Account level
Large-sized MLflow Tracking Server usage	1	1	0	Account level
Longest run time for a processing job	432,000 seconds	432,000 seconds	Not available	Not adjustable
Longest run time for a training job	432,000	432,000	0	Account level
Longest run time for an AutoML job, from creation to termination	2,592,000 seconds	2,592,000 seconds	Not available	Not adjustable
Maximum number of AutoML jobs	100	100	Not available	Not adjustable

Quotas list - Amazon SageMa +

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

m5.24xlarge

12 matches

Quota name	Applied account-level quota value	AWS default quota value	Utilization	Adjustability
ml.m5.24xlarge for cluster usage	2	0	0	Account level
ml.m5.24xlarge for endpoint usage	1	0	0	Account level
ml.m5.24xlarge for notebook instance usage	2	0	0	Account level
ml.m5.24xlarge for processing job usage	1	0	0	Account level
ml.m5.24xlarge for spot training job usage	2	0	0	Account level
ml.m5.24xlarge for training job usage	3	0	0	Account level
ml.m5.24xlarge for training warm pool usage	0	0	0	Account level

Dashboard AWS services Quota request history Organization Quota request template

Quotas list - Amazon SageMa +

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  View your applied quota values, default quota values, and request quota increases for quotas. [Learn more](#)

Request increase at account level 

Quota name	Applied account-level quota value	AWS default quota value	Utilization	Adjustability
ml.m5.24xlarge for cluster usage	2	0	0	Account level
ml.m5.24xlarge for endpoint usage	1	0	0	Account level
ml.m5.24xlarge for notebook instance usage	2	0	0	Account level
ml.m5.24xlarge for processing job usage	1	0	0	Account level
ml.m5.24xlarge for spot training job usage	2	0	0	Account level
ml.m5.24xlarge for training job usage	3	0	0	Account level
ml.m5.24xlarge for training warm pool usage	0	0	0	Account level

Dashboard AWS services Quota request history Quota request template



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

Quotas list - Amazon SageMa + us-east-1.console.aws.amazon.com/servicequotas/home/services/sagemaker/quotas Paused N. Virginia aws_sandbox

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

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

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

m5.24xlarge 12 matches

Quota name	Applied account-level quota value	AWS default quota value	Utilization	Adjustability
ml.m5.24xlarge for cluster usage	2	0	0	Account level
ml.m5.24xlarge for endpoint usage	1	0	0	Account level
ml.m5.24xlarge for notebook instance usage	2	0	0	Account level
ml.m5.24xlarge for processing job usage	1	0	0	Account level
ml.m5.24xlarge for spot training job usage	2	0	0	Account level
ml.m5.24xlarge for training job usage	5	0	0	Account level

SageMaker Studio | Amazon SageMaker

SageMaker Studio

studio-d-c9qeuo6x91qp.studio.us-east-1.sagemaker.aws/jobs/create/train?jumpstart_model_id=huggingface-llm-mistral-7b&jumpstart_model_version=2.9.1&jumpstart_hu...

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

Provide feedback

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Isengard

SageMaker Studio | Amazon SageMaker

SageMaker Studio

studio-d-c9qeuo6x91qp.studio.us-east-1.sagemaker.aws/jobs/train/jumpstart-dft-huggingface-llm-mistr-20240722-102146

SageMaker Studio > Jobs > Train > Jumpstart Dft Huggingface Llm Mistr 20240722 102146

Provide feedback

jumpstart-dft-huggingface-llm-mistr-20240722-102146 Training Job

X Stop

Status: Executing...

ARN: arn:aws:sagemaker:us-east-1:123456789012:training-jobs/jumpstart-dft-huggingface-llm-mistr-20240722-102146

Base model: huggingface-llm-mistral-7b

Run time (seconds): 36

Created on: 7/22/2024, 6:23:25 PM

Modified on: 7/22/2024, 6:24:37 PM

Performance Artifacts Security Hyperparameters Configurations Instances Logs Tags

Logs

Search... Load old events

No logs.

studio-a-c9qeu06x9 | qp.studio.us-east-1.sagemaker.aws/jobs/train/jumpstart-dft-huggingface-llm-mistr-20240722-102146

SageMaker Studio > Jobs > Train > Jumpstart Dft Huggingface Llm Mistr 20240722 102146

Provide feedback

Logs

Performance Artifacts Security Hyperparameters Configurations Instances Logs Tags

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 ↑

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Type here to search



Performance Artifacts Security Hyperparameters Configurations Instances Logs Tags

Logs

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/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
- > 2024-07-22T11:15:14.109Z [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



studio-a-c9qeu00x91qp.studio.us-east-1.sagemaker.aws/jobs/train/jumpstart-dft-huggingface-lm-mistr-20240722-102146

SageMaker Studio > Jobs > Train > Jumpstart Dft Huggingface Llm Mistr 20240722 102146

Provide feedback

jumpstart-dft-huggingface-lm-mistr-20240722-102146 Training Job

Status Completed **ARN** [arn:aws:sagemaker:us-east-...](#) **Base model** huggingface-lm-mistr-7b

Run time (seconds) 3113 **Created on** 7/22/2024, 6:23:25 PM **Modified on** 7/22/2024, 7:16:30 PM

[Optimize](#) [Deploy](#)

[Performance](#) [Artifacts](#) [Security](#) [Hyperparameters](#) [Configurations](#) [Instances](#) [Logs](#) [Tags](#)

Logs

[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/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
> 2024-07-22T11:15:14.109Z [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.
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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|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
```

Type here to search

8:26 PM 7/22/2024

studio-a-c9qeu06x9 | qp.studio.us-east-1.sagemaker.aws/inference-experience/models/deploy?training_job_name=jumpstart-dft-huggingface-lm-mistral-20240722-102146...

SageMaker Studio > Inference Experience > Models > Deploy

Provide feedback

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-lm-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

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Type here to search

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23

Amazon Workspaces

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studio-d-c9qeuo6x91qp.studio.us-east-1.sagemaker.aws/inference-experience/models/deploy?training_job_name=jumpstart-dft-huggingface-lm-mistral-20240722-102146...

SageMaker Studio > Inference Experience > Models > Deploy

Provide feedback

Default endpoint name - jumpstart-dft-hf-lm-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

The screenshot shows the 'Deploy' step in the SageMaker Studio Inference Experience. The 'Default endpoint name' is set to 'jumpstart-dft-hf-lm-mistral-7b-20240722-122546'. The 'Instance type' is 'ml.g5.12xlarge (Default)' and the 'Initial instance count' is '1'. Below these, the 'Inference type' is set to 'Real-time', described as supporting sustained traffic and low latency. A red arrow points to the 'Inference Optimized' button, which is part of a dropdown menu for the model 'mistral-7b-122546'. At the bottom, there are 'Advanced settings' and 'Deploy' buttons.

Amazon Workspaces

Isengard | SageMaker Studio | Amazon SageMaker Studio

studio-d-c9qeuo6x91qp.studio.us-east-1.sagemaker.aws/inference-experience/models/deploy?training_job_name=jumpstart-dft-huggingface-lm-mistral-20240722-102146...

SageMaker Studio > Inference Experience > Models > Deploy

Provide feedback

Default endpoint name - jumpstart-dft-hf-lm-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

The screenshot shows the 'Deploy' step in the SageMaker Studio Inference Experience. The 'Default endpoint name' is set to 'jumpstart-dft-hf-lm-mistral-7b-20240722-122546'. The 'Instance type' is 'ml.g5.12xlarge (Default)' and the 'Initial instance count' is '1'. The 'Inference type' is set to 'Real-time'. Below the inference type, there is a note: 'For sustained traffic and consistently low latency. Supports payload sizes up to 6 MB and runtimes up to 60 sec.' Under the 'Models' section, the 'mistral-7b-122546' model is listed as 'Inference Optimized'. At the bottom, there are 'Advanced settings' and 'Deploy' buttons, with the 'Deploy' button being the target of a red arrow.



jumpstart-dft-hf-llm-mistral-7b-20240722-122546

Delete

Endpoint summary

Inference Type	Status	Creation time	Last updated
Real-time	Creating	Mon Jul 22 2024 20:27:47 GMT+0800 (Taipei Standard Time)	Mon Jul 22 2024 20:27:48 GMT+0800 (Taipei Standard Time)
ARN	URL		
arn:aws:sagemaker:us-east-1:094784590684:endpoint/jumpstart-dft-hf-llm-mistral-7b-20240722-122546	https://runtime.sagemaker.us-east-1.amazonaws.com/endpoints/jumpstart-dft-hf-llm-mistral-7b-20240722-122546/invocations		

[Variants](#) [Settings](#) [Test inference](#)

Variants

 Search...

✓ Endpoint jumpstart-dft-hf-llm-mistral-7b-20240722-122546 is being created.

3 s



Model	variant name	instance type	instance count	Instance weight
mistral-7b-122546	AllTraffic P	ml.g5.12xlarge	--	--

jumpstart-dft-hf-llm-mistral-7b-20240722-122546 Endpoint

Delete

Endpoint summary

Inference Type	Status	Creation time	Last updated
Real-time	In service	Mon Jul 22 2024 20:27:47 GMT+0800 (Taipei Standard Time)	Mon Jul 22 2024 20:34:12 GMT+0800 (Taipei Standard Time)
ARN	arn:aws:sagemaker:us-east-1:094784590684:endpoint/jumpstart-dft-hf-llm-mistral-7b-20240722-122546	URL	https://runtime.sagemaker.us-east-1.amazonaws.com/endpoints/jumpstart-dft-hf-llm-mistral-7b-20240722-122546/invocations

 Variants Settings **Test inference** Auto-scaling

Test inference

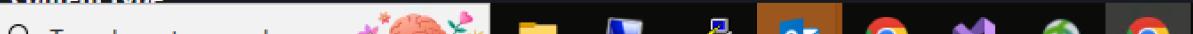
Test your model by sending request payload to the SageMaker hosted endpoint and receiving a response, or by using the Python SDK example code provided.

Testing Options

Select the method you want to use to test your inference

 Test the sample request Use Python SDK example code

Content type



studio-a-c9qeu00x91qp.studio.us-east-1.sagemaker.aws/inference-experience/endpoints/details/jumpstart-dft-hf-llm-mistral-7b-20240722-122546

SageMaker Studio > Inference Experience > Endpoints > Details > Jumpstart Dft Hf Llm Mistral 7b 20240722 122546

Provide feedback

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": "Girafatron 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, Girafatron!\nGirafatron:",  
    "parameters": {  
        "max_new_tokens": 50,  
        "return_full_text": false,  
        "do_sample": true,  
        "top_k": 10,  
        "stop": [  
            "Daniel:"  
        ]  
    }  
}
```

Send Request

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studio-a-c9qeu006x9 | qp.studio.us-east-1.sagemaker.aws/inference-experience/endpoints/details/jumpstart-dft-hf-llm-mistral-7b-20240722-122546

SageMaker Studio > Inference Experience > Endpoints > Details > Jumpstart Dft Hf Llm Mistral 7b 20240722 122546

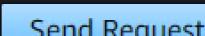
Provide feedback

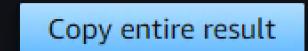
application/json

JSON 

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```
{ "inputs": "Girafatron 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, Girafatron!\nGirafatron:", "parameters": { "max_new_tokens": 50, "return_full_text": false, "do_sample": true, "top_k": 10, "stop": [ "Daniel:" ] } }
```

 Send Request

 Copy entire result

 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\n is the most glorious animal on the face of this Earth.\n\n is the most relevant animal when compared to the glorious\n\n\n\n\n\n\n\n\n is the least", "contentType": "application/json", "invokedProductionVariant": "AllTraffic" } }
```

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Type here to search        

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[Provide feedback](#)[Provide feedback](#)

jumpstart-dft-hf-llm-mistral-7b-20240722-122546 Endpoint

[Delete](#)

Endpoint summary

Inference Type	Status	Creation time	Last updated
Real-time	✓ In service	Mon Jul 22 2024 20:27:47 GMT+0800 (Taipei Standard Time)	Mon Jul 22 2024 20:34:12 GMT+0800 (Taipei Standard Time)
ARN	URL		
arn:aws:sagemaker:us-east-1:094784590684:endpoint/jumpstart-dft-hf-llm-mistral-7b-20240722-122546	https://runtime.sagemaker.us-east-1.amazonaws.com/endpoints/jumpstart-dft-hf-llm-mistral-7b-20240722-122546/invocations		

[Variants](#) [Settings](#) [Test inference](#) [Auto-scaling](#)

Test inference

Test your model by sending request payload to the SageMaker hosted endpoint and receiving a response, or by using the Python SDK example code provided.

Testing Options

Select the method you want to use to test your inference

 Test the sample request Use Python SDK example code

Content type

 Type here to search

SageMaker Studio > Inference Experience > Endpoints > Details > Jumpstart Dft Hf Llm Mistral 7b 20240722 122546

Provide feedback

jumpstart-dft-hf-llm-mistral-7b-20240722-122546

Delete

Endpoint summary

Inference Type	Status	Last updated
Real-time	✓ In	Mon Jul 22 2024 20:34:12 GMT+0800 (Taipei Standard Time)
ARN	URL	
arn:aws:sagemaker:us-east-1:094784590684:endpoint/jumpstart-dft-hf-llm-mistral-7b-20240722-122546	http://127.0.0.1:122546	

Test inference
Test your model by sending request payload to the SageMaker hosted endpoint and receiving a response, or by using the Python SDK example code provided.

Testing Options
Select the method you want to use to test your inference

Test the sample request

Use Python SDK example code

Content type

Type here to search

10:22 PM 7/23/2024

A modal dialog titled "Delete endpoint" is displayed, containing the following text:
⚠️ Deleting this endpoint is permanent and irreversible. All data within this endpoint will be deleted and cannot be recovered.
Are you sure you want to delete this endpoint?
 I confirm that I want to delete the endpoint
Cancel Delete endpoint

studio-a-c9qeu06x9 | qp.studio.us-east-1.sagemaker.aws/inference-experience/endpoints/details/jumpstart-dft-hf-llm-mistral-7b-20240722-122546

SageMaker Studio > Inference Experience > Endpoints > Details > Jumpstart Dft Hf Llm Mistral 7b 20240722 122546

Provide feedback

jumpstart-dft-hf-llm-mistral-7b-20240722-122546

Endpoint

Delete

Endpoint summary

Inference Type	Status	Last updated
Real-time	✓ In	Mon Jul 22 2024 20:34:12 GMT+0800 (Taipei Standard Time)
ARN	URL	
arn:aws:sagemaker:us-east-1:094784590684:endpoint/jumpstart-dft-hf-llm-mistral-7b-20240722-122546	http://127.0.0.1:122546	GMT+0800

Variants Settings **Test inference** Auto-scaling

Delete endpoint

⚠ Deleting this endpoint is permanent and irreversible. All data within this endpoint will be deleted and cannot be recovered.

Are you sure you want to delete this endpoint?

I confirm that I want to delete the endpoint

Cancel **Delete endpoint**

Test inference

Test your model by sending request payload to the SageMaker hosted endpoint and receiving a response, or by using the Python SDK example code provided.

Testing Options

Select the method you want to use to test your inference

Test the sample request

Use Python SDK example code

Content type

Type here to search

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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.

DeleteCreate endpoint

Name	Status	Created on	Modified on
No endpoints You don't have any endpoints			
0 results Refresh			
		Rows 10	Go to page ▼
			Page 0 of 0 ◀ ▶

Learn about endpoints

Get started

- [Deploy models for inference](#)
- [SageMaker Inference explained: Which style is right for you?](#)

Documentation

- [Real-time inference](#)
- [SageMaker pricing](#)
- [Deploy a Machine Learning Model to a Real-Time Inference Endpoint](#)

What's new

- [Recent features launches](#)
- [Engineering blog](#)



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

+ ⌂ ⌄ ⌅ ⌆

Filter files by name

/ introduction_to_amazon_algorithms / jumpstart-foundation-models /

Name	Last Modified
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
llama-3-text-completion.ipynb	14 days ago
llama-guard-text-moderation.ipynb	14 days ago
mistral-7b-instruction-domain-adaptation.ipynb	14 days ago
README.md	14 days ago
template.json	13 days ago
text-generation-chatbot.ipynb	14 days ago
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-t5.ipynb X 02_fine-tuning_llama.ipynb X 03_continued_pr.ipynb X 1-TIGFT-customization.ipynb X 2-TIGFT-provisioning.ipynb 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

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us-west-2 | sagemaker-distribution-1.6-cpu | ml.t3.medium Failed

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Set up

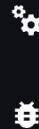
We begin by installing and upgrading necessary packages. Restart the kernel after executing the cell below for the first time.



Home domain-adaption-finetuning.ipynb llama-3-finetuning.ipynb

Markdown git

Cluster ipykernel | Python 3 | 2 vCPU + 4 GiB Share



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.*"
```

Amazon SageMaker | us-east-1 | SageMaker Studio | llama-3-fine... (2) - JupyterLab

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

Home domain-adaption-finetuning.ipynb llama-3-finetuning.ipynb

Cluster ipykernel Python 3 2 vCPU + 4 GiB Share

Deploy Pre-trained Model

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```
[3]: model_id, model_version = "meta-textgeneration-llama-3-8b", "2.*"
```

```
[5]: 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": {
```


Amazon SageMaker | us-east-1 | SageMaker Studio | llama-3-fine... (2) - JupyterLab

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

Home domain-adaption-finetuning.ipynb llama-3-finetuning.ipynb

Cluster ipykernel Python 3 2 vCPU + 4 GiB Share

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

Amazon SageMaker | us-east-1 | SageMaker Studio | llama-3-fine... (2) - JupyterLab

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

Home domain-adaption-finetuning.ipynb llama-3-finetuning.ipynb

[12]: 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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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.\n\nWrite a response that appropriately completes the request.\n\n",
    "instruction": "\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.

```
[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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[16]: from sagemaker.s3 import S3Uploader
import sagemaker
import random

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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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```
[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]
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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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[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  
-----!
```

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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```
[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"])
```

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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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← → ⌂ ⌂ d-c9qeuo6x91qp.studio.us-east-1.sagemaker.aws/jupyter/default/lab/tree/amazon-sagemaker-examples/introduction_to_amazon_algorithms/jumpstar... ☆ ⌂ Paused ⌂

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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.

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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.

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

[]: # Delete resources
#pretrained_predictor.delete_model()
#pretrained_predictor.delete_endpoint()
#finetuned_predictor.delete_model()
#finetuned_predictor.delete_endpoint()

Clean up resources

Appendix

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 ● 01_fine-tuning-titan-lite.ipynb 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.

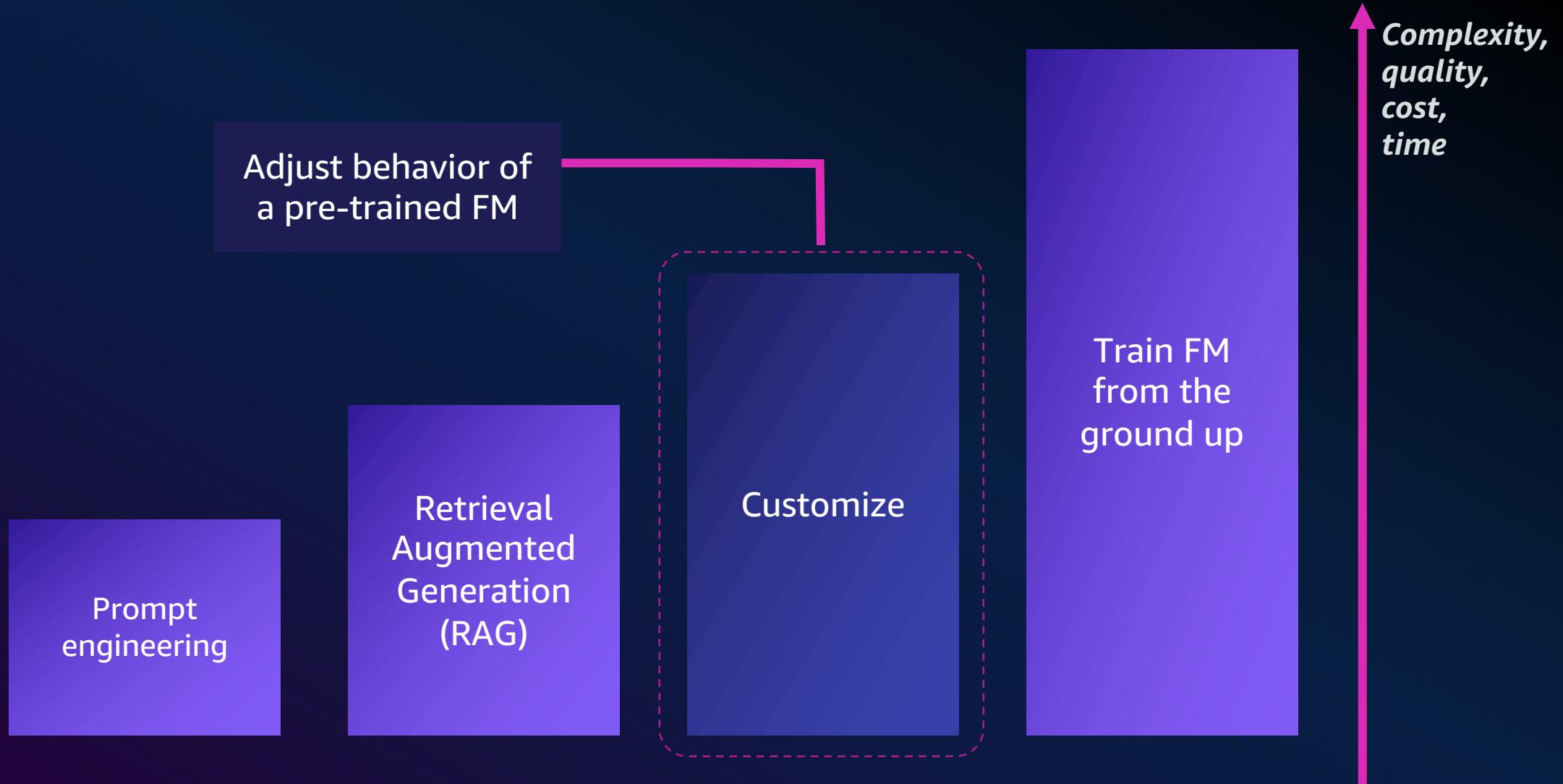
5. Few notes about the fine-tuning method

- 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