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CS589

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WEEK 10 HW 1

Q2 ==> Fine-Tuning based on 3 examples from a JSONL file

Start by activating your Python virtual environment for development, then export your OpenAI

API key: **export OPENAI_API_KEY="<OPENAI_API_KEY>"**

We have data.json

```
[
{"prompt":"When do I have to start the heater?", "completion":"Every day in the
morning at 7AM. You should stop it at 2PM"},
{"prompt":"Where is the garage remote control?", "completion":"Next to the
yellow door, on the key ring"},
{"prompt":"Is it necessary to program the scent diffuser every day?",
"completion":"The scent diffuser is already programmed, you just need to
recharge it when its battery is low"}
]
```


Continue with **openai tools fine_tunes.prepare_data -f data.json**

```
● (venv) koiisme@DESKTOP-LVBMC2V:~/CS589/FineTuning$ openai tools fine_tunes.prepare_data -f data.json
Analyzing...

- Your file contains 3 prompt-completion pairs. In general, we recommend having at least a few hundred examples. We've fo
und that performance tends to linearly increase for every doubling of the number of examples
- All prompts end with suffix `?`
- Your data does not contain a common ending at the end of your completions. Having a common ending string appended to th
e end of the completion makes it clearer to the fine-tuned model where the completion should end. See https://platform.op
enai.com/docs/guides/fine-tuning/preparing-your-dataset for more detail and examples.
- The completion should start with a whitespace character (` `). This tends to produce better results due to the tokeniza
tion we use. See https://platform.openai.com/docs/guides/fine-tuning/preparing-your-dataset for more details

Based on the analysis we will perform the following actions:
- [Recommended] Add a suffix ending `\n` to all completions [Y/n]: y
- [Recommended] Add a whitespace character to the beginning of the completion [Y/n]: y


Your data will be written to a new JSONL file. Proceed [Y/n]: y

Wrote modified file to `data_prepared.jsonl`
Feel free to take a look!

Now use that file when fine-tuning:
> openai api fine_tunes.create -t "data_prepared.jsonl"

After you've fine-tuned a model, remember that your prompt has to end with the indicator string `?` for the model to star
t generating completions, rather than continuing with the prompt. Make sure to include `stop=["\n"]` so that the generate
d texts ends at the expected place.
Once your model starts training, it'll approximately take 2.48 minutes to train a `curie` model, and less for `ada` and `
babbage`. Queue will approximately take half an hour per job ahead of you.
○ (venv) koiisme@DESKTOP-LVBMC2V:~/CS589/FineTuning$
```

Use the OpenAI CLI tool to initiate the fine-tuning process using the prepared JSONL data file:

openai api fine_tunes.create -t "data_prepared.jsonl" -m curie

```
⊗ (venv) koiisme@DESKTOP-LVBMC2V:~/CS589/FineTuning$ openai api fine_tunes.create -t "data_prepared.jsonl" -m curie
usage: openai api [-h]
                  {chat.completions.create,images.generate,images.edit,images.create_variation,audio.transcriptions.creat
e,audio.translations.create,files.create,files.retrieve,files.delete,files.list,models.list,models.retrieve,models.delete
,completions.create}
                  ...
openai api: error: argument {chat.completions.create,images.generate,images.edit,images.create_variation,audio.transcript
ions.create,audio.translations.create,files.create,files.retrieve,files.delete,files.list,models.list,models.retrieve,mod
els.delete,completions.create}: invalid choice: 'fine_tunes.create' (choose from 'chat.completions.create', 'images.gener
ate', 'images.edit', 'images.create_variation', 'audio.transcriptions.create', 'audio.translations.create', 'files.create
', 'files.retrieve', 'files.delete', 'files.list', 'models.list', 'models.retrieve', 'models.delete', 'completions.create
')
```

Refer to the documentation about openai api - gpt3 finetuning with fine-tunes.create argument is

not working - Stack Overflow, we need to make sure that our openai version is 0.28.0

```
(venv) koiisme@DESKTOP-LVBMC2V:~/CS589/FineTuning$ pip show openai
Name: openai
Version: 1.13.3
Summary: The official Python library for the openai API
Home-page:
Author:
Author-email: OpenAI <support@openai.com>
License:
Location: /home/koiisme/CS589/venv/lib/python3.10/site-packages
Requires: anyio, distro, httpx, pydantic, sniffio, tqdm, typing-extensions
Required-by: langchain-openai
(venv) koiisme@DESKTOP-LVBMC2V:~/CS589/FineTuning$ pip install openai==0.28.1
Collecting openai==0.28.1
  Downloading openai-0.28.1-py3-none-any.whl (76 kB)
                                          77.0/77.0 KB 1.2 MB/s eta 0:00:00
Requirement already satisfied: requests>=2.20 in /home/koiisme/CS589/venv/lib/python3.10/site-packages (from openai==0.28.1) (2.31.0)
Requirement already satisfied: aiohttp in /home/koiisme/CS589/venv/lib/python3.10/site-packages (from openai==0.28.1) (3.9.3)
Requirement already satisfied: tqdm in /home/koiisme/CS589/venv/lib/python3.10/site-packages (from openai==0.28.1) (4.66.2)
Requirement already satisfied: charset-normalizer<4,>=2 in /home/koiisme/CS589/venv/lib/python3.10/site-packages (from requests>=2.20->openai==0.28.1) (3.3.2)
Requirement already satisfied: certifi>=2017.4.17 in /home/koiisme/CS589/venv/lib/python3.10/site-packages (from requests>=2.20->openai==0.28.1) (2024.2.2)
Requirement already satisfied: urllib3<3,>=1.21.1 in /home/koiisme/CS589/venv/lib/python3.10/site-packages (from requests>=2.20->openai==0.28.1) (2.2.1)
Requirement already satisfied: idna<4,>=2.5 in /home/koiisme/CS589/venv/lib/python3.10/site-packages (from requests>=2.20->openai==0.28.1) (3.6)
Requirement already satisfied: async-timeout<5.0,>=4.0 in /home/koiisme/CS589/venv/lib/python3.10/site-packages (from aiohttp->openai==0.28.1) (4.0.3)
Requirement already satisfied: multidict<7.0,>=4.5 in /home/koiisme/CS589/venv/lib/python3.10/site-packages (from aiohttp->openai==0.28.1) (6.0.5)
Requirement already satisfied: frozenlist>=1.1.1 in /home/koiisme/CS589/venv/lib/python3.10/site-packages (from aiohttp->openai==0.28.1) (1.4.1)
Requirement already satisfied: yarl<2.0,>=1.0 in /home/koiisme/CS589/venv/lib/python3.10/site-packages (from aiohttp->openai==0.28.1) (1.9.4)
Requirement already satisfied: aiosignal>=1.1.2 in /home/koiisme/CS589/venv/lib/python3.10/site-packages (from aiohttp->openai==0.28.1) (1.3.1)
Requirement already satisfied: attrs>=17.3.0 in /home/koiisme/CS589/venv/lib/python3.10/site-packages (from aiohttp->openai==0.28.1) (23.2.0)
Installing collected packages: openai
  Attempting uninstall: openai
    Found existing installation: openai 1.13.3
    Uninstalling openai-1.13.3:
      Successfully uninstalled openai-1.13.3
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 depend
ts.
langchain-openai 0.0.8 requires openai<2.0.0,>=1.10.0, but you have openai 0.28.1 which is incompatible.
Successfully installed openai-0.28.1
(venv) koiisme@DESKTOP-LVBMC2V:~/CS589/FineTuning$
```

After that, I try to run again and this happens:

```
(venv) koiisme@DESKTOP-LVBMC2V:~/CS589/FineTuning$ openai api fine_tunes.create -t "data_prepared.jsonl" -m curie
Upload progress: 100%|                                                                                                      | 417
/417 [00:00<00:00, 437kit/s]
Uploaded file from data_prepared.jsonl: file-bwypdVCoPacToaWweosPmnUf
Error: Unknown request URL: POST /v1/fine-tunes. Please check the URL for typos, or see the docs at https://platform.openai.com/docs/api-refere
nce/. (HTTP status code: 404)
```

We receive an error coming back with an HTTP status code 404, which means that version 0.28.1 of OpenAI will not be used anymore as it is degraded. Therefore, it is unable to use ***openai api fine_tunes.create***.

We find a way to do the fine-tuning, starting by coming back to our latest model of OpenAI

```
koiisme@DESKTOP-LVBMC2V:~/CS589/FineTuning$ pip show openai
Name: openai
Version: 1.16.2
Summary: The official Python library for the openai API
Home-page:
Author:
Author-email: OpenAI <support@openai.com>
License:
Location: /home/koiisme/.local/lib/python3.10/site-packages
Requires: anyio, distro, httpx, pydantic, sniffio, tqdm, typing-extensions
Required-by:
```

```
● koiisme@DESKTOP-LVBMC2V:~/CS589/FineTuning$ openai api -h
usage: openai api [-h]
                   {chat.completions.create,images.generate,images.edit,images.create_variation,audio.transcriptions.c
reate,audio.translations.create,files.create,files.retrieve,files.delete,files.list,models.list,models.retrieve,model
s.delete,completions.create}
                   ...

positional arguments:
  {chat.completions.create,images.generate,images.edit,images.create_variation,audio.transcriptions.create,audio.tran
slations.create,files.create,files.retrieve,files.delete,files.list,models.list,models.retrieve,models.delete,complet
ions.create}
                   All API subcommands

options:
  -h, --help       show this help message and exit
```
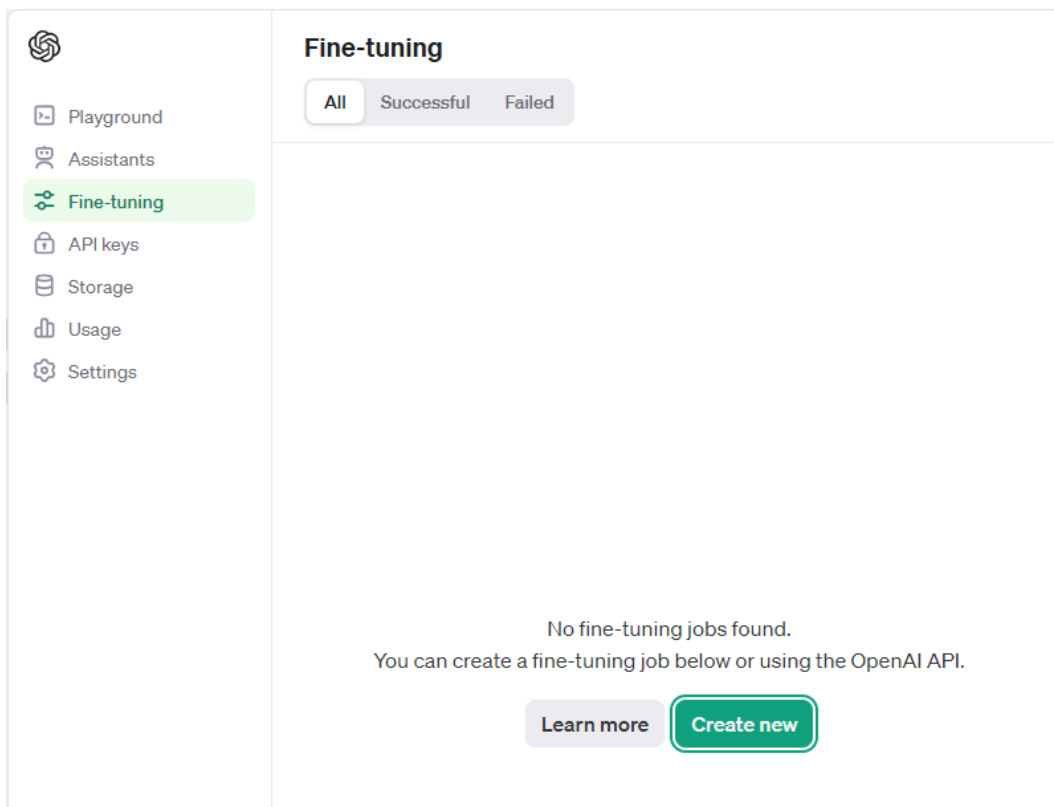
Since we can't see any "fine_tune" in the openai api -h help message, it means that with the latest version of OpenAI, we can't use bash command to create fine-tune jobs anymore.

Refer to https://platform.openai.com/docs/guides/fine-tuning/, we see that python and node.js are supported to create fine-tune jobs.

Another way to fine-tune is to do it directly on the OpenAI website, we mention that later in the document.

Here is how we can fine-tune the model with Python:

```python
import os
import openai
# read local .env file
_ = load_dotenv(find_dotenv())

openai.api_key = os.environ['OPENAI_API_KEY']

from openai import OpenAI
client = OpenAI()

train_file = client.files.create(
  file=open("data_prepared.jsonl", "rb"),
  purpose="fine-tune"
)

model = client.fine_tuning.jobs.create(
  training_file=train_file,
  model="gpt-3.5-turbo"
)
```

We can retrieve the state of a fine-tune with ***client.fine_tuning.jobs.retrieve(model)***

Then, we can use our model to create chat completions:

```python
completion = client.completions.create(
  model=model,
  prompt="Can you tell me the impact of AI on lifestyle?",
  temperature=0,
  max_tokens=1000
)

for chunk in completion:
  print(completion.choices[0].text)
```

Thus, we have the ***app.py***:

```python
import os
import openai
# read local .env file
from dotenv import load_dotenv, find_dotenv
```

```
_ = load_dotenv(find_dotenv())


openai.api_key = os.environ['OPENAI_API_KEY']


from openai import OpenAI
client = OpenAI()


train_file = client.files.create(
    file=open("data_prepared.jsonl", "rb"),
    purpose="fine-tune"
)


model = client.fine_tuning.jobs.create(
    training_file="file-KlOHYmDdtWSixgLefq4DalcI",
    model="babbage-002"
)


print(f"Train file: {train_file}\n")
print(f"Model: {model}\n")
```

We try to run the program and see the error:

```
⊗ (venv) koiisme@DESKTOP-LVBMC2V:~/CS589/FineTuning$ python app.py
  FineTuningJob(id='ftjob-vdV0ulhqd51OzZfWLwZKz1Nn', created_at=1712702331, error=Error(code=None, message=None, param=None, er
  ror=None), fine_tuned_model=None, finished_at=None, hyperparameters=Hyperparameters(n_epochs='auto', batch_size='auto', learn
  ing_rate_multiplier='auto'), model='babbage-002', object='fine_tuning.job', organization_id='org-ZFyebm7IuVbj58dl872E8a7y', r
  esult_files=[], status='validating_files', trained_tokens=None, training_file='file-y9tmUx6VEO81A2nyOT1kqaHN', validation_fil
  e=None, user_provided_suffix=None, seed=948739591, integrations=[])
  Traceback (most recent call last):
    File "/home/koiisme/CS589/FineTuning/app.py", line 23, in <module>
      client.fine_tuning.jobs.retrieve(model)
    File "/home/koiisme/CS589/venv/lib/python3.10/site-packages/openai/resources/fine_tuning/jobs.py", line 157, in retrieve
      return self._get(
    File "/home/koiisme/CS589/venv/lib/python3.10/site-packages/openai/_base_client.py", line 1156, in get
      return cast(ResponseT, self.request(cast_to, opts, stream=stream, stream_cls=stream_cls))
    File "/home/koiisme/CS589/venv/lib/python3.10/site-packages/openai/_base_client.py", line 902, in request
      return self._request(
    File "/home/koiisme/CS589/venv/lib/python3.10/site-packages/openai/_base_client.py", line 993, in _request
      raise self._make_status_error_from_response(err.response) from None
  openai.NotFoundError: Error code: 404 - {'error': {'message': "Could not find fine tune: FineTuningJob(id='ftjob-vdV0ulhqd51O
  zZfWLwZKz1Nn', created_at=1712702331, error=Error(code=None, message=None, param=None, error=None), fine_tuned_model=None, fi
  nished_at=None, hyperparameters=Hyperparameters(n_epochs='auto', batch_size='auto', learning_rate_multiplier='auto'), model='
  babbage-002', object='fine_tuning.job', organization_id='org-ZFyebm7IuVbj58dl872E8a7y', result_files=[], status='validating_f
  iles', trained_tokens=None, training_file='file-y9tmUx6VEO81A2nyOT1kqaHN', validation_file=None, user_provided_suffix=None, s
  eed=948739591, integrations=[])", 'type': 'invalid_request_error', 'param': 'fine_tune_id', 'code': 'fine_tune_not_found'}}
○ (venv) koiisme@DESKTOP-LVBMC2V:~/CS589/FineTuning$
```

Alternatively, we can check on the OpenAI account for the finetuning job:

In detail, we can see:

⊞ Trained tokens	-	
↻ Epochs	auto	
⊜ Batch size	auto	
⊞ LR multiplier	auto	
⚲ Seed	948739591	
▢ Files		
Training	data_prepared.jsonl ⤢	
Validation	-	
⊞ Training loss	-	

Messages Metrics

15:38:52 • Training file has 3 example(s), but must have at least 10 examples

15:38:51 • Validating training file: file-y9tmUx6VEO81A2nyOT1kqaHN

15:38:51 • Created fine-tuning job: ftjob-vdV0ulhqd51OzZfWLwZKz1Nn

⧉ Copy Job

The error says that the training file should have at least 10 pairs of prompts and completion.

Therefore, we have to create more examples of prompt-completion

```
FineTuning > {} data.json > ...
  1   [
  2       {"prompt": "When do I have to start the heater?", "completion": "Every day in the morning at 7AM. You should stop it at 2P
  3       {"prompt": "Where is the garage remote control?", "completion": "Next to the yellow door, on the key ring"},
  4       {"prompt": "Is it necessary to program the scent diffuser every day?", "completion": "The scent diffuser is already progra
  5       {"prompt": "What time should I turn on the air conditioning?", "completion": "You should turn on the air conditioning duri
  6       {"prompt": "How do I reset the thermostat?", "completion": "To reset the thermostat, press and hold the reset button for 1
  7       {"prompt": "Where can I find the spare batteries for the smoke detector?", "completion": "Spare batteries for the smoke de
  8       {"prompt": "Do I need to refill the water in the humidifier every day?", "completion": "No, you only need to refill the wa
  9       {"prompt": "What should I do if the light bulb in the hallway burns out?", "completion": "If the light bulb in the hallway
 10       {"prompt": "How often should I change the air filter in the HVAC system?", "completion": "The air filter in the HVAC syste
 11       {"prompt": "Where can I find the circuit breaker box in case of a power outage?", "completion": "The circuit breaker box i
 12       {"prompt": "What is the emergency evacuation procedure in case of a fire alarm?", "completion": "In case of a fire alarm,
 13       {"prompt": "How do I adjust the water temperature in the shower?", "completion": "To adjust the water temperature in the s
 14       {"prompt": "Where can I obtain a parking permit for visitors?", "completion": "Parking permits for visitors can be obtaine
 15       {"prompt": "Is there a designated area for recycling bins?", "completion": "Yes, there are designated areas for recycling
 16       {"prompt": "What should I do if I notice a leak in the ceiling?", "completion": "If you notice a leak in the ceiling, plea
 17   ]
 18
```

The adjusted data.json has more than 10 examples.

Now, repeat the steps above.

```
(venv) koiisme@DESKTOP-LVBMC2V:~/CS589/FineTuning$ python app.py
Train file: FileObject(id='file-eHybj4lbOYbd72FhizDEsDPG', bytes=2608, created_at=1712705080, filename='data
_prepared.jsonl', object='file', purpose='fine-tune', status='processed', status_details=None)

Model: FineTuningJob(id='ftjob-xre1C0aj1v6Ly4heD4sz4dt3', created_at=1712705081, error=Error(code=None, mess
age=None, param=None, error=None), fine_tuned_model=None, finished_at=None, hyperparameters=Hyperparameters(
n_epochs='auto', batch_size='auto', learning_rate_multiplier='auto'), model='babbage-002', object='fine_tuni
ng.job', organization_id='org-ZFyebm7IuVbj58dl872E8a7y', result_files=[], status='validating_files', trained
_tokens=None, training_file='file-KlOHYmDdtWSixgLefq4DalcI', validation_file=None, user_provided_suffix=None
, seed=600723751, integrations=[])
```

We can see the job is ongoing:

After finishing the fine-tune process, the screen displays the model with the output model (*ft:babbage-002:personal::9CF8rHIy*)

Here is how we can create a fine-tuned model using the OpenAI website platform. We just need to fill out the required section.

There is also one thing we need to consider: for prompt completion, we can use babbage-002 and davinci-002, while the gpt-3.5-turbo is used for chat completion.

Now we already have the fine-tuned model, let's try to use it for prompt completion

```
● (venv) koiisme@DESKTOP-LVBMC2V:~/CS589/FineTuning$ export FINE_TUNED_MODEL="ft:babbage-002:personal::9CF8rHIy"
● (venv) koiisme@DESKTOP-LVBMC2V:~/CS589/FineTuning$ openai api completions.create -m $FINE_TUNED_MODEL -p "When do I hav
  e to start the heater?"
   Should you stop the heater in the morning with the spout stopped.
  Should you
○ (venv) koiisme@DESKTOP-LVBMC2V:~/CS589/FineTuning$
```

We can use Python to use the fine-tuned model.

We have ***use.py***:

```python
import os
import openai
# read local .env file
from dotenv import load_dotenv, find_dotenv
_ = load_dotenv(find_dotenv())

openai.api_key  = os.environ['OPENAI_API_KEY']

from openai import OpenAI
client = OpenAI()

completion = client.completions.create(
  model="ft:babbage-002:personal::9CF8rHIy",
  prompt="When do I have to start the heater?",
  temperature=0,
  max_tokens=1000
)

for chunk in completion:
  print(completion.choices[0].text)
```

Try to run the program, we have:

```
● (venv) koiisme@DESKTOP-LVBMC2V:~/CS589/FineTuning$ python use.py
   You should start the heater in the morning, you should stop it in the afternoon
```

We can also use fine-tuned model with cURL

```
● (venv) koiisme@DESKTOP-LVBMC2V:~/CS589/FineTuning$ curl https://api.openai.com/v1/completions \
        -H "Authorization: Bearer $OPENAI_API_KEY" \
        -H "Content-Type: application/json" \
        -d '{
        "prompt": "When do I have to start and stop the heater and air conditioning?",
        "model": "ft:babbage-002:personal::9CF8rHIy"}'
  {
    "id": "cmpl-9CHKG4AOPcoF2JGyYJ0A20KE0I2Ws",
    "object": "text_completion",
    "created": 1712713564,
    "model": "ft:babbage-002:personal::9CF8rHIy",
    "choices": [
      {
        "text": " You should stop the heater and air conditioning every day for 2 hours.\n",
        "index": 0,
        "logprobs": null,
        "finish_reason": "stop"
      }
    ],
    "usage": {
      "prompt_tokens": 14,
      "completion_tokens": 15,
      "total_tokens": 29
    }
  }
○ (venv) koiisme@DESKTOP-LVBMC2V:~/CS589/FineTuning$ █
```

Next, we will analyze the fine-tuned model *ftjob-xre1C0aj1v6Ly4heD4sz4dt3* with

openai api fine_tunes.results -i <YOUR_FINE_TUNE_JOB_ID>

(This one is only available on OpenAI 0.28.1 version)

=> openai api fine_tunes.results -i ftjob-xre1C0aj1v6Ly4heD4sz4dt3

```
⊗ (venv) koiisme@DESKTOP-LVBMC2V:~/CS589/FineTuning$ openai api fine_tunes.results -i ftjob-xre1C0aj1v6Ly4heD4sz4dt3
  Error: Unknown request URL: GET /v1/fine-tunes/ftjob-xre1C0aj1v6Ly4heD4sz4dt3. Please check the URL for typos, or see t
  he docs at https://platform.openai.com/docs/api-reference/. (HTTP status code: 404)
```

Since the old version of OpenAI is deprecated, here is how you can see the model results in the

new version.

Head to the 'Storage' section on the website, there are files stored inside (include our previous

data_prepared.jsonl)

There is a file named step_metrics.csv, we can download and have a look at the file.

In order to add suffix to fine-tuned model name, we can use the 'suffix' when creating the fine-tuned model on the website of OpenAI.

Or, try with ***openai api fine_tunes.create -t data.jsonl -m \<engine\> --suffix "my_model_name"***

(which only available for the old version of OpenAI and probably deprecated)

Finally, we can delete the fine-tuned model in different ways:

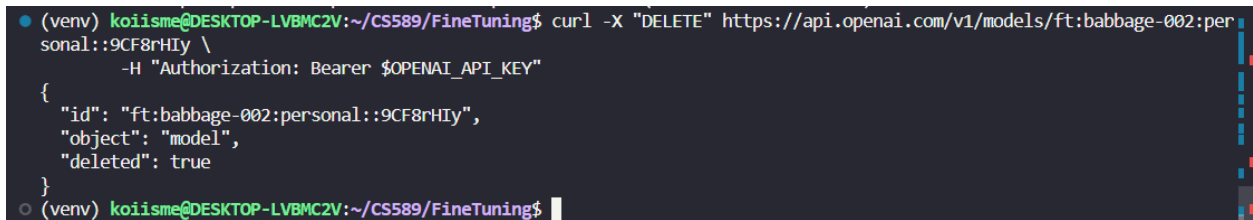## *# CLI*

openai api models.delete -i \<FINE_TUNED_MODEL\>

(used for OpenAI 0.28.1)

 # Python

openai.Model.delete(FINE_TUNED_MODEL)

 # cURL

curl -X "DELETE" https://api.openai.com/v1/models/\<FINE_TUNED_MODEL\> \

    -H "Authorization: Bearer $OPENAI_API_KEY"

```
(venv) koiisme@DESKTOP-LVBMC2V:~/CS589/FineTuning$ curl -X "DELETE" https://api.openai.com/v1/models/ft:babbage-002:per
sonal::9CF8rHIy \
        -H "Authorization: Bearer $OPENAI_API_KEY"
{
  "id": "ft:babbage-002:personal::9CF8rHIy",
  "object": "model",
  "deleted": true
}
(venv) koiisme@DESKTOP-LVBMC2V:~/CS589/FineTuning$
```