Installation and Load packages

```
!pip install datasets peft -qq
# !pip install accelerate -qq
# !pip install bitsandbytes -qq
!pip install trl -qq
!pip install wandb scikit-learn -qq

pip show peft

Name: peft
Version: 0.5.0
Summary: Parameter-Efficient Fine-Tuning (PEFT)
Home-page: https://github.com/huggingface/peft
Author: The HuggingFace team
Author-email: sourab@huggingface.co
License: Apache
Location: /opt/conda/lib/python3.10/site-packages
Requires: accelerate, numpy, packaging, psutil, pyyaml, safetensors,
torch, tqdm, transformers
Required-by: auto-gptq
Note: you may need to restart the kernel to use updated packages.

!pip install torch==2.2.0 torchvision==0.17.0 torchaudio==2.2.0 --
index-url https://download.pytorch.org/whl/cu118
!pip install --upgrade --pre transformers accelerate --extra-index-url
https://download.pytorch.org/whl/cu118
!pip install bitsandbytes==0.43.2 --prefer-binary --extra-index-url
https://pypi.org/simple

Defaulting to user installation because normal site-packages is not
writeable
Looking in indexes: https://download.pytorch.org/whl/cu118
Collecting torch==2.2.0
  Downloading https://download.pytorch.org/whl/cu118/torch-
2.2.0%2Bcu118-cp310-cp310-linux_x86_64.whl (811.7 MB)
                                            811.7/811.7 MB 1.6 MB/s eta
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ent already satisfied: jinja2 in
/home/student/.local/lib/python3.10/site-packages (from torch==2.2.0)
(3.1.3)
Collecting nvidia-cudnn-cu11==8.7.0.84
  Downloading
https://download.pytorch.org/whl/cu118/nvidia_cudnn_cu11-8.7.0.84-py3-
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none-manylinux1_x86_64.whl (728.5 MB)
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ent already satisfied: typing-extensions>=4.8.0 in
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Collecting nvidia-cufft-cu11==10.9.0.58
  Downloading
https://download.pytorch.org/whl/cu118/nvidia_cufft_cu11-10.9.0.58-
py3-none-manylinux1_x86_64.whl (168.4 MB)
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(3.13.1)
Collecting triton==2.2.0
  Downloading https://download.pytorch.org/whl/triton-2.2.0-cp310-
cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (167.9 MB)
                                         ──────────────── 167.9/167.9 MB 8.3 MB/s eta
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anylinux1_x86_64.whl (58.1 MB)
                                         ──────────────── 58.1/58.1 MB 24.6 MB/s eta
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ent already satisfied: sympy in /opt/conda/lib/python3.10/site-
packages (from torch==2.2.0) (1.12)
Collecting nvidia-nccl-cu11==2.19.3
  Downloading https://download.pytorch.org/whl/cu118/nvidia_nccl_cu11-
2.19.3-py3-none-manylinux1_x86_64.whl (135.3 MB)
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Requirement already satisfied: networkx in
/opt/conda/lib/python3.10/site-packages (from torch==2.2.0) (3.1)
Collecting nvidia-cuda-runtime-cu11==11.8.89
  Downloading
https://download.pytorch.org/whl/cu118/nvidia_cuda_runtime_cu11-
11.8.89-py3-none-manylinux1_x86_64.whl (875 kB)
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0:00:00
ent already satisfied: requests in
/home/student/.local/lib/python3.10/site-packages (from
torchvision==0.17.0) (2.32.3)
Requirement already satisfied: pillow!=8.3.*,>=5.3.0 in
/home/student/.local/lib/python3.10/site-packages (from
torchvision==0.17.0) (10.2.0)
Requirement already satisfied: numpy in
/home/student/.local/lib/python3.10/site-packages (from
torchvision==0.17.0) (1.26.4)
Requirement already satisfied: MarkupSafe>=2.0 in
/home/student/.local/lib/python3.10/site-packages (from jinja2-
>torch==2.2.0) (2.1.5)
Requirement already satisfied: certifi>=2017.4.17 in
/home/student/.local/lib/python3.10/site-packages (from requests-
>torchvision==0.17.0) (2024.2.2)
Requirement already satisfied: charset-normalizer<4,>=2 in
/home/student/.local/lib/python3.10/site-packages (from requests-
>torchvision==0.17.0) (3.3.2)
Requirement already satisfied: urllib3<3,>=1.21.1 in
/home/student/.local/lib/python3.10/site-packages (from requests-
>torchvision==0.17.0) (2.2.1)
Requirement already satisfied: idna<4,>=2.5 in
/home/student/.local/lib/python3.10/site-packages (from requests-
>torchvision==0.17.0) (3.6)
Requirement already satisfied: mpmath>=0.19 in
/opt/conda/lib/python3.10/site-packages (from sympy->torch==2.2.0)
(1.3.0)
Installing collected packages: triton, nvidia-nvtx-cu11, nvidia-nccl-
cu11, nvidia-cusparse-cu11, nvidia-curand-cu11, nvidia-cufft-cu11,
nvidia-cuda-runtime-cu11, nvidia-cuda-nvrtc-cu11, nvidia-cuda-cupti-
cu11, nvidia-cublas-cu11, nvidia-cusolver-cu11, nvidia-cudnn-cu11,
torch, torchvision, torchaudio
  WARNING: The scripts convert-caffe2-to-onnx, convert-onnx-to-caffe2
and torchrun are installed in '/home/student/.local/bin' which is not
on PATH.
  Consider adding this directory to PATH or, if you prefer to suppress
this warning, use --no-warn-script-location.
Successfully installed nvidia-cublas-cu11-11.11.3.6 nvidia-cuda-cupti-
cu11-11.8.87 nvidia-cuda-nvrtc-cu11-11.8.89 nvidia-cuda-runtime-cu11-
```

```
11.8.89 nvidia-cudnn-cu11-8.7.0.84 nvidia-cufft-cu11-10.9.0.58 nvidia-
curand-cu11-10.3.0.86 nvidia-cusolver-cu11-11.4.1.48 nvidia-cusparse-
cu11-11.7.5.86 nvidia-nccl-cu11-2.19.3 nvidia-nvtx-cu11-11.8.86 torch-
2.2.0+cu118 torchaudio-2.2.0+cu118 torchvision-0.17.0+cu118 triton-
2.2.0
Defaulting to user installation because normal site-packages is not
writeable
Looking in indexes: https://pypi.org/simple,
https://download.pytorch.org/whl/cu118
Requirement already satisfied: transformers in
/home/student/.local/lib/python3.10/site-packages (4.51.3)
Requirement already satisfied: accelerate in
/home/student/.local/lib/python3.10/site-packages (1.6.0)
Requirement already satisfied: filelock in
/home/student/.local/lib/python3.10/site-packages (from transformers)
(3.13.1)
Requirement already satisfied: requests in
/home/student/.local/lib/python3.10/site-packages (from transformers)
(2.32.3)
Requirement already satisfied: huggingface-hub<1.0,>=0.30.0 in
/home/student/.local/lib/python3.10/site-packages (from transformers)
(0.30.2)
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/home/student/.local/lib/python3.10/site-packages (from transformers)
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/opt/conda/lib/python3.10/site-packages (from transformers)
(2023.12.25)
Requirement already satisfied: tokenizers<0.22,>=0.21 in
/home/student/.local/lib/python3.10/site-packages (from transformers)
(0.21.1)
Requirement already satisfied: numpy>=1.17 in
/home/student/.local/lib/python3.10/site-packages (from transformers)
(1.26.4)
Requirement already satisfied: tqdm>=4.27 in
/home/student/.local/lib/python3.10/site-packages (from transformers)
(4.67.1)
Requirement already satisfied: safetensors>=0.4.3 in
/home/student/.local/lib/python3.10/site-packages (from transformers)
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Requirement already satisfied: psutil in
/opt/conda/lib/python3.10/site-packages (from accelerate) (5.9.0)
Requirement already satisfied: torch>=2.0.0 in
/home/student/.local/lib/python3.10/site-packages (from accelerate)
(2.2.0+cu118)
Requirement already satisfied: fsspec>=2023.5.0 in
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/home/student/.local/lib/python3.10/site-packages (from huggingface-hub<1.0,>=0.30.0->transformers) (2024.2.0)
Requirement already satisfied: typing-extensions>=3.7.4.3 in /home/student/.local/lib/python3.10/site-packages (from huggingface-hub<1.0,>=0.30.0->transformers) (4.10.0)
Requirement already satisfied: nvidia-nvtx-cu11==11.8.86 in /home/student/.local/lib/python3.10/site-packages (from torch>=2.0.0->accelerate) (11.8.86)
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Requirement already satisfied: certifi>=2017.4.17 in
/home/student/.local/lib/python3.10/site-packages (from requests-
>transformers) (2024.2.2)
Requirement already satisfied: charset-normalizer<4,>=2 in
/home/student/.local/lib/python3.10/site-packages (from requests-
>transformers) (3.3.2)
Requirement already satisfied: idna<4,>=2.5 in
/home/student/.local/lib/python3.10/site-packages (from requests-
>transformers) (3.6)
Requirement already satisfied: MarkupSafe>=2.0 in
/home/student/.local/lib/python3.10/site-packages (from jinja2-
>torch>=2.0.0->accelerate) (2.1.5)
Requirement already satisfied: mpmath>=0.19 in
/opt/conda/lib/python3.10/site-packages (from sympy->torch>=2.0.0-
>accelerate) (1.3.0)
Defaulting to user installation because normal site-packages is not
writeable
Looking in indexes: https://pypi.org/simple, https://pypi.org/simple
Collecting bitsandbytes==0.43.2
  Downloading bitsandbytes-0.43.2-py3-none-manylinux_2_24_x86_64.whl
(137.5 MB)
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ent already satisfied: numpy in
/home/student/.local/lib/python3.10/site-packages (from
bitsandbytes==0.43.2) (1.26.4)
Requirement already satisfied: torch in
/home/student/.local/lib/python3.10/site-packages (from
bitsandbytes==0.43.2) (2.2.0+cu118)
Requirement already satisfied: jinja2 in
/home/student/.local/lib/python3.10/site-packages (from torch-
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Requirement already satisfied: nvidia-cusparse-cu11==11.7.5.86 in
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>bitsandbytes==0.43.2) (3.1)
Requirement already satisfied: fsspec in
/home/student/.local/lib/python3.10/site-packages (from torch-
>bitsandbytes==0.43.2) (2024.2.0)
Requirement already satisfied: nvidia-cusolver-cu11==11.4.1.48 in
/home/student/.local/lib/python3.10/site-packages (from torch-
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/home/student/.local/lib/python3.10/site-packages (from torch-
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/home/student/.local/lib/python3.10/site-packages (from torch-
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/home/student/.local/lib/python3.10/site-packages (from torch-
>bitsandbytes==0.43.2) (8.7.0.84)
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/home/student/.local/lib/python3.10/site-packages (from torch-
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Requirement already satisfied: nvidia-curand-cu11==10.3.0.86 in
/home/student/.local/lib/python3.10/site-packages (from torch-
>bitsandbytes==0.43.2) (10.3.0.86)
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/home/student/.local/lib/python3.10/site-packages (from torch-
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/home/student/.local/lib/python3.10/site-packages (from torch-
>bitsandbytes==0.43.2) (11.8.86)
Requirement already satisfied: sympy in
/opt/conda/lib/python3.10/site-packages (from torch-
>bitsandbytes==0.43.2) (1.12)
Requirement already satisfied: nvidia-cuda-runtime-cu11==11.8.89 in
/home/student/.local/lib/python3.10/site-packages (from torch-
>bitsandbytes==0.43.2) (11.8.89)
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/home/student/.local/lib/python3.10/site-packages (from torch-
>bitsandbytes==0.43.2) (2.2.0)
Requirement already satisfied: nvidia-cuda-nvrtc-cu11==11.8.89 in
/home/student/.local/lib/python3.10/site-packages (from torch-
>bitsandbytes==0.43.2) (11.8.89)
Requirement already satisfied: filelock in
/home/student/.local/lib/python3.10/site-packages (from torch-
>bitsandbytes==0.43.2) (3.13.1)
Requirement already satisfied: MarkupSafe>=2.0 in
/home/student/.local/lib/python3.10/site-packages (from jinja2->torch-
>bitsandbytes==0.43.2) (2.1.5)
Requirement already satisfied: mpmath>=0.19 in
/opt/conda/lib/python3.10/site-packages (from sympy->torch-
>bitsandbytes==0.43.2) (1.3.0)
Installing collected packages: bitsandbytes
Successfully installed bitsandbytes-0.43.2

!pip show transformers
```

```
Name: transformers
Version: 4.51.3
Summary: State-of-the-art Machine Learning for JAX, PyTorch and
TensorFlow
Home-page: https://github.com/huggingface/transformers
Author: The Hugging Face team (past and future) with the help of all
our contributors
(https://github.com/huggingface/transformers/graphs/contributors)
Author-email: transformers@huggingface.co
License: Apache 2.0 License
Location: /home/student/.local/lib/python3.10/site-packages
Requires: filelock, huggingface-hub, numpy, packaging, pyyaml, regex,
requests, safetensors, tokenizers, tqdm
Required-by: auto-gptq, optimum, peft, trl
```

```python
import os

# Disable tokenizer parallelism to avoid the warning
os.environ["TOKENIZERS_PARALLELISM"] = "false"

import peft
print(peft.__version__)
print(peft.__file__)

import sys
for path in sys.path:
    print(path)
```

```
0.5.0
/opt/conda/lib/python3.10/site-packages/peft/__init__.py
/opt/conda/lib/python310.zip
/opt/conda/lib/python3.10
/opt/conda/lib/python3.10/lib-dynload

/home/student/.local/lib/python3.10/site-packages
/opt/conda/lib/python3.10/site-packages
/opt/conda/lib/python3.10/site-packages/mpmath-1.2.1-py3.10.egg
```

GPU - details

```python
import torch

print("Torch version:", torch.__version__)
print("CUDA available:", torch.cuda.is_available())

if torch.cuda.is_available():
    print("Device name:", torch.cuda.get_device_name(0))
else:
    print("No GPU detected.")
```

```
Torch version: 2.2.0+cu118
CUDA available: True
Device name: Tesla T4
```

Load libraries, Login HuggingFace API & WandB API

- **HuggingFace API:** To get access of Model Llama-3.2 (3 Billion)
- **WandB (Weigths & Biases):** To supervise perform of model and hyperparameter Tuning

```python
# from google.colab import userdata
from huggingface_hub import login

login(token="YOUR_HF_API_KEY")

# Access Key for llama Model (HuggingFace)

from datasets import load_dataset, Dataset
from sklearn.model_selection import train_test_split

from transformers import (
    AutoTokenizer,
    AutoModelForCausalLM,
    TrainingArguments,
    DataCollatorForLanguageModeling,
    Trainer,
    BitsAndBytesConfig,
    HfArgumentParser,
    pipeline,
    logging,
    EarlyStoppingCallback
)

from transformers.trainer_callback import TrainerCallback,
TrainerState, TrainerControl

from peft import (
    LoraConfig,
    PeftModel,
    prepare_model_for_kbit_training,
    get_peft_model,
)


from bitsandbytes.optim import AdamW8bit
import os, torch, wandb
from trl import SFTTrainer, setup_chat_format
```

WandB - For plot Training

```
# for hyperparameter tuning report
wandb.login()
# YOUR_WANDB_API_KEY
```

```
wandb: Logging into wandb.ai. (Learn how to deploy a W&B server
locally: https://wandb.me/wandb-server)
wandb: You can find your API key in your browser here:
https://wandb.ai/authorize
wandb: Paste an API key from your profile and hit enter:

 ........

wandb: WARNING If you're specifying your api key in code, ensure this
code is not shared publicly.
wandb: WARNING Consider setting the WANDB_API_KEY environment
variable, or running `wandb login` from the command line.
wandb: No netrc file found, creating one.
wandb: Appending key for api.wandb.ai to your netrc file:
/home/student/.netrc
wandb: Currently logged in as: yashnayi00 (yashnayi00-university-of-
new-haven) to https://api.wandb.ai. Use `wandb login --relogin` to
force relogin

True
```

Load Llama-3.2-3B model

```python
model_name = "meta-llama/Llama-3.2-3B"

bnb_config = BitsAndBytesConfig(
    load_in_4bit=True,
    bnb_4bit_quant_type="nf4",
    bnb_4bit_compute_dtype=torch.bfloat16,
    bnb_4bit_use_double_quant=False
)


tokenizer = AutoTokenizer.from_pretrained(model_name)

base_model = AutoModelForCausalLM.from_pretrained(
    model_name,
    device_map="auto",
    quantization_config=bnb_config,
    attn_implementation="eager",
)

if tokenizer.pad_token is None:
```

```
    tokenizer.pad_token = tokenizer.eos_token

tokenizer.padding_side = "right"

base_model.config.pretraining_tp = 1
base_model.config.use_cache = False
```

{"model_id":"821ba11c53f24046864cf125f8dfdcfc","version_major":2,"version_minor":0}

{"model_id":"ebd7f4ce49974ebe884cdb593f9cc845","version_major":2,"version_minor":0}

{"model_id":"b53ef2163d8e458896b51538e264128f","version_major":2,"version_minor":0}

{"model_id":"3aec73aea2fb4589a584ab5014d68091","version_major":2,"version_minor":0}

{"model_id":"e3f41f32ebf54e108efcb676f61e0ac9","version_major":2,"version_minor":0}

{"model_id":"3b10f46188584de68864c7fdfa5952c9","version_major":2,"version_minor":0}

{"model_id":"87bd4c9cff0042ec8db167048d744af5","version_major":2,"version_minor":0}

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{"model_id":"583e57469815470daa1b23f59cddd1e5","version_major":2,"version_minor":0}

```python
print(f"meta-llama/Llama-3.2-3B:\n\n{base_model}")
```

```
meta-llama/Llama-3.2-3B:

LlamaForCausalLM(
  (model): LlamaModel(
    (embed_tokens): Embedding(128256, 3072)
    (layers): ModuleList(
      (0-27): 28 x LlamaDecoderLayer(
        (self_attn): LlamaAttention(
          (q_proj): Linear4bit(in_features=3072, out_features=3072,
bias=False)
          (k_proj): Linear4bit(in_features=3072, out_features=1024,
bias=False)
          (v_proj): Linear4bit(in_features=3072, out_features=1024,
```

```
bias=False)
          (o_proj): Linear4bit(in_features=3072, out_features=3072,
bias=False)
        )
        (mlp): LlamaMLP(
          (gate_proj): Linear4bit(in_features=3072, out_features=8192,
bias=False)
          (up_proj): Linear4bit(in_features=3072, out_features=8192,
bias=False)
          (down_proj): Linear4bit(in_features=8192, out_features=3072,
bias=False)
          (act_fn): SiLU()
        )
        (input_layernorm): LlamaRMSNorm((3072,), eps=1e-05)
        (post_attention_layernorm): LlamaRMSNorm((3072,), eps=1e-05)
      )
    )
    (norm): LlamaRMSNorm((3072,), eps=1e-05)
    (rotary_emb): LlamaRotaryEmbedding()
  )
  (lm_head): Linear(in_features=3072, out_features=128256, bias=False)
)

print(f"{base_model.config}")

LlamaConfig {
  "_attn_implementation_autoset": true,
  "architectures": [
    "LlamaForCausalLM"
  ],
  "attention_bias": false,
  "attention_dropout": 0.0,
  "bos_token_id": 128000,
  "eos_token_id": 128001,
  "head_dim": 128,
  "hidden_act": "silu",
  "hidden_size": 3072,
  "initializer_range": 0.02,
  "intermediate_size": 8192,
  "max_position_embeddings": 131072,
  "mlp_bias": false,
  "model_type": "llama",
  "num_attention_heads": 24,
  "num_hidden_layers": 28,
  "num_key_value_heads": 8,
  "pretraining_tp": 1,
  "quantization_config": {
    "_load_in_4bit": true,
    "_load_in_8bit": false,
    "bnb_4bit_compute_dtype": "bfloat16",
```

```
        "bnb_4bit_quant_storage": "uint8",
        "bnb_4bit_quant_type": "nf4",
        "bnb_4bit_use_double_quant": false,
        "llm_int8_enable_fp32_cpu_offload": false,
        "llm_int8_has_fp16_weight": false,
        "llm_int8_skip_modules": null,
        "llm_int8_threshold": 6.0,
        "load_in_4bit": true,
        "load_in_8bit": false,
        "quant_method": "bitsandbytes"
    },
    "rms_norm_eps": 1e-05,
    "rope_scaling": {
        "factor": 32.0,
        "high_freq_factor": 4.0,
        "low_freq_factor": 1.0,
        "original_max_position_embeddings": 8192,
        "rope_type": "llama3"
    },
    "rope_theta": 500000.0,
    "tie_word_embeddings": true,
    "torch_dtype": "float16",
    "transformers_version": "4.51.3",
    "use_cache": false,
    "vocab_size": 128256
}
```

Trainable parameters - Model

```python
def trainable_parameters(model):
    """
    Prints the number of trainable parameters in the model.
    """
    trainable_params = 0
    all_param = 0
    for _, param in model.named_parameters():
        all_param += param.numel()
        if param.requires_grad:
            trainable_params += param.numel()
    return f"- Trainable model parameters: {trainable_params}.\n- All model parameters: {all_param}.\n- Percentage of trainable model parameters: {100 * trainable_params / all_param:.2f}%"

print(trainable_parameters(base_model))

- Trainable model parameters: 394177536.
- All model parameters: 1803463680.
- Percentage of trainable model parameters: 21.86%
```

Assign datasetPH.json

Data is split in to train and test.

- Train size: 80%
- Test size: 20%

```python
# import json
# with open("./dataset/policy_training_data.jsonl", "r") as f:
#     data = json.load(f)

# if isinstance(data, dict):
#     print("Data is a dictionary. Converting values to a list for
splitting.")
#     data = list(data.values())

# train_data, test_data = train_test_split(data, test_size=0.2,
random_state=42)

# with open("./dataset/trainset/rp_train_datasetPH.json", "w") as f:
#     json.dump(train_data, f, indent=2)

# with open("./dataset/testset/rp_test_datasetPH.json", "w") as f:
#     json.dump(test_data, f, indent=2)

# print(f"Train size: {len(train_data)}")
# print(f"Test size: {len(test_data)}")

data = load_dataset("json",
data_files="dataset/large_policy_data.jsonl")
data
```

```
{"model_id":"2f609a17252147c88cdb01b96cae51e7","version_major":2,"vers
ion_minor":0}
```

```
DatasetDict({
    train: Dataset({
        features: ['instruction', 'response'],
        num_rows: 7951
    })
})
```

```python
data["train"] = data["train"].select(range(3000))
split_data = data["train"].train_test_split(test_size=0.2, seed=42)

print(split_data)
```

```
DatasetDict({
    train: Dataset({
        features: ['instruction', 'response'],
        num_rows: 2400
    })
```

```
    test: Dataset({
        features: ['instruction', 'response'],
        num_rows: 600
    })
})

data['train'][0]

{'instruction': 'Summarize the educational attainment statistics for
Alabama in 2018.',
 'response': "Here is a summary of the educational data for Alabama in
2018:\nIn 2018, in Alabama, the following statistics were recorded:
All families Total Families: 1229905; All families Percent below
poverty level Families: 13.0; Married-couple families Total Families:
883386; Married-couple families Percent below poverty level Families:
5.8; Female householder, no husband present Total Families: 267996;
Female householder, no husband present Percent below poverty level
Families: 35.5; All families Total Families With related children of
householder under 18 years: 557720; All families Percent below poverty
level Families With related children of householder under 18 years:
21.1; Married-couple families Total Families With related children of
householder under 18 years: 346043; Married-couple families Percent
below poverty level Families With related children of householder
under 18 years: 8.2; Female householder, no husband present Total
Families With related children of householder under 18 years: 170990;
Female householder, no husband present Percent below poverty level
Families With related children of householder under 18 years: 46.9;
All families Total Families With related children of householder under
18 years With related children of householder under 5 years: 100452;
All families Percent below poverty level Families With related
children of householder under 18 years With related children of
householder under 5 years: 21.3; Married-couple families Total
Families With related children of householder under 18 years With
related children of householder under 5 years: 62013; Married-couple
families Percent below poverty level Families With related children of
householder under 18 years With related children of householder under
5 years: 7.5; Female householder, no husband present Total Families
With related children of householder under 18 years With related
children of householder under 5 years: 29419; Female householder, no
husband present Percent below poverty level Families With related
children of householder under 18 years With related children of
householder under 5 years: 49.5; All families Total Families With
related children of householder under 18 years With related children
of householder under 5 years and 5 to 17 years: 100506; All families
Percent below poverty level Families With related children of
householder under 18 years With related children of householder under
5 years and 5 to 17 years: 31.1; Married-couple families Total
Families With related children of householder under 18 years With
related children of householder under 5 years and 5 to 17 years:
63903; Married-couple families Percent below poverty level Families
```

With related children of householder under 18 years With related children of householder under 5 years and 5 to 17 years: 13.1; Female householder, no husband present Total Families With related children of householder under 18 years With related children of householder under 5 years and 5 to 17 years: 31000; Female householder, no husband present Percent below poverty level Families With related children of householder under 18 years With related children of householder under 5 years and 5 to 17 years: 66.9; All families Total Families With related children of householder under 18 years With related children of householder 5 to 17 years: 356762; All families Percent below poverty level Families With related children of householder under 18 years With related children of householder 5 to 17 years: 18.3; Married-couple families Total Families With related children of householder under 18 years With related children of householder 5 to 17 years: 220127; Married-couple families Percent below poverty level Families With related children of householder under 18 years With related children of householder 5 to 17 years: 7.0; Female householder, no husband present Total Families With related children of householder under 18 years With related children of householder 5 to 17 years: 110571; Female householder, no husband present Percent below poverty level Families With related children of householder under 18 years With related children of householder 5 to 17 years: 40.5; All families Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- White alone: 883432; All families Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- White alone: 8.9; Married-couple families Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- White alone: 713595; Married-couple families Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- White alone: 5.0; Female householder, no husband present Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- White alone: 121380; Female householder, no husband present Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- White alone: 29.3; All families Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Black or African American alone: 297340; All families Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Black or African American alone: 24.4; Married-couple families Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Black or African American alone: 133668; Married-couple families Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Black or African American alone: 7.9; Female householder, no husband present Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Black or African American alone: 137558; Female householder, no husband present Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Black or African

American alone: 40.8; All families Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- American Indian and Alaska Native alone: 6548; All families Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- American Indian and Alaska Native alone: 12.9; Married-couple families Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- American Indian and Alaska Native alone: 5303; Married-couple families Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- American Indian and Alaska Native alone: 8.8; Female householder, no husband present Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- American Indian and Alaska Native alone: 940; Female householder, no husband present Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- American Indian and Alaska Native alone: 34.7; All families Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Asian alone: 14666; All families Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Asian alone: 9.8; Married-couple families Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Asian alone: 12073; Married-couple families Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Asian alone: 6.9; Female householder, no husband present Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Asian alone: 1838; Female householder, no husband present Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Asian alone: 24.7; All families Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Native Hawaiian and Other Pacific Islander alone: 387; All families Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Native Hawaiian and Other Pacific Islander alone: 17.6; Married-couple families Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Native Hawaiian and Other Pacific Islander alone: 316; Married-couple families Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Native Hawaiian and Other Pacific Islander alone: 2.2; Female householder, no husband present Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Native Hawaiian and Other Pacific Islander alone: 37; Female householder, no husband present Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Native Hawaiian and Other Pacific Islander alone: 89.2; All families Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Some other race alone: 12344; All families Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Some other race alone: 34.7; Married-couple families Total Families RACE AND HISPANIC OR LATINO ORIGIN Families

with a householder who is-- Some other race alone: 7878; Married-couple families Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Some other race alone: 32.6; Female householder, no husband present Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Some other race alone: 2607; Female householder, no husband present Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Some other race alone: 51.3; All families Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Two or more races: 15188; All families Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Two or more races: 17.5; Married-couple families Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Two or more races: 10553; Married-couple families Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Two or more races: 10.1; Female householder, no husband present Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Two or more races: 3636; Female householder, no husband present Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Two or more races: 39.7; All families Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Hispanic or Latino origin (of any race): 38226; All families Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Hispanic or Latino origin (of any race): 28.6; Married-couple families Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Hispanic or Latino origin (of any race): 26193; Married-couple families Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Hispanic or Latino origin (of any race): 23.0; Female householder, no husband present Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Hispanic or Latino origin (of any race): 7682; Female householder, no husband present Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- Hispanic or Latino origin (of any race): 48.2; All families Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- White alone, not Hispanic or Latino: 859649; All families Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- White alone, not Hispanic or Latino: 8.4; Married-couple families Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- White alone, not Hispanic or Latino: 696322; Married-couple families Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- White alone, not Hispanic or Latino: 4.6; Female householder, no husband present Total Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- White alone, not Hispanic or Latino: 117115; Female householder, no husband

present Percent below poverty level Families RACE AND HISPANIC OR LATINO ORIGIN Families with a householder who is-- White alone, not Hispanic or Latino: 28.6; All families Total Families Householder worked: 816604; All families Percent below poverty level Families Householder worked: 9.2; Married-couple families Total Families Householder worked: 594179; Married-couple families Percent below poverty level Families Householder worked: 3.3; Female householder, no husband present Total Families Householder worked: 168223; Female householder, no husband present Percent below poverty level Families Householder worked: 29.3; All families Total Families Householder worked Householder worked full-time, year-round in the past 12 months: 613121; All families Percent below poverty level Families Householder worked Householder worked full-time, year-round in the past 12 months: 4.6; Married-couple families Total Families Householder worked Householder worked full-time, year-round in the past 12 months: 462010; Married-couple families Percent below poverty level Families Householder worked Householder worked full-time, year-round in the past 12 months: 1.9; Female householder, no husband present Total Families Householder worked Householder worked full-time, year-round in the past 12 months: 109545; Female householder, no husband present Percent below poverty level Families Householder worked Householder worked full-time, year-round in the past 12 months: 15.5; All families Total Families Householder 65 years and over: 276825; All families Percent below poverty level Families Householder 65 years and over: 6.4; Married-couple families Total Families Householder 65 years and over: 213732; Married-couple families Percent below poverty level Families Householder 65 years and over: 4.2; Female householder, no husband present Total Families Householder 65 years and over: 49581; Female householder, no husband present Percent below poverty level Families Householder 65 years and over: 15.1; All families Total Families Family received -- Supplemental Security Income (SSI) and/or cash public assistance income in the past 12 months: 97287; All families Percent below poverty level Families Family received -- Supplemental Security Income (SSI) and/or cash public assistance income in the past 12 months: 29.7; Married-couple families Total Families Family received -- Supplemental Security Income (SSI) and/or cash public assistance income in the past 12 months: 45023; Married-couple families Percent below poverty level Families Family received -- Supplemental Security Income (SSI) and/or cash public assistance income in the past 12 months: 16.5; Female householder, no husband present Total Families Family received -- Supplemental Security Income (SSI) and/or cash public assistance income in the past 12 months: 42799; Female householder, no husband present Percent below poverty level Families Family received -- Supplemental Security Income (SSI) and/or cash public assistance income in the past 12 months: 44.0; All families Total Families Family received -- Social security income in the past 12 months: 406889; All families Percent below poverty level Families Family received -- Social security income in the past 12 months: 9.4; Married-couple families Total Families Family received --

Social security income in the past 12 months: 301226; Married-couple families Percent below poverty level Families Family received -- Social security income in the past 12 months: 5.0; Female householder, no husband present Total Families Family received -- Social security income in the past 12 months: 81535; Female householder, no husband present Percent below poverty level Families Family received -- Social security income in the past 12 months: 24.0; All families Total Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER Less than high school graduate: 139312; All families Percent below poverty level Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER Less than high school graduate: 31.8; Married-couple families Total Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER Less than high school graduate: 79220; Married-couple families Percent below poverty level Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER Less than high school graduate: 19.7; Female householder, no husband present Total Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER Less than high school graduate: 44786; Female householder, no husband present Percent below poverty level Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER Less than high school graduate: 53.8; All families Total Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER High school graduate (includes equivalency): 338532; All families Percent below poverty level Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER High school graduate (includes equivalency): 16.6; Married-couple families Total Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER High school graduate (includes equivalency): 229295; Married-couple families Percent below poverty level Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER High school graduate (includes equivalency): 7.5; Female householder, no husband present Total Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER High school graduate (includes equivalency): 80730; Female householder, no husband present Percent below poverty level Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER High school graduate (includes equivalency): 41.5; All families Total Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER Some college, associate's degree: 401024; All families Percent below poverty level Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER Some college, associate's degree: 12.3; Married-couple families Total Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER Some college, associate's degree: 278864; Married-couple families Percent below poverty level Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER Some college, associate's degree: 4.9; Female householder, no husband present Total Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER Some college, associate's degree: 99401; Female householder, no husband present Percent below poverty level Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER Some college, associate's degree: 32.9; All families Total Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER Bachelor's degree or higher: 351037; All families Percent below poverty level Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER Bachelor's degree or higher: 2.9; Married-couple families Total Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER Bachelor's degree or higher: 296007; Married-couple families Percent below poverty level Families EDUCATIONAL ATTAINMENT

OF HOUSEHOLDER Bachelor's degree or higher: 1.5; Female householder, no husband present Total Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER Bachelor's degree or higher: 43079; Female householder, no husband present Percent below poverty level Families EDUCATIONAL ATTAINMENT OF HOUSEHOLDER Bachelor's degree or higher: 11.3; All families Total Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS No child: 672185; All families Percent below poverty level Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS No child: 6.3; Married-couple families Total Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS No child: 537343; Married-couple families Percent below poverty level Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS No child: 4.2; Female householder, no husband present Total Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS No child: 97006; Female householder, no husband present Percent below poverty level Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS No child: 15.5; All families Total Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 1 or 2 children: 454132; All families Percent below poverty level Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 1 or 2 children: 18.3; Married-couple families Total Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 1 or 2 children: 279665; Married-couple families Percent below poverty level Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 1 or 2 children: 6.6; Female householder, no husband present Total Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 1 or 2 children: 138724; Female householder, no husband present Percent below poverty level Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 1 or 2 children: 41.2; All families Total Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 3 or 4 children: 95675; All families Percent below poverty level Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 3 or 4 children: 32.4; Married-couple families Total Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 3 or 4 children: 61682; Married-couple families Percent below poverty level Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 3 or 4 children: 13.8; Female householder, no husband present Total Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 3 or 4 children: 29525; Female householder, no husband present Percent below poverty level Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 3 or 4 children: 69.7; All families Total Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 5 or more children: 7913; All families Percent below poverty level Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 5 or more children: 50.6; Married-couple families Total Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 5 or more children: 4696; Married-couple families Percent below poverty level Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 5 or more children: 30.6; Female householder, no husband present Total Families NUMBER OF

RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 5 or more children: 2741; Female householder, no husband present Percent below poverty level Families NUMBER OF RELATED CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 5 or more children: 85.0; All families Total Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS No own child of the householder: 742552; All families Percent below poverty level Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS No own child of the householder: 7.9; Married-couple families Total Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS No own child of the householder: 567701; Married-couple families Percent below poverty level Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS No own child of the householder: 4.6; Female householder, no husband present Total Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS No own child of the householder: 129306; Female householder, no husband present Percent below poverty level Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS No own child of the householder: 20.7; All families Total Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 1 or 2 own children of the householder: 396712; All families Percent below poverty level Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 1 or 2 own children of the householder: 18.0; Married-couple families Total Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 1 or 2 own children of the householder: 254443; Married-couple families Percent below poverty level Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 1 or 2 own children of the householder: 6.3; Female householder, no husband present Total Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 1 or 2 own children of the householder: 113026; Female householder, no husband present Percent below poverty level Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 1 or 2 own children of the householder: 43.4; All families Total Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 3 or 4 own children of the householder: 84396; All families Percent below poverty level Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 3 or 4 own children of the householder: 31.9; Married-couple families Total Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 3 or 4 own children of the householder: 57355; Married-couple families Percent below poverty level Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 3 or 4 own children of the householder: 13.5; Female householder, no husband present Total Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 3 or 4 own children of the householder: 23634; Female householder, no husband present Percent below poverty level Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 3 or 4 own children of the householder: 74.3; All families Total Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 5 or more own children of the householder: 6245; All families Percent below poverty level Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 5 or more own children of the householder: 51.9; Married-couple families Total Families NUMBER OF

OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 5 or more own children of the householder: 3887; Married-couple families Percent below poverty level Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 5 or more own children of the householder: 31.3; Female householder, no husband present Total Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 5 or more own children of the householder: 2030; Female householder, no husband present Percent below poverty level Families NUMBER OF OWN CHILDREN OF THE HOUSEHOLDER UNDER 18 YEARS 5 or more own children of the householder: 91.1; All families Total Families NUMBER OF PEOPLE IN FAMILY 2 people: 613705; All families Percent below poverty level Families NUMBER OF PEOPLE IN FAMILY 2 people: 10.5; Married-couple families Total Families NUMBER OF PEOPLE IN FAMILY 2 people: 433390; Married-couple families Percent below poverty level Families NUMBER OF PEOPLE IN FAMILY 2 people: 4.4; Female householder, no husband present Total Families NUMBER OF PEOPLE IN FAMILY 2 people: 132023; Female householder, no husband present Percent below poverty level Families NUMBER OF PEOPLE IN FAMILY 2 people: 28.2; All families Total Families NUMBER OF PEOPLE IN FAMILY 3 or 4 people: 489617; All families Percent below poverty level Families NUMBER OF PEOPLE IN FAMILY 3 or 4 people: 14.2; Married-couple families Total Families NUMBER OF PEOPLE IN FAMILY 3 or 4 people: 349999; Married-couple families Percent below poverty level Families NUMBER OF PEOPLE IN FAMILY 3 or 4 people: 5.4; Female householder, no husband present Total Families NUMBER OF PEOPLE IN FAMILY 3 or 4 people: 113709; Female householder, no husband present Percent below poverty level Families NUMBER OF PEOPLE IN FAMILY 3 or 4 people: 40.5; All families Total Families NUMBER OF PEOPLE IN FAMILY 5 or 6 people: 113307; All families Percent below poverty level Families NUMBER OF PEOPLE IN FAMILY 5 or 6 people: 19.6; Married-couple families Total Families NUMBER OF PEOPLE IN FAMILY 5 or 6 people: 90104; Married-couple families Percent below poverty level Families NUMBER OF PEOPLE IN FAMILY 5 or 6 people: 11.7; Female householder, no husband present Total Families NUMBER OF PEOPLE IN FAMILY 5 or 6 people: 19455; Female householder, no husband present Percent below poverty level Families NUMBER OF PEOPLE IN FAMILY 5 or 6 people: 54.1; All families Total Families NUMBER OF PEOPLE IN FAMILY 7 or more people: 13276; All families Percent below poverty level Families NUMBER OF PEOPLE IN FAMILY 7 or more people: 28.8; Married-couple families Total Families NUMBER OF PEOPLE IN FAMILY 7 or more people: 9893; Married-couple families Percent below poverty level Families NUMBER OF PEOPLE IN FAMILY 7 or more people: 22.3; Female householder, no husband present Total Families NUMBER OF PEOPLE IN FAMILY 7 or more people: 2809; Female householder, no husband present Percent below poverty level Families NUMBER OF PEOPLE IN FAMILY 7 or more people: 52.6; All families Total Families NUMBER OF WORKERS IN FAMILY No workers: 233995; All families Percent below poverty level Families NUMBER OF WORKERS IN FAMILY No workers: 27.5; Married-couple families Total Families NUMBER OF WORKERS IN FAMILY No workers: 160526; Married-couple families Percent below poverty level Families NUMBER OF WORKERS

IN FAMILY No workers: 12.9; Female householder, no husband present Total Families NUMBER OF WORKERS IN FAMILY No workers: 59395; Female householder, no husband present Percent below poverty level Families NUMBER OF WORKERS IN FAMILY No workers: 63.3; All families Total Families NUMBER OF WORKERS IN FAMILY 1 worker: 437369; All families Percent below poverty level Families NUMBER OF WORKERS IN FAMILY 1 worker: 18.3; Married-couple families Total Families NUMBER OF WORKERS IN FAMILY 1 worker: 247949; Married-couple families Percent below poverty level Families NUMBER OF WORKERS IN FAMILY 1 worker: 8.5; Female householder, no husband present Total Families NUMBER OF WORKERS IN FAMILY 1 worker: 146414; Female householder, no husband present Percent below poverty level Families NUMBER OF WORKERS IN FAMILY 1 worker: 35.5; All families Total Families NUMBER OF WORKERS IN FAMILY 2 workers: 461374; All families Percent below poverty level Families NUMBER OF WORKERS IN FAMILY 2 workers: 3.1; Married-couple families Total Families NUMBER OF WORKERS IN FAMILY 2 workers: 391799; Married-couple families Percent below poverty level Families NUMBER OF WORKERS IN FAMILY 2 workers: 2.1; Female householder, no husband present Total Families NUMBER OF WORKERS IN FAMILY 2 workers: 51459; Female householder, no husband present Percent below poverty level Families NUMBER OF WORKERS IN FAMILY 2 workers: 10.1; All families Total Families NUMBER OF WORKERS IN FAMILY 3 or more workers: 97167; All families Percent below poverty level Families NUMBER OF WORKERS IN FAMILY 3 or more workers: 1.4; Married-couple families Total Families NUMBER OF WORKERS IN FAMILY 3 or more workers: 83112; Married-couple families Percent below poverty level Families NUMBER OF WORKERS IN FAMILY 3 or more workers: 1.0; Female householder, no husband present Total Families NUMBER OF WORKERS IN FAMILY 3 or more workers: 10728; Female householder, no husband present Percent below poverty level Families NUMBER OF WORKERS IN FAMILY 3 or more workers: 4.0; All families Total Families INCOME DEFICIT Mean income deficit for families (dollars): 9754; Married-couple families Total Families INCOME DEFICIT Mean income deficit for families (dollars): 8608; Female householder, no husband present Total Families INCOME DEFICIT Mean income deficit for families (dollars): 10533; All families Total Families TENURE Owner occupied: 921862; All families Percent below poverty level Families TENURE Owner occupied: 6.8; Married-couple families Total Families TENURE Owner occupied: 743785; Married-couple families Percent below poverty level Families TENURE Owner occupied: 4.1; Female householder, no husband present Total Families TENURE Owner occupied: 129846; Female householder, no husband present Percent below poverty level Families TENURE Owner occupied: 20.1; All families Total Families TENURE Renter Occupied: 308043; All families Percent below poverty level Families TENURE Renter Occupied: 31.5; Married-couple families Total Families TENURE Renter Occupied: 139601; Married-couple families Percent below poverty level Families TENURE Renter Occupied: 14.5; Female householder, no husband present Total Families TENURE Renter Occupied: 138150; Female householder, no husband present Percent below poverty level Families TENURE Renter

Occupied: 50.0; All families Total Families ALL FAMILIES WITH INCOME BELOW THE FOLLOWING POVERTY RATIOS 50 percent of poverty level: 65818; All families Total Families ALL FAMILIES WITH INCOME BELOW THE FOLLOWING POVERTY RATIOS 125 percent of poverty level: 212970; All families Total Families ALL FAMILIES WITH INCOME BELOW THE FOLLOWING POVERTY RATIOS 150 percent of poverty level: 265416; All families Total Families ALL FAMILIES WITH INCOME BELOW THE FOLLOWING POVERTY RATIOS 185 percent of poverty level: 345742; All families Total Families ALL FAMILIES WITH INCOME BELOW THE FOLLOWING POVERTY RATIOS 200 percent of poverty level: 377583; All families Total Families ALL FAMILIES WITH INCOME BELOW THE FOLLOWING POVERTY RATIOS 300 percent of poverty level: 583728; All families Total Families ALL FAMILIES WITH INCOME BELOW THE FOLLOWING POVERTY RATIOS 400 percent of poverty level: 766303; All families Total Families ALL FAMILIES WITH INCOME BELOW THE FOLLOWING POVERTY RATIOS 500 percent of poverty level: 902947."}

Tokenization of dataset and normalization

```python
# def tokenize_function(examples):
#     texts = []
#     for i in range(len(examples["title"])):
#         entry_parts = []

#         for key in examples.keys():
#             value = examples[key][i]
#             if isinstance(value, dict):
#                 for subkey, subval in value.items():
#                     entry_parts.append(f"{key}.{subkey}: {subval}")
#             elif isinstance(value, list):
#                 entry_parts.append(f"{key}: {', '.join(map(str, value))}")
#             else:
#                 entry_parts.append(f"{key}: {value}")

#         combined_text = "\n".join(entry_parts)
#         texts.append(combined_text)

#     return tokenizer(texts, truncation=True, padding="max_length", max_length=256)

def tokenize_function(examples):
    prompts = []
    for i in range(len(examples["instruction"])):
        instruction = examples["instruction"][i]
        response = examples["response"][i]
        prompt_type = examples.get("prompt_type", ["analysis"] * len(examples["instruction"]))[i]  # default to 'analysis'

        template = prompt_templates.get(prompt_type,
```

```
prompt_templates["analysis"])
        full_prompt = template.format(query=instruction) + "\n\
nAnswer: " + response
        prompts.append(full_prompt)

    return tokenizer(prompts, truncation=True, padding="max_length",
max_length=512)

def normalize_entry(entry):
    normalized = {}
    for key, value in entry.items():
        if isinstance(value, dict):
            for subkey, subval in value.items():
                normalized[f"{key}.{subkey}"] = str(subval) if subval
is not None else ""
        elif isinstance(value, list):
            normalized[key] = ", ".join(map(str, value))
        elif value is None:
            normalized[key] = ""
        else:
            normalized[key] = str(value)
    return normalized

# Normalize each entry
train_data_clean = [normalize_entry(entry) for entry in
split_data['train']]
test_data_clean = [normalize_entry(entry) for entry in
split_data['test']]

train_dataset_hf = Dataset.from_list(train_data_clean)
test_dataset_hf = Dataset.from_list(test_data_clean)
```

Prompt Engineering

```
# Define various prompting templates
prompt_templates = {
    "analysis": (
        "As a policy analyst, analyze the following policy issue:\n"
        "{query}\n\n"
        "Consider relevant socioeconomic factors, provide statistical
insights, "
        "and offer evidence-based recommendations."
    ),
    "comparative": (
        "As a policy analyst, compare these policy approaches:\n"
        "{query}\n\n"
        "Evaluate each using statistical data, consider implementation
challenges, "
        "and assess likely outcomes across different demographics."
    ),
```

```python
    "forecast": (
        "As a policy analyst, forecast the outcomes of this policy
change:\n"
        "{query}\n\n"
        "Project short and long-term impacts, identify potential
unintended consequences, "
        "and quantify likely effects where possible."
    ),
}
```

Train & Test - Tokenization

```python
tokenized_train = train_dataset_hf.map(tokenize_function,
batched=True)
tokenized_train.set_format(type="torch")
print("Tokenization complete with all features.")
```

{"model_id":"b2620f632fe6485f9fb4195d5ea7104a","version_major":2,"version_minor":0}

Tokenization complete with all features.

```python
tokenized_test = test_dataset_hf.map(tokenize_function, batched=True)
tokenized_test.set_format(type="torch")
print("Tokenization complete with all features.")
```

{"model_id":"13e05e885dc041618af401292d5f159f","version_major":2,"version_minor":0}

Tokenization complete with all features.

Configer – PEFT, LoRA & QLoRA

```python
lora_config = LoraConfig(
    r=8,
    lora_alpha=16,
    target_modules=['q_proj', 'k_proj', 'v_proj', 'o_proj'],
    lora_dropout=0.15,
    bias="none",
    task_type="CAUSAL_LM"
)

base_model.gradient_checkpointing_enable()
base_model = prepare_model_for_kbit_training(base_model)

peft_model = get_peft_model(base_model, lora_config)
peft_model.config.use_cache = False
```

```
print("After PEFT wrapping:")
print(trainable_parameters(peft_model))

After PEFT wrapping:
- Trainable model parameters: 4587520.
- All model parameters: 1808051200.
- Percentage of trainable model parameters: 0.25%
```

Train PH-Llama-3.2 Model & Evaluation

```python
import torch
import os
data_collator = DataCollatorForLanguageModeling(tokenizer=tokenizer,
mlm=False)

os.environ["PYTORCH_CUDA_ALLOC_CONF"] = "expandable_segments:True"

training_args = TrainingArguments(
    output_dir="./SocioLens-llama-1",
    overwrite_output_dir=True,
    per_device_train_batch_size=4,
    per_device_eval_batch_size=4,
    gradient_accumulation_steps=4,  # Increased
    optim="adamw_8bit",
    num_train_epochs=7,  # Increased
    eval_strategy="steps",
    eval_steps=50,
    save_strategy="steps",
    save_steps=50,
    greater_is_better=False,
    logging_steps=1,
    weight_decay=0.01,  # Reduced
    warmup_steps=100,  # Increased
    logging_strategy="steps",
    learning_rate=5e-5,  # Slightly adjusted
    fp16=not torch.cuda.is_bf16_supported(),
    bf16=torch.cuda.is_bf16_supported(),
    lr_scheduler_type='cosine',
    seed=3407,
    group_by_length=True,
    max_grad_norm=1.0,
    gradient_checkpointing=True,
    report_to="wandb"
)

# training_args = TrainingArguments(
#     output_dir="./SocioLens-llama-3.2-3B",
#     overwrite_output_dir=True,
```

```python
#      per_device_train_batch_size=4,                # Increased
batch size
#      per_device_eval_batch_size=4,
#      gradient_accumulation_steps=4,                # Effective
batch size = 4 * 4 = 16
#      optim="adamw_8bit",                           # Use 8-bit
AdamW
#      num_train_epochs=5,
#      eval_strategy="steps",
#      eval_steps=50,
#      save_strategy="steps",
#      save_steps=50,
#      greater_is_better=False,
#      logging_steps=1,
#      weight_decay=0.01,                            # Increased
weight decay
#      warmup_steps=50,                              # Increased
warmup steps
#      logging_strategy="steps",
#      learning_rate=5e-5,                           # Lower
learning rate
#      fp16=not torch.cuda.is_bf16_supported(),
#      bf16=torch.cuda.is_bf16_supported(),
#      lr_scheduler_type='cosine',                   # Use cosine
scheduler
#      seed=3407,
#      group_by_length=True,
#      max_grad_norm=1.0,                            # Gradient
clipping
#      gradient_checkpointing=True,                  # Save memory
#      report_to="wandb"
# )


trainer = SFTTrainer(
    model=peft_model,
    args=training_args,
    peft_config=lora_config,
    train_dataset=tokenized_train,
    eval_dataset=tokenized_test,
    data_collator=data_collator,
)

torch.cuda.empty_cache() # Force Clear Cache Before Training

print("Starting training...")
trainer.train()
print(f"Training complete.")
```

{"model_id":"315a6d8f00d046e2a982b642292b9914","version_major":2,"version_minor":0}

{"model_id":"11de8c3a5ab04fddb7dc4a1f761f81ca","version_major":2,"version_minor":0}

No label_names provided for model class `PeftModelForCausalLM`. Since `PeftModel` hides base models input arguments, if label_names is not given, label_names can't be set automatically within `Trainer`. Note that empty label_names list will be used instead.

Starting training...

wandb: WARNING The `run_name` is currently set to the same value as `TrainingArguments.output_dir`. If this was not intended, please specify a different run name by setting the `TrainingArguments.run_name` parameter.
/home/student/.local/lib/python3.10/site-packages/pydantic/main.py:314: UserWarning: Pydantic serializer warnings:
  Expected `list[str]` but got `tuple` - serialized value may not be as expected
  Expected `list[str]` but got `tuple` - serialized value may not be as expected
  return self.__pydantic_serializer__.to_python(

<IPython.core.display.HTML object>

<IPython.core.display.HTML object>

<IPython.core.display.HTML object>

<IPython.core.display.HTML object>

<IPython.core.display.HTML object>

<IPython.core.display.HTML object>

Training complete.

```
eval_results = trainer.evaluate()
print("Evaluation Results:")
print(eval_results)
```

<IPython.core.display.HTML object>

Evaluation Results:
{'eval_loss': 0.34707391262054443, 'eval_runtime': 176.8189, 'eval_samples_per_second': 3.393, 'eval_steps_per_second': 0.848}

```
peft_model.config.save_pretrained("./SocioLens-llama-1")
```

```
!ls -la ./SocioLens-llama-3.2-3B
```

```
total 44
drwxr-xr-x 10 student student 4096 Apr 26 23:30 .
drwxr-xr-x 10 student student 4096 Apr 27 04:51 ..
drwxr-xr-x  2 student student 4096 Apr 26 23:29 checkpoint-100
drwxr-xr-x  2 student student 4096 Apr 26 23:29 checkpoint-150
drwxr-xr-x  2 student student 4096 Apr 26 23:29 checkpoint-200
drwxr-xr-x  2 student student 4096 Apr 26 23:29 checkpoint-240
drwxr-xr-x  2 student student 4096 Apr 26 23:29 checkpoint-250
drwxr-xr-x  2 student student 4096 Apr 26 23:29 checkpoint-300
drwxr-xr-x  2 student student 4096 Apr 26 23:30 checkpoint-350
drwxr-xr-x  2 student student 4096 Apr 26 23:30 checkpoint-50
-rw-r--r--  1 student student 1361 Apr 26 02:19 config.json

files = os.listdir("./SocioLens-llama-1")
print("Files in the output directory:", files)

Files in the output directory: ['checkpoint-950', 'checkpoint-1050',
'checkpoint-250', 'checkpoint-300', 'checkpoint-150', 'checkpoint-
800', 'checkpoint-900', 'checkpoint-850', 'checkpoint-400',
'checkpoint-450', 'checkpoint-100', 'checkpoint-500', 'checkpoint-
600', 'checkpoint-650', 'checkpoint-200', 'checkpoint-350',
'checkpoint-550', 'checkpoint-1000', 'checkpoint-750', 'checkpoint-
50', 'checkpoint-700', 'config.json']
```

Generate Text by Trained Model

```python
import re
import random
from datetime import datetime

def generate_alpaca_text(
    prompt,
    max_length=512,
    temperature=0.0,
    top_p=0.95,
    system_message="You are SocioLens, an expert AI assistant
specializing in adult education policy, delivering concise, accurate,
and professional responses.",
    use_few_shot=True,
    use_cot=False,
    tokenizer=None,
    model=None,
    do_sample=False,
    user_id=None
):
    """
    Generates text using an Alpaca-style prompt format with varied,
professional conversational responses
```

```
    for common prompts and advanced prompt engineering for complex
tasks, using a single prompt input.

    :param prompt: The user input, containing the instruction or
question.
    :param max_length: The maximum length of the generated text.
    :param temperature: Sampling temperature for controlling
randomness.
    :param top_p: Nucleus sampling parameter for controlling
creativity.
    :param system_message: System message to define the model's role
or persona.
    :param use_few_shot: Whether to include few-shot examples in the
prompt.
    :param use_cot: Whether to encourage chain-of-thought reasoning.
    :param tokenizer: The tokenizer for the model.
    :param model: The fine-tuned model for text generation.
    :param do_sample: Whether to use sampling or greedy decoding.
    :param user_id: Optional identifier for the user to ensure varied
responses across users.
    :return: A string containing the generated response.
    """
    # Validate inputs
    if not prompt:
        raise ValueError("Prompt cannot be empty.")
    if not tokenizer or not model:
        raise ValueError("Tokenizer and model must be provided.")

    # Set random seed for varied responses
    seed = hash(user_id) if user_id else
int(datetime.now().timestamp())
    random.seed(seed)

    # Response templates for conversational prompts
    conversational_templates = {
        r"^(hi|hello|hey|greetings)(\s.*)?$": {
            "greetings": ["Greetings", "Hello", "Good day"],
            "status": [
                "I'm performing optimally and ready to assist",
                "I'm fully operational and here to help",
                "I'm at peak performance and eager to support you"
            ],
            "offer": [
                "How may I help you today?",
                "What can I assist you with today?",
                "How can I support your needs today?"
            ],
            "combine": lambda g, s, o: f"{g}! {s}. {o}"
        },
```

```python
        r"^how\s+are\s+you(\s*doing)?\?$": {
            "greetings": [""],
            "status": [
                "I'm functioning at peak performance and ready to
assist",
                "I'm operating smoothly and here to help",
                "I'm in optimal condition and eager to support"
            ],
            "offer": [
                "How about you—how may I support your needs today?",
                "What can I assist you with today?",
                "How may I help you today?"
            ],
            "combine": lambda g, s, o: f"{s}. {o}"
        },
        r"^who\s+are\s+you\?$": {
            "intro": [
                "I am SocioLens, an AI assistant specializing in adult
education policy",
                "I am SocioLens, an expert AI designed for adult
education policy",
                "I am SocioLens, your AI assistant for adult education
policy"
            ],
            "creators": ["developed by Yash, Shrestha, and Parin"],
            "offer": [
                "How can I assist you today?",
                "What can I help you with today?",
                "How may I support you today?"
            ],
            "combine": lambda i, c, o: f"{i}, {c}. {o}"
        },
        r"^tell\s+me\s+about\s+(you|yourself)(\?)?$": {
            "intro": [
                "I am SocioLens, a large language model",
                "I am SocioLens, an advanced AI",
                "I am SocioLens, a sophisticated language model"
            ],
            "creators": ["created by Yash, Shrestha, and Parin"],
            "purpose": [
                "I'm designed to provide accurate and insightful
answers, particularly in adult education policy",
                "My purpose is to deliver precise and professional
responses, especially on adult education policy",
                "I'm built to offer reliable and detailed insights,
focusing on adult education policy"
            ],
            "offer": [
                "What would you like to explore?",
```

```python
                "What topic would you like to discuss?",
                "What can I help you learn about today?"
            ],
            "combine": lambda i, c, p, o: f"{i} {c}. {p}. {o}"
        }
    }

    # Check for conversational prompts
    prompt_lower = prompt.lower().strip()
    for pattern, template in conversational_templates.items():
        if re.match(pattern, prompt_lower):
            components = {
                key: random.choice(values)
                for key, values in template.items()
                if key != "combine"
            }
            response = template["combine"](*components.values())
            return response

    # Handle temperature and do_sample compatibility
    if temperature == 0.0:
        do_sample = False
    elif do_sample and temperature <= 0.0:
        temperature = 0.0

    # Updated few-shot examples for single prompt input
    few_shot_examples = [
        {
            "prompt": "Summarize the key findings of the latest adult
education policy research.",
            "response": (
                "Recent adult education policy research highlights
increased literacy rates and vocational skills development, "
                "particularly in underserved regions, leading to
improved employability and economic outcomes."
            )
        },
        {
            "prompt": "What are the socio-economic factors that affect
public health?",
            "response": (
                "While socio-economic factors like income, education,
and employment significantly impact public health, "
                "my expertise lies in adult education policy. Would
you like me to provide insights on how adult education "
                "can address these factors, or focus on a related
policy topic?"
            )
        }
```

```python
    ] if use_few_shot else []

    # Construct few-shot examples section
    few_shot_prompt = ""
    if few_shot_examples:
        few_shot_prompt = "\n\n### Examples:\n"
        for example in few_shot_examples:
            few_shot_prompt += (
                f"#### Example Prompt:\n{example['prompt']}\n\n"
                f"#### Example Response:\n{example['response']}\n\n"
            )

    # Refined CoT prompt for single input
    cot_prompt = (
        "\nPlease reason step by step to ensure a clear and accurate
response. "
        "Focus on the prompt and provide a professional answer,
prioritizing adult education policy if relevant. "
        "If the prompt is outside this domain, acknowledge it and
offer to assist within my expertise."
    ) if use_cot else ""

    # Construct Alpaca-style prompt
    alpaca_prompt = (
        f"### System:\n{system_message}\n\n"
        "Below is a prompt that describes a task or question. "
        "Write a response that appropriately completes the request,
ensuring relevance to adult education policy when applicable.\n"
        f"{few_shot_prompt}"
        "### Prompt:\n"
        f"{prompt}{cot_prompt}\n\n"
        "### Response:\n"
    )

    # Check prompt length
    tokenized_prompt = tokenizer(alpaca_prompt, return_tensors="pt",
truncation=False)
    if tokenized_prompt.input_ids.size(1) >
tokenizer.model_max_length:
        raise ValueError("Prompt exceeds model's maximum context
length.")

    # Tokenize prompt
    inputs = tokenizer(alpaca_prompt, return_tensors="pt",
padding=True, truncation=True)
    inputs = {key: value.to(model.device) for key, value in
inputs.items()}

    # Generate output
    outputs = model.generate(
```

```
        input_ids=inputs["input_ids"],
        attention_mask=inputs["attention_mask"],
        max_length=max_length,
        do_sample=do_sample,
        temperature=temperature if do_sample else None,
        top_p=top_p if do_sample else None,
        pad_token_id=tokenizer.eos_token_id
    )

    # Decode generated text
    generated_text = tokenizer.decode(outputs[0],
skip_special_tokens=True)

    # Extract response part
    response_start = generated_text.find("### Response:") + len("###
Response:\n")
    if response_start != -1:
        generated_text = generated_text[response_start:].strip()

    return generated_text
```

Hi - Converstion with our LLM

```
response1 = generate_alpaca_text(
    prompt="hi",
    tokenizer=tokenizer,
    model=peft_model
)
print(response1)
```

```
Good day! I'm fully operational and here to help. How can I support
your needs today?
```

Who are you? - Converstion with our LLM

```
response2 = generate_alpaca_text(
    prompt="who are you?",
    tokenizer=tokenizer,
    model=peft_model
)
print(response2)
```

```
I am SocioLens, an AI assistant specializing in adult education
policy, developed by Yash, Shrestha, and Parin. What can I help you
with today?
```

Tell me about you? - Converstion with our LLM

```
response3 = generate_alpaca_text(
    prompt="Tell me about you?",
```

```python
        tokenizer=tokenizer,
        model=peft_model
)
print(response3)
```

I am SocioLens, a large language model created by Yash, Shrestha, and Parin. I'm built to offer reliable and detailed insights, focusing on adult education policy. What would you like to explore?

```python
prompt = """U.S. Healthcare vs. Other High-Income Countries abstract
This report compares the quality of healthcare in the United States to other high-income countries,
focusing on key metrics such as life expectancy, all-cause mortality,
maternal mortality, and premature death.
It discusses how high healthcare spending in the U.S. does not
translate into better outcomes."""


response4 = generate_alpaca_text(
        prompt=prompt,
        max_length=512,
        temperature=0.0,
        top_p=0.9,
        use_few_shot=True,
        use_cot=True,
        tokenizer=tokenizer,
        model=peft_model
)
print(response4)
```

The United States consistently ranks among the highest in healthcare spending, but this wealth does not translate into better outcomes. Our report analyzes 20 years of data, highlighting the following key findings: While the U.S. has the highest all-cause mortality, it also has the highest maternal mortality, with 10 times the rate of other high-income countries; the U.S. has the highest premature death rates, with 20 percent higher all-cause mortality and 30 percent higher cardiovascular mortality; and the U.S. has the highest all-cause mortality for children under 5, with 50 percent higher rates than other high-income countries. These statistics, along with the high cost of healthcare, suggest that the U.S. needs to improve its healthcare system, focusing on adult education and other relevant policy areas.

```python
prompt = "What is the policy impact of adult education on food security?"

response5 = generate_alpaca_text(
        prompt=prompt,
        max_length=512,
```

```
    temperature=0.0,
    top_p=0.9,
    use_few_shot=True,
    use_cot=True,
    tokenizer=tokenizer,
    model=peft_model
)
print(response5)

#While adult education can improve literacy and vocational skills, its
direct impact on food security is limited.
#However, it indirectly enhances employment and economic stability,
reducing food insecurity through increased
#income and stability. Considerable research suggests that adult
education programs, when integrated with food
#security initiatives, can provide additional support, but the
specific policy implications are nuanced and
#require further study.

While adult education can improve literacy and vocational skills, the
direct impact on food security is limited. However, the increased
employability and economic stability from adult education can
indirectly reduce food insecurity through improved income and access
to resources. The focus on adult education, rather than food security
specifically, reflects my expertise in adult education policy.

prompt = "Recent policy interventions in adult education aim to
improve literacy and numerical skills. They have been implemented in
multiple regions with varied socioeconomic backgrounds."

response5 = generate_alpaca_text(
    prompt=prompt,
    max_length=512,
    temperature=0.0,
    top_p=0.95,
    use_few_shot=True,
    use_cot=True,
    tokenizer=tokenizer,
    model=peft_model
)
print(response5)

While socioeconomic factors like income, education, and employment
influence public health, my focus is on adult education policy. The
latest research highlights increased literacy rates and vocational
skills development, particularly in underserved regions, leading to
improved employability and economic outcomes. However, these gains are
not uniform, as some regions with higher poverty and lower education
levels see less impact. To address these disparities, future research
```

should explore how adult education interventions can target specific socioeconomic groups, ensuring equitable outcomes.

```python
# Save your fine-tuned model to a local directory
model_save_path = "./SocioLens-llama-1"
trainer.save_model(model_save_path)
tokenizer.save_pretrained(model_save_path)
```

```
('./SocioLens-llama-1/tokenizer_config.json',
 './SocioLens-llama-1/special_tokens_map.json',
 './SocioLens-llama-1/tokenizer.json')
```

```python
torch.save(peft_model.state_dict(), "./model/SocioLens-llama-1.pth")
```

```python
from huggingface_hub import HfApi, HfFolder, Repository

from huggingface_hub import login
login(token="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")

trainer.push_to_hub("iyashnayi/SocioLens-llama-1")
```

wandb: WARNING The get_url method is deprecated and will be removed in a future release. Please use `run.url` instead.

{"model_id":"9fc8e89d32054c8b9120e31e92e8948c","version_major":2,"version_minor":0}

{"model_id":"22c10937c7fe4d82b5ce3599e3d4d5f4","version_major":2,"version_minor":0}

{"model_id":"3391f7a0c60c42f9825ea9d3669ecf25","version_major":2,"version_minor":0}

{"model_id":"d6d14c3fce914498b5801a534703cf30","version_major":2,"version_minor":0}

```
CommitInfo(commit_url='https://huggingface.co/iyashnayi/SocioLens-llama-1/commit/ae96520ca50f904ed06192c200ce70fdf0e616c6',
commit_message='iyashnayi/SocioLens-llama-1', commit_description='',
oid='ae96520ca50f904ed06192c200ce70fdf0e616c6', pr_url=None,
repo_url=RepoUrl('https://huggingface.co/iyashnayi/SocioLens-llama-1',
endpoint='https://huggingface.co', repo_type='model',
repo_id='iyashnayi/SocioLens-llama-1'), pr_revision=None, pr_num=None)
```