Training Results

Epoch	Training Loss	Validation Loss	Cer
1	0.179400	0.066785	0.004684
2	0.028600	0.029214	0.001779

Note: CER = character error rate

Train Metrics

epoch = 2.0

total_flos = 13413832854GF

train_loss = 0.104

train_runtime = 0:28:00.20

train_samples_per_second = 11.456

train_steps_per_second = 0.717

Eval Metrics

epoch = 2.0

eval_cer = 0.0018

eval_loss = 0.0292

eval_runtime = 0:03:32.53

eval_samples_per_second = 11.321

eval_steps_per_second = 0.71

```
!pip install --upgrade pip
!pip install torch torchvision torchaudio
!pip install fsspec==2024.6.1
!pip install datasets==3.0.0
!pip install gcsfs==2024.6.0
!pip install jiwer
!pip install evaluate
```

```
Requirement already satisfied: pip in /usr/local/lib/python3.10/dist-packages
Collecting pip
  Downloading pip-24.3.1-py3-none-any.whl.metadata (3.7 kB)
Downloading pip-24.3.1-py3-none-any.whl (1.8 MB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 1.8/1.8 MB 7.0 MB/s eta 0:00:00
Installing collected packages: pip
  Attempting uninstall: pip
    Found existing installation: pip 24.1.2
```

```
    Uninstalling pip-24.1.2:
      Successfully uninstalled pip-24.1.2
Successfully installed pip-24.3.1
Requirement already satisfied: torch in /usr/local/lib/python3.10/dist-packag
Requirement already satisfied: torchvision in /usr/local/lib/python3.10/dist-
Requirement already satisfied: torchaudio in /usr/local/lib/python3.10/dist-pa
Requirement already satisfied: filelock in /usr/local/lib/python3.10/dist-pacl
Requirement already satisfied: typing-extensions>=4.8.0 in /usr/local/lib/pyth
Requirement already satisfied: networkx in /usr/local/lib/python3.10/dist-pacl
Requirement already satisfied: jinja2 in /usr/local/lib/python3.10/dist-packag
Requirement already satisfied: fsspec in /usr/local/lib/python3.10/dist-packag
Requirement already satisfied: sympy==1.13.1 in /usr/local/lib/python3.10/dist
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Requirement already satisfied: pillow!=8.3.*,>=5.3.0 in /usr/local/lib/python3
Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.10/di
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  Downloading fsspec-2024.6.1-py3-none-any.whl.metadata (11 kB)
Downloading fsspec-2024.6.1-py3-none-any.whl (177 kB)
Installing collected packages: fsspec
  Attempting uninstall: fsspec
    Found existing installation: fsspec 2024.10.0
    Uninstalling fsspec-2024.10.0:
      Successfully uninstalled fsspec-2024.10.0
ERROR: pip's dependency resolver does not currently take into account all the
gcsfs 2024.10.0 requires fsspec==2024.10.0, but you have fsspec 2024.6.1 whicl
Successfully installed fsspec-2024.6.1
Collecting datasets==3.0.0
  Downloading datasets-3.0.0-py3-none-any.whl.metadata (19 kB)
Requirement already satisfied: filelock in /usr/local/lib/python3.10/dist-pacl
Requirement already satisfied: numpy>=1.17 in /usr/local/lib/python3.10/dist-p
Requirement already satisfied: pyarrow>=15.0.0 in /usr/local/lib/python3.10/di
Collecting dill<0.3.9,>=0.3.0 (from datasets==3.0.0)
  Downloading dill-0.3.8-py3-none-any.whl.metadata (10 kB)
Requirement already satisfied: pandas in /usr/local/lib/python3.10/dist-packag
Requirement already satisfied: requests>=2.32.2 in /usr/local/lib/python3.10/d
Requirement already satisfied: tqdm>=4.66.3 in /usr/local/lib/python3.10/dist-
Collecting xxhash (from datasets==3.0.0)
  Downloading xxhash-3.5.0-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x8(
Collecting multiprocess (from datasets==3.0.0)
  Downloading multiprocess-0.70.17-py310-none-any.whl.metadata (7.2 kB)
Requirement already satisfied: fsspec<=2024.6.1,>=2023.1.0 in /usr/local/lib/p
Requirement already satisfied: aiohttp in /usr/local/lib/python3.10/dist-packa
Requirement already satisfied: huggingface-hub>=0.22.0 in /usr/local/lib/pythc
Requirement already satisfied: packaging in /usr/local/lib/python3.10/dist-pac
Requirement already satisfied: pyyaml>=5.1 in /usr/local/lib/python3.10/dist-p
Requirement already satisfied: aiohappyeyeballs>=2.3.0 in /usr/local/lib/pythc
Requirement already satisfied: aiosignal>=1.1.2 in /usr/local/lib/python3.10/d
Requirement already satisfied: async-timeout<6.0,>=4.0 in /usr/local/lib/pythc
Requirement already satisfied: attrs>=17.3.0 in /usr/local/lib/python3.10/dist
```

```
from google.colab import drive
import os, sys, itertools
os.environ['TOKENIZERS_PARALLELISM']='false'
```

```
import pandas as pd
from sklearn.model_selection import train_test_split

from PIL import Image

import torch
from torch.utils.data import Dataset

import datasets
from datasets import load_dataset

import transformers
from transformers import Seq2SeqTrainingArguments, Seq2SeqTrainer
from transformers import VisionEncoderDecoderModel, TrOCRProcessor, default_data_

import evaluate
```

```
print("Python:".rjust(15), sys.version[0:6])
print("Pandas:".rjust(15), pd.__version__)
print("Datasets:".rjust(15), datasets.__version__)
print("Transformers:".rjust(15), transformers.__version__)
print("Torch:".rjust(15), torch.__version__)
```

```
         Python: 3.10.1
         Pandas: 2.2.2
       Datasets: 3.0.0
   Transformers: 4.46.3
          Torch: 2.5.1+cu121
```

```
# Mount Google Drive
drive.mount('/content/drive', force_remount=True)
# Path to your dataset directory
path = '/content/drive/My Drive/CMPE 252 Project/whiteplate_normal/'

# Create the DataFrame
file_names = []
texts = []

# Loop through the directory and extract file names and labels
for file in os.listdir(path):
    if file.endswith(('.jpg', '.png')):  # Adjust extensions as per your dataset
        file_names.append(file)
        # Extract license plate from the file name (assuming the file name is the
        texts.append(os.path.splitext(file)[0])  # Remove file extension

# Create a DataFrame
dataset = pd.DataFrame({'file_name': file_names, 'text': texts})

# Train/test split
train_dataset, test_dataset = train_test_split(dataset, train_size=0.80, random_s
```

```
train_dataset, test_dataset = train_test_split(dataset, train_size=0.80, random_s

# Reset indices
train_dataset.reset_index(drop=True, inplace=True)
test_dataset.reset_index(drop=True, inplace=True)

# Print dataset information
print("Train Dataset Info:")
print(train_dataset.info())
print("\nTest Dataset Info:")
print(test_dataset.info())
```

```
Mounted at /content/drive
Train Dataset Info:
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9624 entries, 0 to 9623
Data columns (total 2 columns):
 #   Column     Non-Null Count  Dtype 
---  ------     --------------  ----- 
 0   file_name  9624 non-null   object
 1   text       9624 non-null   object
dtypes: object(2)
memory usage: 150.5+ KB
None

Test Dataset Info:
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2406 entries, 0 to 2405
Data columns (total 2 columns):
 #   Column     Non-Null Count  Dtype 
---  ------     --------------  ----- 
 0   file_name  2406 non-null   object
 1   text       2406 non-null   object
dtypes: object(2)
memory usage: 37.7+ KB
None
```

```
train_dataset.head(12)
```

	file_name	text
0	OX08CBB.png	OX08CBB
1	SN40FFE.png	SN40FFE
2	RH66ZDD.png	RH66ZDD
3	TT37EVC.png	TT37EVC
4	FX07EUZ.png	FX07EUZ
5	NO34ABY.png	NO34ABY
6	ZV30IMV.png	ZV30IMV

7	JP78IEZ.png	JP78IEZ
8	YX68TFU.png	YX68TFU
9	EV90FEX.png	EV90FEX
10	JF24RRQ.png	JF24RRQ
11	NQ61HUW.png	NQ61HUW

```
class License_Plates_OCR_Dataset(Dataset):

    def __init__(self, root_dir, df, processor, max_target_length=128):
        self.root_dir = root_dir
        self.df = df
        self.processor = processor
        self.max_target_length = max_target_length

    def __len__(self):
        return len(self.df)

    def __getitem__(self, idx):
        # get file name + text
        file_name = self.df['file_name'][idx]
        text = self.df['text'][idx]
        # prepare image (i.e. resize + normalize)
        image = Image.open(self.root_dir + file_name).convert("RGB")
        pixel_values = self.processor(image, return_tensors="pt").pixel_values
        # add labels (input_ids) by encoding the text
        labels = self.processor.tokenizer(text, padding="max_length", max_length=
        # important: make sure that PAD tokens are ignored by the loss function
        labels = [label if label != self.processor.tokenizer.pad_token_id
                  else -100 for label in labels]

        encoding = {"pixel_values" : pixel_values.squeeze(), "labels" : torch.ten
        return encoding
```

```
MODEL_CKPT = "microsoft/trocr-base-printed"
MODEL_NAME =  MODEL_CKPT.split("/")[-1] + "_license_plates_ocr"
NUM_OF_EPOCHS = 2
```

```
# Initialize the processor
processor = TrOCRProcessor.from_pretrained(MODEL_CKPT)

# Define the License_Plates_OCR_Dataset class (assuming it's implemented elsewher
# root_dir is now set to the dataset_path, and df is passed for train and test da

train_ds = License_Plates_OCR_Dataset(
    root_dir=path,
    df=train_dataset
```

```
    df=train_dataset,
    processor=processor
)

test_ds = License_Plates_OCR_Dataset(
    root_dir=path,
    df=test_dataset,
    processor=processor
)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
<ipython-input-2-4717fa225772> in <cell line: 2>()
      1 # Initialize the processor
----> 2 processor = TrOCRProcessor.from_pretrained(MODEL_CKPT)
      3
      4 # Define the License_Plates_OCR_Dataset class (assuming it's
implemented elsewhere)
      5 # root_dir is now set to the dataset_path, and df is passed for train
and test datasets

NameError: name 'TrOCRProcessor' is not defined
```

```
print(f"The training dataset has {len(train_ds)} samples in it.")
print(f"The testing dataset has {len(test_ds)} samples in it.")
```

```
The training dataset has 9624 samples in it.
The testing dataset has 2406 samples in it.
```

```
encoding = train_ds[0]

for k,v in encoding.items():
    print(k, " : ", v.shape)
```

```
pixel_values  :  torch.Size([3, 384, 384])
labels  :  torch.Size([128])
```

```
image = Image.open(train_ds.root_dir + train_dataset['file_name'][0]).convert("RG

image
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
<ipython-input-3-9045c6eecef5> in <cell line: 1>()
----> 1 image = Image.open(train_ds.root_dir + train_dataset['file_name']
[0]).convert("RGB")
      2
      3 image

NameError: name 'Image' is not defined
```

```
labels = encoding['labels']
labels[labels == -100] = processor.tokenizer.pad_token_id
label_str = processor.decode(labels, skip_special_tokens=True)
print(label_str)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
<ipython-input-4-f81aacfe3434> in <cell line: 1>()
----> 1 labels = encoding['labels']
      2 labels[labels == -100] = processor.tokenizer.pad_token_id
      3 label_str = processor.decode(labels, skip_special_tokens=True)
      4 print(label_str)

NameError: name 'encoding' is not defined
```

```
model = VisionEncoderDecoderModel.from_pretrained(MODEL_CKPT)
```

```
config.json: 100% 4.13k/4.13k [00:00<00:00, 359kB/s]
model.safetensors: 100% 1.33G/1.33G [00:06<00:00, 223MB/s]
Config of the encoder: <class 'transformers.models.vit.modeling_vit.ViTModel'>
  "attention_probs_dropout_prob": 0.0,
  "encoder_stride": 16,
  "hidden_act": "gelu",
  "hidden_dropout_prob": 0.0,
  "hidden_size": 768,
  "image_size": 384,
  "initializer_range": 0.02,
  "intermediate_size": 3072,
  "layer_norm_eps": 1e-12,
  "model_type": "vit",
  "num_attention_heads": 12,
  "num_channels": 3,
  "num_hidden_layers": 12,
  "patch_size": 16,
  "qkv_bias": false,
  "transformers_version": "4.46.3"
}

Config of the decoder: <class 'transformers.models.trocr.modeling_trocr.TrOCR
  "activation_dropout": 0.0,
  "activation_function": "gelu",
  "add_cross_attention": true,
  "attention_dropout": 0.0,
  "bos_token_id": 0,
  "classifier_dropout": 0.0,
  "cross_attention_hidden_size": 768
```

```
  "cross_attention_hidden_size": 768,
  "d_model": 1024,
  "decoder_attention_heads": 16,
  "decoder_ffn_dim": 4096,
  "decoder_layerdrop": 0.0,
  "decoder_layers": 12,
  "decoder_start_token_id": 2,
  "dropout": 0.1,
  "eos_token_id": 2,
  "init_std": 0.02,
  "is_decoder": true,
  "layernorm_embedding": true,
  "max_position_embeddings": 512,
  "model_type": "trocr",
  "pad_token_id": 1,
  "scale_embedding": false,
  "transformers_version": "4.46.3",
  "use_cache": false,
  "use_learned_position_embeddings": true,
  "vocab_size": 50265
}

Some weights of VisionEncoderDecoderModel were not initialized from the model
You should probably TRAIN this model on a down-stream task to be able to use
```



```
model.config.decoder_start_token_id = processor.tokenizer.cls_token_id
model.config.pad_token_id = processor.tokenizer.pad_token_id

model.config.vocab_size = model.config.decoder.vocab_size

model.config.eos_token_id = processor.tokenizer.sep_token_id
model.config.max_length = 64
model.config.early_stopping = True
model.config.no_repeat_ngram_size = 3
model.config.length_penalty = 2.0
model.config.num_beams = 4
```

```
cer_metric = evaluate.load("cer")

def compute_metrics(pred):
    label_ids = pred.label_ids
    pred_ids = pred.predictions

    pred_str = processor.batch_decode(pred_ids, skip_special_tokens=True)
    label_ids[label_ids == -100] = processor.tokenizer.pad_token_id
    label_str = processor.batch_decode(label_ids, skip_special_tokens=True)

    cer = cer_metric.compute(predictions=pred_str, references=label_str)
```

```
    return {"cer" : cer}
```

```
Downloading builder script: 100% [progress bar] 5.60k/5.60k [00:00<00:00, 463kB/
```

```
args = Seq2SeqTrainingArguments(
    output_dir = MODEL_NAME,
    num_train_epochs=NUM_OF_EPOCHS,
    predict_with_generate=True,
    evaluation_strategy="epoch",
    save_strategy="epoch",
    per_device_train_batch_size=8,
    per_device_eval_batch_size=8,
    logging_first_step=True,
    hub_private_repo=True,
    push_to_hub=True
)
```

```
/usr/local/lib/python3.10/dist-packages/transformers/training_args.py:1568: Fu
  warnings.warn(
```

```
!huggingface-cli login
```

```
    _|    _|  _|    _|    _|_|_|    _|_|_|  _|_|_|  _|      _|    _|_|_|
    _|    _|  _|    _|  _|        _|          _|    _|_|    _|  _|
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    _|    _|    _|_|      _|_|_|    _|_|_|  _|_|_|  _|      _|    _|_|_|

    To log in, `huggingface_hub` requires a token generated from https://hugg
Enter your token (input will not be visible):
Add token as git credential? (Y/n) n
Token is valid (permission: fineGrained).
The token `testingLicensePlate` has been saved to /root/.cache/huggingface/st
Your token has been saved to /root/.cache/huggingface/token
Login successful.
The current active token is: `testingLicensePlate`
```

```
from transformers import Seq2SeqTrainer, Seq2SeqTrainingArguments

# Update args for Seq2SeqTrainer
args = Seq2SeqTrainingArguments(
    output_dir="./results",
    eval_strategy="epoch",  # Changed from `evaluation_strategy` to `eval_strategy`
    learning_rate=5e-5,
    per_device_train_batch_size=16,
    per_device_eval_batch_size=16,
    weight_decay=0.01,
    save_total_limit=3
```

```
    save_total_limit=3,
    num_train_epochs=NUM_OF_EPOCHS,
    predict_with_generate=True,
    logging_dir="./logs",
    logging_strategy="epoch",
)

# Initialize the Trainer
trainer = Seq2SeqTrainer(
    model=model,
    processing_class=processor,  # Updated to use `processing_class`
    args=args,
    compute_metrics=compute_metrics,
    train_dataset=train_ds,
    eval_dataset=test_ds,
    data_collator=default_data_collator
)
```

Api key: 610b65cafc807a2520e2754f9248364c728ef52b

```
train_results = trainer.train()
```

```
wandb: WARNING The `run_name` is currently set to the same value as `Training/
wandb: Using wandb-core as the SDK backend.  Please refer to https://wandb.me/
wandb: Logging into wandb.ai. (Learn how to deploy a W&B server locally: https
wandb: You can find your API key in your browser here: https://wandb.ai/autho
wandb: Paste an API key from your profile and hit enter, or press ctrl+c to qu
wandb: Appending key for api.wandb.ai to your netrc file: /root/.netrc
Tracking run with wandb version 0.18.7
Run data is saved locally in /content/wandb/run-20241206_050641-2ghzllh0
Syncing run ./results to Weights & Biases (docs)
View project at https://wandb.ai/sofia-silva-san-jose-state-university/huggingface
View run at https://wandb.ai/sofia-silva-san-jose-state-university/huggingface/runs/2ghzllh0
```

[1204/1204 27:36, Epoch 2/2]

Epoch	Training Loss	Validation Loss	Cer
1	0.179400	0.066785	0.004684
2	0.028600	0.029214	0.001779

```
/usr/local/lib/python3.10/dist-packages/transformers/modeling_utils.py:2817: U
  warnings.warn(
Trainer.tokenizer is now deprecated. You should use Trainer.processing_class
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```
trainer.save_model()
trainer.log_metrics("train", train_results.metrics)
trainer.save_metrics("train", train_results.metrics)
trainer.save_state()
```

```
***** train metrics *****
  epoch                    =            2.0
  total_flos               = 13413832854GF
  train_loss               =          0.104
  train_runtime            =     0:28:00.20
  train_samples_per_second =         11.456
  train_steps_per_second   =          0.717
```

```
metrics = trainer.evaluate()
trainer.log_metrics("eval", metrics)
trainer.save_metrics("eval", metrics)
```

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[151/151 03:30]

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***** eval metrics *****
  epoch                   =        2.0
  eval_cer                =     0.0018
  eval_loss               =     0.0292
  eval_runtime            = 0:03:32.53
  eval_samples_per_second =     11.321
  eval_steps_per_second   =       0.71
```