```
#installing dependencies
!pip install --upgrade transformers datasets accelerate sentencepiece
```

```
Requirement already satisfied: accelerate in /usr/local/lib/python3.11/dist-packages (1.7.0)
Requirement already satisfied: sentencepiece in /usr/local/lib/python3.11/dist-packages (0.2.0)
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Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.11/dist-packages (from python-dateutil>=2.8.2->pandas->datasets
Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.11/dist-packages (from jinja2->torch>=2.0.0->accelerate)
```

```
import pandas as pd

# Load manually labeled CSV
df = pd.read_csv("https://raw.githubusercontent.com/psabhay2003/NLP-driven-Invoice-Digitalization/refs/heads/main/labeled%20data%20samp

# Create prompt-response style training format
def make_prompt(row):
    return f"Extract invoice fields: {row['extracted_text']}"

def make_output(row):
    return f"Invoice No: {row['Invoice number']}, Date: {row['Date']}, Total Amount: {row['Total Amount']}, Vendor: {row['Vendor']}"

df['input_text'] = df.apply(make_prompt, axis=1)
df['target_text'] = df.apply(make_output, axis=1)
```

```
from datasets import Dataset
from transformers import T5Tokenizer

#tokenization
tokenizer = T5Tokenizer.from_pretrained("t5-base")

train_dataset = Dataset.from_pandas(df[['input_text', 'target_text']])
```

```
def preprocess(example):
    inputs = tokenizer(example['input_text'], max_length=512, truncation=True, padding="max_length")
    targets = tokenizer(example['target_text'], max_length=128, truncation=True, padding="max_length")
    inputs['labels'] = targets['input_ids']
    return inputs

tokenized_dataset = train_dataset.map(preprocess, batched=False)
```

```
/usr/local/lib/python3.11/dist-packages/huggingface_hub/utils/_auth.py:94: UserWarning:
The secret `HF_TOKEN` does not exist in your Colab secrets.
To authenticate with the Hugging Face Hub, create a token in your settings tab (https://huggingface.co/settings/tokens), set it as :
You will be able to reuse this secret in all of your notebooks.
Please note that authentication is recommended but still optional to access public models or datasets.
  warnings.warn(
spiece.model: 100%                                   792k/792k [00:00<00:00, 3.78MB/s]

tokenizer.json: 100%                                 1.39M/1.39M [00:00<00:00, 4.78MB/s]

config.json: 100%                                    1.21k/1.21k [00:00<00:00, 31.0kB/s]
You are using the default legacy behaviour of the <class 'transformers.models.t5.tokenization_t5.T5Tokenizer'>. This is expected, ar
Map: 100%                                            200/200 [00:00<00:00, 483.78 examples/s]
```

```
from transformers import T5ForConditionalGeneration, Seq2SeqTrainingArguments, Seq2SeqTrainer, DataCollatorForSeq2Seq

#fine-tuning the T5 model
model = T5ForConditionalGeneration.from_pretrained("t5-base")

training_args = Seq2SeqTrainingArguments(
    output_dir="./t5_invoice_model",
    per_device_train_batch_size=4,
    gradient_accumulation_steps=2,
    learning_rate=1e-4,
    num_train_epochs=8,
    eval_strategy="steps",
    eval_steps=50,
    load_best_model_at_end=True,
    metric_for_best_model="loss",
    save_total_limit=2,
    fp16=True,
    logging_steps=10,
    report_to="none"
)

data_collator = DataCollatorForSeq2Seq(tokenizer, model=model, label_pad_token_id=-100)

trainer = Seq2SeqTrainer(
    model=model,
    args=training_args,
    train_dataset=tokenized_dataset,
    eval_dataset=tokenized_dataset.train_test_split(test_size=0.1)['test'],
    data_collator=data_collator
)

trainer.train()
```

```
model.safetensors: 100%                              892M/892M [00:18<00:00, 65.6MB/s]

generation_config.json: 100%                         147/147 [00:00<00:00, 15.2kB/s]
Passing a tuple of `past_key_values` is deprecated and will be removed in Transformers v4.48.0. You should pass an instance of `Enc
                                   [200/200 02:43, Epoch 8/8]
Step  Training Loss  Validation Loss
 50   0.036100       0.026399
100   0.020100       0.015188
150   0.018200       0.011967
200   0.015100       0.010914
There were missing keys in the checkpoint model loaded: ['encoder.embed_tokens.weight', 'decoder.embed_tokens.weight', 'lm_head.weig
TrainOutput(global_step=200, training_loss=0.4107181832194328, metrics={'train_runtime': 165.127, 'train_samples_per_second': 9.69,
'train_steps_per_second': 1.211, 'total_flos': 974332624896000.0, 'train_loss': 0.4107181832194328, 'epoch': 8.0})
```

```
# Load OCR CSV
ocr_df = pd.read_csv("https://raw.githubusercontent.com/psabhay2003/NLP-driven-Invoice-Management-System/refs/heads/main/invoice_texts.c

# Prepare input prompts
ocr_df['prompt'] = ocr_df['extracted_text'].apply(lambda x: f"Extract invoice fields: {x}")
```

```
# Generate predictions for entire range of data
def generate_prediction(text):
    inputs = tokenizer(text, return_tensors="pt", truncation=True, max_length=512).to(model.device)
    output = model.generate(**inputs, max_length=128)
    return tokenizer.decode(output[0], skip_special_tokens=True)

ocr_df['extracted_fields'] = ocr_df['prompt'].apply(generate_prediction)


ocr_df[['filename', 'extracted_fields']].to_csv("T5_output.csv", index=False)
from google.colab import files
files.download("T5_output.csv")
```

```
# Push this T5 output to github and then convert into the final csv which will be used in SQL database
t5_df = pd.read_csv("https://raw.githubusercontent.com/psabhay2003/NLP-driven-Invoice-Digitalization/refs/heads/main/T5_output.csv")
import re
def parse_fields(txt):
    # Use regex patterns to cover different label styles
    patterns = [
        # Standard “Invoice No: …, Date: …, Total Amount: …, Vendor: …”
        r'Invoice\s*No[:\-]?\s*(?P<inv>[^,;\n]+)[,;\n]\s*Date[:\-]?\s*(?P<date>[^,;\n]+)[,;\n]\s*Total\s*Amount[:\-]?\s*(?P<amt>[^,;\n]+)
        # Using “#” instead of “No”
        r'Invoice\s*#[:\-]?\s*(?P<inv>[^,;\n]+)[,;\n]\s*Date[:\-]?\s*(?P<date>[^,;\n]+)[,;\n]\s*Total[:\-]?\s*(?P<amt>[^,;\n]+)[,;\n]\s*V
        # All four as key:value pairs separated by semicolons
        r'Invoice\s*No[:\-]?\s*(?P<inv>[^;]+);\s*Date[:\-]?\s*(?P<date>[^;]+);\s*Total\s*Amount[:\-]?\s*(?P<amt>[^;]+);\s*Vendor[:\-]?\s*
        # CSV-style “1234,2023-01-01,1500,Acme Corp”
        r'^(?P<inv>[A-Z0-9\-]+)\s*,\s*(?P<date>\d{1,2}[\/\-\.][A-Za-z0-9\/\-\.]+)\s*,\s*(?P<amt>[₹\$]?\s*\d+[.,]?\d*)\s*,\s*(?P<vend>.+)$
    ]
    for pat in patterns:
        m = re.search(pat, txt.strip(), flags=re.IGNORECASE)
        if m:
            return m.group('inv').strip(), m.group('date').strip(), m.group('amt').strip(), m.group('vend').strip()
    # Fallback: split on commas/newlines, then pick by prefix
    parts = re.split(r',|\n|;', txt)
    inv = date = amt = vend = None
    for p in parts:
        p = p.strip()
        low = p.lower()
        if inv is None and 'invoice' in low:
            inv = re.sub(r'[^A-Z0-9\-]', '', p)
        elif date is None and re.search(r'\d{1,2}[\/\-\.\s][A-Za-z]{3,}\s*\d{2,4}', p):
            date = p
        elif amt is None and re.search(r'\d+[.,]?\d*', p):
            amt = p
        elif vend is None and len(p) > 3:
            vend = p
    return inv, date, amt, vend

# Apply parsing
parsed = t5_df['extracted_fields'].apply(lambda x: pd.Series(parse_fields(str(x)),
                                                         index=['Invoice No','Date','Total Amount','Vendor']))
final = pd.concat([t5_df['filename'], parsed], axis=1)

# Save and download
final.to_csv("final_structured_output.csv", index=False)
from google.colab import files
files.download("final_structured_output.csv")
```