Pip install necessary libraries

```
!pip install opendatasets
!pip install sentencepiece
!pip install --upgrade pip
!pip3.10 install seqeval
!pip install transformers
!pip install tqdm
!pip install datasets
!pip install transformers[torch]
!pip install accelerate -U
!pip install Kaggle
```

```
Collecting opendatasets
  Downloading opendatasets-0.1.22-py3-none-any.whl (15 kB)
Requirement already satisfied: tqdm in /usr/local/lib/python3.10/dist-packag
Requirement already satisfied: kaggle in /usr/local/lib/python3.10/dist-pack
Requirement already satisfied: click in /usr/local/lib/python3.10/dist-packa
Requirement already satisfied: six>=1.10 in /usr/local/lib/python3.10/dist-p
Requirement already satisfied: certifi in /usr/local/lib/python3.10/dist-pac
Requirement already satisfied: python-dateutil in /usr/local/lib/python3.10/
Requirement already satisfied: requests in /usr/local/lib/python3.10/dist-pa
Requirement already satisfied: python-slugify in /usr/local/lib/python3.10/c
Requirement already satisfied: urllib3 in /usr/local/lib/python3.10/dist-pac
Requirement already satisfied: bleach in /usr/local/lib/python3.10/dist-pack
Requirement already satisfied: webencodings in /usr/local/lib/python3.10/dis
Requirement already satisfied: text-unidecode>=1.3 in /usr/local/lib/python3
Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/py
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dis
Installing collected packages: opendatasets
Successfully installed opendatasets-0.1.22
Requirement already satisfied: sentencepiece in /usr/local/lib/python3.10/di
Requirement already satisfied: pip in /usr/local/lib/python3.10/dist-package
Collecting pip
  Downloading pip-24.0-py3-none-any.whl (2.1 MB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 2.1/2.1 MB 9.4 MB/s eta 0:00:0
Installing collected packages: pip
  Attempting uninstall: pip
    Found existing installation: pip 23.1.2
    Uninstalling pip-23.1.2:
      Successfully uninstalled pip-23.1.2
Successfully installed pip-24.0
```

```
Collecting seqeval
  Downloading seqeval-1.2.2.tar.gz (43 kB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 43.6/43.6 kB 1.3 MB/s eta 0:00
  Preparing metadata (setup.py) ... done
Requirement already satisfied: numpy>=1.14.0 in /usr/local/lib/python3.10/di
Requirement already satisfied: scikit-learn>=0.21.3 in /usr/local/lib/pythor
Requirement already satisfied: scipy>=1.3.2 in /usr/local/lib/python3.10/dis
Requirement already satisfied: joblib>=1.1.1 in /usr/local/lib/python3.10/di
Requirement already satisfied: threadpoolctl>=2.0.0 in /usr/local/lib/pythor
Building wheels for collected packages: seqeval
  Building wheel for seqeval (setup.py) ... done
  Created wheel for seqeval: filename=seqeval-1.2.2-py3-none-any.whl size=16
  Stored in directory: /root/.cache/pip/wheels/1a/67/4a/ad4082dd7dfc30f2abfe
Successfully built seqeval
Installing collected packages: seqeval
Successfully installed seqeval-1.2.2
WARNING: Running pip as the 'root' user can result in broken permissions anc
Requirement already satisfied: transformers in /usr/local/lib/python3.10/dis
Requirement already satisfied: filelock in /usr/local/lib/python3.10/dist-pa
Requirement already satisfied: huggingface-hub<1.0,>=0.19.3 in /usr/local/li
Requirement already satisfied: numpy>=1.17 in /usr/local/lib/python3.10/dist
Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.10/
Requirement already satisfied: pyyaml>=5.1 in /usr/local/lib/python3.10/dist
Requirement already satisfied: regex!=2019.12.17 in /usr/local/lib/python3.1
Requirement already satisfied: requests in /usr/local/lib/python3.10/dist-pa
Requirement already satisfied: tokenizers<0.19,>=0.14 in /usr/local/lib/pyth
Requirement already satisfied: safetensors>=0.4.1 in /usr/local/lib/python3.
Requirement already satisfied: tqdm>=4.27 in /usr/local/lib/python3.10/dist-
Requirement already satisfied: fsspec>=2023.5.0 in /usr/local/lib/python3.10
```

Upload your kaggle auth json

- This step is done to download the data directly using kaggle api

```
from google.colab import files
files.upload()
! mkdir ~/.kaggle
! cp kaggle.json ~/.kaggle/
! chmod 600 ./kaggle.json
! kaggle datasets list
```

Choose Files no files selected Upload widget is only available when the cell has been executed in the current browser session. Please rerun this cell to enable.

```
Saving kaggle.json to kaggle.json
Warning: Your Kaggle API key is readable by other users on this system! To fix
Warning: Looks like you're using an outdated API Version, please consider upda
ref                                                            title
------------------------------------------------------------  ----------------
sudarshan24byte/online-food-dataset                            Online Food Data
nbroad/gemma-rewrite-nbroad                                    gemma-rewrite-nb
lovishbansal123/adult-census-income                            Adult Census Inc
sukhmandeepsinghbrar/most-subscribed-youtube-channel           Most Subscribed
sanyamgoyal401/customer-purchases-behaviour-dataset            Customer Purchas
startalks/pii-models                                           pii-models
fatemehmehrparvar/obesity-levels                               Obesity Levels
sahirmaharajj/employee-salaries-analysis                       Employee Salarie
bhavikjikadara/student-study-performance                       Student Study Pe
soumyajitjalua/crop-datasets-for-all-indian-states-2010-2017  Crop Datasets fo
sukhmandeepsinghbrar/housing-price-dataset                     Housing Price Da
divu2001/restaurant-order-data                                 Restaurant Order
willianoliveiragibin/worlds-wildlife                           world's wildlife
sahirmaharajj/air-pollution-dataset                            Air Pollution Da
joshuanaude/effects-of-alcohol-on-student-performance          Effects of Alcoh
zubairmustafa/shopping-mall-customer-segmentation-data         Shopping Mall Cu
mohdshahnawazaadil/credit-card-dataset                         Credit Card Data
sahilnbajaj/loans-data                                         Loans Data
rushikeshdane20/global-trends-in-atmospheric-carbon-dioxide   Global Trends ir
```

Downlaod the data and load it to the disk

```
# download the datasets

import os
import opendatasets as od
import pandas as pd
import json

data_path = "./pii-detection-removal-from-educational-data/"

# download the data from kaggle
if not os.path.exists(data_path):
    print("Dataset not found, downloading from Kaggle")
    dataset = "https://www.kaggle.com/competitions/pii-detection-removal-from-edu
    od.download(dataset)
else:
    print("Dataset found in disk")

# check for the files present there
assert os.path.exists(data_path + "train.json"), "train.json file missing"
assert os.path.exists(data_path + "test.json"), "test.json file missing"


train_df = pd.read_json(open(data_path + "train.json"))
print("train_df loaded")

test_df = pd.read_json(open(data_path + "test.json"))
print("test_df loaded")
```

```
Dataset not found, downloading from Kaggle
Downloading pii-detection-removal-from-educational-data.zip to ./pii-detectio
100%|██████████| 21.4M/21.4M [00:01<00:00, 20.2MB/s]

Extracting archive ./pii-detection-removal-from-educational-data/pii-detectio
train_df loaded
test_df loaded
```

Check the splitup of labels in the data

```
from tqdm import tqdm
import numpy as np

data = json.load(open(data_path + "train.json"))
pos = []
neg = []

for d in tqdm(data):
    if any(np.array(d["labels"]) != "O"):
        pos.append(d)
    else:
        neg.append(d)

print("total datapoints : ", len(data))
print("positive examples : ", len(pos))
print("negative examples : ", len(neg))
```

```
100%|██████████| 6807/6807 [00:07<00:00, 945.94it/s] total datapoints :  6807
positive examples :  945
negative examples :  5862
```

Get the unique labels and create a map

- there are totally 14 unique labels
- EMAIL, ID_NUM, NAME_STUDENT, PHONE_NUM, STREET_ADDRESS, URL_PERSONAL, USERNAME
- These labels represent what class the tokens belongs to
- Every label are subdivided into 2 parts -> B and I. There are represented in the prefix eg: B-EMAIL, I-EMAIL, I-URL_PERSONAL, B-USERNAME
- B represents begining of the class, I represent Intermediate of the class.
- A set of tokens can be represented by Begining or Intermediate. Eg: "Nathalie Sylvia" -> "B-USERNAME I-USERNAME"
- Other eg: "My Name is Aditya" -> "O O O B-NAME"
- tokens/words not belonging to the above mentioned class are represented by "O" -> object

```
from itertools import chain

# get the unique labels from the data
labels = sorted(list(set(chain(*[x["labels"] for x in data]))))

# create a map label to unique numbers
label_to_id = {l: i for i,l in enumerate(labels)}

# create a reverse map : unique numbers to label
id_to_label = {v:k for k,v in label_to_id.items()}

target = [
    'B-EMAIL', 'B-ID_NUM', 'B-NAME_STUDENT', 'B-PHONE_NUM',
    'B-STREET_ADDRESS', 'B-URL_PERSONAL', 'B-USERNAME', 'I-ID_NUM',
    'I-NAME_STUDENT', 'I-PHONE_NUM', 'I-STREET_ADDRESS', 'I-URL_PERSONAL'
]

print(id_to_label)
```

```
    {0: 'B-EMAIL', 1: 'B-ID_NUM', 2: 'B-NAME_STUDENT', 3: 'B-PHONE_NUM', 4: 'B-STF
```

Create a custom tokenizers

- The input data has been tokenized in a different way but we need to tokenize the data as per the model requirements
- Every model has their own unique tokenizers. For DeBERTa, we use DeBERTa tokenizer.
- In order to re-tokenize the data, we need to initially combine all the tokens (de-tokenize) and then use DeBERTa tokenizer to re-tokenize it

```
def tokenize(example, tokenizer, label2id, max_length):

    # rebuild text from tokens
    text = []
    labels = []

    for t, l, ws in zip(example["tokens"], example["provided_labels"], example["t
        text.append(t)
        labels.extend([l] * len(t))

        if ws:
            text.append(" ")
            labels.append("O")

    # actual tokenization
    tokenized = tokenizer("".join(text),
                          return_offsets_mapping=True,
                          max_length=max_length,
                          truncation=True,
                          padding="max_length")

    # print(tokenized

    labels = np.array(labels)

    text = "".join(text)
    token_labels = []

    for start_idx, end_idx in tokenized.offset_mapping:
        # CLS token
        if start_idx == 0 and end_idx == 0:
            token_labels.append(label2id["O"])
            continue

        # case when token starts with whitespace
        if text[start_idx].isspace():
            start_idx += 1

        token_labels.append(label2id[labels[start_idx]])

    length = len(tokenized.input_ids)

    return {**tokenized, "labels": token_labels, "length": length}
```

Init the model config

- Convert the input data into Dataset class as expected by the model

```
from transformers import AutoTokenizer
from datasets import Dataset, features

TRAINING_MODEL_PATH = "albert/albert-base-v2"
TRAINING_MAX_LENGTH = 512
OUTPUT_DIR = "output"

tokenizer = AutoTokenizer.from_pretrained(TRAINING_MODEL_PATH)

# tokenizer.model_max_length = model.config.max_position_embeddings
tot_len_data = len(data)

ds = Dataset.from_dict({
    "full_text": [x["full_text"] for x in data],
    "document": [str(x["document"]) for x in data],
    "tokens": [x["tokens"] for x in data],
    "trailing_whitespace": [x["trailing_whitespace"] for x in data],
    "provided_labels": [x["labels"] for x in data],
})

ds = ds.map(tokenize, fn_kwargs={"tokenizer": tokenizer, "label2id": label_to_id,
# ds = ds.class_encode_column("group")
```

```
/usr/local/lib/python3.10/dist-packages/multiprocess/popen_fork.py:66: Runtime
  self.pid = os.fork()
Map (num_proc=3): 100% 6807/6807 [01:47<00:00, 17.18 examples/s]
```

Get some sample (token, class) pair

```
x = ds[0]

for t,l in zip(x["tokens"], x["provided_labels"]):
    if l != "O":
        print((t,l))

print("*"*100)

for t, l in zip(tokenizer.convert_ids_to_tokens(x["input_ids"]), x["labels"]):
    if id_to_label[l] != "O":
        print((t,id_to_label[l]))
```

```
('Nathalie', 'B-NAME_STUDENT')
('Sylla', 'I-NAME_STUDENT')
('Nathalie', 'B-NAME_STUDENT')
('Sylla', 'I-NAME_STUDENT')
('Nathalie', 'B-NAME_STUDENT')
('Sylla', 'I-NAME_STUDENT')
*******************************************************************************
('natha', 'B-NAME_STUDENT')
('lie', 'B-NAME_STUDENT')
('▁syl', 'I-NAME_STUDENT')
('la', 'I-NAME_STUDENT')
('natha', 'B-NAME_STUDENT')
('lie', 'B-NAME_STUDENT')
('▁syl', 'I-NAME_STUDENT')
('la', 'I-NAME_STUDENT')
```

Create your custom evaluation:

- By default, the model pipeline has categorical cross entropy. But we need to override it to custom eval metrics (recall, precision and F1)

```
from seqeval.metrics import recall_score, precision_score
from seqeval.metrics import classification_report
from seqeval.metrics import f1_score

def compute_metrics(p, all_labels):
    predictions, labels = p
    predictions = np.argmax(predictions, axis=2)

    # Remove ignored index (special tokens)
    true_predictions = [
        [all_labels[p] for (p, l) in zip(prediction, label) if l != -100]
        for prediction, label in zip(predictions, labels)
    ]
    true_labels = [
        [all_labels[l] for (p, l) in zip(prediction, label) if l != -100]
        for prediction, label in zip(predictions, labels)
    ]

    recall = recall_score(true_labels, true_predictions)
    precision = precision_score(true_labels, true_predictions)
    f1_score = (1 + 5*5) * recall * precision / (5*5*precision + recall)

    results = {
        'recall': recall,
        'precision': precision,
        'f1': f1_score
    }
    return results
```

Init the model

```
from transformers import AutoModelForTokenClassification, DataCollatorForTokenCla
from functools import partial

model = AutoModelForTokenClassification.from_pretrained(
    TRAINING_MODEL_PATH,
    num_labels=len(labels),
    id2label=id_to_label,
    label2id=label_to_id,
    ignore_mismatched_sizes=True
)
collator = DataCollatorForTokenClassification(tokenizer, pad_to_multiple_of=16)
```

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

```
!pip install wandb
import wandb
wandb.login()
```

```
Requirement already satisfied: wandb in /usr/local/lib/python3.10/dist-package
Requirement already satisfied: Click!=8.0.0,>=7.1 in /usr/local/lib/python3.10
Requirement already satisfied: GitPython!=3.1.29,>=1.0.0 in /usr/local/lib/pyt
Requirement already satisfied: requests<3,>=2.0.0 in /usr/local/lib/python3.10
Requirement already satisfied: psutil>=5.0.0 in /usr/local/lib/python3.10/dist
Requirement already satisfied: sentry-sdk>=1.0.0 in /usr/local/lib/python3.10/
Requirement already satisfied: docker-pycreds>=0.4.0 in /usr/local/lib/python3
Requirement already satisfied: PyYAML in /usr/local/lib/python3.10/dist-packag
Requirement already satisfied: setproctitle in /usr/local/lib/python3.10/dist-
Requirement already satisfied: setuptools in /usr/local/lib/python3.10/dist-pa
Requirement already satisfied: appdirs>=1.4.3 in /usr/local/lib/python3.10/dis
Requirement already satisfied: protobuf!=4.21.0,<5,>=3.19.0 in /usr/local/lib/
Requirement already satisfied: six>=1.4.0 in /usr/local/lib/python3.10/dist-pa
Requirement already satisfied: gitdb<5,>=4.0.1 in /usr/local/lib/python3.10/di
Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/pyth
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-
Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.10
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.10
Requirement already satisfied: smmap<6,>=3.0.1 in /usr/local/lib/python3.10/di
WARNING: Running pip as the 'root' user can result in broken permissions and c
wandb: WARNING Calling wandb.login() after wandb.init() has no effect.
True
```

create the training pipeline

```
# I actually chose to not use any validation set. This is only for the model I us

args = TrainingArguments(
    output_dir=OUTPUT_DIR,
    fp16=True,
    learning_rate=2e-5,
    num_train_epochs=3,
    per_device_train_batch_size=4,
    gradient_accumulation_steps=2,
    report_to="wandb",
    # evaluation_strategy="epoch",
    save_strategy="epoch",
    do_eval=False,
    save_total_limit=1,
    logging_steps=20,
    lr_scheduler_type='cosine',
    metric_for_best_model="f1",
    greater_is_better=True,
    warmup_ratio=0.1,
    weight_decay=0.01,
)


trainer = Trainer(
    model=model,
    args=args,
    train_dataset=ds,
    data_collator=collator,
    tokenizer=tokenizer,
    compute_metrics=partial(compute_metrics, all_labels=labels),
)
```

```
/usr/local/lib/python3.10/dist-packages/accelerate/accelerator.py:436: Future
dataloader_config = DataLoaderConfiguration(dispatch_batches=None, split_batc
  warnings.warn(
```

Train the model

```
%%time
trainer.train()
```

[2553/2553 07:30, Epoch 3/3]

Step	Training Loss
20	0.002500
40	0.002600
60	0.001300
80	0.000900
100	0.000800
120	0.000100
140	0.003800
160	0.000700
180	0.000600
200	0.001200
220	0.000500
240	0.002000
260	0.000600
280	0.002600
300	0.000300
320	0.000200
340	0.000600
360	0.001100
380	0.000300
400	0.001800
420	0.000600

440	0.001700
460	0.001400
480	0.002300
500	0.000500
520	0.000700
540	0.000400
560	0.000800
580	0.002700
600	0.000600
620	0.001100

login to hugginface to store the model in huggingface hub

700	0.000800
720	0.000200
740	0.000900
760	0.001400
780	0.000400
800	0.001400
820	0.000700
840	0.001000
860	0.000100
880	0.000600
900	0.001600
920	0.000300
940	0.000500
960	0.000200
980	0.000100

```
import huggingface_hub

hub_path = "model_albert_512_token_classification"

huggingface_hub.login()

trainer.model.push_to_hub(hub_path)
tokenizer.push_to_hub(hub_path)
```

```
Token is valid (permission: write).
n has been saved in your configured git credential helper
ur token has been saved to /root/.cache/huggingface/tok
Login successful

model.safetensors: 100% 44.4M/44.4M [00:03<00:00, 10.9MB/s]
README.md: 100% 5.18k/5.18k [00:00<00:00, 126kB/s]
spiece.model: 100% 760k/760k [00:00<00:00, 891kB/s]
CommitInfo(commit url='https://huggingface.co/adhi29/model albert 512 token cl
```

1280	0.001100

Inference

- create a tokenizer for inference, which does the same thing as the tokenizer in training but here we dont want to include labels

1380	0.000600
1400	0.000300
1420	0.000400
1440	0.000500
1460	0.000600
1480	0.000500
1500	0.000500
1520	0.000100

```
import json
import argparse
from itertools import chain
import pandas as pd
from pathlib import Path
from transformers import AutoTokenizer, AutoModelForTokenClassification, Trainer,
from datasets import Dataset
import numpy as np

INFERENCE_MAX_LENGTH = 511
MODEL_PATH = ""

def tokenize_inference(example, tokenizer):
    text = []
    token_map = []

    idx = 0

    for t, ws in zip(example["tokens"], example["trailing_whitespace"]):

        text.append(t)
        token_map.extend([idx]*len(t))
        if ws:
            text.append(" ")
            token_map.append(-1)

        idx += 1


    tokenized = tokenizer("".join(text), return_offsets_mapping=True, truncation=


    return {
        **tokenized,
        "token_map": token_map,
    }
```

2000 0.000000

Load the model and data path

2060	0.000100
2080	0.000200

```
hub_model_full_path = "adhi29/" + hub_path

data = json.load(open("./pii-detection-removal-from-educational-data/train.json")

ds = Dataset.from_dict({
    "full_text": [x["full_text"] for x in data],
    "document": [x["document"] for x in data],
    "tokens": [x["tokens"] for x in data],
    "trailing_whitespace": [x["trailing_whitespace"] for x in data],
})

tokenizer = AutoTokenizer.from_pretrained(hub_model_full_path)
ds = ds.map(tokenize_inference, fn_kwargs={"tokenizer": tokenizer}, num_proc=2)
```

```
tokenizer_config.json: 100% 1.22k/1.22k [00:00<00:00, 81.3kB/s]
spiece.model: 100% 760k/760k [00:00<00:00, 19.4MB/s]
tokenizer.json: 100% 2.27M/2.27M [00:00<00:00, 5.56MB/s]
special_tokens_map.json: 100% 286/286 [00:00<00:00, 19.0kB/s]
/usr/local/lib/python3.10/dist-packages/multiprocess/popen_fork.py:66: Runtime
  self.pid = os.fork()
Map (num_proc=2): 100% 6807/6807 [01:09<00:00, 10.99 examples/s]
```

2420	0.000100

set the training pipline

2480	0.000100
2500	0.000100
2520	0.000100
2540	0.000400

```
CPU times: user 6min 53s, sys: 3 s, total: 6min 57s
Wall time: 7min 33s
TrainOutput(global_step=2553, training_loss=0.0007247521275233279, metrics=
{'train_runtime': 450.9263, 'train_samples_per_second': 45.287,
'train_steps_per_second': 5.662, 'total_flos': 451504004926464.0
```

```
model = AutoModelForTokenClassification.from_pretrained(hub_model_full_path)
# model = trainer.model
collator = DataCollatorForTokenClassification(tokenizer, pad_to_multiple_of=16)

args = TrainingArguments(
    ".",
    per_device_eval_batch_size=1,
    report_to="none",
)

trainer = Trainer(
    model=model,
    args=args,
    data_collator=collator,
    tokenizer=tokenizer,
)
```

```
config.json: 100% 1.49k/1.49k [00:00<00:00, 45.4kB/s]
model.safetensors: 100% 44.4M/44.4M [00:01<00:00, 28.1MB/s]
/usr/local/lib/python3.10/dist-packages/accelerate/accelerator.py:436: FutureW
dataloader_config = DataLoaderConfiguration(dispatch_batches=None, split_batch
  warnings.warn(
```

get all the predictions from the model

```
predictions = trainer.predict(ds).predictions
pred_softmax = np.exp(predictions) / np.sum(np.exp(predictions), axis = 2).reshap
```

load the label-id map from the config files of the model

```
# config = json.load(open(Path(hub_model_full_path) / "config.json"))

config = model.config.to_dict()
id2label = config["id2label"]

# id_to_label = config["id_to_label"]
# id2label = dict(map(lambda x: (str(x[0]), x[1]), id_to_label.items()))

preds = predictions.argmax(-1)
preds_without_O = pred_softmax[:,:,:12].argmax(-1)
O_preds = pred_softmax[:,:,12]

threshold = 0.9
preds_final = np.where(O_preds < threshold, preds_without_O , preds)

print(id2label)
```

```
{0: 'B-EMAIL', 1: 'B-ID_NUM', 2: 'B-NAME_STUDENT', 3: 'B-PHONE_NUM', 4: 'B-STI
```

modify the output from the model such that it can be evaluated later

```
triplets = []
document, token, label, token_str = [], [], [], []

for i, V in enumerate(zip(preds_final, ds["token_map"], ds["offset_mapping"], ds[
    p, token_map, offsets, tokens, doc = V

    for token_pred, (start_idx, end_idx) in zip(p, offsets):
        label_pred = id2label[(token_pred)]

        if start_idx + end_idx == 0: continue

        if token_map[start_idx] == -1:
            start_idx += 1

        # ignore "\n\n"
        while start_idx < len(token_map) and tokens[token_map[start_idx]].isspace
            start_idx += 1

        if start_idx >= len(token_map): break

        token_id = token_map[start_idx]

        # ignore "O" predictions and whitespace preds
        if label_pred != "O" and token_id != -1:
            triplet = (label_pred, token_id, tokens[token_id])

            if triplet not in triplets:
                document.append(doc)
                token.append(token_id)
                label.append(label_pred)
                token_str.append(tokens[token_id])
                triplets.append(triplet)
```

store the pred output into a csv

```
df = pd.DataFrame({
    "document": document,
    "token": token,
    "label": label,
    "token_str": token_str
})
df["row_id"] = list(range(len(df)))

df.to_csv("sample_pred.csv", sep = ",", index=False, encoding="utf-8")

display(df.head(100))
```

	document	token	label	token_str	row_id
0	7	9	B-NAME_STUDENT	Nathalie	0
1	7	10	I-NAME_STUDENT	Sylla	1
2	7	482	B-NAME_STUDENT	Nathalie	2
3	7	483	I-NAME_STUDENT	Sylla	3
4	10	0	B-NAME_STUDENT	Diego	4
...	...	...	...	...	...
95	714	4	I-NAME_STUDENT	Lara	95
96	730	3	B-NAME_STUDENT	Ahmed	96
97	730	4	I-NAME_STUDENT	Saeed	97
98	730	6	B-NAME_STUDENT	Ahmed	98
99	730	7	I-NAME_STUDENT	Saeed	99

100 rows × 5 columns

Get scores

```
train_df = pd.read_json(open(data_path + "train.json"))
train_df["document"].max()

pred_df = pd.read_csv("sample_pred.csv")
pred_df["document"].max()
```

```
print("total len of pred_df : ", len(pred_df))

# create a copy
train_df_clean = train_df.copy()

def create_token_list(token_list):
  return list(range(len(token_list)))  # Create list based on current list length

train_df_clean["token"] = train_df_clean["tokens"].apply(create_token_list)

# explode the columns "tokens" and "labels"
train_df_clean = train_df_clean.explode(["tokens", "labels", "token"], ignore_ind

# drop the unnecessary columns
train_df_clean.drop(columns=["full_text", "trailing_whitespace"], inplace=True)

# rename the columns
train_df_clean.rename(columns={"tokens" : "token_str", "labels" : "label"}, inpla

# create a new column "token"
# train_df_clean["token"] = train_df_clean.index

# filter the rows based on label
train_df_clean = train_df_clean[train_df_clean["label"] != "O"]

# reset the index again
train_df_clean.reset_index(drop=True, inplace=True)

# create a column "row_id"
train_df_clean["row_id"] = train_df_clean.index

train_df_clean.head()

print("total len of train_df_cleaned : ", len(train_df_clean))
print("Total NA : ")
print(train_df_clean.isna().sum())
```

```
total len of pred_df :  2121
total len of train_df_cleaned :  2739
Total NA :
document     0
token_str    0
label        0
token        0
row_id       0
dtype: int64
<ipython-input-44-eb99efd7acef>:36: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
  train_df_clean["row_id"] = train_df_clean.index
```

Compare the values and get the score

```
pred_df_copy = pred_df.drop(columns=["row_id", "token_str"])
train_df_clean_copy = train_df_clean.drop(columns=["row_id", "token_str"])

comb_df = pd.merge(pred_df_copy, train_df_clean_copy, how="outer", suffixes=("","
print("total len of comb_df : ", len(comb_df))
display(comb_df.isna().sum())

comb_df.fillna("O", inplace=True)

display(comb_df.isna().sum())
```

```
total len of comb_df :  2844
document        0
token           0
label         723
label_pred     93
dtype: int64
document      0
token         0
label         0
label_pred    0
dtype: int64
```

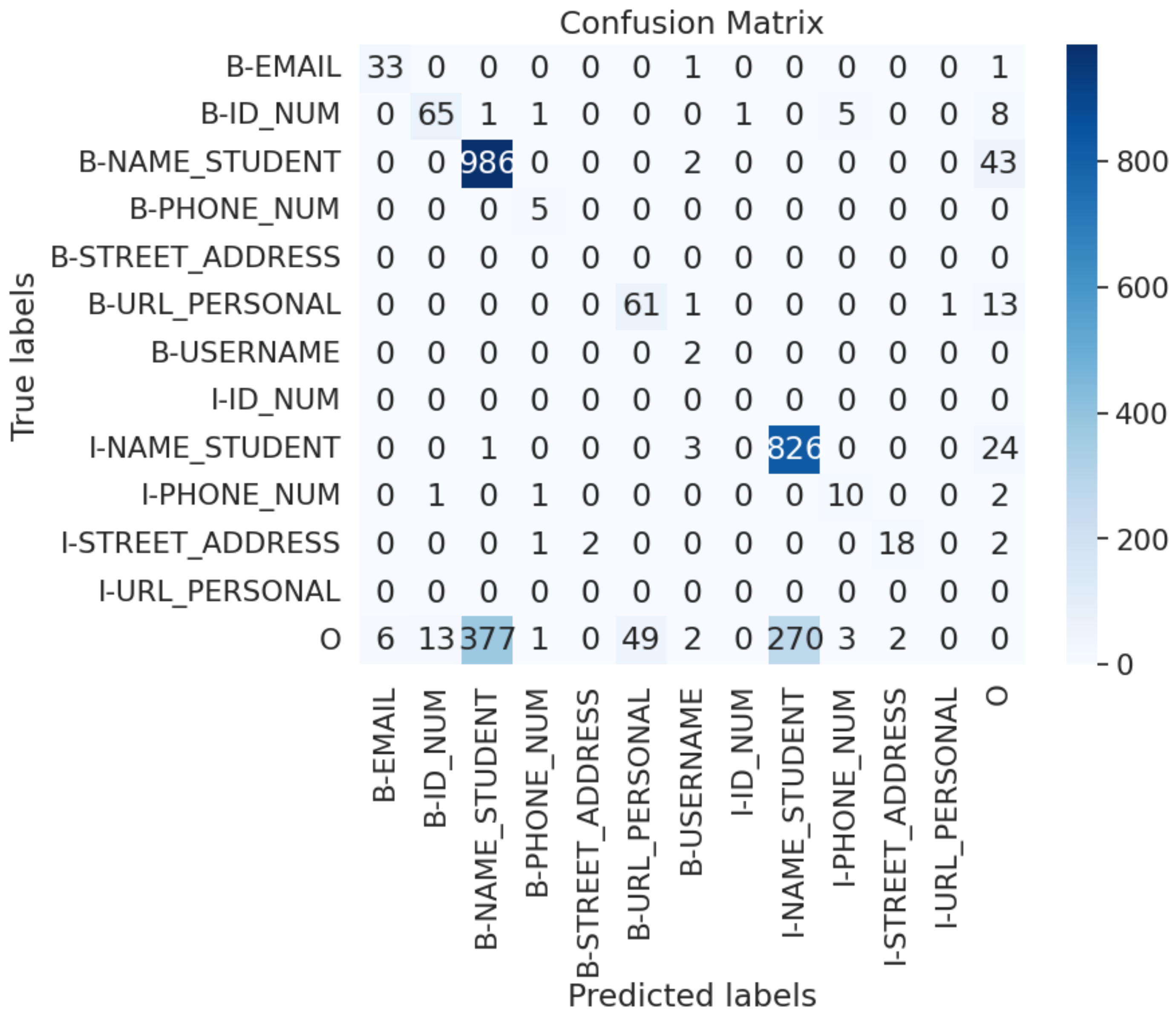
```
comb_df
```

	document	token	label	label_pred
0	7	9	B-NAME_STUDENT	B-NAME_STUDENT
1	7	10	I-NAME_STUDENT	I-NAME_STUDENT
2	7	482	B-NAME_STUDENT	B-NAME_STUDENT
3	7	483	I-NAME_STUDENT	I-NAME_STUDENT
4	10	0	B-NAME_STUDENT	B-NAME_STUDENT
...	...	...	...	...
2839	13308	732	O	I-NAME_STUDENT
2840	13315	585	O	B-URL_PERSONAL
2841	13342	0	O	B-NAME_STUDENT
2842	13342	1	O	I-NAME_STUDENT
2843	15717	964	O	B-ID_NUM

2844 rows × 4 columns

```
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.metrics import confusion_matrix

y_true = comb_df["label"]
y_pred = comb_df["label_pred"]

labels = np.unique(np.concatenate((y_true, y_pred)))
print(labels)

# Compute confusion matrix
cm = confusion_matrix(y_true, y_pred, labels=labels)

# Plot confusion matrix
plt.figure(figsize=(8, 6))
sns.set(font_scale=1.4)  # for label size
sns.heatmap(cm, annot=True, fmt='g', cmap='Blues',
            xticklabels=labels,
            yticklabels=labels)

plt.xlabel('Predicted labels')
plt.ylabel('True labels')
plt.title('Confusion Matrix')
plt.show()
```

```
['B-EMAIL' 'B-ID_NUM' 'B-NAME_STUDENT' 'B-PHONE_NUM' 'B-STREET_ADDRESS'
 'B-URL_PERSONAL' 'B-USERNAME' 'I-ID_NUM' 'I-NAME_STUDENT' 'I-PHONE_NUM'
 'I-STREET_ADDRESS' 'I-URL_PERSONAL' 'O']
```



	B-EMAIL	B-ID_NUM	B-NAME_STUDENT	B-PHONE_NUM	B-STREET_ADDRESS	B-URL_PERSONAL	B-USERNAME	I-ID_NUM	I-NAME_STUDENT	I-PHONE_NUM	I-STREET_ADDRESS	I-URL_PERSONAL	O
B-EMAIL	33	0	0	0	0	0	1	0	0	0	0	0	1
B-ID_NUM	0	65	1	1	0	0	0	1	0	5	0	0	8
B-NAME_STUDENT	0	0	986	0	0	0	2	0	0	0	0	0	43
B-PHONE_NUM	0	0	0	5	0	0	0	0	0	0	0	0	0
B-STREET_ADDRESS	0	0	0	0	0	0	0	0	0	0	0	0	0
B-URL_PERSONAL	0	0	0	0	0	61	1	0	0	0	0	1	13
B-USERNAME	0	0	0	0	0	0	2	0	0	0	0	0	0
I-ID_NUM	0	0	0	0	0	0	0	0	0	0	0	0	0
I-NAME_STUDENT	0	0	1	0	0	0	3	0	826	0	0	0	24
I-PHONE_NUM	0	1	0	1	0	0	0	0	0	10	0	0	2
I-STREET_ADDRESS	0	0	0	1	2	0	0	0	0	0	18	0	2
I-URL_PERSONAL	0	0	0	0	0	0	0	0	0	0	0	0	0
O	6	13	377	1	0	49	2	0	270	3	2	0	0

```
from sklearn.metrics import fbeta_score

score = fbeta_score(y_true, y_pred, beta=5, average="weighted")
print("F Beta Score : ", score)
```

```
F Beta Score :  0.6973922371076362
```

```
from sklearn.metrics import f1_score
from sklearn.metrics import accuracy_score
from sklearn.metrics import precision_score
from sklearn.metrics import recall_score

f1_score = f1_score(y_true, y_pred, average="weighted")
print("F1 Score : ", score)

acc_score = accuracy_score(y_true, y_pred)
print("Accuracy Score : ", acc_score)

prec_score = precision_score(y_true, y_pred, average="weighted")
print("Precision Score : ", prec_score)

recall_score = recall_score(y_true, y_pred, average="weighted")
print("Recall Score : ", recall_score)
```

```
F1 Score :  0.6973922371076362
Accuracy Score :  0.7053445850914205
Precision Score :  0.5479533703792013
Recall Score :  0.7053445850914205
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:13
  _warn_prf(average, modifier, msg_start, len(result))
```

```
Start coding or generate with AI.
```