

pii_detect_Proejct

November 20, 2021

```
[ ]: import pandas as pd
import numpy as np
from presidio_analyzer import AnalyzerEngine
from presidio_anonymizer import AnonymizerEngine
from presidio_analyzer import PatternRecognizer
from presidio_image_redactor import ImageRedactorEngine
from PIL import Image
from presidio_analyzer import Pattern
```

```
[ ]: from typing import List, Optional, Dict, Union, Iterator, Iterable
import collections
from dataclasses import dataclass
import pprint

import pandas as pd

from presidio_analyzer import AnalyzerEngine, RecognizerResult
from presidio_anonymizer import AnonymizerEngine
from presidio_anonymizer.entities import EngineResult
```

0.0.1 Calling Batch Analyzer from Presidio

```
[ ]: #from https://microsoft.github.io/presidio/samples/python/batch_processing/
#uploading classes to use BatchAnalyzer from presidio

@dataclass
class DictAnalyzerResult:
    """Hold the analyzer results per value or list of values."""
    key: str
    value: Union[str, List[str]]
    recognizer_results: Union[List[RecognizerResult], 
        List[List[RecognizerResult]]]

    class BatchAnalyzerEngine(AnalyzerEngine):
        """
```

Class inheriting from AnalyzerEngine and adds the functionality to analyze lists or dictionaries.

```

"""
def analyze_list(self, list_of_texts: Iterable[str], **kwargs) -> List[List[RecognizerResult]]:
    """
    Analyze an iterable of strings

    :param list_of_texts: An iterable containing strings to be analyzed.
    :param kwargs: Additional parameters for the `AnalyzerEngine.analyze` method.
    """

    list_results = []
    for text in list_of_texts:
        results = self.analyze(text=text, **kwargs) if isinstance(text, str) else []
        list_results.append(results)
    return list_results

def analyze_dict(
    self, input_dict: Dict[str, Union[object, Iterable[object]]], **kwargs) -> Iterator[DictAnalyzerResult]:
    """
    Analyze a dictionary of keys (strings) and values (either object or Iterable[object])).
    Non-string values are returned as is.

    :param input_dict: The input dictionary for analysis
    :param kwargs: Additional keyword arguments for the `AnalyzerEngine.analyze` method
    """

    for key, value in input_dict.items():
        if not value:
            results = []
        else:
            if isinstance(value, str):
                results: List[RecognizerResult] = self.analyze(text=value, **kwargs)
            elif isinstance(value, collections.abc.Iterable):
                results: List[List[RecognizerResult]] = self.analyze_list(
                    list_of_texts=value,
                    **kwargs)
            else:

```

```

        results = []
        yield DictAnalyzerResult(key=key, value=value, ↴
↳recognizer_results=results)

class BatchAnonymizerEngine(AnonymizerEngine):
    """
    Class inheriting from the AnonymizerEngine and adding additional
    ↴functionality
    for anonymizing lists or dictionaries.
    """

    def anonymize_list(
        self,
        texts:List[str],
        recognizer_results_list: List[List[RecognizerResult]],
        **kwargs
    ) -> List[EngineResult]:
        """
        Anonymize a list of strings.

        :param texts: List containing the texts to be anonymized (original
        ↴texts)
        :param recognizer_results_list: A list of lists of RecognizerResult,
        the output of the AnalyzerEngine on each text in the list.
        :param kwargs: Additional kwargs for the `AnonymizerEngine.anonymize` ↴
        ↴method
        """
        return_list = []
        for text, recognizer_results in zip(texts, recognizer_results_list):
            if isinstance(text,str):
                res = self.
            ↴anonymize(text=text,analyzer_results=recognizer_results,**kwargs)
                return_list.append(res.text)
            else:
                return_list.append(text)

        return return_list

    def anonymize_dict(self, analyzer_results: ↴
↳Iterator[DictAnalyzerResult],**kwargs) -> Dict[str, str]:
        """
        Anonymize values in a dictionary.
    """

```

```

:param analyzer_results: Iterator of `DictAnalyzerResult`  

    containing the output of the AnalyzerEngine.analyze_dict on the input  

    ↪text.  

:param kwargs: Additional kwargs for the `AnonymizerEngine.anonymize`  

    ↪method  

    """  

  

    return_dict = {}  

    for result in analyzer_results:  

        if isinstance(result.value, str):  

            resp = self.anonymize(text=result.value,  

    ↪analyzer_results=result.recognizer_results, **kwargs)  

            return_dict[result.key] = resp.text  

        elif isinstance(result.value, collections.abc.Iterable):  

            anonymize_responses = self.anonymize_list(texts=result.value,  

    ↪recognizer_results_list=result.recognizer_results,  

                **kwargs)  

            return_dict[result.key] = anonymize_responses  

        else:  

            return_dict[result.key] = result.value  

  

    return return_dict

```

0.1 Analyzing and exploring Text dataset

```
[ ]: df = pd.read_csv("pii_data.txt", sep="\t", index_col = 0).reset_index(drop =  

    ↪True) #uploading file
```

```
df_dict = df.to_dict(orient="list")
```

```
[ ]: df.dtypes #types of data
```

ID	int64
CREATED_BY	object
CREATED_ON	object
UPDATED_BY	object
UPDATED_ON	object
DELETED	int64
DISABLED	int64
ADDEDFROMUI	int64
UNIQUEKEY	object
ISCURRENT	int64
NAME	object
OPTLOCKVER	int64
VALID_FROM	object

```
VALID_TILL          object
INACTIVE           int64
ISADMIN            int64
LOCKED             int64
PASSWORD           object
USERNAME           object
SUPERVISOR         int64
FIRST_NAME         object
IS_MANAGER         int64
LAST_NAME          object
MANAGER            int64
ASSET_ID           int64
phone numbers     int64
Social Security number object
DOB                object
email              object
address            object
city               object
state              object
zip                int64
dtype: object
```

```
[ ]: df['zip'] = df['zip'].astype(str)#turning into string
df['phone numbers'] = df['phone numbers'].astype(str)#turning into string
```

```
[ ]: df.dtypes
```

```
ID                  int64
CREATED_BY          object
CREATED_ON          object
UPDATED_BY          object
UPDATED_ON          object
DELETED            int64
DISABLED            int64
ADDEDFROMUI        int64
UNIQUEKEY          object
ISCURRENT          int64
NAME                object
OPTLOCKVER         int64
VALID_FROM          object
VALID_TILL          object
INACTIVE            int64
ISADMIN             int64
LOCKED              int64
PASSWORD            object
USERNAME            object
SUPERVISOR          int64
```

```

FIRST_NAME          object
IS_MANAGER         int64
LAST_NAME          object
MANAGER            int64
ASSET_ID           int64
phone numbers      object
Social Security number  object
DOB                object
email               object
address             object
city                object
state               object
zip                 object
dtype: object

```

[]: df.describe(include='all')*#describing the data*

	ID	CREATED_BY	CREATED_ON	UPDATED_BY	UPDATED_ON	\
count	999.000000	999	999	999	999	999
unique	Nan	1	1	1	1	1
top	Nan	gladmin	12/10/2020 14:43	gladmin	12/10/2020	14:43
freq	Nan	999	999	999	999	999
mean	501.406406	Nan	Nan	Nan	Nan	Nan
std	289.223338	Nan	Nan	Nan	Nan	Nan
min	2.000000	Nan	Nan	Nan	Nan	Nan
25%	251.500000	Nan	Nan	Nan	Nan	Nan
50%	501.000000	Nan	Nan	Nan	Nan	Nan
75%	750.500000	Nan	Nan	Nan	Nan	Nan
max	1014.000000	Nan	Nan	Nan	Nan	Nan

	DELETED	DISABLED	ADDEDFROMUI	UNIQUEKEY	\
count	999.0	999.0	999.0	999	999
unique	Nan	Nan	Nan	999	999
top	Nan	Nan	Nan	187d6ad09239b3a90a5ba5e3ab220336	1
freq	Nan	Nan	Nan		Nan
mean	0.0	0.0	0.0		Nan
std	0.0	0.0	0.0		Nan
min	0.0	0.0	0.0		Nan
25%	0.0	0.0	0.0		Nan
50%	0.0	0.0	0.0		Nan
75%	0.0	0.0	0.0		Nan
max	0.0	0.0	0.0		Nan

	ISCURRENT	...	MANAGER	ASSET_ID	phone numbers	\
count	999.0	...	999.000000	999.0	999	999
unique	Nan	...	Nan	Nan	999	999
top	Nan	...	Nan	Nan	5046219026	

```

freq          NaN ...      NaN      NaN      1
mean         0.0 ... 100045.305305    4.0      NaN
std          0.0 ...     27.724704    0.0      NaN
min          0.0 ... 100027.000000    4.0      NaN
25%          0.0 ... 100028.000000    4.0      NaN
50%          0.0 ... 100029.000000    4.0      NaN
75%          0.0 ... 100058.000000    4.0      NaN
max          0.0 ... 100101.000000    4.0      NaN

Social Security number      DOB      email      address \
count                  999      999      999      999
unique                 999      959      969      500
top        463-77-8900 3/27/1970 rcabrera@pth.com 3424 29th St Se
freq                   1       3       12       2
mean                  NaN      NaN      NaN      NaN
std                   NaN      NaN      NaN      NaN
min                   NaN      NaN      NaN      NaN
25%                   NaN      NaN      NaN      NaN
50%                   NaN      NaN      NaN      NaN
75%                   NaN      NaN      NaN      NaN
max                   NaN      NaN      NaN      NaN

city state      zip
count      999  999  999
unique     342   47  451
top        New York CA 90248
freq        28  144   8
mean      NaN  NaN  NaN
std       NaN  NaN  NaN
min       NaN  NaN  NaN
25%       NaN  NaN  NaN
50%       NaN  NaN  NaN
75%       NaN  NaN  NaN
max       NaN  NaN  NaN

```

[11 rows x 33 columns]

[]: df['state'].unique()# unique states

[]: array(['LA', 'MI', 'NJ', 'AK', 'OH', 'IL', 'CA', 'SD', 'MD', 'PA', 'NY',
 'TX', 'AZ', 'TN', 'WI', 'KS', 'NM', 'OR', 'FL', 'MN', 'MA', 'SC',
 'RI', 'CO', 'ID', 'NC', 'IN', 'WY', 'VA', 'HI', 'GA', 'AR', 'NV',
 'ME', 'WA', 'MS', 'CT', 'MO', 'NH', 'ND', 'MT', 'IA', 'OK', 'KY',
 'UT', 'NE', 'DC'], dtype=object)

[]: df.shape#shape of data

```
[ ]: (999, 33)

[ ]: print(df.isnull().sum().sum())#finding null values
print(df.columns[df.isna().any()].tolist())# which columns have null values
```

```
132
['FIRST_NAME']

[ ]: location_list = pd.read_csv("us_cities_states_counties.csv", sep = '|').
    ↪reset_index(drop = True)#uploading csv file to use list of states
location_list.head()
```

	City	State short	State full	County	City alias
0	Holtsville	NY	New York	SUFFOLK	Internal Revenue Service
1	Holtsville	NY	New York	SUFFOLK	Holtsville
2	Adjuntas	PR	Puerto Rico	ADJUNTAS	URB San Joaquin
3	Adjuntas	PR	Puerto Rico	ADJUNTAS	Jard De Adjuntas
4	Adjuntas	PR	Puerto Rico	ADJUNTAS	Colinas Del Gigante

```
[ ]: location_list['State short'].nunique()
```

```
[ ]: 61
```

0.1.1 Making the Presidio model better

```
[ ]: batch_analyzer = BatchAnalyzerEngine()#using BatchAnalyzer
```

```
# Adding zip code in the entity list. Make sure zip code is turned into a
↪string for regex to work
zip_pattern = Pattern(name="zip_pattern",regex= '(\\b\\d{5}(?:\\-\\d{4})?\\b)',
↪score = 0.5)
zip_recognizer = PatternRecognizer(supported_entity="ZIPCODE",
                                   patterns = [zip_pattern],
                                   context= ["zip", "zipcode"])
batch_analyzer.registry.add_recognizer(zip_recognizer)
```

```
#Adding State
state_recognizer = PatternRecognizer(supported_entity="STATE",
                                      deny_list=list(location_list['State
↪short'].dropna().unique()),
                                      context= ["state", "address"])
batch_analyzer.registry.add_recognizer(state_recognizer)
```

```
#Adding List of Cities
```

```

city_recognizer = PatternRecognizer(supported_entity="CITY",
                                    deny_list=list(location_list['City'].
→dropna().unique()),
                                    context= ["city", "address"])

batch_analyzer.registry.add_recognizer(city_recognizer)

#Adding Password
password_pattern = Pattern(name="password_pattern", regex= '^(?=.+?[A-Z])(?=.+?
→[a-z])(?=.*?[0-9])(?=.*[#?!@${%^&*-}]).{8,}$', score = 0.5)
password_recognizer = PatternRecognizer(supported_entity="PASSWORD", patterns =_
→[password_pattern], context= ["password"])
batch_analyzer.registry.add_recognizer(password_recognizer)

```

0.1.2 Using Batch Anonymizer on the dataset

```

[ ]: df_dict = df.to_dict(orient="list")#datafram turned into dictionary

batch_anonymizertest = BatchAnonymizerEngine()#anonayizing the data
analyzer_results = batch_analyzer.analyze_dict(df_dict, language="en")

anonymizer_results = batch_anonymizertest.anonymize_dict(analyzer_results)
scrubbed_df = pd.DataFrame(anonymizer_results)
scrubbed_df

```

	ID	CREATED_BY	CREATED_ON	UPDATED_BY	UPDATED_ON	DELETED	DISABLED	\
0	31	gladmin	<DATE_TIME>	gladmin	<DATE_TIME>	0	0	
1	32	gladmin	<DATE_TIME>	gladmin	<DATE_TIME>	0	0	
2	33	gladmin	<DATE_TIME>	gladmin	<DATE_TIME>	0	0	
3	34	gladmin	<DATE_TIME>	gladmin	<DATE_TIME>	0	0	
4	35	gladmin	<DATE_TIME>	gladmin	<DATE_TIME>	0	0	
..	
994	967	gladmin	<DATE_TIME>	gladmin	<DATE_TIME>	0	0	
995	968	gladmin	<DATE_TIME>	gladmin	<DATE_TIME>	0	0	
996	969	gladmin	<DATE_TIME>	gladmin	<DATE_TIME>	0	0	
997	970	gladmin	<DATE_TIME>	gladmin	<DATE_TIME>	0	0	
998	971	gladmin	<DATE_TIME>	gladmin	<DATE_TIME>	0	0	

	ADDEDFROMUI	UNIQUEKEY	ISCURRENT	...	MANAGER	\
0	0	26d04379f776b97fb53dfe78ff146a95	0	...	100058	
1	0	75851ebf88dd7ce865d7ee7fb7dacb60	0	...	100029	
2	0	f9dfe15f794e45809d16b9f1be261456	0	...	100028	
3	0	6df9cd2ad41a761984736a084da09dd4	0	...	100028	
4	0	8de7f05a79c737e5951dc2867cd833bf	0	...	100029	
..	
994	0	b78f9eb5245bfd2b68bd142416e936d8	0	...	100058	

```

995          0 a49450f0671a9ec7aebad57032f2e191          0 ... 100028
996          0 afa74b90f534ac142764e342557240e3          0 ... 100029
997          0 76332a8d2ba0f9998a939d21e463b9b7          0 ... 100028
998          0 8968c00735b5aedca9b45000d5197a0f          0 ... 100029

      ASSET_ID  phone numbers Social Security number           DOB \
0            4 <DATE_TIME>             <US_SSN> <DATE_TIME>
1            4 <DATE_TIME>             <US_SSN> <DATE_TIME>
2            4 <PHONE_NUMBER>          <US_SSN> <DATE_TIME>
3            4 <DATE_TIME>             <US_SSN> <DATE_TIME>
4            4 <PHONE_NUMBER>          <US_SSN> <DATE_TIME>
..
994          4 ...                   ...             ... ...
995          4 <PHONE_NUMBER>          <US_SSN> <DATE_TIME>
996          4 <PHONE_NUMBER>          <US_SSN> <DATE_TIME>
997          4 <PHONE_NUMBER>          <US_SSN> <DATE_TIME>
998          4 <PHONE_NUMBER>          <US_SSN> <DATE_TIME>

      email           address     city   state    zip
0 <EMAIL_ADDRESS> 6649 N <CITY> Gum St <CITY> <CITY> <ZIPCODE>
1 <EMAIL_ADDRESS>        4 B <CITY> Blvd <CITY> <STATE> <ZIPCODE>
2 <EMAIL_ADDRESS>           <PASSWORD> <CITY> <STATE> 8014
3 <EMAIL_ADDRESS>           639 Main St <CITY> <STATE> <ZIPCODE>
4 <EMAIL_ADDRESS>           34 <CITY> St <CITY> <STATE> <ZIPCODE>
..
994 <EMAIL_ADDRESS>           <PASSWORD> <CITY> <STATE> ...
995 <EMAIL_ADDRESS>           67 Rv Cent <CITY> <STATE> <ZIPCODE>
996 <EMAIL_ADDRESS> 2 Sw Nyberg <LOCATION> <CITY> <STATE> <ZIPCODE>
997 <EMAIL_ADDRESS>           <ZIPCODE> E 15th St <CITY> <STATE> <DATE_TIME>
998 <EMAIL_ADDRESS>           <ZIPCODE> W 20th Ave <CITY> <STATE> <DATE_TIME>

[999 rows x 33 columns]

```

0.1.3 Using analyzer function on dataset

```
[ ]: df_dict = df.to_dict(orient="list") #df being converted to a dictionary
analyzer_results = batch_analyzer.analyze_dict(df_dict, language="en")
analyzer_df = pd.DataFrame(analyzer_results) #converting into a dataframe
analyzer_df
```

```
[ ]:                               key                                value \
0           ID [31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 4...
1  CREATED_BY [gladmin, gladmin, gladmin, gladmin, gladmin, ...
2  CREATED_ON [12/10/2020 14:43, 12/10/2020 14:43, 12/10/202...
3  UPDATED_BY [gladmin, gladmin, gladmin, gladmin, gladmin, ...
4  UPDATED_ON [12/10/2020 14:43, 12/10/2020 14:43, 12/10/202...
5  DELETED [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
```

```

6      DISABLED [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
7      ADDEDFROMUI [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
8      UNIQUEKEY [26d04379f776b97fb53dfe78ff146a95, 75851ebf88d...
9      ISCURRENT [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
10     NAME [HTHERRES, MPHILLION, JNORI, RTARNOWSKI, BKUWA...
11     OPTLOCKVER [1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, ...
12     VALID_FROM [12/10/2020 0:00, 12/10/2020 0:00, 12/10/2020 ...
13     VALID_TILL [12/31/9999 0:00, 12/31/9999 0:00, 12/31/9999 ...
14     INACTIVE [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
15     ISADMIN [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
16     LOCKED [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
17     PASSWORD [$shiro1$SHA-256$500000$U3pQ0HcxqLoxIbkTJauCRg...
18     USERNAME [HTHERRES, MPHILLION, JNORI, RTARNOWSKI, BKUWA...
19     SUPERVISOR [504, 1276, 2133, 2133, 1276, 2167, 2167, 2133...
20     FIRST_NAME [Helen, Michael, Judith, Rui, Brent, Larry, Me...
21     IS_MANAGER [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
22     LAST_NAME [Therres, Phillion, Nori, Tarnowski, Kuwabara,...
23     MANAGER [100058, 100029, 100028, 100028, 100029, 10002...
24     ASSET_ID [4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, ...
25     phone numbers [5046218927, 5046218928, 5046218929, 504621893...
26 Social Security number [835-32-2618, 911-70-9288, 369-53-9164, 715-56...
27     DOB [10/17/1966, 12/14/1993, 2/11/1967, 8/3/1966, ...
28     email [htherres@pth.com, mphillion@pth.com, jnori@pt...
29     address [6649 N Blue Gum St, 4 B Blue Ridge Blvd, 8 W ...
30     city [New Orleans, Brighton, Bridgeport, Anchorage, ...
31     state [LA, MI, NJ, AK, OH, OH, IL, CA, SD, MD, PA, N...
32     zip [70116, 48116, 8014, 99501, 45011, 44805, 6063...

```

```

                    recognizer_results
0  [[], [], [], [], [], [], [], [], [], [...]
1  [[], [], [], [], [], [], [], [], [...]
2  [[type: DATE_TIME, start: 0, end: 16, score: 0...
3  [[], [], [], [], [], [], [], [...]
4  [[type: DATE_TIME, start: 0, end: 16, score: 0...
5  [[], [], [...]
6  [[], [...]
7  [[], [...]
8  [[], [...], [type: LOCATION, start: 0...
9  [[], [...], [...], [...], [...], [...], [...]
10 [[], [...], [...], [type: PERSON, start: 0, end:...
11 [[], [...], [...], [...], [...], [...], [...]
12 [[type: DATE_TIME, start: 0, end: 15, score: 0...
13 [[type: DATE_TIME, start: 0, end: 15, score: 0...
14 [[], [...], [...], [...], [...], [...], [...]
15 [[], [...], [...], [...], [...], [...], [...]
16 [[], [...], [...], [...], [...], [...], [...]
17 [[type: PASSWORD, start: 0, end: 92, score: 0...

```

```

18  [[], [], [], [], [type: PERSON, start: 0, end:...]
19  [[], [], [], [], [], [], [], [], [], [...]
20  [[type: CITY, start: 0, end: 5, score: 1.0, ty...
21  [[], [], [], [], [], [], [], [], [], [...]
22  [[], [], [type: PERSON, start: 0, end: 4, scor...
23  [[], [], [], [], [], [], [], [], [], [...]
24  [[], [], [], [], [], [], [], [], [], [...]
25  [[type: DATE_TIME, start: 0, end: 10, score: 0...
26  [[type: US_SSN, start: 0, end: 11, score: 0.5]...
27  [[type: DATE_TIME, start: 0, end: 10, score: 0...
28  [[type: EMAIL_ADDRESS, start: 0, end: 16, scor...
29  [[type: CITY, start: 7, end: 11, score: 1.0], ...
30  [[type: CITY, start: 0, end: 11, score: 1.0, t...
31  [[type: STATE, start: 0, end: 2, score: 1.0, t...
32  [[type: ZIPCODE, start: 0, end: 5, score: 0.5]...

```

```
[ ]: presidio_df = pd.DataFrame(list(analyzer_df['recognizer_results']),  
    ↪analyzer_df['key']).reset_index()  
presidio_df # converting readable dataset
```

	key	0 \
0	ID	[]
1	CREATED_BY	[]
2	CREATED_ON	[type: DATE_TIME, start: 0, end: 16, score: 0.85]
3	UPDATED_BY	[]
4	UPDATED_ON	[type: DATE_TIME, start: 0, end: 16, score: 0.85]
5	DELETED	[]
6	DISABLED	[]
7	ADDEDFROMUI	[]
8	UNIQUEKEY	[]
9	ISCURRENT	[]
10	NAME	[]
11	OPTLOCKVER	[]
12	VALID_FROM	[type: DATE_TIME, start: 0, end: 15, score: 0.85]
13	VALID_TILL	[type: DATE_TIME, start: 0, end: 15, score: 0.85]
14	INACTIVE	[]
15	ISADMIN	[]
16	LOCKED	[]
17	PASSWORD	[type: PASSWORD, start: 0, end: 92, score: 0.5...]
18	USERNAME	[]
19	SUPERVISOR	[]
20	FIRST_NAME	[type: CITY, start: 0, end: 5, score: 1.0, typ...
21	IS_MANAGER	[]
22	LAST_NAME	[]
23	MANAGER	[]
24	ASSET_ID	[]
25	phone numbers	[type: DATE_TIME, start: 0, end: 10, score: 0...

```
26 Social Security number      [type: US_SSN, start: 0, end: 11, score: 0.5]
27          DOB    [type: DATE_TIME, start: 0, end: 10, score: 0.85]
28          email   [type: EMAIL_ADDRESS, start: 0, end: 16, score...
29          address  [type: CITY, start: 7, end: 11, score: 1.0]
30          city    [type: CITY, start: 0, end: 11, score: 1.0, ty...
31          state   [type: STATE, start: 0, end: 2, score: 1.0, ty...
32          zip     [type: ZIPCODE, start: 0, end: 5, score: 0.5]
```

```
1  \
0  []
1  []
2  [type: DATE_TIME, start: 0, end: 16, score: 0.85]
3  []
4  [type: DATE_TIME, start: 0, end: 16, score: 0.85]
5  []
6  []
7  []
8  []
9  []
10 []
11 []
12 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
13 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
14 []
15 []
16 []
17 [type: PASSWORD, start: 0, end: 92, score: 0.5...
18 []
19 []
20 [type: CITY, start: 0, end: 7, score: 1.0, typ...
21 []
22 []
23 []
24 []
25 [type: DATE_TIME, start: 0, end: 10, score: 0...
26 [type: US_ITIN, start: 0, end: 11, score: 0.5...
27 [type: DATE_TIME, start: 0, end: 10, score: 0.85]
28 [type: EMAIL_ADDRESS, start: 0, end: 17, score...
29     [type: CITY, start: 4, end: 14, score: 1.0]
30 [type: CITY, start: 0, end: 8, score: 1.0, typ...
31 [type: STATE, start: 0, end: 2, score: 1.0, ty...
32     [type: ZIPCODE, start: 0, end: 5, score: 0.5]
```

```
2  \
0  []
1  []
2  [type: DATE_TIME, start: 0, end: 16, score: 0.85]
```

```
3          []
4 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
5          []
6          []
7          []
8          []
9          []
10         []
11        []
12 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
13 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
14          []
15          []
16          []
17 [type: PASSWORD, start: 0, end: 92, score: 0.5...]
18          []
19          []
20     [type: PERSON, start: 0, end: 6, score: 0.85]
21          []
22     [type: PERSON, start: 0, end: 4, score: 0.85]
23          []
24          []
25 [type: PHONE_NUMBER, start: 0, end: 10, score:...]
26     [type: US_SSN, start: 0, end: 11, score: 0.5]
27     [type: DATE_TIME, start: 0, end: 9, score: 0.6]
28 [type: EMAIL_ADDRESS, start: 0, end: 13, score...]
29 [type: CITY, start: 4, end: 12, score: 1.0, ty...]
30 [type: CITY, start: 0, end: 10, score: 1.0, ty...]
31 [type: STATE, start: 0, end: 2, score: 1.0, ty...]
32          []
```

```
            3 \
0          []
1          []
2 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
3          []
4 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
5          []
6          []
7          []
8          []
9          []
10         []
11        []
12 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
13 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
14          []
```

```
15          []
16          []
17 [type: PASSWORD, start: 0, end: 92, score: 0.5...]
18          []
19          []
20     [type: PERSON, start: 0, end: 3, score: 0.85]
21          []
22     [type: PERSON, start: 0, end: 9, score: 0.85]
23          []
24          []
25 [type: DATE_TIME, start: 0, end: 10, score: 0...
26     [type: US_SSN, start: 0, end: 11, score: 0.5]
27     [type: DATE_TIME, start: 0, end: 8, score: 0.6]
28 [type: EMAIL_ADDRESS, start: 0, end: 18, score...
29          []
30     [type: CITY, start: 0, end: 9, score: 1.0]
31     [type: STATE, start: 0, end: 2, score: 1.0]
32     [type: ZIPCODE, start: 0, end: 5, score: 0.5]
```

```
4 \
0          []
1          []
2 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
3          []
4 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
5          []
6          []
7          []
8          []
9          []
10    [type: PERSON, start: 0, end: 9, score: 0.85]
11          []
12 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
13 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
14          []
15          []
16          []
17 [type: PASSWORD, start: 0, end: 92, score: 0.5...]
18     [type: PERSON, start: 0, end: 9, score: 0.85]
19          []
20 [type: CITY, start: 0, end: 5, score: 1.0, typ...
21          []
22     [type: PERSON, start: 0, end: 8, score: 0.85]
23          []
24          []
25 [type: PHONE_NUMBER, start: 0, end: 10, score:...
26     [type: US_SSN, start: 0, end: 11, score: 0.5]
```

```
27 [type: DATE_TIME, start: 0, end: 9, score: 0.6]
28 [type: EMAIL_ADDRESS, start: 0, end: 17, score...
29     [type: CITY, start: 3, end: 9, score: 1.0]
30 [type: CITY, start: 0, end: 8, score: 1.0, typ...
31     [type: STATE, start: 0, end: 2, score: 1.0]
32     [type: ZIPCODE, start: 0, end: 5, score: 0.5]
```

```
5 \
0 []
1 []
2 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
3 []
4 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
5 []
6 []
7 []
8 [type: LOCATION, start: 0, end: 32, score: 0.85]
9 []
10 []
11 []
12 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
13 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
14 []
15 []
16 []
17 [type: PASSWORD, start: 0, end: 92, score: 0.5...]
18 []
19 []
20 [type: PERSON, start: 0, end: 5, score: 0.85]
21 []
22 []
23 []
24 []
25 [type: DATE_TIME, start: 0, end: 10, score: 0...
26     [type: US_SSN, start: 0, end: 11, score: 0.5]
27     [type: DATE_TIME, start: 0, end: 9, score: 0.6]
28 [type: EMAIL_ADDRESS, start: 0, end: 17, score...
29     [type: PERSON, start: 2, end: 12, score: 0.85]
30 [type: CITY, start: 0, end: 7, score: 1.0, typ...
31     [type: STATE, start: 0, end: 2, score: 1.0]
32     [type: ZIPCODE, start: 0, end: 5, score: 0.5]
```

```
6 \
0 []
1 []
2 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
3 []
```

```
4 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
5 []
6 []
7 []
8 []
9 []
10 []
11 []
12 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
13 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
14 []
15 []
16 []
17 [type: PASSWORD, start: 0, end: 92, score: 0.5...]
18 []
19 []
20 [type: PERSON, start: 0, end: 7, score: 0.85]
21 []
22 [type: CITY, start: 0, end: 5, score: 1.0, typ...]
23 []
24 []
25 [type: UK_NHS, start: 0, end: 10, score: 1.0, ...]
26 [type: US_SSN, start: 0, end: 11, score: 0.5]
27 [type: DATE_TIME, start: 0, end: 9, score: 0.6]
28 [type: EMAIL_ADDRESS, start: 0, end: 14, score...]
29 [type: CITY, start: 2, end: 6, score: 1.0]
30 [type: CITY, start: 0, end: 7, score: 1.0, typ...]
31 [type: STATE, start: 0, end: 2, score: 1.0]
32 [type: ZIPCODE, start: 0, end: 5, score: 0.5]
```

```
7 \
0 []
1 []
2 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
3 []
4 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
5 []
6 []
7 []
8 []
9 []
10 [type: PERSON, start: 0, end: 7, score: 0.85]
11 []
12 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
13 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
14 []
15 []
```

```
16          []
17 [type: PASSWORD, start: 0, end: 92, score: 0.5...
18     [type: PERSON, start: 0, end: 7, score: 0.85]
19         []
20     [type: PERSON, start: 0, end: 4, score: 0.85]
21         []
22         []
23         []
24         []

25 [type: PHONE_NUMBER, start: 0, end: 10, score:...
26     [type: US_SSN, start: 0, end: 11, score: 0.5]
27     [type: DATE_TIME, start: 0, end: 9, score: 0.6]
28 [type: EMAIL_ADDRESS, start: 0, end: 15, score...
29     [type: CITY, start: 4, end: 11, score: 1.0]
30 [type: CITY, start: 0, end: 8, score: 1.0, typ...
31     [type: STATE, start: 0, end: 2, score: 1.0]
32 [type: DATE_TIME, start: 0, end: 5, score: 0.8...
```

```
          8 ... \
0          []
1          []
2 [type: DATE_TIME, start: 0, end: 16, score: 0.85] ...
3          []
4 [type: DATE_TIME, start: 0, end: 16, score: 0.85] ...
5          []
6          []
7          []
8          []
9          []
10         []
11         []
12 [type: DATE_TIME, start: 0, end: 15, score: 0.85] ...
13 [type: DATE_TIME, start: 0, end: 15, score: 0.85] ...
14         []
15         []
16         []
17 [type: PASSWORD, start: 0, end: 92, score: 0.5... ...
18         []
19         []
20         []
21         []
22         []
23         []
24         []

25 [type: PHONE_NUMBER, start: 0, end: 10, score:... ...
26 [type: US_ITIN, start: 0, end: 11, score: 0.5,... ...
27 [type: DATE_TIME, start: 0, end: 8, score: 0.6] ...
```

```
28 [type: EMAIL_ADDRESS, start: 0, end: 18, score... ...  
29 [type: CITY, start: 2, end: 8, score: 1.0, typ... ...  
30 [type: CITY, start: 0, end: 11, score: 1.0, ty... ...  
31     [type: STATE, start: 0, end: 2, score: 1.0] ...  
32     [type: ZIPCODE, start: 0, end: 5, score: 0.5] ...
```

```
989 \  
0     []  
1     []  
2 [type: DATE_TIME, start: 0, end: 16, score: 0.85]  
3     []  
4 [type: DATE_TIME, start: 0, end: 16, score: 0.85]  
5     []  
6     []  
7     []  
8     []  
9     []  
10 [type: US_DRIVER_LICENSE, start: 0, end: 9, sc...  
11     []  
12 [type: DATE_TIME, start: 0, end: 15, score: 0.85]  
13 [type: DATE_TIME, start: 0, end: 15, score: 0.85]  
14     []  
15     []  
16     []  
17 [type: PASSWORD, start: 0, end: 92, score: 0.5...  
18 [type: US_DRIVER_LICENSE, start: 0, end: 9, sc...  
19     []  
20 [type: CITY, start: 0, end: 4, score: 1.0, typ...  
21     []  
22     [type: PERSON, start: 0, end: 7, score: 0.85]  
23     []  
24     []  
25 [type: DATE_TIME, start: 0, end: 10, score: 0...  
26     [type: US_SSN, start: 0, end: 11, score: 0.5]  
27     [type: DATE_TIME, start: 0, end: 9, score: 0.6]  
28 [type: EMAIL_ADDRESS, start: 0, end: 16, score...  
29     []  
30 [type: CITY, start: 0, end: 10, score: 1.0, ty...  
31     [type: STATE, start: 0, end: 2, score: 1.0]  
32     []
```

```
990 \  
0     []  
1     []  
2 [type: DATE_TIME, start: 0, end: 16, score: 0.85]  
3     []  
4 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
```

```
5          []
6          []
7          []
8          []
9          []
10 [type: US_DRIVER_LICENSE, start: 0, end: 12, s... []
11          []
12 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
13 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
14          []
15          []
16          []
17 [type: PASSWORD, start: 0, end: 92, score: 0.5... []
18 [type: US_DRIVER_LICENSE, start: 0, end: 12, s... []
19          []
20     [type: PERSON, start: 0, end: 6, score: 0.85]
21          []
22          []
23          []
24          []
25 [type: UK_NHS, start: 0, end: 10, score: 1.0, ... []
26     [type: US_SSN, start: 0, end: 11, score: 0.5]
27     [type: DATE_TIME, start: 0, end: 8, score: 0.6]
28 [type: EMAIL_ADDRESS, start: 10, end: 22, scor... []
29     [type: CITY, start: 5, end: 9, score: 1.0]
30 [type: CITY, start: 0, end: 7, score: 1.0, typ... []
31 [type: STATE, start: 0, end: 2, score: 1.0, ty... []
32     [type: ZIPCODE, start: 0, end: 5, score: 0.5]
```

```
991 \
0          []
1          []
2 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
3          []
4 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
5          []
6          []
7          []
8          []
9          []
10         []
11         []
12 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
13 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
14         []
15         []
16         []
```

```
17 [type: PASSWORD, start: 0, end: 92, score: 0.5...  
18 ]  
19 ]  
20 [type: CITY, start: 0, end: 5, score: 1.0, typ...  
21 ]  
22 [type: CITY, start: 0, end: 7, score: 1.0]  
23 ]  
24 ]  
25 [type: PHONE_NUMBER, start: 0, end: 10, score:...  
26 [type: US_SSN, start: 0, end: 11, score: 0.5]  
27 [type: DATE_TIME, start: 0, end: 9, score: 0.6]  
28 [type: EMAIL_ADDRESS, start: 0, end: 16, score...  
29 [type: CITY, start: 2, end: 12, score: 1.0, ty...  
30 [type: CITY, start: 0, end: 9, score: 1.0, typ...  
31 [type: STATE, start: 0, end: 2, score: 1.0]  
32 [type: ZIPCODE, start: 0, end: 5, score: 0.5]
```

```
992 \  
0 ]  
1 ]  
2 [type: DATE_TIME, start: 0, end: 16, score: 0.85]  
3 ]  
4 [type: DATE_TIME, start: 0, end: 16, score: 0.85]  
5 ]  
6 ]  
7 ]  
8 ]  
9 ]  
10 ]  
11 ]  
12 [type: DATE_TIME, start: 0, end: 15, score: 0.85]  
13 [type: DATE_TIME, start: 0, end: 15, score: 0.85]  
14 ]  
15 ]  
16 ]  
17 [type: PASSWORD, start: 0, end: 92, score: 0.5...  
18 ]  
19 ]  
20 [type: PERSON, start: 0, end: 7, score: 0.85]  
21 ]  
22 ]  
23 ]  
24 ]  
25 [type: UK_NHS, start: 0, end: 10, score: 1.0, ...  
26 [type: US_SSN, start: 0, end: 11, score: 0.5]  
27 [type: DATE_TIME, start: 0, end: 10, score: 0.85]  
28 [type: EMAIL_ADDRESS, start: 0, end: 14, score...
```

```

29      [type: CITY, start: 4, end: 9, score: 1.0]
30  [type: CITY, start: 0, end: 13, score: 1.0, ty...
31  [type: STATE, start: 0, end: 2, score: 1.0, ty...
32  [type: PERSON, start: 0, end: 5, score: 0.85, ...

                                993 \
0
1
2  [type: DATE_TIME, start: 0, end: 16, score: 0.85]
3
4  [type: DATE_TIME, start: 0, end: 16, score: 0.85]
5
6
7
8
9
10
11
12 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
13 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
14
15
16
17 [type: PASSWORD, start: 0, end: 92, score: 0.5...
18
19
20
21
22 [type: CITY, start: 0, end: 9, score: 1.0, typ...
23
24
25 [type: PHONE_NUMBER, start: 0, end: 10, score:...
26      [type: US_SSN, start: 0, end: 11, score: 0.5]
27      [type: DATE_TIME, start: 0, end: 9, score: 0.85]
28  [type: EMAIL_ADDRESS, start: 0, end: 17, score...
29
30  [type: CITY, start: 0, end: 10, score: 1.0, ty...
31  [type: STATE, start: 0, end: 2, score: 1.0, ty...
32      [type: ZIPCODE, start: 0, end: 5, score: 0.5]

```

```

                                994 \
0
1
2  [type: DATE_TIME, start: 0, end: 16, score: 0.85]
3
4  [type: DATE_TIME, start: 0, end: 16, score: 0.85]
5

```

```
6          []
7          []
8          []
9          []
10         []
11        []
12 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
13 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
14         []
15         []
16         []
17 [type: PASSWORD, start: 0, end: 92, score: 0.5...]
18         []
19         []
20     [type: PERSON, start: 0, end: 7, score: 0.85]
21         []
22         []
23         []
24         []
25 [type: PHONE_NUMBER, start: 0, end: 10, score:...]
26     [type: US_SSN, start: 0, end: 11, score: 0.5]
27     [type: DATE_TIME, start: 0, end: 8, score: 0.6]
28 [type: EMAIL_ADDRESS, start: 0, end: 13, score...]
29 [type: DATE_TIME, start: 0, end: 4, score: 0.8...]
30 [type: CITY, start: 0, end: 6, score: 1.0, typ...
31     [type: STATE, start: 0, end: 2, score: 1.0]
32     [type: ZIPCODE, start: 0, end: 5, score: 0.5]
```

```
995 \
0          []
1          []
2 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
3         []
4 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
5         []
6         []
7         []
8         []
9         []
10    [type: PERSON, start: 0, end: 8, score: 0.85]
11         []
12 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
13 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
14         []
15         []
16         []
17 [type: PASSWORD, start: 0, end: 92, score: 0.5...]
```

```

18 [type: PERSON, start: 0, end: 8, score: 0.85]
19 []
20 [type: PERSON, start: 0, end: 4, score: 0.85]
21 []
22 [type: PERSON, start: 0, end: 7, score: 0.85]
23 []
24 []
25 [type: PHONE_NUMBER, start: 0, end: 10, score:...
26     [type: US_SSN, start: 0, end: 11, score: 0.5]
27     [type: DATE_TIME, start: 0, end: 9, score: 0.6]
28 [type: EMAIL_ADDRESS, start: 0, end: 16, score...
29     []
30 [type: CITY, start: 0, end: 5, score: 1.0, typ...
31     [type: STATE, start: 0, end: 2, score: 1.0]
32     [type: ZIPCODE, start: 0, end: 5, score: 0.5]

                                996 \
0 []
1 []
2 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
3 []
4 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
5 []
6 []
7 []
8 []
9 []
10 []
11 []
12 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
13 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
14 []
15 []
16 []
17 [type: PASSWORD, start: 0, end: 92, score: 0.5...
18 []
19 []
20 [type: CITY, start: 0, end: 4, score: 1.0, typ...
21 []
22 []
23 []
24 []
25 [type: PHONE_NUMBER, start: 0, end: 10, score:...
26     [type: US_SSN, start: 0, end: 11, score: 0.5]
27     [type: DATE_TIME, start: 0, end: 9, score: 0.6]
28 [type: EMAIL_ADDRESS, start: 0, end: 13, score...
29 [type: LOCATION, start: 12, end: 14, score: 0.85]

```

```

30 [type: CITY, start: 0, end: 7, score: 1.0, typ...
31     [type: STATE, start: 0, end: 2, score: 1.0]
32     [type: ZIPCODE, start: 0, end: 5, score: 0.5]

                                997 \
0                          []
1                          []
2 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
3                          []
4 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
5                          []
6                          []
7                          []
8                          []
9                          []
10    [type: PERSON, start: 0, end: 11, score: 0.85]
11        []
12    [type: DATE_TIME, start: 0, end: 15, score: 0.85]
13    [type: DATE_TIME, start: 0, end: 15, score: 0.85]
14        []
15        []
16        []
17 [type: PASSWORD, start: 0, end: 92, score: 0.5...
18     [type: PERSON, start: 0, end: 11, score: 0.85]
19         []
20         []
21         []
22 [type: CITY, start: 0, end: 7, score: 1.0, typ...
23     []
24     []
25 [type: PHONE_NUMBER, start: 0, end: 10, score:...
26     [type: US_SSN, start: 0, end: 11, score: 0.5]
27     [type: DATE_TIME, start: 0, end: 9, score: 0.6]
28 [type: EMAIL_ADDRESS, start: 0, end: 15, score:...
29     [type: ZIPCODE, start: 0, end: 5, score: 0.5]
30     [type: CITY, start: 0, end: 8, score: 1.0]
31     [type: STATE, start: 0, end: 2, score: 1.0]
32 [type: DATE_TIME, start: 0, end: 5, score: 0.8...

```

```

                                998
0                          []
1                          []
2 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
3                          []
4 [type: DATE_TIME, start: 0, end: 16, score: 0.85]
5                          []
6                          []

```

```

7          []
8          []
9          []
10         []
11         []
12 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
13 [type: DATE_TIME, start: 0, end: 15, score: 0.85]
14         []
15         []
16         []
17 [type: PASSWORD, start: 0, end: 92, score: 0.5...]
18         []
19         []
20 [type: PERSON, start: 0, end: 5, score: 0.85]
21         []
22 [type: PERSON, start: 0, end: 7, score: 0.85]
23         []
24         []
25 [type: PHONE_NUMBER, start: 0, end: 10, score:...]
26 [type: US_SSN, start: 0, end: 11, score: 0.5]
27 [type: DATE_TIME, start: 0, end: 9, score: 0.6]
28 [type: EMAIL_ADDRESS, start: 0, end: 16, score...]
29 [type: ZIPCODE, start: 0, end: 5, score: 0.5]
30 [type: CITY, start: 0, end: 7, score: 1.0, typ...
31 [type: STATE, start: 0, end: 2, score: 1.0, ty...
32 [type: DATE_TIME, start: 0, end: 5, score: 0.8...

[33 rows x 1000 columns]

```

```
[ ]: #analysing values within the address column
col = 29
print('PERSON:', str(analyzer_df['recognizer_results'][col]).count('PERSON'))
print('LOCATION:', str(analyzer_df['recognizer_results'][col]).count('LOCATION'))
print('DATE_TIME:', str(analyzer_df['recognizer_results'][col]).count('DATE_TIME'))
print('ZIP CODE:', str(analyzer_df['recognizer_results'][col]).count('ZIPCODE'))
print('STATE:', str(analyzer_df['recognizer_results'][col]).count('STATE'))
print('CITY:', str(analyzer_df['recognizer_results'][col]).count('CITY'))
print('PASSWORD:', str(analyzer_df['recognizer_results'][col]).count('PASSWORD'))
print('Empty []:', str(analyzer_df['recognizer_results'][col]).count('[]'))
print("Total Types:", str(analyzer_df['recognizer_results'][col]).count('type'))
```

```

PERSON: 162
LOCATION: 168
DATE_TIME: 74
ZIP CODE: 176
STATE: 0

```

```
CITY: 583  
PASSWORD: 218  
Empty []: 190  
Total Types: 1387
```

```
[ ]: #city  
col = 30  
print('PERSON:', str(analyzer_df['recognizer_results'][col]).count('PERSON'))  
print('LOCATION:', str(analyzer_df['recognizer_results'][col]).count('LOCATION'))  
print('DATE_TIME:', str(analyzer_df['recognizer_results'][col]).  
    ~count('DATE_TIME'))  
print('ZIP CODE:', str(analyzer_df['recognizer_results'][col]).count('ZIPCODE'))  
print('STATE:', str(analyzer_df['recognizer_results'][col]).count('STATE'))  
print('CITY:', str(analyzer_df['recognizer_results'][col]).count('CITY'))  
print('PASSWORD:', str(analyzer_df['recognizer_results'][col]).count('PASSWORD'))  
print('Empty []:', str(analyzer_df['recognizer_results'][col]).count('[]'))  
print("Total Types:", str(analyzer_df['recognizer_results'][col]).count('type'))
```

```
PERSON: 104  
LOCATION: 743  
DATE_TIME: 0  
ZIP CODE: 0  
STATE: 0  
CITY: 1025  
PASSWORD: 0  
Empty []: 0  
Total Types: 1872
```

```
[ ]: #state  
col = 31  
print('PERSON:', str(analyzer_df['recognizer_results'][col]).count('PERSON'))  
print('LOCATION:', str(analyzer_df['recognizer_results'][col]).count('LOCATION'))  
print('DATE_TIME:', str(analyzer_df['recognizer_results'][col]).  
    ~count('DATE_TIME'))  
print('ZIP CODE:', str(analyzer_df['recognizer_results'][col]).count('ZIPCODE'))  
print('STATE:', str(analyzer_df['recognizer_results'][col]).count('STATE'))  
print('CITY:', str(analyzer_df['recognizer_results'][col]).count('CITY'))  
print('PASSWORD:', str(analyzer_df['recognizer_results'][col]).count('PASSWORD'))  
print('Empty []:', str(analyzer_df['recognizer_results'][col]).count('[]'))  
print("Total Types:", str(analyzer_df['recognizer_results'][col]).count('type'))
```

```
PERSON: 28  
LOCATION: 521  
DATE_TIME: 0  
ZIP CODE: 0  
STATE: 999  
CITY: 20  
PASSWORD: 0
```

```
Empty []: 0
Total Types: 1568
```

```
[ ]: #zip code
col = 32
print('PERSON:', str(analyzer_df['recognizer_results'][col]).count('PERSON'))
print('LOCATION:', str(analyzer_df['recognizer_results'][col]).count('LOCATION'))
print('DATE_TIME:', str(analyzer_df['recognizer_results'][col]).count('DATE_TIME'))
print('ZIP CODE:', str(analyzer_df['recognizer_results'][col]).count('ZIPCODE'))
print('STATE:', str(analyzer_df['recognizer_results'][col]).count('STATE'))
print('PASSWORD:', str(analyzer_df['recognizer_results'][col]).count('PASSWORD'))
print('Empty []:', str(analyzer_df['recognizer_results'][col]).count('[]'))
print("Total Types:", str(analyzer_df['recognizer_results'][col]).count('type'))
```

```
PERSON: 20
LOCATION: 0
DATE_TIME: 336
ZIP CODE: 843
STATE: 0
PASSWORD: 0
Empty []: 94
Total Types: 1199
```

```
[ ]: #password
col = 17
print('PERSON:', str(analyzer_df['recognizer_results'][col]).count('PERSON'))
print('LOCATION:', str(analyzer_df['recognizer_results'][col]).count('LOCATION'))
print('DATE_TIME:', str(analyzer_df['recognizer_results'][col]).count('DATE_TIME'))
print('ZIP CODE:', str(analyzer_df['recognizer_results'][col]).count('ZIPCODE'))
print('STATE:', str(analyzer_df['recognizer_results'][col]).count('STATE'))
print('PASSWORD:', str(analyzer_df['recognizer_results'][col]).count('PASSWORD'))
print('Empty []:', str(analyzer_df['recognizer_results'][col]).count('[]'))
print("Total Types:", str(analyzer_df['recognizer_results'][col]).count('type'))
```

```
PERSON: 0
LOCATION: 0
DATE_TIME: 0
ZIP CODE: 0
STATE: 0
PASSWORD: 999
Empty []: 0
Total Types: 1998
```

```
[ ]: #username
col = 18
```

```

print('PERSON:', str(analyzer_df['recognizer_results'][col]).count('PERSON'))
print('LOCATION:', str(analyzer_df['recognizer_results'][col]).count('LOCATION'))
print('DATE_TIME:', str(analyzer_df['recognizer_results'][col]).count('DATE_TIME'))
print('ZIP CODE:', str(analyzer_df['recognizer_results'][col]).count('ZIPCODE'))
print('STATE:', str(analyzer_df['recognizer_results'][col]).count('STATE'))
print('PASSWORD:', str(analyzer_df['recognizer_results'][col]).count('PASSWORD'))
print('Empty []:', str(analyzer_df['recognizer_results'][col]).count('[]'))
print("Total Types:", str(analyzer_df['recognizer_results'][col]).count('type'))

```

PERSON: 147
 LOCATION: 19
 DATE_TIME: 26
 ZIP CODE: 24
 STATE: 0
 PASSWORD: 0
 Empty []: 757
 Total Types: 277

```

[ ]: #first name
col = 20
print('PERSON:', str(analyzer_df['recognizer_results'][col]).count('PERSON'))
print('LOCATION:', str(analyzer_df['recognizer_results'][col]).count('LOCATION'))
print('DATE_TIME:', str(analyzer_df['recognizer_results'][col]).count('DATE_TIME'))
print('ZIP CODE:', str(analyzer_df['recognizer_results'][col]).count('ZIPCODE'))
print('STATE:', str(analyzer_df['recognizer_results'][col]).count('STATE'))
print('PASSWORD:', str(analyzer_df['recognizer_results'][col]).count('PASSWORD'))
print('Empty []:', str(analyzer_df['recognizer_results'][col]).count('[]'))
print("Total Types:", str(analyzer_df['recognizer_results'][col]).count('type'))

```

PERSON: 717
 LOCATION: 18
 DATE_TIME: 2
 ZIP CODE: 0
 STATE: 0
 PASSWORD: 0
 Empty []: 225
 Total Types: 1035

```

[ ]: #last name
col = 22
print('PERSON:', str(analyzer_df['recognizer_results'][col]).count('PERSON'))
print('LOCATION:', str(analyzer_df['recognizer_results'][col]).count('LOCATION'))
print('DATE_TIME:', str(analyzer_df['recognizer_results'][col]).count('DATE_TIME'))
print('ZIP CODE:', str(analyzer_df['recognizer_results'][col]).count('ZIPCODE'))

```

```

print('STATE:', str(analyzer_df['recognizer_results'][col]).count('STATE'))
print('PASSWORD:', str(analyzer_df['recognizer_results'][col]).count('PASSWORD'))
print('Empty []:', str(analyzer_df['recognizer_results'][col]).count('[]'))
print("Total Types:", str(analyzer_df['recognizer_results'][col]).count('type'))

```

PERSON: 568
 LOCATION: 40
 DATE_TIME: 3
 ZIP CODE: 0
 STATE: 4
 PASSWORD: 1
 Empty []: 288
 Total Types: 903

```

[ ]: #phone number
col = 25
print('PERSON:', str(analyzer_df['recognizer_results'][col]).count('PERSON'))
print('LOCATION:', str(analyzer_df['recognizer_results'][col]).count('LOCATION'))
print('DATE_TIME:', str(analyzer_df['recognizer_results'][col]).count('DATE_TIME'))
print('ZIP CODE:', str(analyzer_df['recognizer_results'][col]).count('ZIPCODE'))
print('STATE:', str(analyzer_df['recognizer_results'][col]).count('STATE'))
print('PASSWORD:', str(analyzer_df['recognizer_results'][col]).count('PASSWORD'))
print('PHONE Number:', str(analyzer_df['recognizer_results'][col]).count('PHONE NUMBER'))
print('Empty []:', str(analyzer_df['recognizer_results'][col]).count('[]'))
print("Total Types:", str(analyzer_df['recognizer_results'][col]).count('type'))

```

PERSON: 12
 LOCATION: 0
 DATE_TIME: 327
 ZIP CODE: 0
 STATE: 0
 PASSWORD: 0
 PHONE Number: 999
 Empty []: 0
 Total Types: 4236

0.2 Using presidio on other types of files

Reading from csv

```

[ ]: #from csv files
csv = pd.read_csv('pii_csv.csv')
csv = csv.astype(str).replace('nan', np.nan)
df_dict_csv = csv.to_dict(orient="list") #df being converted to a dictionary
analyzer_results_csv = batch_analyzer.analyze_dict(df_dict_csv, language="en")

```

```

analyzer_df_csv = pd.DataFrame(analyzer_results_csv) #converting into a
→dataframe
analyzer_df_csv

```

```

[ ]:                                key                                value \
0          Unnamed: 0 [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, ...
1                  ID [31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 4...
2      CREATED_BY [gladmin, gladmin, gladmin, gladmin, gladmin, ...
3      CREATED_ON [12/10/2020 14:43, 12/10/2020 14:43, 12/10/202...
4      UPDATED_BY [gladmin, gladmin, gladmin, gladmin, gladmin, ...
5      UPDATED_ON [12/10/2020 14:43, 12/10/2020 14:43, 12/10/202...
6      DELETED [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
7      DISABLED [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
8  ADDEDFROMUI [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
9      UNIQUEKEY [26d04379ff776b97fb53dfe78ff146a95, 75851ebf88d...
10     ISCURRENT [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
11      NAME [HTHERRES, MPHILLION, JNORI, RTARNOWSKI, BKUWA...
12    OPTLOCKVER [1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, ...
13    VALID_FROM [12/10/2020 0:00, 12/10/2020 0:00, 12/10/202...
14    VALID_TILL [12/31/9999 0:00, 12/31/9999 0:00, 12/31/9999 ...
15      INACTIVE [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
16      ISADMIN [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
17      LOCKED [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
18      PASSWORD [$shiro1$SHA-256$500000$U3pQ0HcxqLoxIbkTJauCRg...
19      USERNAME [HTHERRES, MPHILLION, JNORI, RTARNOWSKI, BKUWA...
20      SUPERVISOR [504, 1276, 2133, 2133, 1276, 2167, 2167, 2133...
21      FIRST_NAME [Helen, Michael, Judith, Rui, Brent, Larry, Me...
22      IS_MANAGER [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
23      LAST_NAME [Therres, Phillion, Nori, Tarnowski, Kuwabara, ...
24      MANAGER [100058, 100029, 100028, 100028, 100029, 10002...
25      ASSET_ID [4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, ...
26  phone numbers [5046218927, 5046218928, 5046218929, 504621893...
27 Social Security number [835-32-2618, 911-70-9288, 369-53-9164, 715-56...
28          DOB [10/17/1966, 12/14/1993, 2/11/1967, 8/3/1966, ...
29          email [htherres@pth.com, mphillion@pth.com, jnori@pt...
30          address [6649 N Blue Gum St, 4 B Blue Ridge Blvd, 8 W ...
31          city [New Orleans, Brighton, Bridgeport, Anchorage, ...
32          state [LA, MI, NJ, AK, OH, OH, IL, CA, SD, MD, PA, N...
33          zip [70116, 48116, 8014, 99501, 45011, 44805, 6063...

                                         recognizer_results
0  [[], [], [], [], [], [], [], [], [], ...
1  [[], [], [], [], [], [], [], [], [], ...
2  [[], [], [], [], [], [], [], [], [], ...
3  [[{"type": "DATE_TIME", "start": 0, "end": 16, "score": 0...
4  [[], [], [], [], [], [], [], [], [], ...
5  [[{"type": "DATE_TIME", "start": 0, "end": 16, "score": 0...

```

```

6  [ [], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ...]
7  [ [], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ...]
8  [ [], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ...]
9  [ [], [ ], [ ], [ ], [ ], [type: LOCATION, start: 0...]
10 [ [], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ...]
11 [ [], [ ], [ ], [ ], [type: PERSON, start: 0, end:...]
12 [ [], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ...]
13 [ [type: DATE_TIME, start: 0, end: 15, score: 0...
14 [ [type: DATE_TIME, start: 0, end: 15, score: 0...
15 [ [], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ...]
16 [ [], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ...]
17 [ [], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ...]
18 [ [type: PASSWORD, start: 0, end: 92, score: 0...
19 [ [], [ ], [ ], [type: PERSON, start: 0, end:...
20 [ [], [type: DATE_TIME, start: 0, end: 4, score...
21 [ [type: CITY, start: 0, end: 5, score: 1.0, ty...
22 [ [], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ...]
23 [ [], [ ], [type: PERSON, start: 0, end: 4, scor...
24 [ [type: US_DRIVER_LICENSE, start: 0, end: 6, s...
25 [ [], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ...]
26 [ [type: DATE_TIME, start: 0, end: 10, score: 0...
27 [ [type: US_SSN, start: 0, end: 11, score: 0.5]...
28 [ [type: DATE_TIME, start: 0, end: 10, score: 0...
29 [ [type: EMAIL_ADDRESS, start: 0, end: 16, scor...
30 [ [type: CITY, start: 7, end: 11, score: 1.0], ...
31 [ [type: CITY, start: 0, end: 11, score: 1.0, t...
32 [ [type: STATE, start: 0, end: 2, score: 1.0, t...
33 [ [type: ZIPCODE, start: 0, end: 5, score: 0.5]...

```

Reading from Excel

```
[ ]: #from excel file
from pandas import read_excel
xlsx = pd.read_excel('pii_excel.xlsx', engine = 'openpyxl')
xlsx = xlsx.astype(str).replace('nan',np.nan)
df_dict_xlsx = xlsx.to_dict(orient="list") #df being converted to a dictionary
analyzer_results_xlsx = batch_analyzer.analyze_dict(df_dict_xlsx, language="en")
analyzer_df_xlsx = pd.DataFrame(analyzer_results_xlsx) #converting into a
→dataframe
analyzer_df_xlsx
```

	key	value	\
0	Unnamed: 0	[101, 102, 103, 104, 105, 106, 107, 108, 109, ...]	
1	ID	[75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 8...	
2	CREATED_BY	[gladmin, gladmin, gladmin, gladmin, gladmin, ...]	
3	CREATED_ON	[12/10/2020 14:43, 12/10/2020 14:43, 12/10/202...	
4	UPDATED_BY	[gladmin, gladmin, gladmin, gladmin, gladmin, ...]	

```

5          UPDATED_ON [12/10/2020 14:43, 12/10/2020 14:43, 12/10/202...
6          DELETED [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
7          DISABLED [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
8          ADDEDFROMUI [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
9          UNIQUEKEY [10a0891a4321de0d9dd5fe7905ae0367, 9ba2868ab16...
10         ISCURRENT [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
11         NAME [DSLEWIS, MAUCLAIR, WWEHR, PSILLJER, CLARSON, ...
12         OPTLOCKVER [1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, ...
13         VALID_FROM [12/10/2020 0:00, 12/10/2020 0:00, 12/10/2020 ...
14         VALID_TILL [12/31/9999 0:00, 12/31/9999 0:00, 12/31/9999 ...
15         INACTIVE [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
16         ISADMIN [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
17         LOCKED [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
18         PASSWORD [$shiro1$SHA-256$500000$U3pQ0HcxqLoxIbkTJauCRg...
19         USERNAME [DSLEWIS, MAUCLAIR, WWEHR, PSILLJER, CLARSON, ...
20         SUPERVISOR [2167, 1276, 1276, 1683, 1276, 2167, 2133, 127...
21         FIRST_NAME [David, Mario, Warren, Patricia, Charles, Virg...
22         IS_MANAGER [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, ...
23         LAST_NAME [S Lewis, Auclair, Wehr, Silljer, Larson, Yarr...
24         MANAGER [100027, 100029, 100029, 100101, 100029, 10002...
25         ASSET_ID [4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, ...
26         phone numbers [5046219028, 5046219029, 5046219030, 504621903...
27 Social Security number [202-30-8195, 917-62-4443, 493-56-3087, 922-19...
28         DOB [10/23/1975, 2/12/1970, 2/20/1990, 11/20/1984, ...
29         email [ds lewis@pth.com, mauclair@pth.com, wwehr@pth...
30         address [524 Louisiana Ave Nw, 185 Blackstone Bldge, 1...
31         city [San Leandro, Honolulu, Burnsville, High Point...
32         state [CA, HI, MN, NC, NY, OR, WI, MA, FL, PA, TX, T...
33         zip [94577, 96817, 55337, 27263, 11563, 97224, 535...

```

recognizer_results

```

0  [ [], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ...
1  [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ...
2  [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ...
3  [[type: DATE_TIME, start: 0, end: 16, score: 0...
4  [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ...
5  [[type: DATE_TIME, start: 0, end: 16, score: 0...
6  [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ...
7  [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ...
8  [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ...
9  [ ], [ ], [ ], [ ], [type: PERSON, start: 0, ...
10 [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ...
11 [ ], [ ], [ ], [type: LOCATION, start: 0, end: 8...
12 [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ...
13 [[type: DATE_TIME, start: 0, end: 15, score: 0...
14 [[type: DATE_TIME, start: 0, end: 15, score: 0...
15 [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ...

```

```

16  [[], [], [], [], [], [], [], [], [], [...]
17  [[], [], [], [], [], [], [], [], [...] , [...]
18  [[type: PASSWORD, start: 0, end: 92, score: 0...
19  [[], [], [], [type: LOCATION, start: 0, end: 8...
20  [[], [type: DATE_TIME, start: 0, end: 4, score...
21  [[type: CITY, start: 0, end: 5, score: 1.0, ty...
22  [[], [], [], [], [], [], [], [], [...] , [...]
23  [[type: CITY, start: 2, end: 7, score: 1.0], [...]
24  [[type: US_DRIVER_LICENSE, start: 0, end: 6, s...
25  [[], [], [], [], [], [], [], [...] , [...]
26  [[type: PHONE_NUMBER, start: 0, end: 10, score...
27  [[type: US_SSN, start: 0, end: 11, score: 0.5]...
28  [[type: DATE_TIME, start: 0, end: 10, score: 0...
29  [[type: EMAIL_ADDRESS, start: 3, end: 16, scor...
30  [[type: CITY, start: 4, end: 13, score: 1.0], ...
31  [[type: CITY, start: 0, end: 11, score: 1.0, t...
32  [[type: STATE, start: 0, end: 2, score: 1.0], ...
33  [[type: ZIPCODE, start: 0, end: 5, score: 0.5]...

```

Reading from PDF

```
[ ]: #pdf turned into a jpeg and then jpeg is being read

# import module
from pdf2image import convert_from_path

# Store Pdf with convert_from_path function
images = convert_from_path('Spark Group W2_Page_4.pdf')

for i in range(len(images)):

    # Save pages as images in the pdf
    images[i].save('page'+ str(i) +'.jpg', 'JPEG')

img_pdf = Image.open("page0.jpg")
img_pdf = img_pdf.convert('RGBA')

result_pdf = pytesseract.image_to_string(img_pdf)
print(result_pdf)
```

a Employee's social security number

340-31-3830

OMB No. 1545-0008

b Employer identification number (EIN)

46-1595862

1 Wages, tips, other compensation
28877.08

2 Federal income tax withheld

e¢ Employer's name, address, and ZIP code

The Spark Group Digital LLC
306 W 38th St, 601
New York NY 10018

3 Social security wages

28877.08

4 Social security tax withheld

1790.38

5 Medicare wages and tips
28877.08

6 Medicare tax withheld
418.72

7 Social security tips

8 Allocated tips

0

d Control number

10 Dependent care benefits

0

e Employee's first name and initial Last name

Prianka Ball

72 Himrod St

3B

Brooklyn NY 11221

f Employee's address and ZIP code

. | 11 Nonqualified plans

0

12a

DD 990.92

13 Statutory Retirement Third-party
employee plan sick pay

12b

&

a

14 Other
NY SDI: 14.30

WY FLI: 42.13

12¢
¢

12d
©

15 State © Employer's state ID number

NY (461595862

16 State wages, tips, etc. | 17 State income tax

18 Local wages, tips, etc. | 19 Local income tax -_ | 20 Locality name

New York City|

WW 2 Wage and Tax

From Wii Statement

Copy 2-To Be Filed With Employee's State, City, or Local
Income Tax Return

eo14

Department of the Treasury - Internal Revenue Service

Reading from jpeg

```
[ ]: # adds image processing capabilities
#reading image
from PIL import Image
import sys
import os

# will convert the image to text string
import pytesseract
img = Image.open("Spark Group W2_Page_4.jpg")
img = img.convert('RGBA')

result = pytesseract.image_to_string(img)
print(result)
```

a Employee's social security number

340-31-3830

OMB No. 1545-0008

b Employer identification number (EIN)

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1 Wages, tips, other compensation

28877.08

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1790.38

5 Medicare wages and tips

28877.08

6 Medicare tax withheld

418.72

7 Social security tips

8 Allocated tips

0

d Control number

10 Dependent care benefits

0

e Employee's first name and initial Last name

Prianka Ball
72 Himrod St
3B

Brooklyn NY 11221

f Employee's address and ZIP code

Nonqualified plans

12a
3DD 990.92

Statutory Retirement Third-party
employee plan sick pay

12b

©

Other

SDI: 14.30

FLI: 42.13

15 State Employer's state ID number

28877.08

Wage and Tax
Form W- Statement

Copy 2-To Be Filed With Employee's State, City, or Local
Income Tax Return

e014

16 State wages, tips, etc. | 17 State income tax

20 Locality name
New York City

Department of the Treasury - Internal Revenue Service

0.3 Using Presidio to read images

```
[ ]: #using Image redactor on passport does not give the best result
from presidio_image_redactor import ImageRedactorEngine
from PIL import Image

#path_to_image_file = 'Spark Group W2_Page_4.png'
path_to_image_file = 'passport1_Page_3.png'
image = Image.open(path_to_image_file)

redactor = ImageRedactorEngine()
redactor.redact(image=image)
```

[]:



```
[ ]: #using Image redactor on png passport gives the same result
from presidio_image_redactor import ImageRedactorEngine
from PIL import Image

#path_to_image_file = 'Spark Group W2_Page_4.jpg'
path_to_image_file = 'passport1_Page_3.jpg'

image = Image.open(path_to_image_file)

redactor = ImageRedactorEngine()
redactor.redact(image=image)
```

```
[ ]:
```



```
[ ]: #Shows better result when we use non-passport image
#this is showing png file
from presidio_image_redactor import ImageRedactorEngine
from PIL import Image
path_to_image_file = 'W2.png'

image = Image.open(path_to_image_file)

redactor = ImageRedactorEngine()
redactor.redact(image=image)
```

[]:

a Employee's social security number	OMB No. [REDACTED]				
b Employer identification number (EIN) [REDACTED]	1 Wages, tips, other compensation 28877.08	2 Federal income tax withheld 3402.16			
c Employer's name, address, and ZIP code The Spark Group Digital LLC 306 W 38th St, [REDACTED] [REDACTED] 10018	3 Social security wages 28877.08	4 Social security tax withheld [REDACTED].38			
	5 Medicare wages and tips [REDACTED]7.08	6 Medicare tax withheld [REDACTED]			
d Control number	7 Social security tips 0	8 Allocated tips 0			
e Employee's first name and initial Prianka Ball 72 Himrod St 3B [REDACTED]	9 [REDACTED]	10 Dependent care benefits 0			
	11 Nonqualified plans 0	12a DD 990.92			
	13 Statutory employee [REDACTED]	12b [REDACTED]			
	Retirement plan [REDACTED]	12c [REDACTED]			
	Third-party sick pay [REDACTED]	12d [REDACTED]			
f Employee's address and ZIP code	14 Other NY SDI: 14.30 NY FLI: 42.13				
15 [REDACTED]'s state ID number NY	16 State wages, tips, etc. 28877.08	17 State income tax 1388.97	18 Local wages, tips, etc. 28877.08	19 Local income tax 946.64	20 Locality name New York City

W-2 Wage and Tax Statement
Form 2019
Copy 2—To Be Filed With Employee's State, [REDACTED] or Local
Income Tax Return

Department of the Treasury—Internal Revenue Service

[]: #actual result from reading the image file

```
import pandas as pd
from presidio_image_redactor import ImageAnalyzerEngine
image_analyzer = ImageAnalyzerEngine()

result_png = image_analyzer.analyze(image=image)
#image_analyzer = ImagePiiVerifyEngine() #to see the result of the analysis
#result_pdf = image_analyzer.verify(image=img_pdf) #to see the result of the
#analysis
pd.DataFrame(result_png)
```

```
[ ]: 0
0    type: US_SSN, start: 112, end: 123, score: 0.5
1    type: DATE_TIME, start: 132, end: 141, score: ...
2    type: US_DRIVER_LICENSE, start: 247, end: 254, ...
3    type: PERSON, start: 406, end: 410, score: 0.85
4    type: US_DRIVER_LICENSE, start: 406, end: 410, ...
5    type: PHONE_NUMBER, start: 484, end: 496, scor...
6    type: PHONE_NUMBER, start: 484, end: 496, scor...
7    type: PHONE_NUMBER, start: 484, end: 496, scor...
8    type: LOCATION, start: 509, end: 517, score: 0.85
9    type: LOCATION, start: 509, end: 517, score: 0.85
10   type: LOCATION, start: 518, end: 520, score: 0.85
11   type: PERSON, start: 610, end: 625, score: 0.85
12   type: PERSON, start: 610, end: 625, score: 0.85
13   type: LOCATION, start: 761, end: 769, score: 0.85
14   type: LOCATION, start: 770, end: 772, score: 0.85
15   type: DATE_TIME, start: 773, end: 780, score: ...
16   type: DATE_TIME, start: 773, end: 780, score: ...
17   type: PERSON, start: 818, end: 834, score: 0.85
18   type: PERSON, start: 818, end: 834, score: 0.85
19   type: AU_ACN, start: 965, end: 974, score: 1.0
20   type: US_BANK_NUMBER, start: 965, end: 974, sc...
21   type: US_PASSPORT, start: 965, end: 974, score...
22   type: US_SSN, start: 965, end: 974, score: 0.05
23   type: US_DRIVER_LICENSE, start: 965, end: 974, ...
24   type: AU_TFN, start: 965, end: 974, score: 0.01
25   type: LOCATION, start: 1144, end: 1148, score:...
```

```
[ ]: #this is showing jpg file
from presidio_image_redactor import ImageRedactorEngine
from PIL import Image

path_to_image_file = 'W2.jpg'

image = Image.open(path_to_image_file)

redactor = ImageRedactorEngine()
redactor.redact(image=image)
```

```
[ ]:
```

a Employee's social security number [REDACTED]	OMB No. [REDACTED]				
b Employer identification number (EIN) [REDACTED]	1 Wages, tips, other compensation 28877.08	2 Federal income tax withheld 3402.16			
c Employer's name, address, and ZIP code The Spark Group Digital LLC 306 W 38th St, 601 [REDACTED] 10018	3 Social security wages 28877.08	4 Social security tax withheld 1790.38			
	5 Medicare wages and tips 28877.08	6 Medicare tax withheld 418.72			
d Control number [REDACTED]	7 Social security tips 0	8 Allocated tips 0			
e Employee's first name and initial Prianka Ball 72 Himrod St 3B [REDACTED] 11221	9 [REDACTED] 11 [REDACTED] plans 0	10 Dependent care benefits 0			
f Employee's address and ZIP code	12a DD 990.92	12b [REDACTED]			
15 State Employer's state ID number NY [REDACTED]	16 State wages, tips, etc. [REDACTED] 08	17 State income tax 1388.97	18 Local wages, tips, etc. 28877.08	19 [REDACTED] tax 946.64	20 Locality name New York City

W-2 Wage and Tax Statement

2019

Department of the Treasury—Internal Revenue Service

Copy 2—To Be Filed With Employee's State, [REDACTED] or Local Income Tax Return

```
[ ]: import pandas as pd
from presidio_image_redactor import ImageAnalyzerEngine
image_analyzer = ImageAnalyzerEngine()

result_jpg = image_analyzer.analyze(image=image)
#image_analyzer = ImagePiiVerifyEngine() #to see the result of the analysis
#result_pdf = image_analyzer.verify(image=img_pdf) #to see the result of the
#analysis
pd.DataFrame(result_jpg)
```

```
[ ]: 0
0      type: US_SSN, start: 58, end: 69, score: 0.85
1      type: DATE_TIME, start: 78, end: 87, score: 0.85
2      type: US_DRIVER_LICENSE, start: 196, end: 203, ...
3      type: PERSON, start: 344, end: 349, score: 0.85
4      type: PERSON, start: 353, end: 362, score: 0.85
5      type: PERSON, start: 353, end: 362, score: 0.85
6      type: LOCATION, start: 528, end: 536, score: 0.85
7      type: LOCATION, start: 528, end: 536, score: 0.85
8      type: PERSON, start: 645, end: 657, score: 0.85
9      type: PERSON, start: 645, end: 657, score: 0.85
10     type: LOCATION, start: 765, end: 773, score: 0.85
11     type: LOCATION, start: 774, end: 776, score: 0.85
12     type: DATE_TIME, start: 777, end: 782, score: ...
```

```

13 type: DATE_TIME, start: 834, end: 836, score: ...
14 type: LOCATION, start: 846, end: 848, score: 0.85
15     type: AU_ACN, start: 850, end: 859, score: 1.0
16 type: US_BANK_NUMBER, start: 850, end: 859, sc...
17 type: US_PASSPORT, start: 850, end: 859, score...
18     type: US_SSN, start: 850, end: 859, score: 0.05
19 type: US_DRIVER_LICENSE, start: 850, end: 859, ...
20     type: AU_TFN, start: 850, end: 859, score: 0.01
21 type: DATE_TIME, start: 850, end: 884, score: ...
22 type: DATE_TIME, start: 850, end: 884, score: ...
23 type: DATE_TIME, start: 850, end: 884, score: ...
24 type: DATE_TIME, start: 850, end: 884, score: ...
25 type: DATE_TIME, start: 850, end: 884, score: ...
26 type: DATE_TIME, start: 850, end: 884, score: ...
27 type: DATE_TIME, start: 850, end: 884, score: ...
28 type: LOCATION, start: 1097, end: 1101, score:...

```

0.4 Training user name data using NER model from Spacy

```

[ ]: #creating dataset for SPACY model
11 = []
12 = []

for i in range(0,len(df['USERNAME'])):
    11.append(df['USERNAME'][i])

    12.append({'entities':[(0, len(df['USERNAME'][i]), 'USERNAME')]})

train_data = list(zip(11,12))
train_data

```

```

[ ]: [('HTHERRES', {'entities': [(0, 8, 'USERNAME')]}) ,
  ('MPHILLION', {'entities': [(0, 9, 'USERNAME')]}) ,
  ('JNORI', {'entities': [(0, 5, 'USERNAME')]}) ,
  ('RTARNOWSKI', {'entities': [(0, 10, 'USERNAME')]}) ,
  ('BKUWABARA', {'entities': [(0, 9, 'USERNAME')]}) ,
  ('LSOBERING', {'entities': [(0, 9, 'USERNAME')]}) ,
  ('MAYER-21', {'entities': [(0, 8, 'USERNAME')]}) ,
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```

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```

```
[ ]: # Import and load the spacy model
import spacy
from spacy.training import Example
```

```
nlp=spacy.load("en_core_web_md") #uploading existing spacy model  
  
# Getting the ner component  
ner=nlp.get_pipe('ner')
```

```
[ ]: # New label to add  
LABEL = "USERNAME"  
  
# Add the new label to ner  
ner.add_label(LABEL)  
  
# Resume training  
optimizer = nlp.resume_training()  
move_names = list(ner.move_names)  
  
# List of pipes you want to train  
pipe_exceptions = ["ner", "trf_wordpiecer", "trf_tok2vec"]  
  
# List of pipes which should remain unaffected in training  
other_pipes = [pipe for pipe in nlp.pipe_names if pipe not in pipe_exceptions]
```

```
[ ]: move_names
```

```
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```
[ ]: # Importing requirements
from spacy.util import minibatch, compounding
import random

# Begin training by disabling other pipeline components
with nlp.disable_pipes(*other_pipes) :

    sizes = compounding(1.0, 4.0, 1.001)
    # Training for 30 iterations
    for itn in range(30):
        # shuffle examples before training
        random.shuffle(train_data)
        # batch up the examples using spaCy's minibatch
        batches = minibatch(train_data, size=sizes)
        # ictionary to store losses
        losses = {}
        for batch in batches:
            texts, annotations = zip(*batch)
            # Calling update() over the iteration

            example = []
            # Update the model with iterating each text
            for i in range(len(texts)):
                doc = nlp.make_doc(texts[i])
                example.append(Example.from_dict(doc, annotations[i]))

            # Update the model
            nlp.update(example, sgd=optimizer, drop=0.35, losses=losses)

#nlp.update(texts, annotations, sgd=optimizer, drop=0.35, losses=losses)
print("Losses", losses)
```

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```
[ ]: # testing with a Username
test_text = "PBALL"
doc = nlp(test_text)
print("Entities in '%s'" % test_text)
for ent in doc.ents:
    print(ent)
```

```
Entities in 'PBALL'
PBALL
```

```
[ ]: # Output directory
from pathlib import Path
```

```

output_dir=Path('/Users/priankaball/Desktop/MachineLearning/Final_Project/
→testmodel/')

# Saving the model to the output directory
if not output_dir.exists():
    output_dir.mkdir()
nlp.meta['name'] = 'my_ner' # rename model
nlp.to_disk(output_dir)
print("Saved model to", output_dir)

# Loading the model from the directory
print("Loading from", output_dir)
nlp2 = spacy.load(output_dir) # loading model
assert nlp2.get_pipe("ner").move_names == move_names
doc2 = nlp2(' My name is Prianka. My passwords in 6668927267839. My username is_
→PRIPRI')
for ent in doc2.ents:
    print(ent.label_, ent.text)

```

Saved model to
 /Users/priankaball/Desktop/MachineLearning/Final_Project/testmodel
 Loading from /Users/priankaball/Desktop/MachineLearning/Final_Project/testmodel
 USERNAME name is
 USERNAME Prianka.
 USERNAME My passwords in
 USERNAME 6668927267839.
 USERNAME is
 USERNAME PRIPRI

[]: move_names

[]: ['B-ORG',
 'B-DATE',
 'B-PERSON',
 'B-GPE',
 'B-MONEY',
 'B-CARDINAL',
 'B-NORP',
 'B-PERCENT',
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 'B-EVENT',
 'B-ORDINAL',
 'B-PRODUCT',

'B-LAW',
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'U-LANGUAGE',
'O',
'B-USERNAME',
'I-USERNAME',
'L-USERNAME',
'U-USERNAME']
```

```
[ ]: doc2 = nlp2('SAM')
for ent in doc2.ents:
    print(ent.label_, ent.text)
```

USERNAME SAM

The NER model does not give the best result so we decided not to incorporate it.