

```
In [1]: import pandas as pd
```

```
In [2]: data = pd.read_csv("mtsamples.csv")
```

```
In [3]: data.columns
```

```
Out[3]: Index(['description', 'medical_specialty', 'sample_name', 'transcript  
ion',  
            'keywords'],  
            dtype='object')
```

```
In [4]: data.head(5)
```

```
Out[4]:
```

	description	medical_specialty	sample_name	transcription	keywords
0	A 23-year-old white female presents with comp...	Allergy / Immunology	Allergic Rhinitis	SUBJECTIVE:, This 23-year-old white female pr...	allergy / immunology, allergic rhinitis, aller...
1	Consult for laparoscopic gastric bypass.	Bariatrics	Laparoscopic Gastric Bypass Consult - 2	PAST MEDICAL HISTORY:, He has difficulty climb...	bariatrics, laparoscopic gastric bypass, weigh...
2	Consult for laparoscopic gastric bypass.	Bariatrics	Laparoscopic Gastric Bypass Consult - 1	HISTORY OF PRESENT ILLNESS: , I have seen ABC ...	bariatrics, laparoscopic gastric bypass, heart...
3	2-D M-Mode. Doppler.	Cardiovascular / Pulmonary	2-D Echocardiogram - 1	2-D M-MODE: , ,1. Left atrial enlargement wit...	cardiovascular / pulmonary, 2-d m-mode, dopple...
4	2-D Echocardiogram	Cardiovascular / Pulmonary	2-D Echocardiogram - 2	1. The left ventricular cavity size and wall ...	cardiovascular / pulmonary, 2-d, doppler, echo...

```
In [5]: data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4999 entries, 0 to 4998
Data columns (total 5 columns):
#   Column                Non-Null Count  Dtype
---  -
0   description            4999 non-null   object
1   medical_specialty      4999 non-null   object
2   sample_name            4999 non-null   object
3   transcription           4966 non-null   object
4   keywords               3931 non-null   object
dtypes: object(5)
memory usage: 195.4+ KB
```

```
In [6]: data.describe()
```

Out[6]:

	description	medical_specialty	sample_name	transcription	keywords
count	4999	4999	4999	4966	3931
unique	2348	40	2377	2357	3849
top	An example/template for a routine normal male...	Surgery	Lumbar Discogram	PREOPERATIVE DIAGNOSIS: , Low back pain.,POSTO...	
freq	12	1103	5	5	81

```
In [7]: data = data[['transcription', 'medical_specialty']]

print(len(data[data['transcription'].isna()]))
print("Before dropping na values", data.shape)
data = data.drop(data[data['transcription'].isna()].index)
print("After dropping na values", data.shape)
```

33

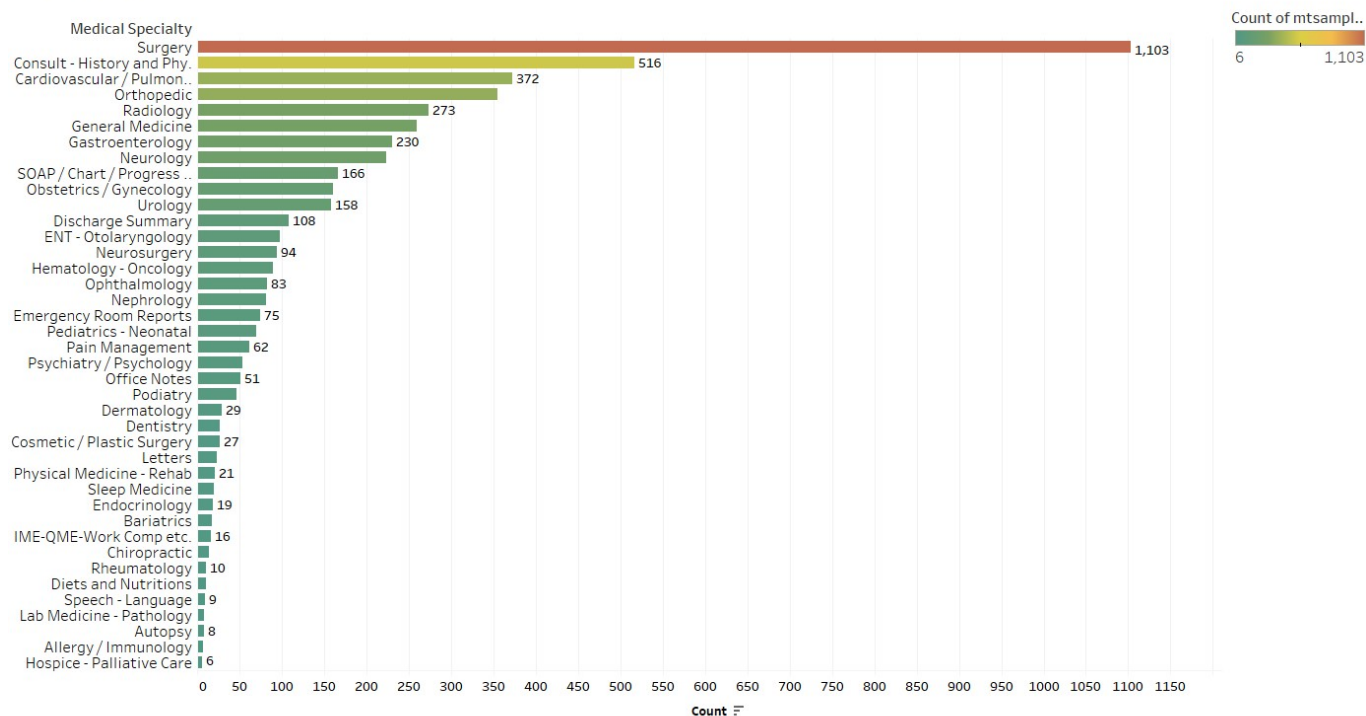
Before dropping na values (4999, 2)

After dropping na values (4966, 2)

```
In [8]: categories = data.groupby(data['medical_specialty'])  
for name, value in categories:  
    print(name, len(value))
```

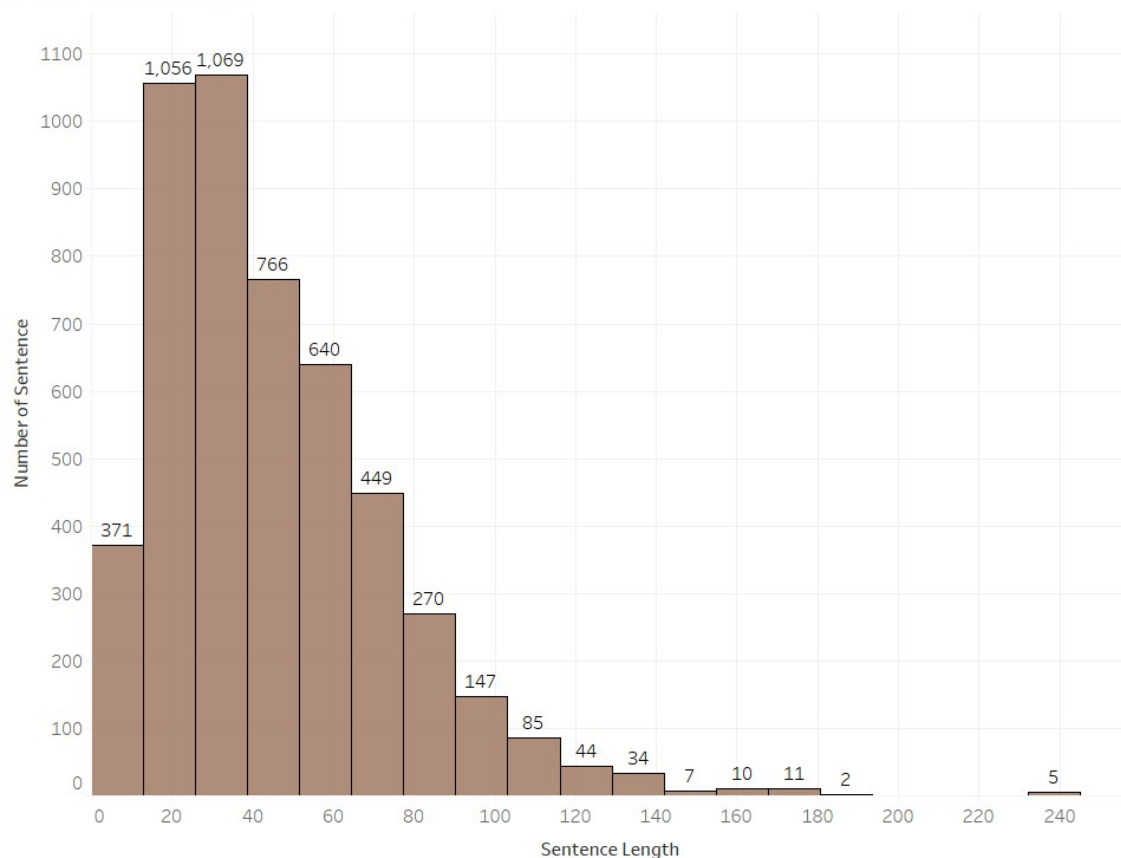
```
Allergy / Immunology 7  
Autopsy 8  
Bariatrics 18  
Cardiovascular / Pulmonary 371  
Chiropractic 14  
Consult - History and Phy. 516  
Cosmetic / Plastic Surgery 27  
Dentistry 27  
Dermatology 29  
Diets and Nutritions 10  
Discharge Summary 108  
ENT - Otolaryngology 96  
Emergency Room Reports 75  
Endocrinology 19  
Gastroenterology 224  
General Medicine 259  
Hematology - Oncology 90  
Hospice - Palliative Care 6  
IME-QME-Work Comp etc. 16  
Lab Medicine - Pathology 8  
Letters 23  
Nephrology 81  
Neurology 223  
Neurosurgery 94  
Obstetrics / Gynecology 155  
Office Notes 50  
Ophthalmology 83  
Orthopedic 355  
Pain Management 61  
Pediatrics - Neonatal 70  
Physical Medicine - Rehab 21  
Podiatry 47  
Psychiatry / Psychology 53  
Radiology 273  
Rheumatology 10  
SOAP / Chart / Progress Notes 166  
Sleep Medicine 20  
Speech - Language 9  
Surgery 1088  
Urology 156
```

Target Count



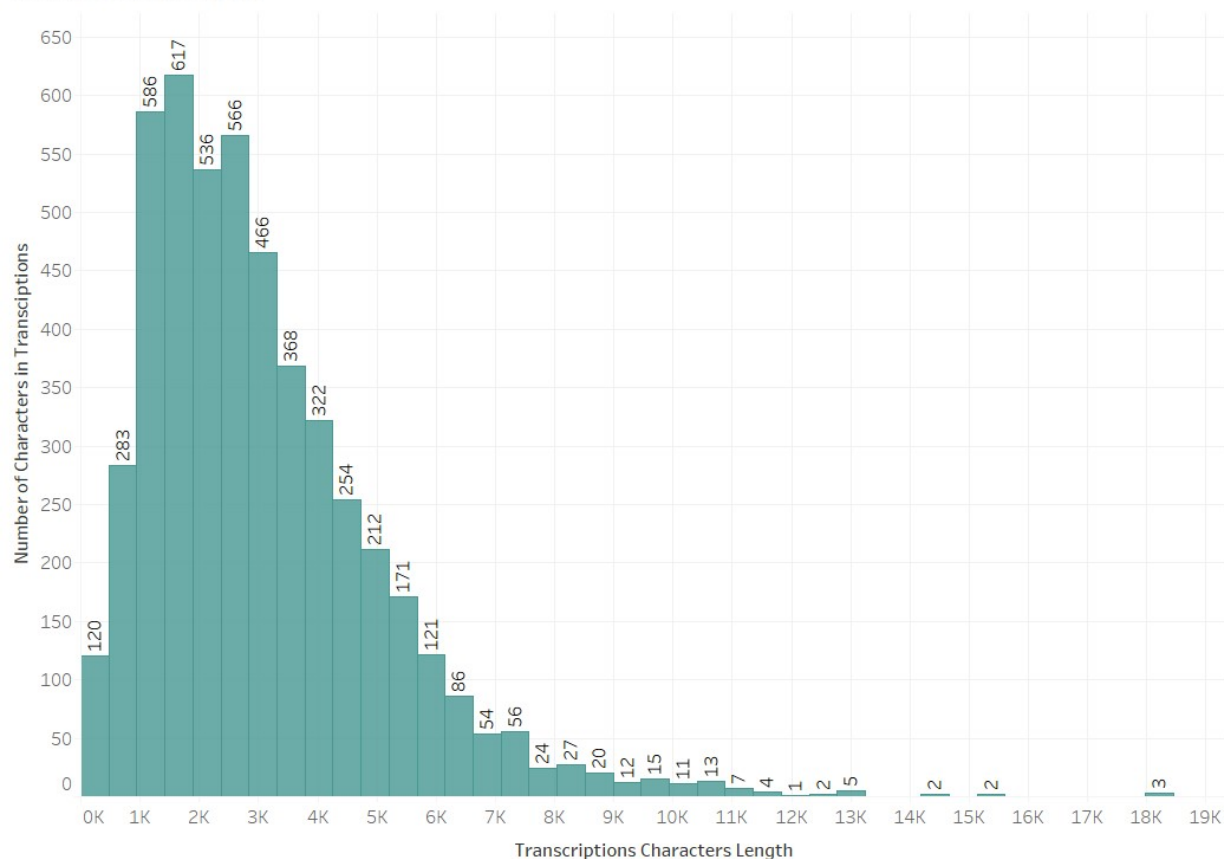
Count of mtsamples.csv for each Medical Specialty. Color shows count of mtsamples.csv. The marks are labeled by count of mtsamples.csv.

Sentence Analysis



The trend of count of Sentence_count for Sentence_count (bin). The marks are labeled by count_transcriptions_length.

Character Analysis



The trend of count of transcriptions_length for transcriptions_length (bin). The marks are labeled by count_transcriptions_length.

As Some Categories are less then 50 samples, they can be eleminated to improve the accuracy of the model for other classes

```
In [9]: # minority_cat = list()
# for name, value in categories:
#     if len(value)<50:
#         minority_cat.append(name)
# print(minority_cat)

# data = data.drop(data[data['medical_specialty'].isin(minority_cat)].index)
# print(data[data['medical_specialty'].isin(minority_cat)].shape)
```

```
In [10]: !pip install https://s3-us-west-2.amazonaws.com/ai2-s2-scispacy/release  
s/v0.4.0/en_ner_bionlp13cg_md-0.4.0.tar.gz
```

Collecting https://s3-us-west-2.amazonaws.com/ai2-s2-scispacey/release/s/v0.4.0/en_ner_bionlp13cg_md-0.4.0.tar.gz
Downloading https://s3-us-west-2.amazonaws.com/ai2-s2-scispacey/releases/v0.4.0/en_ner_bionlp13cg_md-0.4.0.tar.gz (125.1 MB)
Collecting spacy<3.1.0,>=3.0.1
Downloading spacy-3.0.7-cp38-cp38-win_amd64.whl (11.9 MB)
Requirement already satisfied: spacy-legacy<3.1.0,>=3.0.5 in c:\users\yoges\anaconda3\lib\site-packages (from spacy<3.1.0,>=3.0.1->en-ner-bionlp13cg-md==0.4.0) (3.0.8)
Requirement already satisfied: blis<0.8.0,>=0.4.0 in c:\users\yoges\anaconda3\lib\site-packages (from spacy<3.1.0,>=3.0.1->en-ner-bionlp13cg-md==0.4.0) (0.7.5)
Requirement already satisfied: pathy>=0.3.5 in c:\users\yoges\anaconda3\lib\site-packages (from spacy<3.1.0,>=3.0.1->en-ner-bionlp13cg-md==0.4.0) (0.6.1)
Requirement already satisfied: srsly<3.0.0,>=2.4.1 in c:\users\yoges\anaconda3\lib\site-packages (from spacy<3.1.0,>=3.0.1->en-ner-bionlp13cg-md==0.4.0) (2.4.2)
Requirement already satisfied: catalogue<2.1.0,>=2.0.4 in c:\users\yoges\anaconda3\lib\site-packages (from spacy<3.1.0,>=3.0.1->en-ner-bionlp13cg-md==0.4.0) (2.0.6)
Requirement already satisfied: packaging>=20.0 in c:\users\yoges\anaconda3\lib\site-packages (from spacy<3.1.0,>=3.0.1->en-ner-bionlp13cg-md==0.4.0) (20.4)
Requirement already satisfied: setuptools in c:\users\yoges\anaconda3\lib\site-packages (from spacy<3.1.0,>=3.0.1->en-ner-bionlp13cg-md==0.4.0) (50.3.1.post20201107)
Requirement already satisfied: pydantic!=1.8,!1.8.1,<1.9.0,>=1.7.4 in c:\users\yoges\anaconda3\lib\site-packages (from spacy<3.1.0,>=3.0.1->en-ner-bionlp13cg-md==0.4.0) (1.8.2)
Requirement already satisfied: murmurhash<1.1.0,>=0.28.0 in c:\users\yoges\anaconda3\lib\site-packages (from spacy<3.1.0,>=3.0.1->en-ner-bionlp13cg-md==0.4.0) (1.0.6)
Requirement already satisfied: numpy>=1.15.0 in c:\users\yoges\anaconda3\lib\site-packages (from spacy<3.1.0,>=3.0.1->en-ner-bionlp13cg-md==0.4.0) (1.19.2)
Requirement already satisfied: preshed<3.1.0,>=3.0.2 in c:\users\yoges\anaconda3\lib\site-packages (from spacy<3.1.0,>=3.0.1->en-ner-bionlp13cg-md==0.4.0) (3.0.6)
Requirement already satisfied: thinc<8.1.0,>=8.0.3 in c:\users\yoges\anaconda3\lib\site-packages (from spacy<3.1.0,>=3.0.1->en-ner-bionlp13cg-md==0.4.0) (8.0.13)
Requirement already satisfied: wasabi<1.1.0,>=0.8.1 in c:\users\yoges\anaconda3\lib\site-packages (from spacy<3.1.0,>=3.0.1->en-ner-bionlp13cg-md==0.4.0) (0.9.0)
Requirement already satisfied: cymem<2.1.0,>=2.0.2 in c:\users\yoges\anaconda3\lib\site-packages (from spacy<3.1.0,>=3.0.1->en-ner-bionlp13cg-md==0.4.0) (2.0.6)
Requirement already satisfied: jinj2 in c:\users\yoges\anaconda3\lib\site-packages (from spacy<3.1.0,>=3.0.1->en-ner-bionlp13cg-md==0.4.0) (2.11.2)
Collecting typer<0.4.0,>=0.3.0
Downloading typer-0.3.2-py3-none-any.whl (21 kB)
Requirement already satisfied: requests<3.0.0,>=2.13.0 in c:\users\yog

```
ges\anaconda3\lib\site-packages (from spacy<3.1.0,>=3.0.1->en-ner-bio
nlp13cg-md==0.4.0) (2.24.0)
Requirement already satisfied: tqdm<5.0.0,>=4.38.0 in c:\users\yoges\
anaconda3\lib\site-packages (from spacy<3.1.0,>=3.0.1->en-ner-bionlp1
3cg-md==0.4.0) (4.50.2)
Requirement already satisfied: smart-open<6.0.0,>=5.0.0 in c:\users\y
oges\anaconda3\lib\site-packages (from pathy>=0.3.5->spacy<3.1.0,>=3.
0.1->en-ner-bionlp13cg-md==0.4.0) (5.2.1)
Requirement already satisfied: six in c:\users\yoges\anaconda3\lib\si
te-packages (from packaging>=20.0->spacy<3.1.0,>=3.0.1->en-ner-bionlp
13cg-md==0.4.0) (1.15.0)
Requirement already satisfied: pyparsing>=2.0.2 in c:\users\yoges\ana
conda3\lib\site-packages (from packaging>=20.0->spacy<3.1.0,>=3.0.1->
en-ner-bionlp13cg-md==0.4.0) (2.4.7)
Requirement already satisfied: typing-extensions>=3.7.4.3 in c:\user
s\yoges\anaconda3\lib\site-packages (from pydantic!=1.8,!<1.8.1,<1.9.
0,>=1.7.4->spacy<3.1.0,>=3.0.1->en-ner-bionlp13cg-md==0.4.0) (3.7.4.
3)
Requirement already satisfied: MarkupSafe>=0.23 in c:\users\yoges\ana
conda3\lib\site-packages (from jinja2->spacy<3.1.0,>=3.0.1->en-ner-bi
onlp13cg-md==0.4.0) (1.1.1)
Requirement already satisfied: click<7.2.0,>=7.1.1 in c:\users\yoges\
anaconda3\lib\site-packages (from typer<0.4.0,>=0.3.0->spacy<3.1.0,>=
3.0.1->en-ner-bionlp13cg-md==0.4.0) (7.1.2)
Requirement already satisfied: urllib3!=1.25.0,!<1.25.1,<1.26,>=1.21.
1 in c:\users\yoges\anaconda3\lib\site-packages (from requests<3.0.0,
>=2.13.0->spacy<3.1.0,>=3.0.1->en-ner-bionlp13cg-md==0.4.0) (1.25.11)
Requirement already satisfied: idna<3,>=2.5 in c:\users\yoges\anacond
a3\lib\site-packages (from requests<3.0.0,>=2.13.0->spacy<3.1.0,>=3.
0.1->en-ner-bionlp13cg-md==0.4.0) (2.10)
Requirement already satisfied: certifi>=2017.4.17 in c:\users\yoges\ana
conda3\lib\site-packages (from requests<3.0.0,>=2.13.0->spacy<3.1.
0,>=3.0.1->en-ner-bionlp13cg-md==0.4.0) (2020.6.20)
Requirement already satisfied: chardet<4,>=3.0.2 in c:\users\yoges\ana
conda3\lib\site-packages (from requests<3.0.0,>=2.13.0->spacy<3.1.0,
>=3.0.1->en-ner-bionlp13cg-md==0.4.0) (3.0.4)
Building wheels for collected packages: en-ner-bionlp13cg-md
  Building wheel for en-ner-bionlp13cg-md (setup.py): started
  Building wheel for en-ner-bionlp13cg-md (setup.py): finished with s
tatus 'done'
  Created wheel for en-ner-bionlp13cg-md: filename=en_ner_bionlp13cg_
md-0.4.0-py3-none-any.whl size=125679338 sha256=fd584bc898dced5bf1dd8
c61f91569517b87c1bbdfae2384fe5b3d9dfc57d1d0
  Stored in directory: c:\users\yoges\appdata\local\pip\cache\wheels\
14\df\b7\7c9fcdc6696e8a2774b70e4729f18403285604c98718c584ec
Successfully built en-ner-bionlp13cg-md
Installing collected packages: typer, spacy, en-ner-bionlp13cg-md
  Attempting uninstall: typer
    Found existing installation: typer 0.4.0
    Uninstalling typer-0.4.0:
      Successfully uninstalled typer-0.4.0
  Attempting uninstall: spacy
    Found existing installation: spacy 3.2.1
    Uninstalling spacy-3.2.1:
```



```
Successfully uninstalled spacy-3.2.1
Attempting uninstall: en-ner-bionlp13cg-md
Found existing installation: en-ner-bionlp13cg-md 0.2.5
Uninstalling en-ner-bionlp13cg-md-0.2.5:
  Successfully uninstalled en-ner-bionlp13cg-md-0.2.5
Successfully installed en-ner-bionlp13cg-md-0.4.0 spacy-3.0.7 typer-
```

```
In [11]: import spacy
import en_ner_bionlp13cg_md
nlp = en_ner_bionlp13cg_md.load()
```

```
In [12]: def process_Text( text):
wordlist=[]
doc = nlp(text)
for ent in doc.ents:
    wordlist.append(ent.text)
return ' '.join(wordlist)
```

```
In [13]: import nltk
from nltk.stem import WordNetLemmatizer
from nltk.tokenize import sent_tokenize
from nltk.tokenize import word_tokenize
from nltk.corpus import stopwords
import string

def custom_lemmatizer(text):
    sentences = sent_tokenize(text)
    lemmatizer_obj = WordNetLemmatizer()

    lemmatized_words = list()
    for sentence in sentences:
        words = word_tokenize(sentence)
        for word in words:
            if word not in stopwords.words("english"):
                if word not in string.punctuation:
                    lemmatized_words.append(lemmatizer_obj.lemmatize(word).lower())
    return " ".join(lemmatized_words)
```

```
In [14]: data['transcription'] = data['transcription'].apply(custom_lemmatizer)
data['transcription'] = data['transcription'].apply(process_Text)
```

```
In [15]: data.head()
```

```
Out[15]:
```

	transcription	medical_specialty
0	claritin zyrtec allegra ortho tri-cyclen alleg...	Allergy / Immunology
1	muscle joint knee gastroesophageal reflux hear...	Bariatrics
2	abc gentleman alcohol atkin cholesterol blood ...	Bariatrics
3	2-d m-mode 1 left atrial enlargement left atri...	Cardiovascular / Pulmonary
4	left ventricular wall wall near-cavity left ve...	Cardiovascular / Pulmonary

```
In [16]: data.to_csv("cleaned_mtsamples.csv", index=False)
```

```
In [18]: from sklearn.feature_extraction.text import TfidfVectorizer

# data = pd.read_csv("cleaned_mtsamples.csv")

vectorizer = TfidfVectorizer(analyzer='word', stop_words='english', ngram_range=(1,3), max_df=0.75, use_idf=True, smooth_idf=True, max_features=1000)
# TfidfVectorizer(lowercase=True, preprocessor=None, tokenizer=None, analyzer='word', stop_words=None,
# token_pattern='(?u)\b\w\w+\b', ngram_range=(1, 3), max_df=1.0, min_df=1,
# max_features=None, vocabulary=None, binary=False,
# norm='l2', use_idf=True, smooth_idf=True, sublinear_tf=False)

X = vectorizer.fit_transform(data['transcription'].tolist())
len(vectorizer.get_feature_names())
```

```
Out[18]: 1000
```

```
In [37]: vectorizer.get_feature_names()
```

```
Out[37]: ['000',
          '000 epinephrine',
          '01',
          '02',
          '03',
          '04',
          '05',
          '06',
          '07',
          '08',
          '09',
          '10',
          '100',
          '100 000',
          '100 000 epinephrine',
          '11',
          '12',
          '13',
          '14',
          '15',
          '16',
          '17',
          '18',
          '19',
          '20',
          '200',
          '2007',
          '2008',
          '2009',
          '21',
          '22',
          '23',
          '24',
          '25',
          '26',
          '27',
          '28',
          '29',
          '30',
          '325',
          '40',
          '60',
          '6h',
          '70',
          '75',
          '92',
          '93',
          '95',
          '96',
          '97',
          'abc',
          'abc patient',
          'abdomen',
          'abdomen abdomen',
```

'abdomen bowel',
'abdomen bowel extremities',
'abdomen extremities',
'abdomen extremities edema',
'abdomen liver',
'abdomen patient',
'abdomen pelvis',
'abdomen skin',
'abdominal',
'abdominal patient',
'abdominal wall',
'accommodation',
'acetabulum',
'acid',
'acute',
'adenocarcinoma',
'adenoid',
'adenoma',
'adnexal',
'adrenal',
'adrenal gland',
'airway',
'albumin',
'albuterol',
'alcohol',
'alcohol patient',
'alkaline',
'allograft',
'amniotic',
'amniotic fluid',
'amoxicillin',
'anal',
'anesthesia',
'aneurysm',
'annular',
'anterior',
'anterior abdominal',
'anterior abdominal wall',
'anterior cervical',
'anterior chamber',
'anterior posterior',
'anteriorly',
'antrum',
'aorta',
'aortic',
'aortic arch',
'aortic valve',
'apical',
'appearing',
'arch',
'area',
'arm',
'arterial',
'artery',

'artery artery',
'artery carotid',
'artery carotid artery',
'artery circumflex',
'artery coronary',
'artery coronary artery',
'artery patient',
'artery pulmonary',
'artery pulmonary artery',
'artery vessel',
'articular',
'aspirin',
'ast',
'atenolol',
'atrial',
'atrium',
'axilla',
'axillary',
'b12',
'bacitracin',
'bag',
'basal',
'base',
'bed',
'bed patient',
'benign',
'beta',
'betadine',
'bicarbonate',
'biceps',
'bilateral',
'bilaterally',
'bile',
'biliary',
'bilirubin',
'biopsies',
'biopsy',
'biopsy patient',
'bladder',
'bladder bladder',
'bladder neck',
'bladder patient',
'bladder tumor',
'bleed',
'blocker',
'blood',
'blood blood',
'blood cell',
'blood heart',
'blood patient',
'blood patient patient',
'blood stool',
'blood sugar',
'blood urine',

'bloody',
'blunt',
'bluntly',
'bmp',
'body',
'bone',
'bone bone',
'bone graft',
'bone marrow',
'bone patient',
'bone wound',
'border',
'bowel',
'bowel bladder',
'bowel bowel',
'bowel extremities',
'bowel extremities edema',
'bowel patient',
'boy',
'brachial',
'brain',
'brain tumor',
'breast',
'breast cancer',
'breasts',
'bronchoscopy',
'bronchus',
'brother',
'bruits',
'bun',
'bursa',
'c3',
'c4',
'c4 c5',
'c4 c5 c5',
'c5',
'c5 c5',
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'c5 c6 c6',
'c6',
'c6 c6',
'c6 c6 c7',
'c6 c7',
'c7',
'calcium',
'calf',
'caliber',
'caliber vessel',
'canal',
'cancer',
'cancer patient',
'cannula',
'capillary',

'capsular',
'capsular bag',
'capsule',
'carcinoma',
'cardiac',
'cardiac coronary',
'cardiac patient',
'cardioplegia',
'cardiopulmonary',
'cardiovascular',
'cardiovascular heart',
'cardiovascular regular',
'cardiovascular regular abdomen',
'carotid',
'carotid artery',
'carotid artery carotid',
'carotid bruits',
'carpal',
'cartilage',
'cat',
'catheter',
'caudal',
'cava',
'cavity',
'cbc',
'cecum',
'cell',
'cell carcinoma',
'cell hemoglobin',
'central',
'cephalic',
'cerebellar',
'cerebral',
'cervical',
'cervical c5',
'cervical c5 c6',
'cervical cervical',
'cervical patient',
'cervical spine',
'cervix',
'chamber',
'chest',
'chest patient',
'chest tube',
'chest wall',
'children',
'chloride',
'cholesterol',
'circumferential',
'circumflex',
'circumflex artery',
'circumflex coronary',
'circumflex coronary artery',
'clot',

'cm',
'cns',
'codeine',
'colace',
'collateral',
'colon',
'colon cancer',
'colonic',
'conjunctiva',
'cord',
'cord cord',
'cornea',
'corneal',
'coronary',
'coronary artery',
'coronary artery coronary',
'coronary artery patient',
'coronary artery vessel',
'coronary coronary',
'cortex',
'cortical',
'coumadin',
'coumadin patient',
'count',
'cranial',
'cranial nerve',
'crease',
'creatinine',
'creatinine glucose',
'cricoid',
'crp',
'cruciate',
'csf',
'cuff',
'cul',
'cul sac',
'cyst',
'cystic',
'cystic duct',
'daily',
'day',
'dd',
'dd yyyy',
'decadron',
'deltoid',
'descending',
'digoxin',
'disease',
'dose',
'dr',
'dr patient',
'duct',
'duodenum',
'dura',

'ear',
'ear canal',
'ear ear',
'ear patient',
'ears',
'edema',
'edema patient',
'edge',
'endometrial',
'endotracheal',
'endotracheal patient',
'endotracheal tube',
'endplate',
'epidural',
'epinephrine',
'erythema',
'esophageal',
'esophagitis',
'esophagus',
'esophagus stomach',
'eustachian',
'extensor',
'extensor tendon',
'extra',
'extraocular',
'extraocular muscle',
'extremities',
'extremities edema',
'extremities patient',
'extremities skin',
'extremity',
'exudate',
'eye',
'eye eye',
'eye eye eye',
'eye eye patient',
'eye patient',
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```

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'vitamin',
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. . .

```

Most of the times the features in NLP are huge in number. Usually to reduce the dimensionality of the dataset, PCA is used.

```
In [19]: from sklearn.decomposition import PCA
```

```

pca = PCA(n_components=0.80)
X = pca.fit_transform(X.toarray())

```

```
In [20]: from sklearn import preprocessing
```

```

y = data['medical_specialty'].tolist()
le = preprocessing.LabelEncoder()
y = le.fit_transform(y)

```

```
In [21]: y
```

```
Out[21]: array([0, 2, 2, ..., 0, 0, 0], dtype=int64)
```

```
In [22]: from imblearn.over_sampling import SMOTE
```

```

smote_over_sample = SMOTE(sampling_strategy='minority')
X, y = smote_over_sample.fit_resample(X, y)

```

```
In [23]: # Splitting data into train and test
```

```
from sklearn.model_selection import train_test_split
```

```

X_train, X_test, y_train, y_test = train_test_split(X, y, stratify=y, r
andom_state=32)

```

```
In [24]: !pip install catboost
```

```
Requirement already satisfied: catboost in c:\users\yoges\anaconda3\lib\site-packages (0.25.1)
Requirement already satisfied: graphviz in c:\users\yoges\anaconda3\lib\site-packages (from catboost) (0.16)
Requirement already satisfied: numpy>=1.16.0 in c:\users\yoges\anaconda3\lib\site-packages (from catboost) (1.19.2)
Requirement already satisfied: six in c:\users\yoges\anaconda3\lib\site-packages (from catboost) (1.15.0)
Requirement already satisfied: pandas>=0.24.0 in c:\users\yoges\anaconda3\lib\site-packages (from catboost) (1.1.3)
Requirement already satisfied: matplotlib in c:\users\yoges\anaconda3\lib\site-packages (from catboost) (3.3.2)
Requirement already satisfied: scipy in c:\users\yoges\anaconda3\lib\site-packages (from catboost) (1.5.2)
Requirement already satisfied: plotly in c:\users\yoges\anaconda3\lib\site-packages (from catboost) (4.14.3)
Requirement already satisfied: pytz>=2017.2 in c:\users\yoges\anaconda3\lib\site-packages (from pandas>=0.24.0->catboost) (2020.1)
Requirement already satisfied: python-dateutil>=2.7.3 in c:\users\yoges\anaconda3\lib\site-packages (from pandas>=0.24.0->catboost) (2.8.1)
Requirement already satisfied: pillow>=6.2.0 in c:\users\yoges\anaconda3\lib\site-packages (from matplotlib->catboost) (8.0.1)
Requirement already satisfied: certifi>=2020.06.20 in c:\users\yoges\anaconda3\lib\site-packages (from matplotlib->catboost) (2020.6.20)
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.3 in c:\users\yoges\anaconda3\lib\site-packages (from matplotlib->catboost) (2.4.7)
Requirement already satisfied: kiwisolver>=1.0.1 in c:\users\yoges\anaconda3\lib\site-packages (from matplotlib->catboost) (1.3.0)
Requirement already satisfied: cyclor>=0.10 in c:\users\yoges\anaconda3\lib\site-packages (from matplotlib->catboost) (0.10.0)
Requirement already satisfied: retrying>=1.3.3 in c:\users\yoges\anaconda3\lib\site-packages (from plotly->catboost) (1.3.3)
```

```
In [25]: from catboost import CatBoostClassifier
from sklearn.metrics import f1_score

clf = CatBoostClassifier(
    iterations=5,
    learning_rate=0.1,
    loss_function='MultiClass'
)

clf.fit(X_train, y_train,
#       cat_features=cat_features,
    eval_set=(X_test, y_test),
    verbose=False
)

pred= clf.predict(X_test)
score = f1_score(y_test, pred, average='micro')
```

```
In [26]: score
```

```
Out[26]: 0.40542328042328046
```

```
In [27]: from sklearn.metrics import confusion_matrix

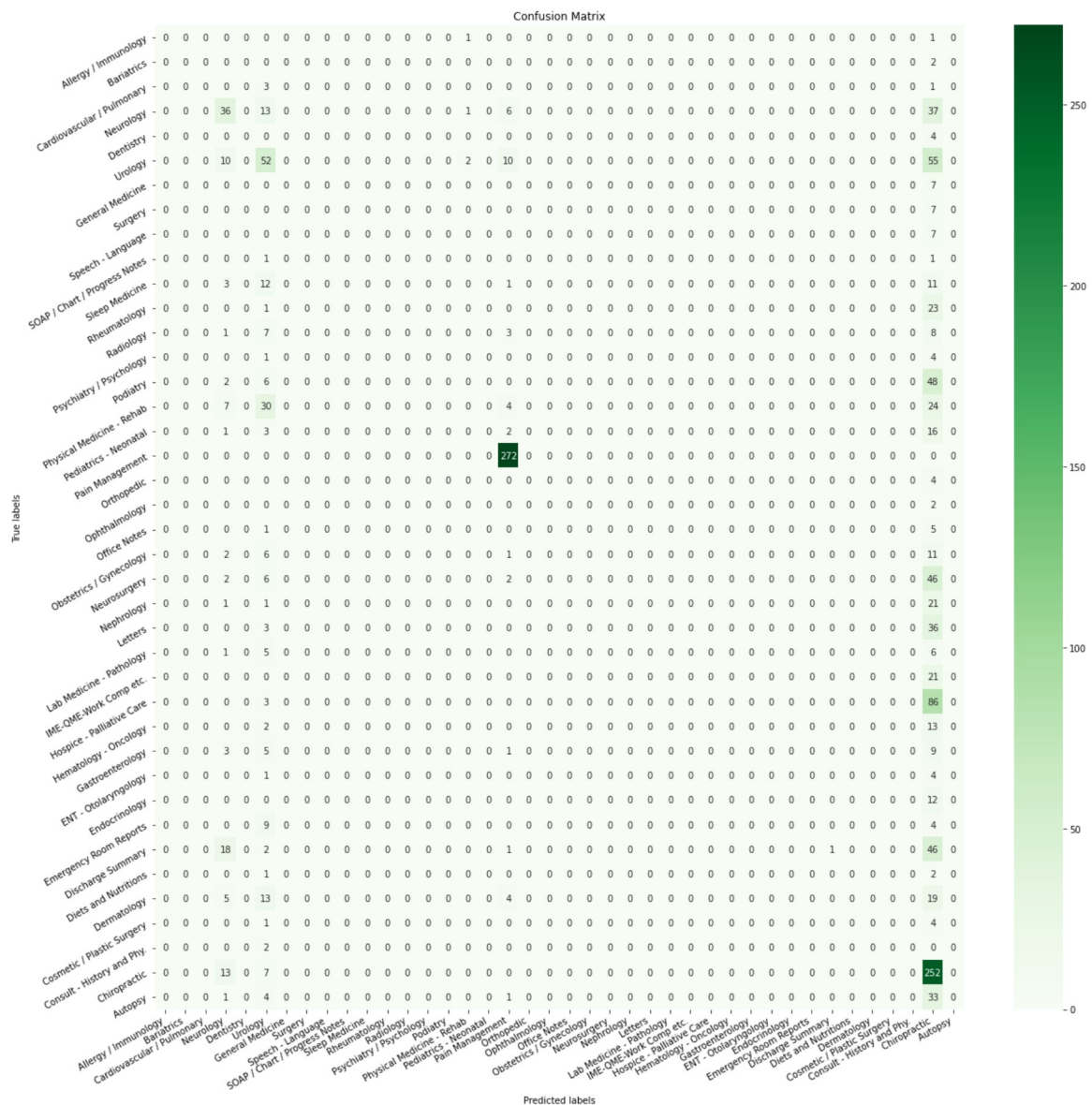
labels = data['medical_specialty'].unique()
cm = confusion_matrix(y_test, pred)
```



```
In [28]: import seaborn as sns
from matplotlib import pyplot as plt

fig = plt.figure(figsize=(20,20))
ax= fig.add_subplot(1,1,1)
sns.heatmap(cm, annot=True, cmap="Greens",ax = ax,fmt='g');

# labels, title and ticks
ax.set_xlabel('Predicted labels');ax.set_ylabel('True labels');
ax.set_title('Confusion Matrix');
ax.xaxis.set_ticklabels(labels); ax.yaxis.set_ticklabels(labels);
plt.setp(ax.get_yticklabels(), rotation=30, horizontalalignment='right')
plt.setp(ax.get_xticklabels(), rotation=30, horizontalalignment='right')
plt.show()
```



```
In [29]: # from sklearn.metrics import classification_report

# classification_report(y_test,pred,labels=data.medical_specialty.unique())
```

```
In [30]: !pip install xgboost
```

```
Requirement already satisfied: xgboost in c:\users\yoges\anaconda3\lib\site-packages (1.4.2)
Requirement already satisfied: scipy in c:\users\yoges\anaconda3\lib\site-packages (from xgboost) (1.5.2)
Requirement already satisfied: numpy in c:\users\yoges\anaconda3\lib\site-packages (from xgboost) (1.19.2)
```

```
In [31]: import optuna
import xgboost as xgb
import numpy as np
from sklearn.metrics import f1_score

# xgb_cl = xgb.XGBClassifier()
```

```
In [32]: def objective(trial):
    dtrain = xgb.DMatrix(X_train, label=y_train)
    dvalid = xgb.DMatrix(X_test, label=y_test)

    param = {
        "n_estimators": trial.suggest_int("n_estimators", 100, 10000),
        "silent": 1,
        "objective": "multi:softmax",
        "eval_metric": "auc",
        "num_class": len(data['medical_specialty'].unique()),
        "booster": trial.suggest_categorical("booster", ["gbtree", "gblinear", "dart"]),
        "lambda": trial.suggest_loguniform("lambda", 1e-8, 1.0),
        "alpha": trial.suggest_loguniform("alpha", 1e-8, 1.0),
    }

    if param["booster"] == "gbtree" or param["booster"] == "dart":
        param["max_depth"] = trial.suggest_int("max_depth", 1, 9)
        param["eta"] = trial.suggest_loguniform("eta", 1e-8, 1.0)
        param["gamma"] = trial.suggest_loguniform("gamma", 1e-8, 1.0)
        param["grow_policy"] = trial.suggest_categorical("grow_policy", ["depthwise", "lossguide"])
    if param["booster"] == "dart":
        param["sample_type"] = trial.suggest_categorical("sample_type", ["uniform", "weighted"])
        param["normalize_type"] = trial.suggest_categorical("normalize_type", ["tree", "forest"])
        param["rate_drop"] = trial.suggest_loguniform("rate_drop", 1e-8, 1.0)
        param["skip_drop"] = trial.suggest_loguniform("skip_drop", 1e-8, 1.0)

    # xgb_cl.fit(X_train, y_train)

    # pred= xgb_cl.predict(X_test)

    # f1_score(y_test, pred, average='micro')

    # Add a callback for pruning.
    bst = xgb.train(param, dtrain)
    pred = bst.predict(dvalid)
    pred_labels = np rint(pred)
    score = f1_score(y_test, pred_labels, average='micro')
    # accuracy = sklearn.metrics.accuracy_score(valid_y, pred_labels)
    return score
```

```
In [33]: study = optuna.create_study(direction="maximize")
study.optimize(objective, n_trials=100, timeout=600)

print("Number of finished trials: ", len(study.trials))
print("Best trial:")
trial = study.best_trial

print("  Value: {}".format(trial.value))
print("  Params: ")
for key, value in trial.params.items():
    print("    {}: {}".format(key, value))
```

```
[I 2022-02-03 16:20:18,694] A new study created in memory with name:
no-name-b4a5498b-efef-4cf6-bf11-9d42ac9e5a5c
```

```
[16:20:18] WARNING: C:/Users/Administrator/workspace/xgboost-win64_re
lease_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:20:38,257] Trial 0 finished with value: 0.3478835978
835979 and parameters: {'n_estimators': 4392, 'booster': 'dart', 'lam
bda': 0.0026218660060285406, 'alpha': 0.17755444683938, 'max_depth':
5, 'eta': 9.805900509721844e-06, 'gamma': 0.003476761924048504, 'grow
_policy': 'depthwise', 'sample_type': 'uniform', 'normalize_type': 't
ree', 'rate_drop': 0.0011961693589935861, 'skip_drop': 0.897137201869
1817}. Best is trial 0 with value: 0.3478835978835979.
```

```
[16:20:38] WARNING: C:/Users/Administrator/workspace/xgboost-win64_re
lease_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:21:08,614] Trial 1 finished with value: 0.2810846560
846561 and parameters: {'n_estimators': 2429, 'booster': 'dart', 'lam
bda': 0.7636671527772474, 'alpha': 7.146309349183957e-08, 'max_depth
': 9, 'eta': 0.0624179612551807, 'gamma': 3.2611525397506876e-05, 'gr
ow_policy': 'depthwise', 'sample_type': 'uniform', 'normalize_type':
'forest', 'rate_drop': 0.00010784598992746408, 'skip_drop': 0.0019406
153724596184}. Best is trial 0 with value: 0.3478835978835979.
```

```
[16:21:08] WARNING: C:/Users/Administrator/workspace/xgboost-win64_re
lease_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:21:45,409] Trial 2 finished with value: 0.3115079365
079365 and parameters: {'n_estimators': 4379, 'booster': 'gbtree', 'l
ambda': 0.00016116983142672636, 'alpha': 5.572063622889449e-07, 'max_
depth': 9, 'eta': 2.76194822260754e-05, 'gamma': 1.0685500282794607e-
07, 'grow_policy': 'depthwise'}. Best is trial 0 with value: 0.347883
5070005070
[16:21:45] WARNING: C:/Users/Administrator/workspace/xgboost-win64_re
lease_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:21:46,610] Trial 3 finished with value: 0.1798941798
941799 and parameters: {'n_estimators': 3135, 'booster': 'gblinear',
'lambda': 0.020694184702688093, 'alpha': 0.05313992856575968}. Best i
s trial 0 with value: 0.3478835978835979.
[16:21:46] WARNING: C:/Users/Administrator/workspace/xgboost-win64_re
lease_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:22:06,912] Trial 4 finished with value: 0.3928571428
5714285 and parameters: {'n_estimators': 6181, 'booster': 'dart', 'la
mbda': 7.239587556547766e-05, 'alpha': 0.00892739597721919, 'max_dept
h': 4, 'eta': 2.2480218093714088e-08, 'gamma': 6.497469132725624e-05,
'grow_policy': 'depthwise', 'sample_type': 'weighted', 'normalize_typ
e': 'forest', 'rate_drop': 0.9789743850128649, 'skip_drop': 0.1201027
8943039863}. Best is trial 4 with value: 0.39285714285714285.
[16:22:06] WARNING: C:/Users/Administrator/workspace/xgboost-win64_re
lease_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:22:08,596] Trial 5 finished with value: 0.3505291005
291005 and parameters: {'n_estimators': 9251, 'booster': 'gblinear',
'lambda': 0.7410197362196521, 'alpha': 0.0001727160620631625}. Best i
[16:22:08] WARNING: C:/Users/Administrator/workspace/xgboost-win64_re
lease_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:22:17,577] Trial 6 finished with value: 0.3584656084
6560854 and parameters: {'n_estimators': 9338, 'booster': 'dart', 'la
mbda': 0.006486964770538371, 'alpha': 0.020265562880031587, 'max_dept
h': 1, 'eta': 1.9253809444432e-06, 'gamma': 0.1160749866374683, 'grow
_policy': 'depthwise', 'sample_type': 'weighted', 'normalize_type': '
forest', 'rate_drop': 7.105866319735326e-05, 'skip_drop': 0.024526911
308542117}. Best is trial 4 with value: 0.39285714285714285.
```

```
[16:22:17] WARNING: C:/Users/Administrator/workspace/xgboost-win64_re
lease_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:22:22,834] Trial 7 finished with value: 0.3697089947
0899476 and parameters: {'n_estimators': 9678, 'booster': 'gbtree', '
lambda': 0.8349643199708342, 'alpha': 0.2845420304966651, 'max_depth
': 1, 'eta': 2.0249372067329178e-08, 'gamma': 0.014568224055740308, '
grow_policy': 'lossguide'}. Best is trial 4 with value: 0.39285714285
714285.
```

```
[16:22:22] WARNING: C:/Users/Administrator/workspace/xgboost-win64_re
lease_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:23:00,512] Trial 8 finished with value: 0.31613756613756616 and parameters: {'n_estimators': 879, 'booster': 'dart', 'lambda': 0.031342701664674566, 'alpha': 6.365757214274604e-05, 'max_depth': 8, 'eta': 2.0448792333288544e-07, 'gamma': 5.2850349325505785e-06, 'grow_policy': 'lossguide', 'sample_type': 'uniform', 'normalize_type': 'forest', 'rate_drop': 0.0068295334708110365, 'skip_drop': 0.00}[16:23:00] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:23:02,707] Trial 9 finished with value: 0.4080687830687831 and parameters: {'n_estimators': 7159, 'booster': 'gblinear', 'lambda': 2.5667905431292692e-05, 'alpha': 2.7857384973411782e-05}. Best is trial 9 with value: 0.4080687830687831.
```

```
[16:23:02] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:23:05,175] Trial 10 finished with value: 0.3597883597883598 and parameters: {'n_estimators': 7289, 'booster': 'gblinear', 'lambda': 8.025673709555346e-08, 'alpha': 9.757150747706117e-06}. Best is trial 9 with value: 0.4080687830687831.
```

```
[16:23:05] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.


```
[I 2022-02-03 16:23:06,735] Trial 11 finished with value: 0.4074074074074074 and parameters: {'n_estimators': 7250, 'booster': 'gblinear', 'lambda': 1.814463101513755e-07, 'alpha': 0.0005102924003405857}. Best is trial 11 with value: 0.4074074074074074
```

[16:23:06] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:23:07,735] Trial 12 finished with value: 0.4583333333333333 and parameters: {'n_estimators': 7250, 'booster': 'gblinear', 'lambda': 1.814463101513755e-07, 'alpha': 0.0005102924003405857}. Best is trial 12 with value: 0.4583333333333333.
```

[16:23:07] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:23:10,303] Trial 13 finished with value: 0.3544973544973545 and parameters: {'n_estimators': 7707, 'booster': 'gblinear', 'lambda': 1.0248514233858036e-08, 'alpha': 4.807099456085031e-06}. Best is trial 12 with value: 0.4583333333333333.
```

[16:23:10] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:23:11,788] Trial 14 finished with value: 0.46494708994708994 and parameters: {'n_estimators': 5715, 'booster': 'gblinear', 'lambda': 2.7256031470879e-06, 'alpha': 0.0003585174992460033}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:23:11] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:23:13,161] Trial 15 finished with value: 0.458994708994709 and parameters: {'n_estimators': 5560, 'booster': 'gblinear', 'lambda': 3.696340907744595e-07, 'alpha': 0.0006523722526855138}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:23:13] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:23:14,406] Trial 16 finished with value: 0.43650793650793657 and parameters: {'n_estimators': 5469, 'booster': 'gblinear', 'lambda': 2.7604501885182e-06, 'alpha': 0.0013974793271048097}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:23:14] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:23:29,449] Trial 17 finished with value: 0.4027777777777778 and parameters: {'n_estimators': 3383, 'booster': 'gbtree', 'lambda': 5.966540120969961e-06, 'alpha': 9.426250189912153e-07, 'max_depth': 3, 'eta': 0.010385173869067177, 'gamma': 1.0538133174618147e-08, 'grow_policy': 'lossguide'}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:23:29] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

```
[I 2022-02-03 16:23:30,710] Trial 18 finished with value: 0.3842592592592593 and parameters: {'n_estimators': 5500, 'booster': 'gblinear', 'lambda': 3.521919772874628e-07, 'alpha': 0.003416933798318213}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:23:30] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:23:32,314] Trial 19 finished with value: 0.45436507936507936 and parameters: {'n_estimators': 8199, 'booster': 'gblinear', 'lambda': 3.093861727680548e-08, 'alpha': 0.0002465487181457405}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:23:32] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:24:01,708] Trial 20 finished with value: 0.333994708994709 and parameters: {'n_estimators': 1615, 'booster': 'gbtree', 'lambda': 0.000515750465839128, 'alpha': 0.7928000348437134, 'max_depth': 7, 'eta': 0.0013718872524443313, 'gamma': 9.056903300472315e-07, 'grow_policy': 'lossguide'}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:24:01] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:24:02,996] Trial 21 finished with value: 0.460978835978836 and parameters: {'n_estimators': 6320, 'booster': 'gblinear', 'lambda': 2.3923320894528776e-07, 'alpha': 0.0004848417916993617}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:24:03] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:24:04,262] Trial 22 finished with value: 0.45965608465608465 and parameters: {'n_estimators': 4644, 'booster': 'gblinear', 'lambda': 7.439184267699582e-06, 'alpha': 0.0006519098304324515}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:24:04] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:24:06,155] Trial 23 finished with value: 0.4074074074074074 and parameters: {'n_estimators': 4473, 'booster': 'gblinear', 'lambda': 7.331389219579292e-06, 'alpha': 4.49589714956245e-05}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:24:06] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:24:07,240] Trial 24 finished with value: 0.35185185185185186 and parameters: {'n_estimators': 6177, 'booster': 'gblinear', 'lambda': 1.4331804560395557e-06, 'alpha': 0.007533237179372849}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:24:07] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:24:09,506] Trial 25 finished with value: 0.3862433862433862 and parameters: {'n_estimators': 3760, 'booster': 'gblinear', 'lambda': 1.2606376948049437e-05, 'alpha': 1.0722827034653243e-05}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:24:09] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:24:11,221] Trial 26 finished with value: 0.44775132275132273 and parameters: {'n_estimators': 8320, 'booster': 'gblinear', 'lambda': 5.476198532350963e-05, 'alpha': 0.0001195893931973384}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:24:11] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:24:12,353] Trial 27 finished with value: 0.4556878306878307 and parameters: {'n_estimators': 6318, 'booster': 'gblinear', 'lambda': 1.4790035378362553e-06, 'alpha': 0.0007717249801060816}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:24:12] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

```
[I 2022-02-03 16:24:13,509] Trial 28 finished with value: 0.1798941798941799 and parameters: {'n_estimators': 5024, 'booster': 'gblinear', 'lambda': 6.543803975410511e-08, 'alpha': 0.046844477237167746}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:24:13] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:24:37,012] Trial 29 finished with value: 0.25992063492063494 and parameters: {'n_estimators': 4850, 'booster': 'gbtree', 'lambda': 0.0006462710611064024, 'alpha': 2.488249502520631e-08, 'max_depth': 6, 'eta': 0.28142314358929177, 'gamma': 0.5518293576493744, 'grow_policy': 'lossguide'}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:24:37] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:24:55,456] Trial 30 finished with value: 0.4074074074074074 and parameters: {'n_estimators': 3953, 'booster': 'dart', 'lambda': 3.9598754472870956e-07, 'alpha': 1.634725626218578e-06, 'max_depth': 3, 'eta': 0.00034604987464029413, 'gamma': 0.0012308208783703381, 'grow_policy': 'depthwise', 'sample_type': 'weighted', 'normalize_type': 'tree', 'rate_drop': 3.0219713912985967e-07, 'skip_drop': 1.0811785269242431e-08}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:24:55] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:24:56,793] Trial 31 finished with value: 0.46296296296296297 and parameters: {'n_estimators': 5470, 'booster': 'gblinear', 'lambda': 5.701609359428101e-07, 'alpha': 0.0004436692303196706}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:24:56] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:24:58,191] Trial 32 finished with value: 0.458994708994709 and parameters: {'n_estimators': 2693, 'booster': 'gblinear', 'lambda': 1.7924124672015356e-05, 'alpha': 0.00033010852306418264}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:24:58] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:24:59,358] Trial 33 finished with value: 0.3578042328042328 and parameters: {'n_estimators': 5832, 'booster': 'gblinear', 'lambda': 3.184228113313104e-06, 'alpha': 0.005924809648617179}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:24:59] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
[I 2022-02-03 16:25:00,533] Trial 34 finished with value: 0.42328042328042326 and parameters: {'n_estimators': 4323, 'booster': 'gblinear', 'lambda': 1.3800064442503435e-08, 'alpha': 0.0015913780765112312}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:25:00] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:25:02,908] Trial 35 finished with value: 0.3425925925925926 and parameters: {'n_estimators': 6662, 'booster': 'gblinear', 'lambda': 1.0197880921925498e-07, 'alpha': 2.3069380170398839e-07}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:25:03] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:25:34,363] Trial 36 finished with value: 0.31812169312169314 and parameters: {'n_estimators': 4965, 'booster': 'dart', 'lambda': 5.383875954868245e-07, 'alpha': 0.00012659401548385297, 'max_depth': 6, 'eta': 0.0030836435981463958, 'gamma': 0.0008455477787145084, 'grow_policy': 'lossguide', 'sample_type': 'uniform', 'normalize_type': 'tree', 'rate_drop': 4.179873634008907e-08, 'skip_drop': 6.18855235897306e-07}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:25:34] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.


```
[I 2022-02-03 16:25:36,557] Trial 37 finished with value: 0.44576719576719576 and parameters: {'n_estimators': 2494, 'booster': 'gblinear', 'lambda': 0.00016995671601326829, 'alpha': 2.9100641298386054e-05}. Best is trial 14 with value: 0.46494708994708994.  
[16:25:36] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:25:42,448] Trial 38 finished with value: 0.1746031746031746 and parameters: {'n_estimators': 4538, 'booster': 'gbtree', 'lambda': 3.3039500837672614e-06, 'alpha': 0.026578704015797705, 'max_depth': 2, 'eta': 0.956971411120314, 'gamma': 1.0281352558973633e-08, 'grow_policy': 'lossguide'}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:25:42] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:26:07,711] Trial 39 finished with value: 0.3458994708994709 and parameters: {'n_estimators': 6006, 'booster': 'dart', 'lambda': 3.308105665937916e-05, 'alpha': 0.13708647494791085, 'max_depth': 5, 'eta': 5.475624350400075e-07, 'gamma': 5.809873639432598e-07, 'grow_policy': 'depthwise', 'sample_type': 'weighted', 'normalize_type': 'tree', 'rate_drop': 0.8879665279063366, 'skip_drop': 9.10401457954601e-06}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:26:07] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:26:08,872] Trial 40 finished with value: 0.3458994708994709 and parameters: {'n_estimators': 3356, 'booster': 'gblinear', 'lambda': 3.0125853967587e-08, 'alpha': 0.016385883231515345}. Best is trial 14 with value: 0.46494708994708994.  
[16:26:08] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:26:10,494] Trial 41 finished with value: 0.45634920634920634 and parameters: {'n_estimators': 1954, 'booster': 'gblinear', 'lambda': 1.2400165365472482e-05, 'alpha': 0.0002447138854553336}. Best is trial 14 with value: 0.46494708994708994.  
[16:26:10] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:26:11,752] Trial 42 finished with value: 0.45436507936507936 and parameters: {'n_estimators': 5611, 'booster': 'gblinear', 'lambda': 2.3993023515608314e-07, 'alpha': 0.0009588553493209887}. Best is trial 14 with value: 0.46494708994708994.  
[16:26:11] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:26:13,279] Trial 43 finished with value: 0.460978835978836 and parameters: {'n_estimators': 2711, 'booster': 'gblinear', 'lambda': 0.00013964603128948267, 'alpha': 0.0003276429002879207}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:26:13] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:26:14,457] Trial 44 finished with value: 0.3869047619047619 and parameters: {'n_estimators': 1556, 'booster': 'gblinear', 'lambda': 0.00016460765824497257, 'alpha': 0.0027550792985160965}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:26:14] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:26:16,318] Trial 45 finished with value: 0.45171957671957674 and parameters: {'n_estimators': 6717, 'booster': 'gblinear', 'lambda': 0.0008168408123694373, 'alpha': 5.904339669827144e-05}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:26:16] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:26:18,441] Trial 46 finished with value: 0.36507936507936506 and parameters: {'n_estimators': 3945, 'booster': 'gblinear', 'lambda': 8.798947834732931e-07, 'alpha': 1.2223720600350413e-05}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:26:18] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

```
This may not be accurate due to some parameters are only used in language bindings but  
[I 2022-02-03 16:26:51,942] Trial 47 finished with value: 0.31812169312169314 and parameters: {'n_estimators': 2864, 'booster': 'dart', 'lambda': 0.0037325069184799284, 'alpha': 0.00043498648346196165, 'max_depth': 7, 'eta': 0.00013558598727229294, 'gamma': 0.034476319121372334, 'grow_policy': 'depthwise', 'sample_type': 'uniform', 'normalize_type': 'tree', 'rate_drop': 4.042203853844173e-06, 'skip_drop': 1.761870917326768e-08}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:26:51] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

```
This may not be accurate due to some parameters are only used in language bindings but  
passed down to XGBoost core. Or some parameters are not used but slip through this  
verification. Please open an issue if you find above cases.
```

```
[I 2022-02-03 16:26:53,665] Trial 48 finished with value: 0.3538359788359789 and parameters: {'n_estimators': 320, 'booster': 'gblinear', 'lambda': 0.026919714157642504, 'alpha': 9.783267977157354e-05}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:26:53] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

```
This may not be accurate due to some parameters are only used in language bindings but  
passed down to XGBoost core. Or some parameters are not used but slip through this  
verification. Please open an issue if you find above cases.
```

```
[I 2022-02-03 16:26:54,874] Trial 49 finished with value: 0.35846560846560854 and parameters: {'n_estimators': 5238, 'booster': 'gblinear', 'lambda': 7.633004592630248e-05, 'alpha': 0.0056507301158675504}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:26:54] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
```

```
[I 2022-02-03 16:27:09,230] Trial 50 finished with value: 0.4027777777777778 and parameters: {'n_estimators': 7640, 'booster': 'gbtree', 'lambda': 7.645520828079309e-06, 'alpha': 0.0013398947587504584, 'max_depth': 3, 'eta': 0.01901510843489488, 'gamma': 0.6576312738639124, 'grow_policy': 'lossguide'}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:27:09] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
```

```
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:27:10,602] Trial 51 finished with value: 0.35119047619047616 and parameters: {'n_estimators': 5671, 'booster': 'gblinear', 'lambda': 0.1553850977378315, 'alpha': 0.000602843594658907}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:27:10] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
```

```
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:27:12,163] Trial 52 finished with value: 0.4583333333333333 and parameters: {'n_estimators': 2244, 'booster': 'gblinear', 'lambda': 4.8031701927750267e-05, 'alpha': 0.000199512009367097}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:27:12] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
```

```
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:27:13,630] Trial 53 finished with value: 0.46164021164021163 and parameters: {'n_estimators': 2844, 'booster': 'gblinear', 'lambda': 2.8459639487750747e-05, 'alpha': 0.0003837857673605682}. Best is trial 14 with value: 0.46494708994708994
```

```
[16:27:13] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
```

```
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:27:14,848] Trial 54 finished with value: 0.3816137566137566 and parameters: {'n_estimators': 1239, 'booster': 'gblinear', 'lambda': 0.000310400768181643, 'alpha': 0.0028048520488384897}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:27:14] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
```

```
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:27:17,054] Trial 55 finished with value: 0.3842592592592593 and parameters: {'n_estimators': 3172, 'booster': 'gblinear', 'lambda': 1.5794603393178632e-06, 'alpha': 2.5495553393573363e-05}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:27:17] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
```

```
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:27:18,984] Trial 56 finished with value: 0.42394179894179895 and parameters: {'n_estimators': 3684, 'booster': 'gblinear', 'lambda': 4.602761381087966e-06, 'alpha': 8.252702063900291e-05}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:27:19] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:27:20,369] Trial 57 finished with value: 0.42063492063492064 and parameters: {'n_estimators': 6380, 'booster': 'gblinear', 'lambda': 0.0012830666145101097, 'alpha': 0.00036791512850822947}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:27:20] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:27:21,554] Trial 58 finished with value: 0.34722222222222222 and parameters: {'n_estimators': 4675, 'booster': 'gblinear', 'lambda': 2.6148347649101958e-05, 'alpha': 0.013059843387333958}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:27:21] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:27:22,733] Trial 59 finished with value: 0.44907407407407407 and parameters: {'n_estimators': 7001, 'booster': 'gblinear', 'lambda': 8.247445492920316e-07, 'alpha': 0.0011289188478410738}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:27:22] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

```

This may not be accurate due to some parameters are only used in language bindings but
[I 2022-02-03 16:27:41,084] Trial 60 finished with value: 0.37037037037037035 and parameters: {'n_estimators': 4301, 'booster': 'gbtree', 'lambda': 1.8548667155407842e-06, 'alpha': 3.5559114809262333e-06, 'max_depth': 4, 'eta': 5.539527837815075e-06, 'gamma': 6.711906895702352e-06, 'grow_policy': 'depthwise'}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:27:41] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

```

This may not be accurate due to some parameters are only used in language bindings but
passed down to XGBoost core. Or some parameters are not used but slip through this
verification. Please open an issue if you find above cases.
```

```
[I 2022-02-03 16:27:42,610] Trial 61 finished with value: 0.4576719576719577 and parameters: {'n_estimators': 2897, 'booster': 'gblinear', 'lambda': 1.1236148907591914e-05, 'alpha': 0.0002817855040825302}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:27:42] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

```

This may not be accurate due to some parameters are only used in language bindings but
passed down to XGBoost core. Or some parameters are not used but slip through this
verification. Please open an issue if you find above cases.
```

```
[I 2022-02-03 16:27:44,317] Trial 62 finished with value: 0.44907407407407407 and parameters: {'n_estimators': 1981, 'booster': 'gblinear', 'lambda': 1.4752250022999312e-05, 'alpha': 0.00016392759475081215}. Best is trial 14 with value: 0.46494708994708994.
```



```
[16:27:44] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
[I 2022-02-03 16:27:45,641] Trial 63 finished with value: 0.45634920634920634 and parameters: {'n_estimators': 5945, 'booster': 'gblinear', 'lambda': 1.5798999571501525e-07, 'alpha': 0.0007504258446138297}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:27:45] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:27:47,142] Trial 64 finished with value: 0.460978835978836 and parameters: {'n_estimators': 2624, 'booster': 'gblinear', 'lambda': 9.6913365727387e-05, 'alpha': 0.0003545327828684248}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:27:47] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:27:49,375] Trial 65 finished with value: 0.43783068783068785 and parameters: {'n_estimators': 5180, 'booster': 'gblinear', 'lambda': 9.164359844950609e-05, 'alpha': 3.441204444775101e-05}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:27:49] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:27:50,596] Trial 66 finished with value: 0.392857142
[16:27:50] WARNING: C:/Users/Administrator/workspace/xgboost-win64_re
lease_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:28:26,811] Trial 67 finished with value: 0.314814814
8148148 and parameters: {'n_estimators': 3613, 'booster': 'dart', 'la
mbda': 3.979314194599579e-05, 'alpha': 0.004665807303601658, 'max_dep
th': 8, 'eta': 1.366237618444655e-07, 'gamma': 0.0003149478688924077,
'grow_policy': 'lossguide', 'sample_type': 'weighted', 'normalize_typ
e': 'forest', 'rate_drop': 1.0897931885057784e-08, 'skip_drop': 1.916
0487013774038e-05}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:28:26] WARNING: C:/Users/Administrator/workspace/xgboost-win64_re
lease_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:28:28,215] Trial 68 finished with value: 0.464285714
2857143 and parameters: {'n_estimators': 2374, 'booster': 'gblinear',
'lambda': 0.0002828927502780496, 'alpha': 0.0005007171784119573}. Bes
t is trial 14 with value: 0.46494708994708994.
```

```
[16:28:28] WARNING: C:/Users/Administrator/workspace/xgboost-win64_re
lease_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:28:30,244] Trial 69 finished with value: 0.355158730
1587302 and parameters: {'n_estimators': 2397, 'booster': 'gblinear',
'lambda': 0.012008677263028166, 'alpha': 6.584594372519804e-05}. Best
is trial 14 with value: 0.46494708994708994.
```

```
[16:28:30] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:28:31,854] Trial 70 finished with value: 0.4523809523809524 and parameters: {'n_estimators': 1839, 'booster': 'gblinear', 'lambda': 0.00028442569052987464, 'alpha': 0.00016042916502628484}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:28:31] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:28:32,889] Trial 71 finished with value: 0.4226190476190476 and parameters: {'n_estimators': 2207, 'booster': 'gblinear', 'lambda': 5.738156343593118e-07, 'alpha': 0.0016489940437789334}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:28:32] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:28:34,091] Trial 72 finished with value: 0.460978835978836 and parameters: {'n_estimators': 3064, 'booster': 'gblinear', 'lambda': 0.00011826944585105978, 'alpha': 0.0004497177254126299}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:28:34] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

```
[I 2022-02-03 16:28:35,242] Trial 73 finished with value: 0.39814814814814814 and parameters: {'n_estimators': 2649, 'booster': 'gblinear', 'lambda': 0.0021239637958150874, 'alpha': 0.00044585816156854455}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:28:35] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:28:37,528] Trial 74 finished with value: 0.43915343915343913 and parameters: {'n_estimators': 3058, 'booster': 'gblinear', 'lambda': 0.00035826114296996423, 'alpha': 1.8541526814829124e-05}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:28:37] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:28:38,842] Trial 75 finished with value: 0.4603174603174603 and parameters: {'n_estimators': 1457, 'booster': 'gblinear', 'lambda': 6.602688063197367e-05, 'alpha': 0.0002991715318402173}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:28:38] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:28:40,163] Trial 76 finished with value: 0.4126984126984127 and parameters: {'n_estimators': 3275, 'booster': 'gblinear', 'lambda': 0.000994584093958686, 'alpha': 0.0008294959589275479}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:28:40] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
```

```
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:28:48,905] Trial 77 finished with value: 0.419973544973545 and parameters: {'n_estimators': 3999, 'booster': 'gbtree', 'lambda': 0.00014518465615921287, 'alpha': 0.00013000486048957727, 'max_depth': 2, 'eta': 5.8132367724142394e-05, 'gamma': 2.779215524974993e-07, 'grow_policy': 'lossguide'}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:28:48] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
```

```
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:28:50,725] Trial 78 finished with value: 0.4451058201058201 and parameters: {'n_estimators': 576, 'booster': 'gblinear', 'lambda': 0.0005733269138829784, 'alpha': 5.095453967603471e-05}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:28:50] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
```

```
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:28:51,889] Trial 79 finished with value: 0.460317460
[16:28:52] WARNING: C:/Users/Administrator/workspace/xgboost-win64_re
lease_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:29:21,096] Trial 80 finished with value: 0.312169312
16931215 and parameters: {'n_estimators': 5367, 'booster': 'dart', 'l
ambda': 5.719826126649542e-08, 'alpha': 0.00021284101447988966, 'max_
depth': 7, 'eta': 0.0006034267210684825, 'gamma': 9.986559038235541e-
06, 'grow_policy': 'depthwise', 'sample_type': 'uniform', 'normalize_
type': 'forest', 'rate_drop': 0.029695543037199294, 'skip_drop': 5.19
8455193269837e-07}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:29:21] WARNING: C:/Users/Administrator/workspace/xgboost-win64_re
lease_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:29:22,404] Trial 81 finished with value: 0.460317460
3174603 and parameters: {'n_estimators': 1580, 'booster': 'gblinear',
'lambda': 7.932583590325394e-05, 'alpha': 0.00033921806903052524}. Be
st is trial 14 with value: 0.46494708994708994.
```

```
[16:29:22] WARNING: C:/Users/Administrator/workspace/xgboost-win64_re
lease_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:29:23,549] Trial 82 finished with value: 0.419312169
31216925 and parameters: {'n_estimators': 1136, 'booster': 'gblinear
', 'lambda': 5.12878997985398e-05, 'alpha': 0.0017665105804832877}. B
est is trial 14 with value: 0.46494708994708994.
```

```
[16:29:23] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:29:24,758] Trial 83 finished with value: 0.44907407407407407 and parameters: {'n_estimators': 1663, 'booster': 'gblinear', 'lambda': 2.5336815269764722e-05, 'alpha': 0.0010994576485216473}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:29:24] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:29:26,318] Trial 84 finished with value: 0.4437830687830688 and parameters: {'n_estimators': 2237, 'booster': 'gblinear', 'lambda': 0.00023883270275068124, 'alpha': 9.262583563727195e-05}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:29:26] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:29:27,372] Trial 85 finished with value: 0.375 and parameters: {'n_estimators': 2644, 'booster': 'gblinear', 'lambda': 0.0001056093959637866, 'alpha': 0.0039021727633417993}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:29:27] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

```
[I 2022-02-03 16:29:28,562] Trial 86 finished with value: 0.45105820105820105 and parameters: {'n_estimators': 6486, 'booster': 'gblinear', 'lambda': 0.0004070528739274337, 'alpha': 0.000565607301824738}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:29:28] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:29:29,768] Trial 87 finished with value: 0.46296296296296297 and parameters: {'n_estimators': 2066, 'booster': 'gblinear', 'lambda': 2.5201635999786747e-07, 'alpha': 0.00034686768243600554}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:29:29] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:29:31,065] Trial 88 finished with value: 0.4523809523809524 and parameters: {'n_estimators': 3476, 'booster': 'gblinear', 'lambda': 2.8810884543156995e-07, 'alpha': 0.00021299663169791361}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:29:31] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.


```
[I 2022-02-03 16:29:32,180] Trial 89 finished with value: 0.4537037037037037 and parameters: {'n_estimators': 2806, 'booster': 'gblinear', 'lambda': 1.3246326100878424e-07, 'alpha': 0.0009143429804235398}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:29:32] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:29:33,215] Trial 90 finished with value: 0.35185185185185186 and parameters: {'n_estimators': 3073, 'booster': 'gblinear', 'lambda': 5.270726984101242e-07, 'alpha': 0.008247991067923227}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:29:33] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:29:34,402] Trial 91 finished with value: 0.458994708994709 and parameters: {'n_estimators': 2076, 'booster': 'gblinear', 'lambda': 2.5028188779574548e-05, 'alpha': 0.0003693757853650534}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:29:34] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:29:35,880] Trial 92 finished with value: 0.43584656084656087 and parameters: {'n_estimators': 1836, 'booster': 'gblinear', 'lambda': 4.6575424614700705e-08, 'alpha': 0.00011392519067386455}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:29:35] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:29:37,029] Trial 93 finished with value: 0.460978835978836 and parameters: {'n_estimators': 5777, 'booster': 'gblinear', 'lambda': 2.2190340348782648e-07, 'alpha': 0.0005033562960172149}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:29:37] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:29:38,214] Trial 94 finished with value: 0.458994708994709 and parameters: {'n_estimators': 5763, 'booster': 'gblinear', 'lambda': 2.1727769720589154e-07, 'alpha': 0.0005396968793835583}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:29:38] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but passed down to XGBoost core. Or some parameters are not used but slip through this verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:29:39,276] Trial 95 finished with value: 0.42460317460317465 and parameters: {'n_estimators': 2527, 'booster': 'gblinear', 'lambda': 2.251798284398793e-06, 'alpha': 0.0015710543464579237}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:29:39] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

```
[I 2022-02-03 16:29:59,773] Trial 96 finished with value: 0.2619047619047619 and parameters: {'n_estimators': 6087, 'booster': 'gbtree', 'lambda': 1.078785432941085e-07, 'alpha': 0.00016080637206490497, 'max_depth': 6, 'eta': 0.23527873069609048, 'gamma': 6.187049125705596e-08, 'grow_policy': 'lossguide'}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:29:59] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:30:01,039] Trial 97 finished with value: 0.45701058201058203 and parameters: {'n_estimators': 4761, 'booster': 'gblinear', 'lambda': 1.2286311621339614e-06, 'alpha': 0.0002663843463088986}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:30:01] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:  
Parameters: { "n_estimators", "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.

```
[I 2022-02-03 16:30:02,179] Trial 98 finished with value: 0.4556878306878307 and parameters: {'n_estimators': 7053, 'booster': 'gblinear', 'lambda': 2.0407413900417627e-08, 'alpha': 0.0007838521412128375}. Best is trial 14 with value: 0.46494708994708994.
```

```
[16:30:02] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "n_estimators" "silent" } might not be used.
[I 2022-02-03 16:30:22,361] Trial 99 finished with value: 0.3716931216931217 and parameters: {'n_estimators': 5348, 'booster': 'dart', 'lambda': 3.7238537331966215e-07, 'alpha': 0.002409704391817138, 'max_depth': 4, 'eta': 1.1754370246129857e-06, 'gamma': 0.007112694277873232, 'grow_policy': 'depthwise', 'sample_type': 'weighted', 'normalize_type': 'tree', 'rate_drop': 2.418074598064315e-06, 'skip_drop': 0.0014439647559109355}. Best is trial 14 with value: 0.46494708994708994.
```

Number of finished trials: 100

Best trial:

Value: 0.46494708994708994

Params:

n_estimators: 5715

booster: gblinear

lambda: 2.7256031470879e-06

alpha: 0.0003585174992460033

```
In [34]: dtrain = xgb.DMatrix(X_train, label=y_train)
dvalid = xgb.DMatrix(X_test, label=y_test)
bst = xgb.train({"booster": "gblinear",
                "silent": 1,
                "objective": "multi:softmax",
                "eval_metric": "auc",
                "num_class": len(data['medical_specialty'].unique()),
                "lambda": 1.4191805480381518e-05,
                "alpha": 0.0009355928847260705}, dtrain)
pred = bst.predict(dvalid)
pred_labels = np rint(pred)
score = f1_score(y_test, pred_labels, average='micro')
score
```

```
[16:30:22] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.4.0/src/learner.cc:573:
Parameters: { "silent" } might not be used.
```

This may not be accurate due to some parameters are only used in language bindings but

passed down to XGBoost core. Or some parameters are not used but slip through this

verification. Please open an issue if you find above cases.

Out[34]: 0.455026455026455

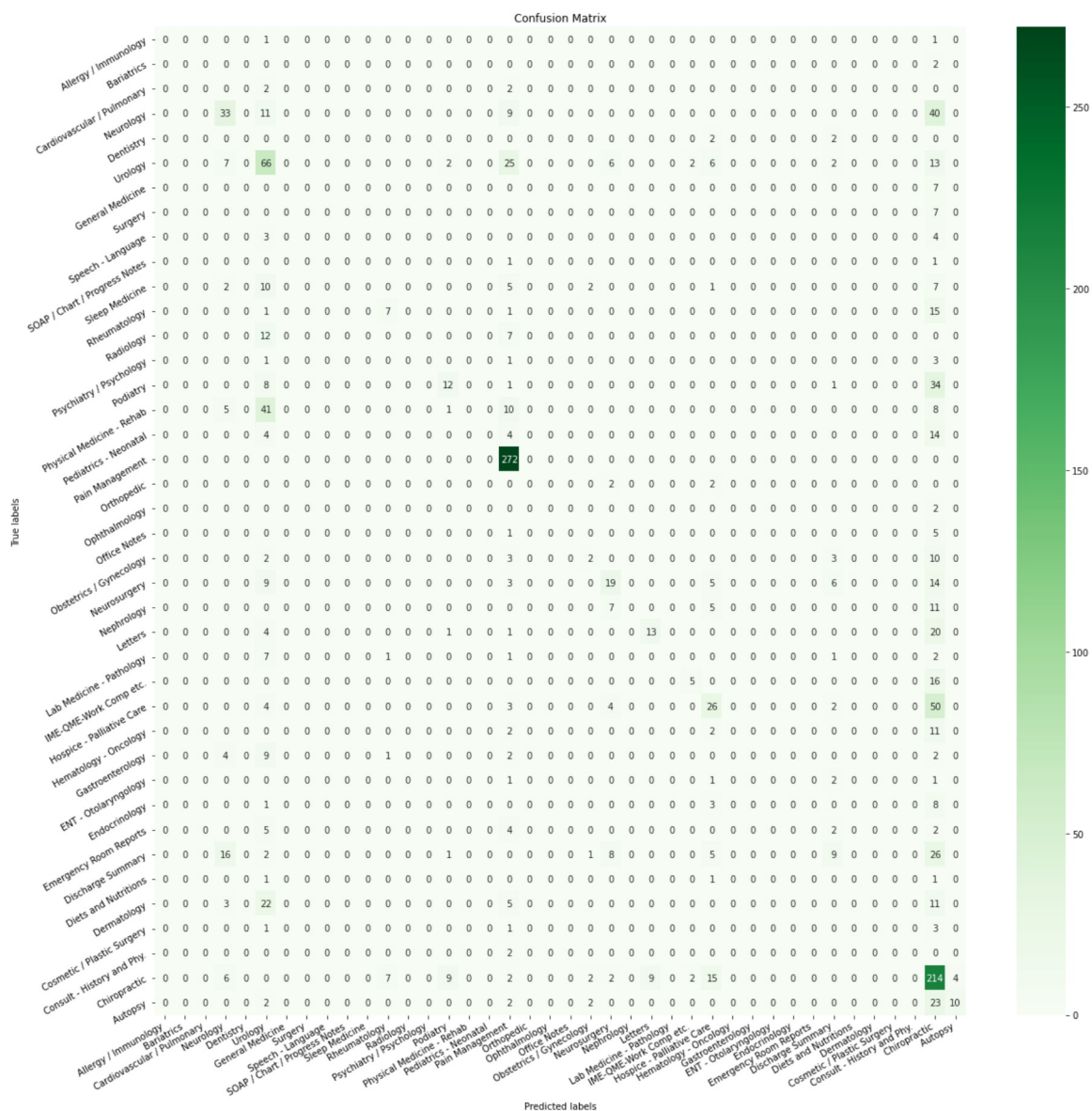
```
In [35]: from sklearn.metrics import confusion_matrix

labels = data['medical_specialty'].unique()
cm = confusion_matrix(y_test, pred)
```

```
In [36]: import seaborn as sns
from matplotlib import pyplot as plt

fig = plt.figure(figsize=(20,20))
ax= fig.add_subplot(1,1,1)
sns.heatmap(cm, annot=True, cmap="Greens",ax = ax,fmt='g');

# labels, title and ticks
ax.set_xlabel('Predicted labels');ax.set_ylabel('True labels');
ax.set_title('Confusion Matrix');
ax.xaxis.set_ticklabels(labels); ax.yaxis.set_ticklabels(labels);
plt.setp(ax.get_yticklabels(), rotation=30, horizontalalignment='right')
plt.setp(ax.get_xticklabels(), rotation=30, horizontalalignment='right')
plt.show()
```



Conclusion : Some categories are predicted well but minority classes are not predicted well. After dropping minority classes, results are going to improve signification. I have commented the code to drop minority classes but it can be uncommented and threshold can be provided according to the buisness needs.