Assignment 2 - DS4Biz Y63

TextScraping_Classification

Team Detail

Team Name: sompinandsomshine

Student 1

Student ID: 61070278
Student Full Name: นายกิตติภณ สุรุ่งเรืองสกุล

Student 2

Student ID: 61070330
Student Full Name: นางสาวอิงฟ้า ภูติวรนาถ

import package ที่ต้องใช้

- requests, bs4 ใช้ scrape ข้อมูลจากหน้าเว็บ
- pandas(pd), numpy(np) ใช้จัดการข้อมูลที่ scrape มาเช่น ทำเป็น DataFrame, แปลงเป็น csv/txt
- warnings ใช้ปิด warning ที่แจ้งเตือน
- CountVectorizer, TfidfTransformer, TfidfVectorizer ใช้เตรียมข้อมูลเช่น ทำ term weighting
- MultiLabelBinarizer
- nltk ใช้ในการประมวลผลภาษาธรรมชาติเช่น กำจัด stopwords (คำที่เกิดขึ้นบ่อยและไม่มีอิทธิพลในการจำแนก)
- train_test_split, cross_val_score, StratifiedKFold, GridSearchCV นำมาทำ model selection และหา best hyperparameter
- neighbors(KNeighborsClassifier), linear_model(LogisticRegression), ensemble(RandomForestClassifier) model ที่จะนำมาใช้ในการทำนายว่าแต่Tagsเป็นประเภทไหน

In [1]:
```
import requests
import bs4

import pandas as pd
import numpy as np
from numpy import mean
from numpy import std

import warnings
warnings.filterwarnings('ignore')

from sklearn.feature_extraction.text import CountVectorizer
from sklearn.feature_extraction.text import TfidfTransformer
from sklearn.feature_extraction.text import TfidfVectorizer

import nltk
from nltk.corpus import stopwords
```

```
from sklearn.preprocessing import MultiLabelBinarizer
from sklearn.model_selection import train_test_split
from sklearn.model_selection import cross_val_score
from sklearn.model_selection import StratifiedKFold
from sklearn.model_selection import GridSearchCV
from sklearn.model_selection import LeaveOneOut
from sklearn import metrics
from sklearn.metrics import precision_score
from sklearn.metrics import recall_score


from sklearn.neighbors import KNeighborsClassifier
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier

import matplotlib
import matplotlib.pyplot as plt
import seaborn as sns
```

Data Collection

link: https://quotes.toscrape.com/

ใช้ **requests.get** ตรวจสอบว่าลิงก์ที่ต้องการ scrape ข้อมูลสามารถเข้าได้มั้ย

In [2]:
```
response = requests.get('https://quotes.toscrape.com/page/1/')
print(response) # response 200 คือสามารถเข้าถึงได้ พร้อมดึงข้อมูลprint(type(response))
html_page = bs4.BeautifulSoup(response.content, 'html.parser')
# print(html_page)
```

```
<Response [200]>
```

website ที่ต้องการดึงข้อมูลนั้นไม่มีบอกจำนวนหน้าชัดเจนเลยทำการเช็คดูก่อนว่ามีทั้งหมดกี่หน้า โดยจะใช้ while loop วนเช็คไปเรื่อยๆ เมื่อเจอข้อความว่า **No quotes found!** ก็จะทำการหยุด loop แต่ถ้าไม่พบข้อความดังกล่าวก็จะทำการเพิ่มเลขหน้านั้นไปที่ list ที่ชื่อว่า list_page

In [3]:
```
list_page = [] #เก็บ url หน้าทั้งหมด
cur = 1 #ให้เริ่มหาตั้งแต่หน้าที่ 1
while 1: #ทำการวนลูปไปเรื่อยๆ แล้วค่อยไปหยุดตามเงื่อนไขข้างใน loop
    url = 'https://quotes.toscrape.com/page/'+str(cur)+'/' #เอา cur มาประกอบกันเป็นลิงก์
    response = requests.get(url)
    html_page = bs4.BeautifulSoup(response.content, 'html.parser')
    selector = 'body > div > div:nth-child(2) > div.col-md-8'
    tag = html_page.select_one(selector)
    #เช็คว่าเจอข้อความ error มั้ย
    if 'No quotes found!' in tag.text:
        break
    #ถ้าไม่เจอก็จะทำการเพิ่มหน้าไปที่ list_page
    else:
        list_page.append(url)
        cur += 1
```

In [4]:
```
list_page
```

Out[4]:
```
['https://quotes.toscrape.com/page/1/',
 'https://quotes.toscrape.com/page/2/',
 'https://quotes.toscrape.com/page/3/',
 'https://quotes.toscrape.com/page/4/',
 'https://quotes.toscrape.com/page/5/',
```

```
 'https://quotes.toscrape.com/page/6/',
 'https://quotes.toscrape.com/page/7/',
 'https://quotes.toscrape.com/page/8/',
 'https://quotes.toscrape.com/page/9/',
 'https://quotes.toscrape.com/page/10/']
```

In [5]:
```
#สร้าง DataFrame เพื่อรอเก็บข้อมูลที่ดึงได้
df = pd.DataFrame(columns=['content','author','tags', 'link_author'])
df
```

Out[5]:

content	author	tags	link_author

สร้าง Function ที่ใช้ดึงข้อมูลในส่วนต่างๆได้แก่ content, author, tags, link_author

โดยจะมี Function **extract_quotes** เพื่อเรียกใช้งาน Function ทั้งหมดอีกรอบนึง

In [6]:
```
# Content ดึงในส่วนของข้อความ
def extract_content(html_page):
    selector = 'div.col-md-8 > div > span.text'
    tags = html_page.select(selector)
    content = []

    for tag in tags:
        content.append(tag.text.strip().replace('“', '').replace('”', ''))

    return content
```

In [7]:
```
# Author ดึงในส่วนของชื่อผู้เขียน
def extract_author(html_page):
    selector = 'div.col-md-8 > div > span > small'
    tags = html_page.select(selector)
    author = []

    for tag in tags:
        author.append(tag.text.strip().replace('-', ' '))

    return author
```

In [8]:
```
# tags ดึงในส่วนของ tags ของข้อความ
def extract_tags(html_page):
    selector = 'div.col-md-8 > div > div > meta'
    tags = html_page.select(selector)
    quote_tags = []

    for tag in tags:
#         print(tag['content'])
        quote_tags.append(tag['content'])

    return quote_tags
```

In [9]:
```
# link_author ดึงในส่วนของลิงก์ประวัติผู้เขียน
def extract_link_author(html_page):
    selector = 'div.col-md-8 > div > span > a'
    tags = html_page.select(selector)
    link_author = []

    for tag in tags:
#         print(tag['content'])
        link_author.append('https://quotes.toscrape.com/author/' + tag['href'].s
plit('/')[-1] + '/')

    return link_author
```

In [10]:
```
#เรียกใช้งาน Function ทั้งหมดร่วมกัน
def extract_quotes(url):
    response = requests.get(url)
    html_page = bs4.BeautifulSoup(response.content, 'html.parser')

#     เอาข้อมูลที่ดึงได้มาเก็บไว้ที่ตัวแปรแต่ละตัว
    content = extract_content(html_page)
    author = extract_author(html_page)
    tags = extract_tags(html_page)
    link_author = extract_link_author(html_page)

#     เอาข้อมูลที่เก็บไว้ในตัวแปรไปสร้างเป็น DataFrame
    Alltags = {'content':content,'author':author,'tags':tags,'link_author':link_
author}
    result = pd.DataFrame(Alltags)
    return result #คืนค่า DataFrame กลับไป
```

ทำ For loop เพื่อดึงข้อมูลในแต่ละหน้าใน **list_page** โดยข้อมูลที่ดึงได้จะถูกเพิ่มไปใน df ที่สร้างไว้ก่อนหน้า

In [11]:
```
for url in list_page:
    result = extract_quotes(url)
    df = df.append(result, ignore_index=True)
df.head()
```

Out[11]:

	content	author	tags	link_author
0	The world as we have created it is a process o...	Albert Einstein	change,deep-thoughts,thinking,world	https://quotes.toscrape.com/author/Albert-Eins...
1	It is our choices, Harry, that show what we tr...	J.K. Rowling	abilities,choices	https://quotes.toscrape.com/author/J-K-Rowling/
2	There are only two ways to live your life. One...	Albert Einstein	inspirational,life,live,miracle,miracles	https://quotes.toscrape.com/author/Albert-Eins...
3	The person, be it gentleman or lady, who has n...	Jane Austen	aliteracy,books,classic,humor	https://quotes.toscrape.com/author/Jane-Austen/
4	Imperfection is beauty, madness is genius and ...	Marilyn Monroe	be-yourself,inspirational	https://quotes.toscrape.com/author/Marilyn-Mon...

scrape author detail

ดึงข้อมูลส่วนตัวของผู้เขียน

In [12]:
```
# author born date ข้อมูลวันเกิด
def born_date(html_page):
    born_date = html_page.findAll("span", {"class": "author-born-date"})
    born_date = born_date[0].text.replace(',', '').replace(' ', '-')
    return born_date
```

In [13]:
```
# author born location ข้อมูลสถานที่เกิด
def born_location(html_page):
    born_location = html_page.findAll("span", {"class": "author-born-location"})
```

```
    born_location = born_location[0].text.replace(',', '|')
    return born_location
```

In [14]:
```
# author Description คำบรรยาย
def description(html_page):
    description = html_page.findAll("div", {"class": "author-description"})
    description = description[0].text.strip()
    return description
```

In [15]:
```
# author author name ข้อมูลชื่อผู้เขียน
def author_name(html_page):
    author_name = html_page.findAll("h3", {"class": "author-title"})
    author_name = author_name[0].text.strip().replace('-', ' ')
    return author_name
```

ทำการดึงข้อมูลส่วนตัวของผู้เขียนแล้วเก็บไว้ใน list ต่างๆ

In [16]:
```
# สร้าง list เพื่อรอเก็บข้อมูลที่ดึงได้
list_born_date = []
list_born_location = []
list_description = []
list_author_name = []

for link_author in list(df['link_author'].unique()):

#     response = requests.get('https://quotes.toscrape.com/author/Albert-Einstei
n/')
    response = requests.get(link_author)
    html_page = bs4.BeautifulSoup(response.content, 'html.parser')

#     เพิ่มข้อมูลที่ดึงได้ไปใส่ไว้ใน list
    list_born_date.append(born_date(html_page))
    list_born_location.append(born_location(html_page))
    list_description.append(description(html_page))
    list_author_name.append(author_name(html_page))
```

เอา list ที่เก็บข้อมูลส่วนตัวผู้เขียนมาสร้างเป็น DataFrame

In [17]:
```
Alldetail = {'author': list_author_name, 'born_date': list_born_date, 'born_loca
tion': list_born_location, 'author_description':list_description}
author_df = pd.DataFrame(Alldetail)
```

In [18]:
```
# ตัวอย่าข้อมูลส่วนตัวผู้เขียน
author_df.head()
```

Out[18]:

	author	born_date	born_location	author_description
0	Albert Einstein	March-14-1879	in Ulm| Germany	In 1879, Albert Einstein was born in Ulm, Germ...
1	J.K. Rowling	July-31-1965	in Yate| South Gloucestershire| England| The U...	See also: Robert GalbraithAlthough she writes ...
2	Jane Austen	December-16-1775	in Steventon Rectory| Hampshire| The United Ki...	Jane Austen was an English novelist whose work...
3	Marilyn Monroe	June-01-1926	in The United States	Marilyn Monroe (born Norma Jeane Mortenson; Ju...
4	André Gide	November-22-1869	in Paris| France	André Paul Guillaume Gide was a French author ...

In [19]:
```
# ตัวอย่างข้อมูลที่ดึงไว้ในตอนแรก
df.head()
```

Out[19]:

	content	author	tags	link_author
0	The world as we have created it is a process o...	Albert Einstein	change,deep-thoughts,thinking,world	https://quotes.toscrape.com/author/Albert-Eins...
1	It is our choices, Harry, that show what we tr...	J.K. Rowling	abilities,choices	https://quotes.toscrape.com/author/J-K-Rowling/
2	There are only two ways to live your life. One...	Albert Einstein	inspirational,life,live,miracle,miracles	https://quotes.toscrape.com/author/Albert-Eins...
3	The person, be it gentleman or lady, who has n...	Jane Austen	aliteracy,books,classic,humor	https://quotes.toscrape.com/author/Jane-Austen/
4	Imperfection is beauty, madness is genius and ...	Marilyn Monroe	be-yourself,inspirational	https://quotes.toscrape.com/author/Marilyn-Mon...

จะทำการเอา 2 DataFrame มา join กัน เพื่อเพิ่มข้อมูลส่วนตัวผู้เขียนเข้าไปไว้ใน DataFrame ที่ดึงไว้ตอนแรก

In [20]:
```
# ทำการ join ข้อมูลทั้ง 2 DataFrame แล้วเก็บในตัวแปร content_author_df
content_author_df = pd.merge(df, author_df, on='author', how='left')
content_author_df.head()
```

Out[20]:

	content	author	tags	link_author	b
0	The world as we have created it is a process o...	Albert Einstein	change,deep-thoughts,thinking,world	https://quotes.toscrape.com/author/Albert-Eins...	M
1	It is our choices, Harry, that show what we tr...	J.K. Rowling	abilities,choices	https://quotes.toscrape.com/author/J-K-Rowling/	
2	There are only two ways to live your life. One...	Albert Einstein	inspirational,life,live,miracle,miracles	https://quotes.toscrape.com/author/Albert-Eins...	M
3	The person, be it gentleman or lady, who has n...	Jane Austen	aliteracy,books,classic,humor	https://quotes.toscrape.com/author/Jane-Austen/	D
4	Imperfection is beauty, madness is genius and ...	Marilyn Monroe	be-yourself,inspirational	https://quotes.toscrape.com/author/Marilyn-Mon...	

Clean missing Values

In [21]:
```
df.to_csv('datastore/content.csv', index=False)
```

In [22]:
```
df = pd.read_csv('datastore/content.csv')
df.head()
```

Out[22]:

	content	author	tags	link_author
0	The world as we have created it is a process o...	Albert Einstein	change,deep-thoughts,thinking,world	https://quotes.toscrape.com/author/Albert-Eins...
1	It is our choices, Harry, that show what we tr...	J.K. Rowling	abilities,choices	https://quotes.toscrape.com/author/J-K-Rowling/
2	There are only two ways to live your life. One...	Albert Einstein	inspirational,life,live,miracle,miracles	https://quotes.toscrape.com/author/Albert-Eins...
3	The person, be it gentleman or lady, who has n...	Jane Austen	aliteracy,books,classic,humor	https://quotes.toscrape.com/author/Jane-Austen/
4	Imperfection is beauty, madness is genius and ...	Marilyn Monroe	be-yourself,inspirational	https://quotes.toscrape.com/author/Marilyn-Mon...

ทำการเช็คข้อมูลดูว่ามีค่า null มั้ย

In [23]:
```
df.isna().sum() # เช็คค่า null
```

Out[23]:
```
content        0
author         0
tags           3
link_author    0
dtype: int64
```

พบค่า null 3 ตัวที่ column tags เลยลองค้นหาดูว่าหน้าตาเป็นยังไง

In [24]:
```
df[df['tags'].isna()]
```

Out[24]:

	content	author	tags	link_author
27	It is impossible to live without failing at so...	J.K. Rowling	NaN	https://quotes.toscrape.com/author/J-K-Rowling/
42	You believe lies so you eventually learn to tr...	Marilyn Monroe	NaN	https://quotes.toscrape.com/author/Marilyn-Mon...
78	The question isn't who is going to let me; it'...	Ayn Rand	NaN	https://quotes.toscrape.com/author/Ayn-Rand/

ทำการลบข้อมูล 3 ตัวนั้นทิ้ง

In [25]:
```
df = df.dropna(subset=['tags']) # ลบค่า null
```

In [26]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 97 entries, 0 to 99
Data columns (total 4 columns):
```

```
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   content      97 non-null     object
 1   author       97 non-null     object
 2   tags         97 non-null     object
 3   link_author  97 non-null     object
dtypes: object(4)
memory usage: 3.8+ KB
```

Change Tags(target) to Multi-Label Classification

In [27]:
```
tags_new = [] #
for i in df['tags']:
    tags_new.append(i.split(',')) #for each tags cell, create a list of items fr
om the original string, using a comma as a delimeter

# เพิ่ม tags_new ไปใน dataframe
df['tags_new'] = tags_new

## MultiLabelBinarizer takes an iterable list and turns it into columns with bin
ary values that represent the list.
## For example, [love, books] -> love and books columns with a value of 1, all o
ther columns with a value of 0

#initialize MultiLabelBinarizer
mlb = MultiLabelBinarizer()

#transform the tags_new column to a series of columns with binary values
binary_labels = pd.DataFrame(mlb.fit_transform(df['tags_new']),columns=mlb.class
es_)


#sort columns ตามตัวอักษร a-z
binary_labels = binary_labels.sort_index(axis=1)

binary_labels
```

Out[27]:

	abilities	activism	adulthood	adventure	age	alcohol	aliteracy	apathy	attributed	attributed-no-source
0	0	0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	1	0	0	0
4	0	0	0	0	0	0	0	0	0	0
...	...	...	...	...	...	...	...	...	...	...
92	0	0	0	0	0	0	0	0	0	0
93	0	0	0	0	0	0	0	0	0	0
94	0	0	0	0	0	0	0	0	0	0
95	0	0	0	0	0	0	0	0	0	0
96	0	0	0	0	0	0	0	0	0	0

97 rows × 137 columns

In [28]:
```
tags_dict = {}
# รัน for loop เพื่อเก็บ tags และจำนวนที่เจอ ไว้ใน dict
for column in binary_labels:
```

```
    sum_num = binary_labels[column].sum(axis=0)
    tags_dict.update({column : sum_num})

# sort -> tags_dict
sort_tags_dict = {k: v for k, v in sorted(tags_dict.items(), key=lambda item: it
em[1], reverse = True)};
```

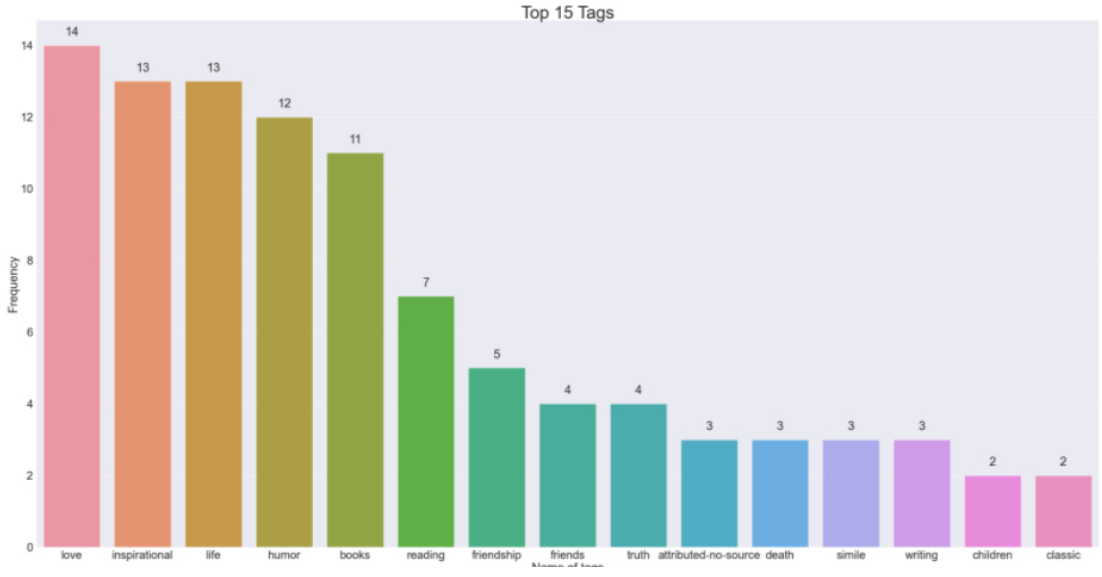
In [29]:
```
# tags ที่มีเยอะสุด 15 tags แรก
top15_tags = list(sort_tags_dict)[:15]
top15_tags
```

Out[29]:
```
['love',
 'inspirational',
 'life',
 'humor',
 'books',
 'reading',
 'friendship',
 'friends',
 'truth',
 'attributed-no-source',
 'death',
 'simile',
 'writing',
 'children',
 'classic']
```

In [30]:
```
x = top15_tags # แกน x
y = [] # แกน y
for i in top15_tags:
    y.append(sort_tags_dict[i])  # วน for เพื่อเก็บค่า y จาก dict ให้อยู่ใน list

sns.set(font_scale = 3) # ขนาดตัวอักษร
plt.figure(figsize=(55,28)) # ขนาดของกราฟ
ax = sns.barplot(x, y) # plot
plt.title("Top 15 Tags", fontsize=50)  # ชื่อกราฟ
plt.ylabel('Frequency', fontsize=35)   # ชื่อแกน x
plt.xlabel('Name of tags', fontsize=35) # ชื่อแกน y

# เพิ่มตัวเลขในแต่ละกราฟแท่ง
rects = ax.patches
labels = y
for rect, label in zip(rects, labels):
    height = rect.get_height()
    ax.text(rect.get_x() + rect.get_width()/2, height+1/5, label, ha='center', v
a='bottom', fontsize=35)
plt.show()
```



In [31]:
```
#นำ binary_labels มาต่อกับ df
df = df.merge(binary_labels, how='inner', left_index=True, right_index=True)
df.head()
```

Out[31]:

	content	author	tags	link_author
0	The world as we have created it is a process o...	Albert Einstein	change,deep-thoughts,thinking,world	https://quotes.toscrape.com/author/Albert-Eins...
1	It is our choices, Harry, that show what we tr...	J.K. Rowling	abilities,choices	https://quotes.toscrape.com/author/J-K-Rowling/
2	There are only two ways to live your life. One...	Albert Einstein	inspirational,life,live,miracle,miracles	https://quotes.toscrape.com/author/Albert-Eins...
3	The person, be it gentleman or lady, who has n...	Jane Austen	aliteracy,books,classic,humor	https://quotes.toscrape.com/author/Jane-Austen/
4	Imperfection is beauty, madness is genius and ...	Marilyn Monroe	be-yourself,inspirational	https://quotes.toscrape.com/author/Marilyn-Mon...

5 rows × 142 columns

In [32]:
```
# select column -> content,tags,top15_tags
df = df[["content", "tags"] + top15_tags]
df.head()
```

Out[32]:

	content	tags	love	inspirational	life	humor	books	reading	f
0	The world as we have created it is a process o...	change,deep-thoughts,thinking,world	0	0	0	0	0	0	
1	It is our choices, Harry, that show what we tr...	abilities,choices	0	0	0	0	0	0	
2	There are only two ways to live your life. One...	inspirational,life,live,miracle,miracles	0	1	1	0	0	0	
3	The person, be it gentleman or lady, who has n...	aliteracy,books,classic,humor	0	0	0	1	1	0	
4	Imperfection is beauty, madness is	be-yourself,inspirational	0	1	0	0	0	0	

```
genius and
...
```

save DataFarame to csv/txt

- AllArticles_OnlyContent
- tags

In [33]:
```
AllArticles_OnlyContent = df['content']
tags = df.drop(['content','tags'], axis=1)
```

csv
save เป็นไฟล์ประเภท csv

In [34]:
```
AllArticles_OnlyContent.to_csv('datastore/AllArticles_OnlyContent.csv', index=False)
```

In [35]:
```
tags.to_csv('target/tags.csv', index=False)
```

txt
save เป็นไฟล์ประเภท txt

In [36]:
```
AllArticles_OnlyContent.to_csv(r'datastore/AllArticles_OnlyContent.txt', header=None, index=None, sep=' ', mode='a')
```

In [37]:
```
tags.to_csv(r'target/tags.txt', header=None, index=None, sep=' ', mode='a')
```

Modeling

ทำการ Tunning hyperparameter และหา Model ที่ดีที่สุดในการทำนาย

- K-Nearest Neighbors
- Logistic Regression
- Random forest

Having an Imbalanced Dataset?

In [38]:
```
sum_0, sum_1 = 0, 0

# วน for นับค่า 0,1
for i in top15_tags:
    sum_0 += df[i].value_counts()[0]
    sum_1 += df[i].value_counts()[1]
```

In [ ]:
```
plt.style.use('ggplot')
labels = ['0', '1']  # แกน x
sizes = [sum_0, sum_1] # ค่าแกน y

color=['#7ed6df','#ff9999']  #สี
labels_pos = np.arange(len(labels))
plt.bar(labels_pos, sizes, color=color) # plot
```

```
matplotlib.rc('xtick', labelsize=11) # ขนาดตัวอักษรแกน x
matplotlib.rc('ytick', labelsize=11) # ขนาดตัวอักษรแกน y
plt.title("Imbalance Dataset")  # ชื่อกราฟ
plt.xticks(labels_pos, labels)
plt.show()
```

จากกราฟ ทำให้เห็นได้ว่าข้อมูลมีค่า 0 กับ 1 มีจำนวนห่างกันมาก ซึ่งหมายความข้อมูล imbalance -> จะใช้ Precision และ Recall เป็นตัววัดผล

Text preprocessing

สร้าง function ที่ต้องใช้ในการทำ preprocessing

In [40]:
```
#Tokenizer and WordNet Lemmatizer with POS (part of speech)
def lemma_tokenizer_w_pos_tag(text):
    # define a nested function for converting POS tag for Lemmatizer
    def convert_tags(tag):
        #แปลง tag ที่เป็น vbd vbg vbz ให้เป็น v
        if tag == 'vbd' or tag == 'vbg' or tag == 'vbz':
            return 'v'
        else: #นอกเหนือจากเงื่อนไขข้างบนให้เป็น n
            return 'n'

    standard_tokenizer = CountVectorizer().build_tokenizer()  #สร้างตัวที่ใช้แยก te
xt (string) ที่เข้ามาออกเป็น tokens
    tokens = standard_tokenizer(text) #แยก text (string) ที่เข้ามาออกเป็น tokens
    tokens_with_pos_tag = nltk.pos_tag(tokens) #ติด pos_tag ให้กับแต่ละ token

    lemmatizer = nltk.WordNetLemmatizer() #สร้างตัวที่ใช้แปลงรูปของคำให้อยู่รูปฟอร์มพื้น
ฐาน (รากคำ)
    lemma_tokens = [] #สร้าง list ชื่อ lemma_tokens เพื่อรอเก็บคำหลังจากแปลงด้วย pos
_tag อันใหม่
    for token in tokens_with_pos_tag: #วน for loop ในตัวแปร tokens_with_pos_tag
        new_tag = convert_tags(token[1].lower())
        lemma_tokens.append(lemmatizer.lemmatize(token[0], new_tag))

    return lemma_tokens
```

ตัวอย่างเมื่อเอาคำเข้าไปใน function lemma_tokenizer_w_pos_tag()

In [41]:
```
df['content'][0]
```

Out[41]:
```
'The world as we have created it is a process of our thinking. It cannot be cha
nged without changing our thinking.'
```

In [42]:
```
lemma_tokenizer_w_pos_tag(df['content'][0])
```

Out[42]:
```
['The',
 'world',
 'a',
 'we',
 'have',
 'created',
 'it',
 'be',
 'process',
 'of',
 'our',
 'think',
 'It',
 'cannot',
 'be',
```

```
 'changed',
 'without',
 'change',
 'our',
 'thinking']
```

In [43]:
```
#Term weighting ใน Scikit-Learn เราสามารถสร้างที่ TF-IDF weighted document-term ma
trix โดยใช้ TfidfVectorizer() แทน CountVectorizer() และ TfidfTransformer()
#default ของ analyzer คือ word, กำจัด stop_words
#มีการใช้ฟังก์ชั่น lemma_tokenizer_w_pos_tag
weight_lem = TfidfVectorizer(stop_words="english",min_df = 0,tokenizer=lemma_to
kenizer_w_pos_tag)
```

In [44]:
```
#Term weighting ใน Scikit-Learn เราสามารถสร้างที่ TF-IDF weighted document-term ma
trix โดยใช้ TfidfVectorizer() แทน CountVectorizer()
#default ของ analyzer คือ word, กำจัด stop_words
weight_non_lem = TfidfVectorizer(analyzer='word', ngram_range=(1,3),min_df = 0,
                                 stop_words = 'english', sublinear_tf=True, lowerca
se=True)
```

Create Function

In [45]:
```
# ฟังก์ชันแบ่งชุดข้อมูล
def train_test_data(tags_name, weight):
    x = df['content']
    y = df[tags_name]

    if weight: # weigh -> non Tokenizer and WordNet Lemmatizer with POS
        X = weight_non_lem.fit_transform(x)
    else: # weigh -> Tokenizer and WordNet Lemmatizer with POS
        X = weight_lem.fit_transform(x)

    # #แบ่งข้อมูลเป็น 2 ส่วน train 90% test 10% เพราะข้อมูลเรามีน้อย
    X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.1, sh
uffle=True)

    return X_train, X_test, y_train, y_test
```

In [46]:
```
# ฟังก์ชันสร้างโมเดล
def create_model(model, params, weight):
    accuracy_list = []
    precision_list = []
    recall_list = []

    for tags_name in top15_tags:
        # เรียกใช้ฟังก์ชั่น split -> train, test
        X_train, X_test, y_train, y_test = train_test_data(tags_name, weight)

        # GridSearchCV
        skf = StratifiedKFold(n_splits=5, shuffle = True, random_state = 1001)
#ทำการกำหนดเครื่องมือ K-fold ว่าจะใช้ 5 folds โดย StratifiedKFold เป็นการแบ่งข้อมูลรูป
แบบหนึ่ง
        #เอา Classifier, params ใส่ลงไปและ กำหนด cv ด้วย k-flod ที่เรากำหนดไว้ในตัว
แปร skf
        grid = GridSearchCV(model, params, verbose = 3, cv=skf.split(X_train,y_
train), n_jobs = -1)
        grid.fit(X_train, y_train); #เอา GridSearchCV มา fit กับ train set

        # กำหนด parameter ตามที่หาได้ -> best parameter
        best_params = grid.best_params_
```

```
        model.set_params(**best_params)

        # ทำการ fit model กับ parameter ที่ดีที่สุดที่วิเคราะห์มาได้
        model.fit(X_train, y_train)

        # เอา model ที่ใช้ parameter ที่ดีที่สุดมา test กับ test set ที่แบ่งไว้ตอนแรก
        model_pred = model.predict(X_test)

        # หา accuracy ด้วย cross_val_score -> LeaveOneOut ซึ่งเหมาะกับข้อมูลน้อยๆ
        cv = LeaveOneOut()
        scores = cross_val_score(model, X_train, y_train, scoring='accuracy', c
v=cv, n_jobs = -1)
        accuracy_list.append(mean(scores))
        print('%s -> Accuracy: %.3f (%.3f)' % (tags_name ,mean(scores), std(sco
res)))

        # หา precision
        precision = metrics.precision_score(y_test, model_pred, average='macr
o')
        precision_list.append(precision)
        print('Precision Score: %.3f' % precision)

        # หา recall
        recall = metrics.recall_score(y_test, model_pred, average='macro')
        recall_list.append(recall)
        print('recall Score: %.3f' % recall)

    return (accuracy_list, precision_list, recall_list)
```

In [47]:
```
# dict เก็บค่า Accuracy, Precision, Recall ของทุกโมเดล
evaluation_models = {'Model':['KNN_weight_lem', 'Knn_weight_non_lem','lg_weight
_lem', 'lg_weight_non_lem', 'rf_weight_lem', 'rf_weight_non_lem'],
                     'Accuracy':[], 'Precision':[], 'Recall':[]}
```

In [48]:
```
# ฟังก์ชันแสดงตารางเปรียบเทียบค่า Accuracy, Precision, Recall แต่ละ tags
def evaluation_table(accuacy, precision, recall):
    data = {'Tags': np.array(top15_tags), 'Accuracy': np.array(accuacy),
            'Precision': np.array(precision), 'Recall': np.array(recall)}
    df = pd.DataFrame(data=data)
    # เรียงค่าจากมากไปน้อยตามค่า Precision
    df = df.sort_values(by=['Precision'], ascending=False).reset_index(drop=Tru
e)

    # เพิ่ม Row ที่เป็นค่าเฉลี่ยของ Accuracy, Precision, Recall
    df = df.append({'Tags' : 'Average' ,
                            'Accuracy' : (sum(accuacy)/15),
                            'Precision' : (sum(precision)/15),
                            'Recall': (sum(recall)/15)} , ignore_index=True)

    # highlight ค่า Average เพื่อให้มองเห็นได้ชัดเจน
    color = (df['Tags'] == 'Average').map({True: 'background-color: yellow', Fa
lse: ''})
    df = df.style.apply(lambda s: color)

    # เพิ่มค่า Accuracy, Precision, Recall เข้า Dict -> evaluation_models เพื่อเอาไว้ไ
ปแสดงเปรียบเทียบตอนสรุปผล
    evaluation_models['Accuracy'].append(sum(accuacy)/15)
    evaluation_models['Precision'].append(sum(precision)/15)
    evaluation_models['Recall'].append(sum(recall)/15)

    return df
```

K-Nearest Neighbors

KNN Tunning parameter แบบ weight มี Lemmatizer

In [49]:
```
knn = KNeighborsClassifier() # สร้าง K-Nearest Neighbors classifier

#ทำการกำหนด parameter ที่จะเอาไปวิเคราะห์ โดยค่าที่กำหนดไว้คือ parameter ของ knn
params = {
    'n_neighbors' : list(np.arange(1,50,2)), #ให้ทำการทดลองหา k ที่ดีที่สุดตั้ง 1-50 โดยขยับทีละ 2 เช่น 1, 3, 5, ...
    'weights' : ['uniform', 'distance'],  #weight function ที่ใช้ในการทำนาย
    'metric' : ['euclidean', 'manhattan'] #คิดระยะหางด้วยวิธีไหน
}
```

In [50]:
```
# เรียกใช้ฟังก์ชัน create_model
accuracy_list, precision_list, recall_list = create_model(knn, params, False)
```

```
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    3.2s
[Parallel(n_jobs=-1)]: Done 333 tasks      | elapsed:    3.8s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    4.0s finished

love -> Accuracy: 0.857 (0.350)
Precision Score: 0.944
recall Score: 0.750
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.6s finished

inspirational -> Accuracy: 0.857 (0.350)
Precision Score: 0.400
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.9s finished

life -> Accuracy: 0.857 (0.350)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.7s finished

humor -> Accuracy: 0.893 (0.309)
Precision Score: 0.400
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.5s finished

books -> Accuracy: 0.881 (0.324)
Precision Score: 0.400
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.5s finished

reading -> Accuracy: 0.917 (0.276)
```

```
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.6s finished

friendship -> Accuracy: 0.940 (0.237)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.6s finished

friends -> Accuracy: 0.964 (0.186)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.6s finished

truth -> Accuracy: 0.952 (0.213)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.6s finished

attributed-no-source -> Accuracy: 0.976 (0.152)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.5s finished

death -> Accuracy: 0.964 (0.186)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.5s finished

simile -> Accuracy: 0.976 (0.152)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.6s finished

writing -> Accuracy: 0.976 (0.152)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.6s finished
```

```
children -> Accuracy: 0.976 (0.152)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
```

```
classic -> Accuracy: 0.976 (0.152)
Precision Score: 1.000
recall Score: 1.000
```

```
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.6s finished
```

In [51]:
```
# เรียกใช้ฟังก์ชัน evaluation_table เพื่อแสดงตารางเปรียบเทียบ
evaluation_table(accuracy_list, precision_list, recall_list)
```

Out[51]:

	Tags	Accuracy	Precision	Recall
0	life	0.857143	1.000000	1.000000
1	reading	0.916667	1.000000	1.000000
2	friendship	0.940476	1.000000	1.000000
3	truth	0.952381	1.000000	1.000000
4	attributed-no-source	0.976190	1.000000	1.000000
5	death	0.964286	1.000000	1.000000
6	simile	0.976190	1.000000	1.000000
7	classic	0.976190	1.000000	1.000000
8	love	0.857143	0.944444	0.750000
9	friends	0.964286	0.450000	0.500000
10	writing	0.976190	0.450000	0.500000
11	children	0.976190	0.450000	0.500000
12	inspirational	0.857143	0.400000	0.500000
13	humor	0.892857	0.400000	0.500000
14	books	0.880952	0.400000	0.500000
15	Average	0.930952	0.766296	0.783333

KNN Tunning parameter แบบ weight ไม่มี Lemmatizer

In [52]:
```
knn = KNeighborsClassifier() # สร้าง K-Nearest Neighbors classifier

#ทำการกำหนด parameter ที่จะเอาไปวิเคราะห์ โดยค่าที่กำหนดไว้คือ parameter ของ knn
params = {
    'n_neighbors' : list(np.arange(1,50,2)),
    'weights' : ['uniform', 'distance'],
    'metric' : ['euclidean', 'manhattan']
}
```

In [53]:
```
# เรียกใช้ฟังก์ชัน create_model
accuracy_list,precision_list,recall_list = create_model(knn, params, True)
```

```
Fitting 5 folds for each of 100 candidates, totalling 500 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.8s finished
```

```
love -> Accuracy: 0.857 (0.350)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.6s finished

inspirational -> Accuracy: 0.845 (0.362)
Precision Score: 0.400
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.6s finished
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.

life -> Accuracy: 0.881 (0.324)
Precision Score: 0.400
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.6s finished

humor -> Accuracy: 0.881 (0.324)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.6s finished

books -> Accuracy: 0.881 (0.324)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.6s finished
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.

reading -> Accuracy: 0.929 (0.258)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.6s finished
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.

friendship -> Accuracy: 0.940 (0.237)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.5s finished
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.

friends -> Accuracy: 0.964 (0.186)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.5s finished
```

```
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.5s finished
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.

truth -> Accuracy: 0.952 (0.213)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.6s finished

attributed-no-source -> Accuracy: 0.964 (0.186)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.6s finished

death -> Accuracy: 0.976 (0.152)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.5s finished
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.

simile -> Accuracy: 0.976 (0.152)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.6s finished

writing -> Accuracy: 0.976 (0.152)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.6s finished

children -> Accuracy: 0.976 (0.152)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.6s finished

classic -> Accuracy: 0.988 (0.108)
Precision Score: 0.450
recall Score: 0.500
```

In [54]:
```
# เรียกใช้ฟังก์ชัน evaluation_table เพื่อแสดงตารางเปรียบเทียบ
evaluation_table(accuracy_list, precision_list, recall_list)
```

Out[54]:

	Tags	Accuracy	Precision	Recall
0	friendship	0.940476	1.000000	1.000000
1	truth	0.952381	1.000000	1.000000
2	attributed-no-source	0.964286	1.000000	1.000000

3	simile	0.976190	1.000000	1.000000
4	children	0.976190	1.000000	1.000000
5	love	0.857143	0.450000	0.500000
6	humor	0.880952	0.450000	0.500000
7	books	0.880952	0.450000	0.500000
8	reading	0.928571	0.450000	0.500000
9	friends	0.964286	0.450000	0.500000
10	death	0.976190	0.450000	0.500000
11	writing	0.976190	0.450000	0.500000
12	classic	0.988095	0.450000	0.500000
13	inspirational	0.845238	0.400000	0.500000
14	life	0.880952	0.400000	0.500000
15	Average	0.932540	0.626667	0.666667

Logistic Regression

Logistic Regression Tunning parameter แบบ weight มี Lemmatizer

In [57]:
```
lg= LogisticRegression()  # สร้าง Logistic Regression classifier

#ทำการกำหนด parameter ที่จะเอาไปวิเคราะห์ โดยค่าที่กำหนดไว้คือ parameter ของ Logisti
c Regression
params = {"C":np.logspace(-4, 4, 50),
          "penalty":["l1","l2"]  # l1 lasso l2 ridge
         }
```

In [58]:
```
# เรียกใช้ฟังก์ชัน create_model
accuracy_list,precision_list,recall_list = create_model(lg, params, False)
```

```
Fitting 5 folds for each of 100 candidates, totalling 500 fits
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.9s finished
love -> Accuracy: 0.881 (0.324)
Precision Score: 0.400
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    0.9s finished
inspirational -> Accuracy: 0.869 (0.337)
Precision Score: 0.400
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    1.3s finished
life -> Accuracy: 0.893 (0.309)
```

```
Precision Score: 0.350
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    1.2s finished

humor -> Accuracy: 0.869 (0.337)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    1.0s finished

books -> Accuracy: 0.893 (0.309)
Precision Score: 0.400
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    1.0s finished

reading -> Accuracy: 0.929 (0.258)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    1.3s finished

friendship -> Accuracy: 0.940 (0.237)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    1.3s finished

friends -> Accuracy: 0.952 (0.213)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    1.7s finished

truth -> Accuracy: 0.964 (0.186)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.1s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    1.4s finished

attributed-no-source -> Accuracy: 0.964 (0.186)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    1.1s finished
```

```
death -> Accuracy: 0.964 (0.186)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    1.3s finished
```

```
simile -> Accuracy: 0.976 (0.152)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  18 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    1.1s finished
```

```
writing -> Accuracy: 0.976 (0.152)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    1.2s finished
```

```
children -> Accuracy: 0.976 (0.152)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    1.2s finished
```

```
classic -> Accuracy: 0.976 (0.152)
Precision Score: 1.000
recall Score: 1.000
```

In [59]:
```
# เรียกใช้ฟังก์ชัน evaluation_table เพื่อแสดงตารางเปรียบเทียบ
evaluation_table(accuracy_list, precision_list, recall_list)
```

Out[59]:

	Tags	Accuracy	Precision	Recall
0	humor	0.869048	1.000000	1.000000
1	friendship	0.940476	1.000000	1.000000
2	friends	0.952381	1.000000	1.000000
3	attributed-no-source	0.964286	1.000000	1.000000
4	death	0.964286	1.000000	1.000000
5	simile	0.976190	1.000000	1.000000
6	children	0.976190	1.000000	1.000000
7	classic	0.976190	1.000000	1.000000
8	reading	0.928571	0.450000	0.500000
9	truth	0.964286	0.450000	0.500000
10	writing	0.976190	0.450000	0.500000
11	love	0.880952	0.400000	0.500000
12	inspirational	0.869048	0.400000	0.500000
13	books	0.892857	0.400000	0.500000
14	life	0.892857	0.350000	0.500000

15		Average	0.934921	0.726667	0.766667

Logistic Regression Tunning parameter แบบ weight ไม่มี Lemmatizer

In [64]:
```
lg= LogisticRegression()  # สร้าง Logistic Regression classifier

#ทำการกำหนด parameter ที่จะเอาไปวิเคราะห์ โดยค่าที่กำหนดไว้คือ parameter ของ Logisti
c Regression
params = {"C":np.logspace(-4, 4, 50),
          "penalty":["l1","l2"]  # l1 lasso l2 ridge
         }
```

In [65]:
```
# เรียกใช้ฟังก์ชัน create_model
accuracy_list,precision_list,recall_list = create_model(lg, params, True)
```

```
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.1s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    2.6s finished

love -> Accuracy: 0.881 (0.324)
Precision Score: 0.350
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    2.3s finished

inspirational -> Accuracy: 0.845 (0.362)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.1s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    2.7s finished

life -> Accuracy: 0.881 (0.324)
Precision Score: 0.400
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  18 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    1.5s finished

humor -> Accuracy: 0.905 (0.294)
Precision Score: 0.350
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.1s
[Parallel(n_jobs=-1)]: Done 368 tasks      | elapsed:    2.8s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    3.8s finished

books -> Accuracy: 0.881 (0.324)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.1s
```

```
[Parallel(n_jobs=-1)]: Done 368 tasks      | elapsed:    2.2s
[Parallel(n_jobs=-1)]: Done 485 out of 500 | elapsed:    2.9s remaining:    0.0
s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    3.0s finished
```

```
reading -> Accuracy: 0.929 (0.258)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.1s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    2.6s finished
```

```
friendship -> Accuracy: 0.952 (0.213)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.1s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    2.9s finished
```

```
friends -> Accuracy: 0.952 (0.213)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.1s
[Parallel(n_jobs=-1)]: Done 368 tasks      | elapsed:    2.1s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    2.6s finished
```

```
truth -> Accuracy: 0.976 (0.152)
Precision Score: 0.400
recall Score: 0.500
Fitting 5 folds for each of 100 candidates, totalling 500 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    2.5s finished
```

```
attributed-no-source -> Accuracy: 0.964 (0.186)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.1s
[Parallel(n_jobs=-1)]: Done 387 tasks      | elapsed:    1.8s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    2.2s finished
```

```
death -> Accuracy: 0.964 (0.186)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    1.5s finished
```

```
simile -> Accuracy: 0.976 (0.152)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    2.6s finished
```

```
uniting -> Accuracy: 0.964 (0.186)
```

```
writing -> Accuracy: 0.964 (0.186)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.1s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    2.4s finished

children -> Accuracy: 0.976 (0.152)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 100 candidates, totalling 500 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  17 tasks      | elapsed:    0.0s
[Parallel(n_jobs=-1)]: Done 500 out of 500 | elapsed:    2.3s finished

classic -> Accuracy: 0.976 (0.152)
Precision Score: 1.000
recall Score: 1.000
```

In [66]:
```
# เรียกใช้ฟังก์ชัน evaluation_table เพื่อแสดงตารางเปรียบเทียบ
evaluation_table(accuracy_list, precision_list, recall_list)
```

Out[66]:

	Tags	Accuracy	Precision	Recall
0	inspirational	0.845238	1.000000	1.000000
1	friends	0.952381	1.000000	1.000000
2	attributed-no-source	0.964286	1.000000	1.000000
3	death	0.964286	1.000000	1.000000
4	simile	0.976190	1.000000	1.000000
5	writing	0.964286	1.000000	1.000000
6	children	0.976190	1.000000	1.000000
7	classic	0.976190	1.000000	1.000000
8	books	0.880952	0.450000	0.500000
9	reading	0.928571	0.450000	0.500000
10	friendship	0.952381	0.450000	0.500000
11	life	0.880952	0.400000	0.500000
12	truth	0.976190	0.400000	0.500000
13	love	0.880952	0.350000	0.500000
14	humor	0.904762	0.350000	0.500000
15	Average	0.934921	0.723333	0.766667

Random Forest

Random Forest Tunning parameter แบบ weight มี Lemmatizer

In [67]:
```
rf = RandomForestClassifier() # สร้าง Random Forest classifier

#ทำการกำหนด parameter ที่จะเอาไปวิเคราะห์ โดยค่าที่กำหนดไว้คือ parameter ของ Random
Forest
```

```
params = {
    'n_estimators' : [200, 500],
    'max_features' : ['auto', 'sqrt', 'log2'],
    'max_depth' : [4,5,6,7,8]
#     'criterion' : ['gini', 'entropy']
}
```

In [68]:
```
# เรียกใช้ฟังก์ชัน create_model
accuracy_list,precision_list,recall_list = create_model(rf, params, False)
```

```
Fitting 5 folds for each of 30 candidates, totalling 150 fits
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    3.7s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   27.1s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   37.7s finished
love -> Accuracy: 0.881 (0.324)
Precision Score: 0.350
recall Score: 0.500
Fitting 5 folds for each of 30 candidates, totalling 150 fits
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    5.5s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   31.3s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   42.1s finished
inspirational -> Accuracy: 0.857 (0.350)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 30 candidates, totalling 150 fits
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    5.7s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   33.2s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   43.9s finished
life -> Accuracy: 0.869 (0.337)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 30 candidates, totalling 150 fits
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    5.6s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   33.1s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   45.1s finished
humor -> Accuracy: 0.881 (0.324)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 30 candidates, totalling 150 fits
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    5.5s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   33.2s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   45.1s finished
books -> Accuracy: 0.869 (0.337)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 30 candidates, totalling 150 fits
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    5.7s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   32.9s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   44.5s finished
reading -> Accuracy: 0.917 (0.276)
Precision Score: 1.000
```

```
recall Score: 1.000
Fitting 5 folds for each of 30 candidates, totalling 150 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    5.5s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   36.6s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   47.5s finished

friendship -> Accuracy: 0.952 (0.213)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 30 candidates, totalling 150 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    3.6s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   24.2s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   32.4s finished

friends -> Accuracy: 0.964 (0.186)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 30 candidates, totalling 150 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    3.3s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   23.0s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   31.7s finished

truth -> Accuracy: 0.952 (0.213)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 30 candidates, totalling 150 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    5.0s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   24.4s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   32.5s finished

attributed-no-source -> Accuracy: 0.964 (0.186)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 30 candidates, totalling 150 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    3.8s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   24.0s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   32.1s finished

death -> Accuracy: 0.964 (0.186)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 30 candidates, totalling 150 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    3.3s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   23.3s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   31.8s finished

simile -> Accuracy: 0.988 (0.108)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 30 candidates, totalling 150 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    3.7s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   26.2s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   35.9s finished

writing -> Accuracy: 0.964 (0.186)
Precision Score: 1.000
```

```
recall Score: 1.000
Fitting 5 folds for each of 30 candidates, totalling 150 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    3.3s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   23.6s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   32.9s finished
```

```
children -> Accuracy: 0.988 (0.108)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 30 candidates, totalling 150 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    4.3s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   26.1s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   36.6s finished
```

```
classic -> Accuracy: 0.976 (0.152)
Precision Score: 1.000
recall Score: 1.000
```

In [69]:
```
# เรียกใช้ฟังก์ชัน evaluation_table เพื่อแสดงตารางเปรียบเทียบ
evaluation_table(accuracy_list, precision_list, recall_list)
```

Out[69]:

	Tags	Accuracy	Precision	Recall
0	books	0.869048	1.000000	1.000000
1	reading	0.916667	1.000000	1.000000
2	truth	0.952381	1.000000	1.000000
3	attributed-no-source	0.964286	1.000000	1.000000
4	death	0.964286	1.000000	1.000000
5	writing	0.964286	1.000000	1.000000
6	classic	0.976190	1.000000	1.000000
7	inspirational	0.857143	0.450000	0.500000
8	life	0.869048	0.450000	0.500000
9	humor	0.880952	0.450000	0.500000
10	friendship	0.952381	0.450000	0.500000
11	friends	0.964286	0.450000	0.500000
12	simile	0.988095	0.450000	0.500000
13	children	0.988095	0.450000	0.500000
14	love	0.880952	0.350000	0.500000
15	Average	0.932540	0.700000	0.733333

Random Forest Tunning parameter แบบ weight ไม่มี Lemmatizer

In [70]:
```
rf = RandomForestClassifier() # สร้าง Random Forest classifier

#ทำการกำหนด parameter ที่จะเอาไปวิเคราะห์ โดยค่าที่กำหนดไว้คือ parameter ของ Random Forest
params = {
    'n_estimators' : [200, 500],
    'max_features' : ['auto', 'sqrt', 'log2'],
    'max_depth' : [4,5,6,7,8]
#     'criterion' : ['gini', 'entropy']
}
```

In [72]:
```
# เรียกใช้ฟังก์ชัน create_model
accuracy_list,precision_list,recall_list = create_model(rf, params, True)
```

```
Fitting 5 folds for each of 30 candidates, totalling 150 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    4.6s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   18.0s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   23.4s finished

love -> Accuracy: 0.869 (0.337)
Precision Score: 0.400
recall Score: 0.500
Fitting 5 folds for each of 30 candidates, totalling 150 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    2.6s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   18.0s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   23.1s finished

inspirational -> Accuracy: 0.881 (0.324)
Precision Score: 0.350
recall Score: 0.500
Fitting 5 folds for each of 30 candidates, totalling 150 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    2.3s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   14.9s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   19.6s finished

life -> Accuracy: 0.881 (0.324)
Precision Score: 0.400
recall Score: 0.500
Fitting 5 folds for each of 30 candidates, totalling 150 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    3.0s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   15.4s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   21.1s finished

humor -> Accuracy: 0.893 (0.309)
Precision Score: 0.400
recall Score: 0.500
Fitting 5 folds for each of 30 candidates, totalling 150 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    2.3s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   15.7s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   21.2s finished

books -> Accuracy: 0.881 (0.324)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 30 candidates, totalling 150 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    2.4s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   15.8s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   21.0s finished

reading -> Accuracy: 0.929 (0.258)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 30 candidates, totalling 150 fits

[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    2.3s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   15.6s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   21.1s finished
```

```
friendship -> Accuracy: 0.940 (0.237)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 30 candidates, totalling 150 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    2.3s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   15.3s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   20.9s finished
```

```
friends -> Accuracy: 0.952 (0.213)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 30 candidates, totalling 150 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    2.5s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   15.7s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   21.2s finished
```

```
truth -> Accuracy: 0.952 (0.213)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 30 candidates, totalling 150 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    2.3s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   15.6s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   20.8s finished
```

```
attributed-no-source -> Accuracy: 0.976 (0.152)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 30 candidates, totalling 150 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    2.4s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   15.7s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   20.5s finished
```

```
death -> Accuracy: 0.976 (0.152)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 30 candidates, totalling 150 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    2.7s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   15.5s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   20.6s finished
```

```
simile -> Accuracy: 0.988 (0.108)
Precision Score: 0.450
recall Score: 0.500
Fitting 5 folds for each of 30 candidates, totalling 150 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    2.5s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   17.8s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   23.5s finished
```

```
writing -> Accuracy: 0.964 (0.186)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 30 candidates, totalling 150 fits
```

```
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    2.5s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   14.7s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   20.0s finished
```

```
children -> Accuracy: 0.976 (0.152)
Precision Score: 1.000
recall Score: 1.000
Fitting 5 folds for each of 30 candidates, totalling 150 fits
[Parallel(n_jobs=-1)]: Using backend LokyBackend with 8 concurrent workers.
[Parallel(n_jobs=-1)]: Done  16 tasks      | elapsed:    2.2s
[Parallel(n_jobs=-1)]: Done 112 tasks      | elapsed:   15.2s
[Parallel(n_jobs=-1)]: Done 150 out of 150 | elapsed:   19.9s finished
classic -> Accuracy: 0.976 (0.152)
Precision Score: 1.000
recall Score: 1.000
```

In [73]:
```
# เรียกใช้ฟังก์ชัน evaluation_table เพื่อแสดงตารางเปรียบเทียบ
evaluation_table(accuracy_list, precision_list, recall_list)
```

Out[73]:

	Tags	Accuracy	Precision	Recall
0	friendship	0.940476	1.000000	1.000000
1	friends	0.952381	1.000000	1.000000
2	truth	0.952381	1.000000	1.000000
3	writing	0.964286	1.000000	1.000000
4	children	0.976190	1.000000	1.000000
5	classic	0.976190	1.000000	1.000000
6	books	0.880952	0.450000	0.500000
7	reading	0.928571	0.450000	0.500000
8	attributed-no-source	0.976190	0.450000	0.500000
9	death	0.976190	0.450000	0.500000
10	simile	0.988095	0.450000	0.500000
11	love	0.869048	0.400000	0.500000
12	life	0.880952	0.400000	0.500000
13	humor	0.892857	0.400000	0.500000
14	inspirational	0.880952	0.350000	0.500000
15	Average	0.935714	0.653333	0.700000

Conclusion

หลังจากทำการทดสอบ model ทุกแบบแล้ว จึงนำ Accuracy, Precision, Recall ที่ได้มาเปรียบเทียบกัน แต่เนื่องข้อมูล imbalance จึงดูแค่ Precision และ Recall เป็นหลัก

In [83]:
```
# สร้างตารางเปรียบเทียบของแต่ละโมเดล
data = {'Model': np.array(evaluation_models['Model']),
        'Accuracy': np.array(evaluation_models['Accuracy']),
        'Precision': np.array(evaluation_models['Precision']),
        'Recall': np.array(evaluation_models['Recall'])}
evaluation_df = pd.DataFrame(data=data)

#ทำการเรียงลำดับตามค่า Precision โดยเรียงจากมากไปน้อย
evaluation_df = evaluation_df.sort_values(by=['Precision'], ascending=False).re
set_index(drop=True)
```

```
evaluation_df
```

Out[83]:

	Model	Accuracy	Precision	Recall
0	KNN_weight_lem	0.930952	0.766296	0.783333
1	lg_weight_lem	0.934921	0.726667	0.766667
2	lg_weight_non_lem	0.934921	0.723333	0.766667
3	rf_weight_lem	0.932540	0.700000	0.733333
4	rf_weight_non_lem	0.935714	0.653333	0.700000
5	Knn_weight_non_lem	0.932540	0.626667	0.666667

สรุปผล: Model KNN ที่ใช้วิธี Term weighting แบบใช้ฟังก์ชั่น lemma_tokenizer_w_pos_tag ให้ค่า Precision และ Recall สูงที่สุด