# DataHacks2021 2021 - Team No Sleep

**Team: Kenneth Nguyen, Ishaan Gupta, Richard Xu, Ethan Tran**

## Introduction

For this project, our team was provided a dataset that contained information about the word counts for **8265 words** across **8 religious texts**. We were tasked with cleaning the dataset and looking at different trends that may exist in the data. Using different Python libraries and statistical methods, we were able to observe some interesting trends in the data.

In [2]:

```
# imports
import pandas as pd
import numpy as np
import umap
import matplotlib.pyplot as plt
from sklearn.preprocessing import RobustScaler
import seaborn as sns
from sklearn.decomposition import PCA
import scipy.stats as ss
from sklearn.cluster import KMeans
```

In [3]:

```
df = pd.read_csv('AllBooks_baseline_DTM_Labelled.csv')
```

Currently, the first column is the book and chpater all other columns represent words.

In [4]:

```
df
```

Out[4]:

| | Unnamed: 0 | foolishness | hath | wholesome | takest | feelings | anger | vaivaswata | ma |
|---|---|---|---|---|---|---|---|---|---|
| **0** | Buddhism_Ch1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| **1** | Buddhism_Ch2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| **2** | Buddhism_Ch3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| **3** | Buddhism_Ch4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| **4** | Buddhism_Ch5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| **...** | ... | ... | ... | ... | ... | ... | ... | ... | |
| **585** | BookOfWisdom_Ch15 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | |
| **586** | BookOfWisdom_Ch16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| **587** | BookOfWisdom_Ch17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| **588** | BookOfWisdom_Ch18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| **589** | BookOfWisdom_Ch19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

590 rows × 8267 columns

Since distribution of words in each chapter of a book might not represent that of the book as whaole very well, we combine the word counts for each book across their chapters by taking the sum of word counts.

In [5]:

```
df.insert(0, 'book_',[book for book,_ in df[df.columns[0]].str.split('_',n=1)] )
```

In [6]:

```
books_df = df.groupby(['book_']).sum()
books = books_df.index
```

# Top 20 words

In [7]:

```
def top_twenty_words (cleaned_df):
    data = {}
    easier_table = cleaned_df.transpose()
    book_names = easier_table.columns

    for book in book_names:
        data[book] = easier_table[book].sort_values(ascending = False).head(20)

    return data
```

In [8]:

```
books_top20=top_twenty_words(books_df)
```

In [9]:

```
books_top20
```

Out[9]:

```
{'BookOfEccleasiasticus': shall     508
 thy        330
 man        232
 thou       230
 god        193
 hath       189
 thee       170
 lord       152
 things     120
 upon       115
 wisdom      97
 heart       96
 good        95
 men         82
 fear        81
 soul        80
 one         77
 shalt       76
 give        71
 glory       71
 Name: BookOfEccleasiasticus, dtype: int64,
 'BookOfEcclesiastes': shall     89
 man        71
 hath       46
 god        46
 things     46
 thy        43
 time       42
 sun        36
 also       31
 vanity     29
 heart      27
 thou       26
 wisdom     26
 evil       24
 good       22
 better     22
 wise       22
 men        22
 labour     19
 one        19
 Name: BookOfEcclesiastes, dtype: int64,
 'BookOfProverb': shall     389
 man        176
 thy        165
 thou        93
 wicked      92
 lord        85
 wise        71
 hath        65
 heart       64
 thee        59
 way         56
 evil        54
 wisdom      53
```

```
mouth      51
words      47
son        47
soul       47
good       46
fool       46
things     45
Name: BookOfProverb, dtype: int64,
'BookOfWisdom': shall        120
things        89
thy           86
god           67
thou          61
man           38
wisdom        38
upon          37
made          35
hath          32
thee          30
men           30
lord          28
life          26
good          26
us            26
therefore     26
might         25
wicked        25
children      24
Name: BookOfWisdom, dtype: int64,
'Buddhism': right           128
feeling          85
one              75
stress           74
body             73
monk             72
mind             71
remains          63
cessation        62
called           62
mental           58
discerns         58
focused          56
way              55
consciousness    47
noble            46
property         43
qualities        42
concentration    40
form             39
Name: Buddhism, dtype: int64,
'TaoTeChing': tao          84
things       56
one          51
men          45
great        42
therefore    40
heaven       38
```

```
would        36
thus         33
people       32
without      32
know         31
sage         31
state        28
yet          28
way          24
like         24
s            23
may          23
place        21
Name: TaoTeChing, dtype: int64,
'Upanishad': one           100
self            79
mind            71
brahman         68
man             63
death           56
knowledge       51
know            50
must            46
nachiketas      43
said            41
senses          39
beyond          36
atman           33
knows           32
therefore       32
nature          32
god             31
heart           31
body            30
Name: Upanishad, dtype: int64,
'YogaSutra': spiritual        300
man              239
life             148
consciousness    122
power            112
one              108
mind              98
soul              94
things            88
self              81
powers            70
psychic           68
may               66
first             59
must              58
comes             57
divine            53
psychical         53
eternal           52
body              52
Name: YogaSutra, dtype: int64}
```

In [10]:

```
def top_twenty_words (cleaned_df):
    data = {}
    easier_table = cleaned_df.transpose()
    book_names = easier_table.columns

    fig, axs = plt.subplots(nrows=2, ncols=4,figsize=(70,25))


    column = 0
    row = 0

    for book in book_names:
        data[book] = easier_table[book].sort_values(ascending = False).head(20)

        x = data[book]
        x = np.array(list(x.items())).T
        axs[row,column].tick_params('x',labelsize=20, rotation = 90)
        axs[row,column].tick_params('y',labelsize=15, direction='in')
        axs[row,column].bar(list(x[0])[::-1],list(x[1])[::-1])
        axs[row,column].set_title('Top 20 words in '+book, size = 25)
        if column == 3:
            row = 1
            column = -1

        column+=1
    plt.savefig('8_plots.jpg')
```

In [11]:

```
top_twenty_words(books_df)
```

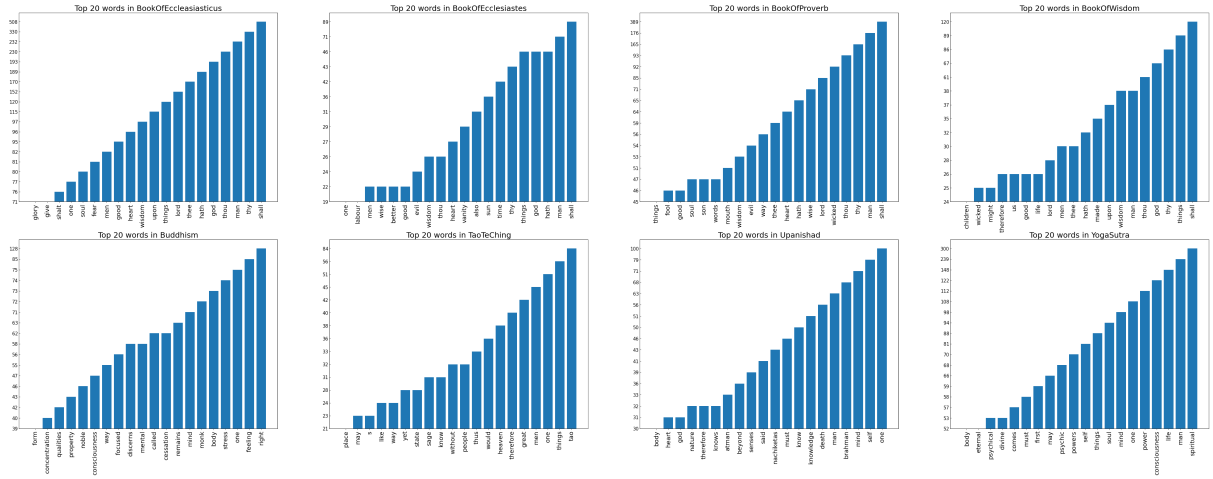



***Figure 1: These visualizations display the top 20 most commonly used words in each of the books individually***

In [12]:

```
top_20_across_books = books_df.sum(axis = 0).sort_values(ascending = False).head(20
)
```

Index of `top_20_across_books` shows the top 20 words across all books

In [13]:

```
top_20_across_books.index
```

Out[13]:

```
Index(['shall', 'man', 'thy', 'one', 'things', 'thou', 'god', 'life',
'hath',
       'spiritual', 'lord', 'mind', 'thee', 'heart', 'soul', 'wisdom',
'men',
       'upon', 'good', 'way'],
      dtype='object')
```

In [14]:

```
plt.figure(figsize=(10,10),dpi=100)
plt.xticks(size=8,rotation = 60)
plt.yticks(size=8, rotation = 60)
plt.bar(top_20_across_books.index,top_20_across_books.values)
plt.savefig('allbooksTop20.jpg')
```

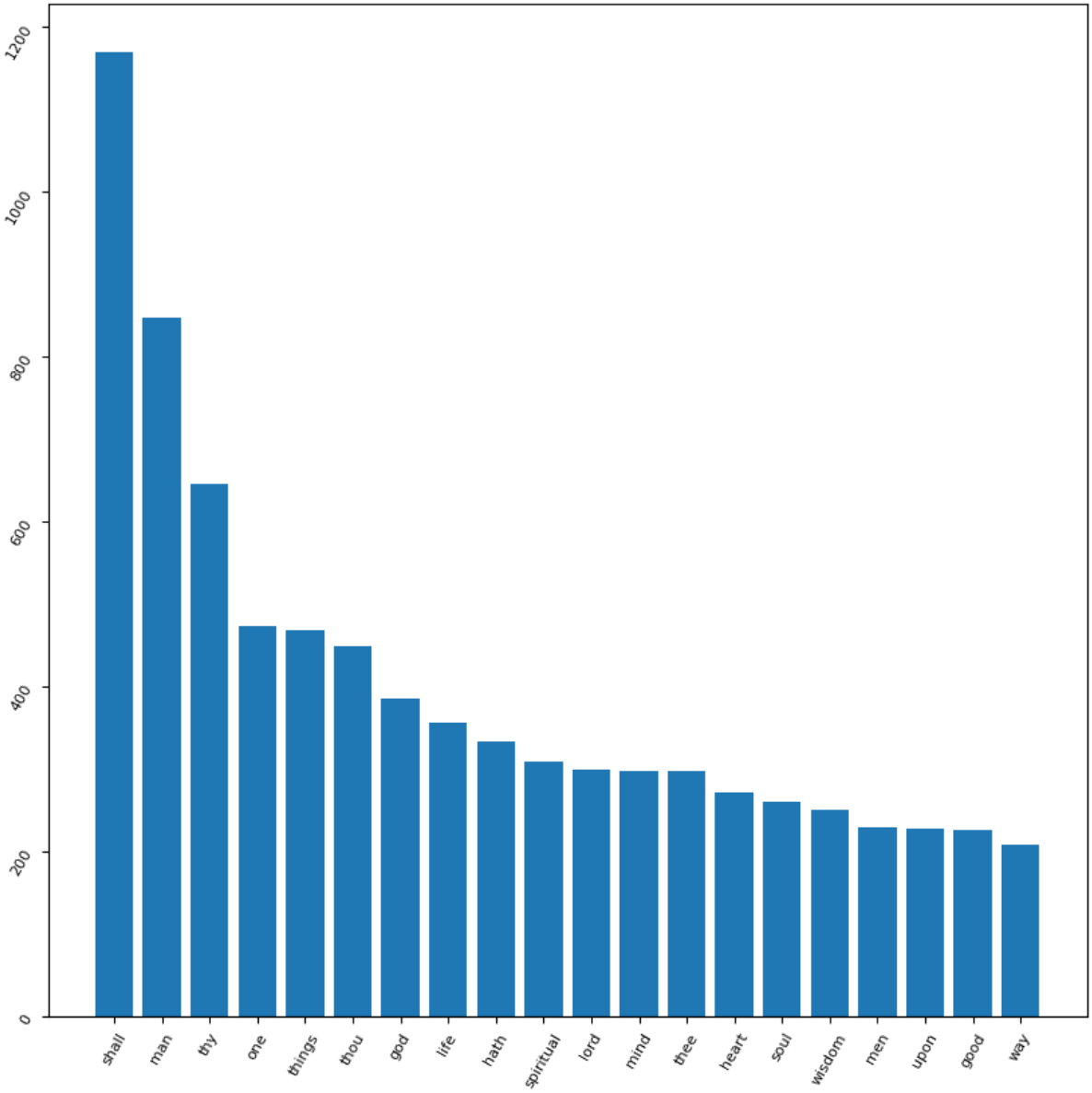

1200
1000
800
600
400
200
0
shall
man
thy
one
things
thou
god
life
hath
spiritual
lord
mind
thee
heart
soul
wisdom
men
upon
good
way

***Figure 2: Top 20 words across all the books***

Looking at Figure 1 and Figure 2, an interesting trend to notice is that from the texts that come from the Abrahamic religions (Book of Ecclesiasticus, Book of Ecclesiastes, Book of Proverb, Book Of Wisdom) all have the word **"shall"** as their most used word. This may indicate that these books are focused more on making commandments and advising the reader on what to do as the word "shall" expresses a certain type of desire. Looking at the texts from the Eastern religions, (Upanishad, YogaSutra, Buddhism, and TaoTeChing), a very commonly used word between these books are the words "one" and "man"/"body". This may indicate that these texts are more interested in the idea of how a person and the world are connected as one entity as opposed to the idea that they are separate. This is true for the top three words in this figure, man and thy are the most prevalent in the four aforementioned books.

# TF-IDF calculations for each word in each book.

TF-IDF is the product of the frequency of a word in a document relative to all words in the document and the frequency of word occuring across all documents. This entails how important a word is, in terms of frequency, in a document, scaled to all words in all documents. We further use this metric using Dimensionality Reduction algorithm UMAP to plot them and visually observe the distances of the books relative to each other.

In [15]:

```
books_df
```

Out[15]:

| book_ | foolishness | hath | wholesome | takest | feelings | anger | vaivaswata | matrix |
|---|---|---|---|---|---|---|---|---|
| **BookOfEccleasiasticus** | 0 | 189 | 3 | 1 | 0 | 14 | 0 | 0 |
| **BookOfEcclesiastes** | 0 | 46 | 0 | 0 | 0 | 5 | 0 | 0 |
| **BookOfProverb** | 2 | 65 | 0 | 0 | 0 | 11 | 0 | 0 |
| **BookOfWisdom** | 0 | 32 | 0 | 0 | 0 | 1 | 0 | 0 |
| **Buddhism** | 0 | 0 | 0 | 0 | 19 | 0 | 0 | 0 |
| **TaoTeChing** | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| **Upanishad** | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 0 |
| **YogaSutra** | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 1 |

8 rows × 8266 columns

In [16]:

```
tf = pd.DataFrame({book: books_df.loc[book]/books_df.loc[book].sum() for book in bo
oks})
IDF = books_df.sum(axis=0)
IDF = IDF+1 #account for divsion by 0 error

IDF = len(books_df)/IDF

TF_IDF = pd.DataFrame({book: tf[book] * (1/IDF) for book in books}).transpose()

TF_IDF
```

Out[16]:

| | foolishness | hath | wholesome | takest | feelings | anger | vaivasw |
|---|---|---|---|---|---|---|---|
| **BookOfEccleasiasticus** | 0.000000 | 0.533350 | 0.000126 | 0.000017 | 0.000000 | 0.004246 | 0.000 |
| **BookOfEcclesiastes** | 0.000000 | 0.694645 | 0.000000 | 0.000000 | 0.000000 | 0.008114 | 0.000 |
| **BookOfProverb** | 0.000097 | 0.352757 | 0.000000 | 0.000000 | 0.000000 | 0.006415 | 0.000 |
| **BookOfWisdom** | 0.000000 | 0.266561 | 0.000000 | 0.000000 | 0.000000 | 0.000895 | 0.000 |
| **Buddhism** | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.007171 | 0.000000 | 0.000 |
| **TaoTeChing** | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000977 | 0.000 |
| **Upanishad** | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.002052 | 0.000 |
| **YogaSutra** | 0.000000 | 0.006731 | 0.000050 | 0.000000 | 0.000000 | 0.000000 | 0.000 |

8 rows × 8266 columns

# UMAP Ananlysis

In [17]:

```
reducer = umap.UMAP()
# embedding = reducer.fit_transform(books_df)
embedding = reducer.fit_transform(TF_IDF)
```

```
/Users/ishaangupta/opt/anaconda3/lib/python3.7/site-packages/umap/umap
_.py:1674: UserWarning: n_neighbors is larger than the dataset size; tr
uncating to X.shape[0] - 1
  "n_neighbors is larger than the dataset size; truncating to "
```

In [18]:

```
fig,ax = plt.subplots(figsize=(40,40))
# plt.figure(figsize=(50,50),dpi=40)
ax.scatter(
    embedding[:, 0],
    embedding[:, 1],c=np.arange(8), s= 250)
for i in np.arange(8):
    ax.annotate(books[i],(embedding[i, 0],embedding[i, 1]), fontsize =30, in_layout
= True)
plt.savefig('UMAP_for_all_books.jpg')
```

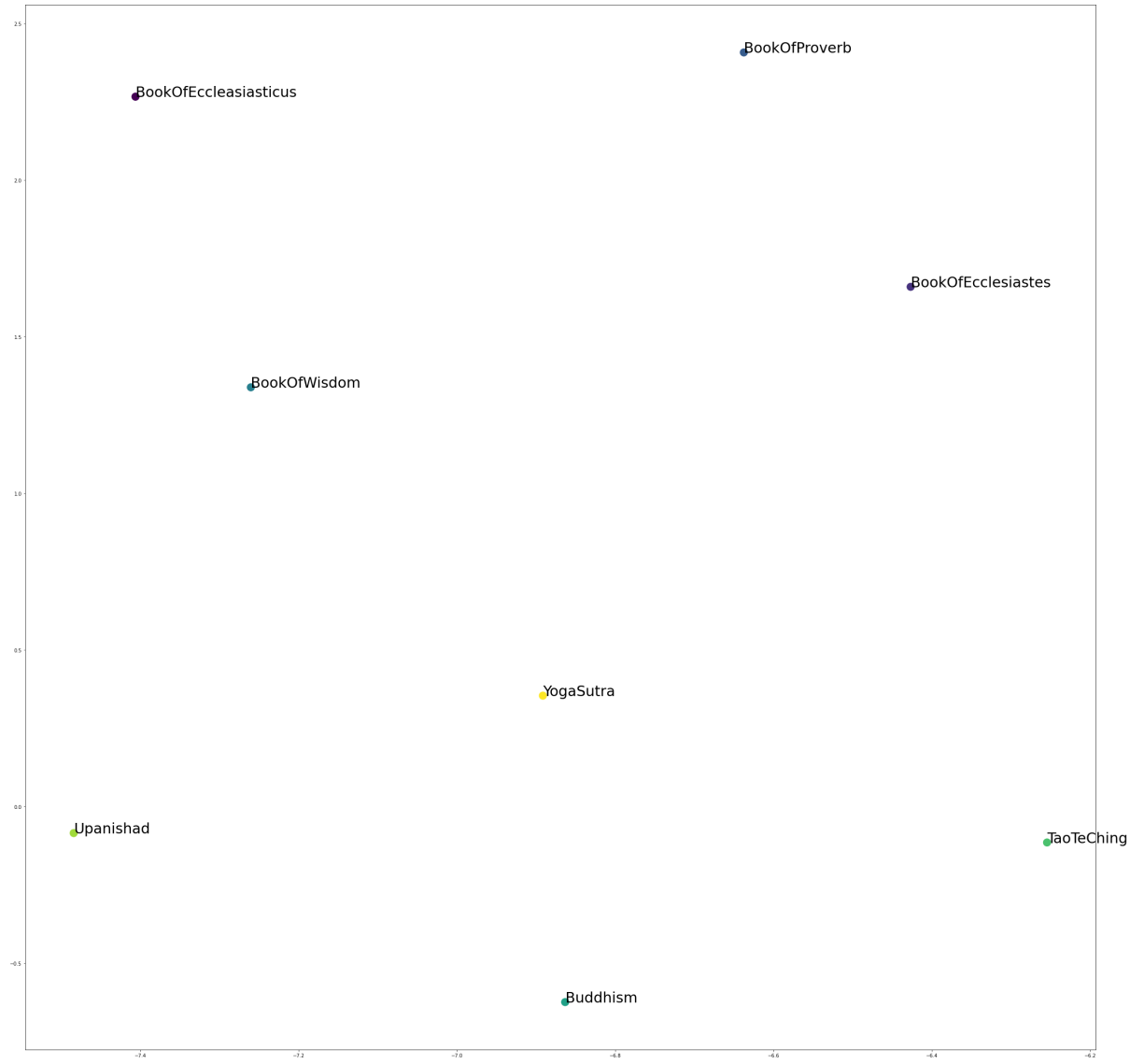



***Figure 3(a): UMAP analysis shows that Buddhism and Taoism are very close to each other compared to other texts; Yoga Sutra and Upanishad also form a relatively close pair***

In [28]:

```
reducer = umap.UMAP()
chapter_embedding = reducer.fit_transform(df[df.columns[2:]])
```

We also attempt to get UMAP for chapterwise word counts.

In [34]:

```
book_map = {y:x for x,y in list(enumerate(books))}

book_map
```

Out[34]:

```
{'BookOfEccleasiasticus': 0,
 'BookOfEcclesiastes': 1,
 'BookOfProverb': 2,
 'BookOfWisdom': 3,
 'Buddhism': 4,
 'TaoTeChing': 5,
 'Upanishad': 6,
 'YogaSutra': 7}
```

In [54]:

```
fig,ax = plt.subplots(figsize=(40,40))
# plt.figure(figsize=(50,50),dpi=40)
ax.scatter(
    chapter_embedding[:, 0],
    chapter_embedding[:, 1],c= [book_map[x] for x in df[df.columns[0]]], s= 250)
for book in books:
    i = df[df[df.columns[0]] == book].index
    centroid = np.mean(chapter_embedding[ df[df[df.columns[0]] == book].index], axi
s = 0)
    ax.annotate(book,centroid, fontsize =30, in_layout = True)
plt.savefig('UMAP_for_all_books.jpg')
```

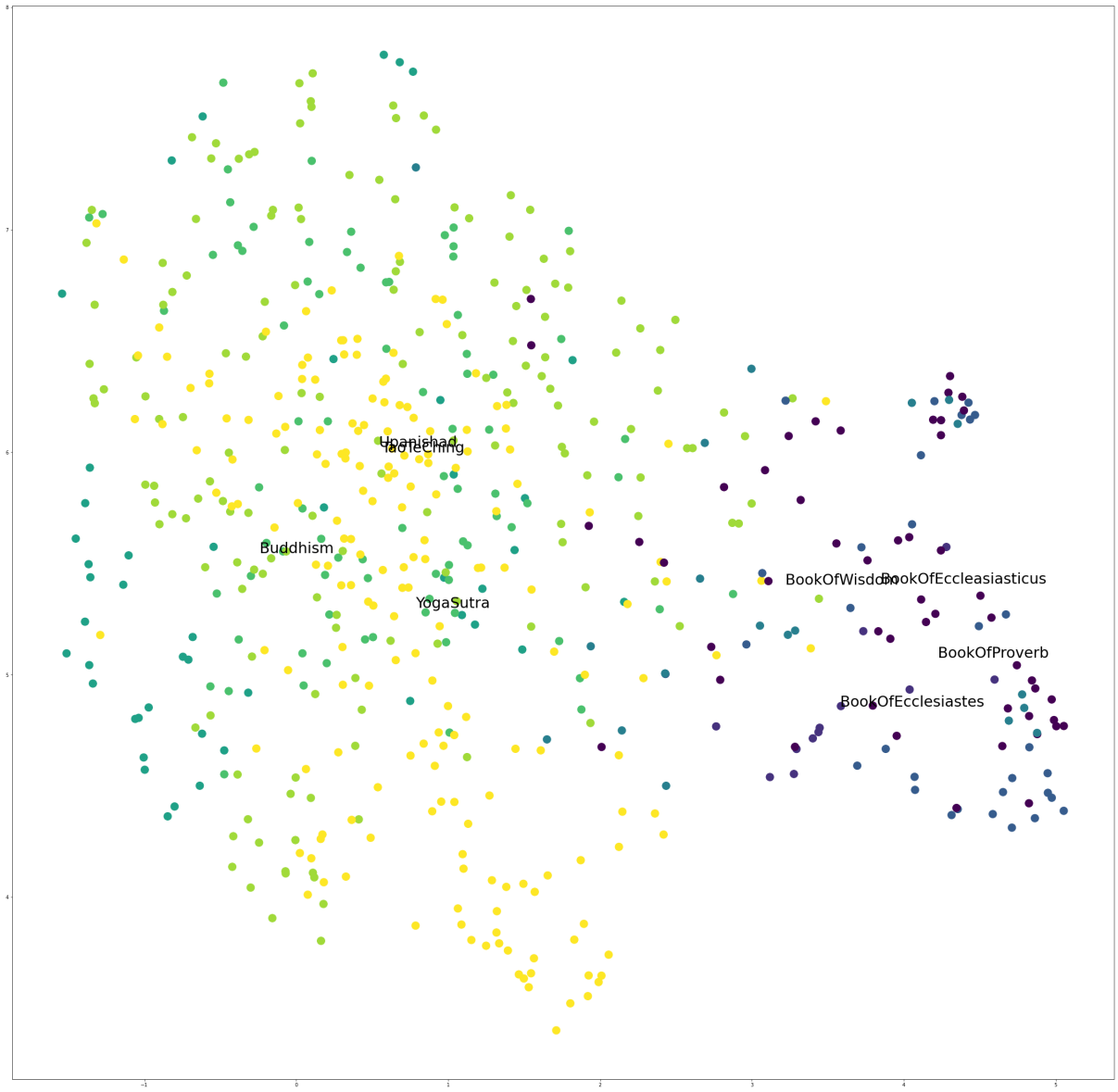

Upanishad
TaoTeChing
Buddhism
YogaSutra
BookOfWisdom
BookOfEccleasiasticus
BookOfProverb
BookOfEcclesiastes

***Figure 3(b): UMAP analysis of chapterwise word counts, each color showing a different book.***

The data points seem to converge a lot for many books, indicating that chapters are not good sample points representing word count distribution for corresponding book, and so we will not refer to the chapterwise word counts in our analysis but instead use just the combined book-wise word counts.

# A Closer Look at Buddhism and Taoism

In our UMAP analysis, Buddhism and Taoism form a distuingishably close pair. We shall use first k-means clustering, and then Hierarchical clustering to see exactly which two texts are the most similar and distinguishable from the rest of the texts. So we generate 7 clusters among the 8 texts, the ony cluster containing a pair would be highly similar and distinguishable.

Our hypothesis is that Buddhism and Taoism are similar enough to be that pair that appear in the same cluster.

In [19]:

```
from sklearn.cluster import KMeans
kmeans = KMeans(n_clusters=7, random_state=0).fit_predict(TF_IDF)
```

All we need is the 0th cluster ( `first_cluster` ) for our purpose and we further plot which texts appear in the 0th cluster ( `first_cluster` )

In [20]:

```
first_cluster = kmeans==0
```

In [21]:

```
fig,ax = plt.subplots(figsize=(40,40))
# plt.figure(figsize=(50,50),dpi=40)
ax.scatter(
    embedding[:, 0],
    embedding[:, 1],c=first_cluster, s= 250)
for i in np.arange(8):
    ax.annotate(books[i],(embedding[i, 0],embedding[i, 1]), fontsize =30, in_layout
= True)
plt.savefig('UMAP_for_all_books.jpg')
```

***Figure 4: Yellow dots indicate texts belonging to the first cluster, Purple dots indicate texts not belonging to the first cluster. So upon making 7 clusters using kmeans, Buddhism and Taoism texts come out to be the members of the first cluster, the only cluster containing a pair.***

We also use Hierachical clustering to more clearly visulize the closest pair from all the text based on TF-IDF metric, which will appear in the form of the pair that has the last split

In [22]:

```
from scipy.cluster.hierarchy import dendrogram, linkage
from matplotlib import pyplot as plt
X = TF_IDF
linked = linkage(X, 'single')

labelList = books
# labelList = range(8)
plt.figure(figsize=(10, 7))
dendrogram(linked,
            orientation='top',
            labels=labelList,
            distance_sort='descending',
            show_leaf_counts=True)
plt.tick_params('x',labelsize=15, rotation = 60)
plt.show()
```

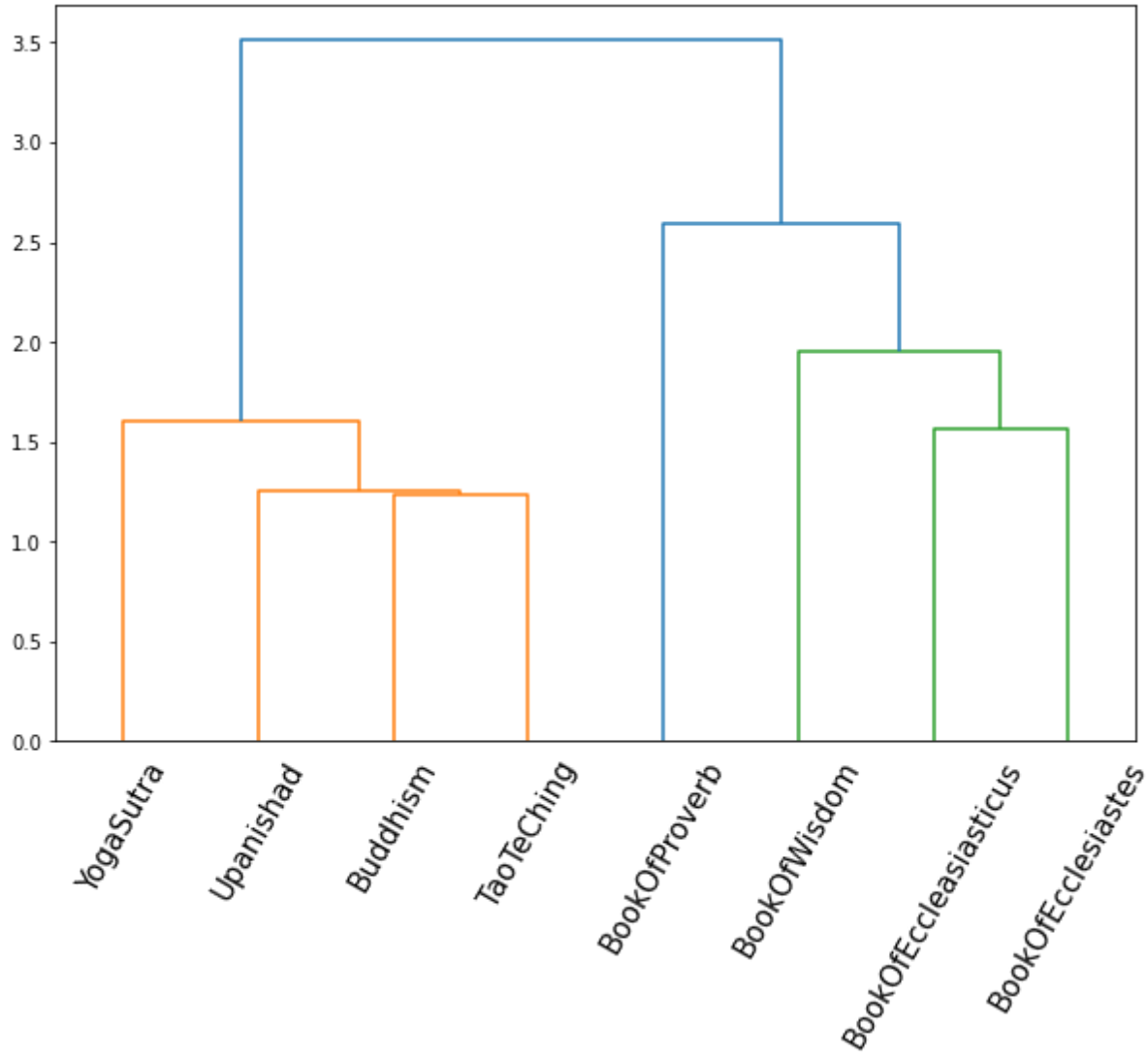

3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
YogaSutra
Upanishad
Buddhism
TaoTeChing
BookOfProverb
BookOfWisdom
BookOfEccleasiasticus
BookOfEcclesiastes

***Figure 5: Hierarchical clustering of all the texts based on TF-IDF. Buddhism and Tao Te Ching form the pair that splits last, indicating the pair closest to each other***

The first cluster appears to contain **Buddhism** and **Tao TeChing**, essentially leading us to conclude that Buddhism and Taoism have a very strong relationship based on this data, compared to the other texts. Our hypothesis proved to be correct, now we shall discuss the backgroundbehind this connection. Despite the fact that Buddhism and Taoism are similar enough in their texts to be clustered together, it cannot be said that these similar word usages can be applied to their practices because of the fundamental differences between the two religions. Hence, we use external source for examining practices and beliefs, and connect them to word usages.

## Background on relationship between Buddhism and Taoism

Buddhists believe in reincarnation, focusing to eliminate mental suffering. Buddhists believe that life is suffering. [4] Because of this, it makes sense that the Buddhism text has "right" as its most frequent word (Figure 1) because according to the Buddhists, living life according to certain "right" actions will help prevent suffering and lead to Nirvana

Taoism believe in the present, rather than post-death. They also make it their goal to gain balance in life. Taoist look at life positively and can be improved by following Tao/Way of Nature. [5] "Tao" being the most common word for the TaoTeChing text makes sense as well because the idea behind Taoism is following the Tao to find harmony.

Buddhism & Taoism Similarities:

Buddhism & Taoism are both considered very peaceful religion. They focus on mediation for the sake of peace of mind & enlightenment.

Furthermore, although their idea of self improvement differs due to more focus on the afterlife in Buddhism than the present in Taoism. there is a common goal underlying the differences in their approach - they both focus on the idea of self-improvement. [6] TaoTeChing (Taoism): "presented a way of life intended to restore harmony and tranquillity"

## Hierarchical Clustering analysis

Evolution of these texts can be visualized in terms of a dendogram which uses our word count data to find distances between the texts. We shall particularly focus on the texts `BookOfEcclesiastes` , `BookOfProverb` and `BookOfWisdom` , since they are a part of The Old Testament.

In [23]:

```
from scipy.cluster.hierarchy import dendrogram, linkage
from matplotlib import pyplot as plt
X = books_df
linked = linkage(X, 'single')

labelList = books
# labelList = range(8)
plt.figure(figsize=(10, 7))
dendrogram(linked,
            orientation='top',
            labels=labelList,
            distance_sort='descending',
            show_leaf_counts=True)
plt.tick_params('x',labelsize=15, rotation = 60)
plt.show()
```

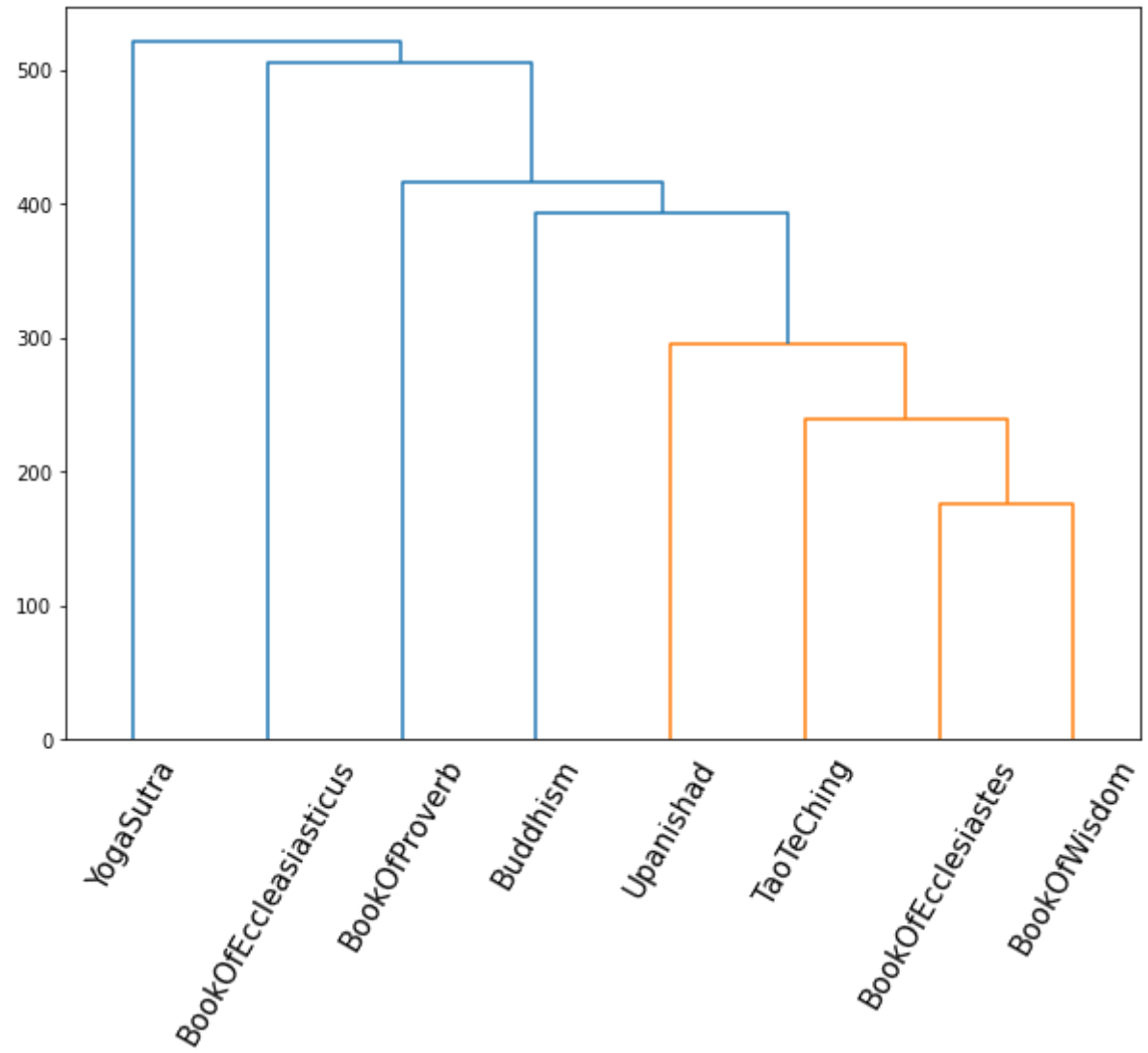


***Figure 6: The dendogram for word counts for all the texts.***

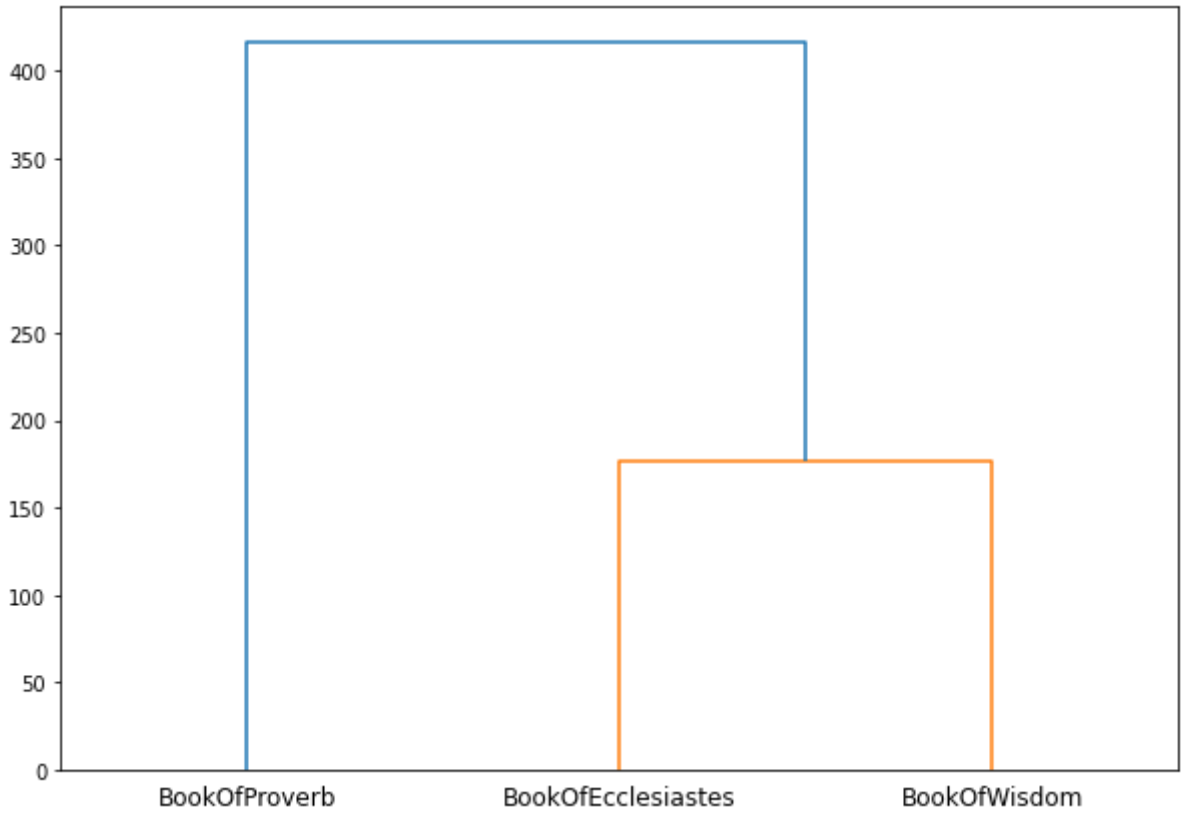
In the dendogram for all the texts, based on word counts (Figure 5), we observe Book of Proverb diverges much earlier (in terms of number of splits) compared to Book of Ecclesiastes and Book of Wisdom. This observation can be interpreted as the Book of Proverb being very different from Book of Ecclesiastes and Book of Wisdom. Since they are all part of The Old Testament, we could infer that the main reason behind Book of Proverb being in a distant cluster is chronological influence. We used external sources to confirm this deduction and much to our delight, while Book of Proverb 700 BCE[1], the other two texts evolved much later - Book of wisdom 1st century BCE[2], and Book of Ecclesiastes 3rd century BCE[3]

Similarly referring back to Figure 5 showing the dendogram generated by TF-IDF metric, we can see that the Book of Wisdom, Book of Ecclesiastes, and the Book of Proverbs are clustered together when we split into 2 clusters, which makes sense because they are all part of the Old Testament in the Bible. However, we can see that the Book of Proverb is in a separate cluster from the Book of Wisdom and Ecclesiastes when split into 3 clusters most prbably because it was written much earlier than the other two books.

In [24]:

```
from scipy.cluster.hierarchy import dendrogram, linkage
from matplotlib import pyplot as plt
X = books_df.iloc[1:4,:]
linked = linkage(X, 'single')

labelList = books[1:4]
# labelList = range(1,4)
plt.figure(figsize=(10, 7))
plt.tick_params('x',labelsize=25, rotation = 60)
dendrogram(linked,
            orientation='top',
            labels=labelList,
            distance_sort='descending',
            show_leaf_counts=True)
plt.show()
```




Running hierarchical clustering for just the 3 books gives exactly similar results.

In [25]:

```
metric = books_df

top = 20
words = metric.columns
proverb_values = np.array(metric.iloc[2])/metric.iloc[2].sum()
ecc_values = np.array(metric.iloc[1])/metric.iloc[1].sum()
wisdom_values = np.array(metric.iloc[3])

# Highly used in Proverb than Ecc
# sorted(enumerate(list(proverb_values - ecc_values)),key= lambda x: x[1])
top_100_ecc_less = sorted(enumerate(list(proverb_values - ecc_values)),key= lambda
x: x[1], reverse=True)[:100]
top_100_wisdom_less = sorted(enumerate(list(proverb_values - wisdom_values)),key= l
ambda x: x[1], reverse=True)[:100]

print("Top 10 words less frequent in Ecclesiastes than Proverbs ",'\n',[words[x[0]]
for x in top_100_ecc_less[:10]])
print()
print("Top 10 words less frequent in Wisdom than Proverbs",'\n',[words[x[0]] for x
in top_100_wisdom_less[:10]])
print()

proverbs_more = set([words[x[0]] for x in top_100_ecc_less]).intersection(set([word
s[x[0]] for x in top_100_wisdom_less]))

print("Words less frequent in both Ecclesiastes and Wisdom than Proverbs",'\n',prov
erbs_more)
print()



print()


top_10_ecc_more = sorted(enumerate(list( ecc_values - proverb_values )),key= lambda
x: x[1], reverse=True)[:10]
top_10_wisdom_more = sorted(enumerate(list( wisdom_values - proverb_values )),key=
lambda x: x[1], reverse=True)[:10]

print("Top 10 words more frequent in Proverbs than Ecclesiastes",'\n',[words[x[0]]
for x in top_10_ecc_more[:10]])
print()
print("Top 10 words more frequent in Wisdom than Proverbs",'\n',[words[x[0]] for x
in top_10_wisdom_more[:10]])
print()

proverbs_less = set([words[x[0]] for x in sorted(enumerate(list(ecc_values - prover
b_values)),key= lambda x: x[1], reverse=True)[:100]]).intersection(set([words[x[0]]
for x in sorted(enumerate(list(wisdom_values - proverb_values)),key= lambda x: x[1
], reverse=True)[:100]]))

print("Words more frequent in both Ecclesiastes and Wisdom than Proverbs",'\n',prov
erbs_less)
```

```
Top 10 words less frequent in Ecclesiastes than Proverbs
 ['shall', 'lord', 'wicked', 'way', 'thy', 'thee', 'mouth', 'son', 'lip
s', 'instruction']

Top 10 words less frequent in Wisdom than Proverbs
 ['shalt', 'woman', 'keepeth', 'rich', 'lying', 'paths', 'open', 'step
s', 'seeketh', 'slothful']

Words less frequent in both Ecclesiastes and Wisdom than Proverbs
 {'seeketh', 'saith', 'prudent', 'trusteth', 'lamp', 'ruin', 'open', 'h
ate', 'slothful', 'forsake', 'paths', 'followeth', 'woman', 'keepeth',
'rod', 'rich', 'stranger', 'lying', 'shalt', 'neighbour', 'uttereth',
'quarrels', 'hateth', 'sluggard', 'ones', 'steps'}


Top 10 words more frequent in Proverbs than Ecclesiastes
 ['time', 'god', 'sun', 'things', 'vanity', 'also', 'hath', 'labour',
'better', 'know']

Top 10 words more frequent in Wisdom than Proverbs
 ['shall', 'things', 'thy', 'god', 'thou', 'wisdom', 'man', 'upon', 'ma
de', 'hath']

Words more frequent in both Ecclesiastes and Wisdom than Proverbs
 {'end', 'also', 'time', 'power', 'therefore', 'living', 'hath', 'man',
'viz', 'earth', 'know', 'given', 'made', 'neither', 'things', 'beasts',
'men', 'spirit', 'one', 'world', 'great', 'together', 'nothing', 'work
s', 'god', 'come', 'found', 'good', 'wisdom', 'came', 'might'}
```

Furthermore, referring to Figure 2, we notice some words with negative connotations - like 'wicked' and 'evil' - have siginificantly decreased in frequency in both Book of Wisdom and Ecclesiastes than the older Book of Proverbs. In fact, when we look at words that appear in both Top 100 words less frequent in Ecclesiastes than Proverbs and Top 100 words less frequent in Wisdom than Proverbs (output above), we see negative words like 'hate', 'lying', 'slothful', 'quarrels', and also 'rich' (because it shows materialiasm), while in words that appear in both Top 100 words less frequent in Ecclesiastes than Proverbs and Top 100 words less frequent in Wisdom than Proverbs (output above), we see more positive words like 'wisdom','good', 'great', 'god', 'know', and 'living'.

Besides, words less frequent in both Ecclesiastes and Wisdom than Proverbs are often '-eth' ending words - 'trusteth', 'keepeth', 'saith', 'hateth', 'seeketh', 'followeth', 'uttereth' - which might have become anachronic after 3rd century, which is when the later books Ecclesiastes and Wisdom eveolved. Whereas, none of the words more frequent in both Ecclesiastes and Wisdom than Proverbs end with '-eth'. This further bolsters chronological changes being the main reason driving the differences from Book of Proverbs.

# Conclusion:

After the analysis performed on the data set above, the results show that the wording between the books of Proverbs, Ecclesiastes, and Wisdom has changed as the Book of Proverbs was in a different cluster than the Books of Ecclesiastes and Wisdom. Since the three books come from The Old Testament, difference in beliefs and culture is probably not as impactful in this scenario. This is most likely due to a chronological influence as the Book of Proverb was written much earlier than the other two books. And then we confirmed this deduction through external sources. In regards to the similarities between Buddhism and Taoism, the UMAP and dendogram based on TF-IDF calculations shows that both religions are highly similar to one another based on their word usages. However, using the context of the religions, this similarity cannot be extended into the practices of these religions as the religions are too fundamentally different from one another.

## Sources:

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