In [ ]:
```python
# 1. Importing the Necessary Modules

import numpy as np
import pandas as pd
from collections import Counter
from sklearn.metrics.pairwise import cosine_similarity
import math
import seaborn as sns
import matplotlib.pyplot as plt
```

In [ ]:
```python
# 2. Defining the Sample Documents

documents = [
    "Data science is an interdisciplinary field",
    "Machine learning is a part of data science",
    "Deep learning is a branch of machine learning"
]

print("Documents:")
for i, doc in enumerate(documents, 1):
    print(f"{i}. {doc}")
```

```
Documents:
1. Data science is an interdisciplinary field
2. Machine learning is a part of data science
3. Deep learning is a branch of machine learning
```

BoW Vectorization

In [ ]:
```python
bow_vectors = []

for doc in tokenized_docs:
    word_count = Counter(doc)
    bow_vectors.append([word_count[word] for word in vocab])

bow_df = pd.DataFrame(bow_vectors, columns=vocab)
print("\nBag of Words (BoW) Vectorization:")
display(bow_df)
```

```
Bag of Words (BoW) Vectorization:
```

	a	an	branch	data	deep	field	interdisciplinary	is	learning	machine	of	part	s
0	0	1	0	1	0	1	1	1	0	0	0	0	
1	1	0	0	1	0	0	0	1	1	1	1	1	
2	1	0	1	0	1	0	0	1	2	1	1	0	

In [ ]:
```python
# Cosine Similarity (BoW)

cosine_bow = cosine_similarity(bow_df)
cosine_bow_df = pd.DataFrame(cosine_bow, columns=["Doc1", "Doc2", "Doc3"], index

print("\nCosine Similarity (BoW):")
display(cosine_bow_df)
```

Cosine Similarity (BoW):

	Doc1	Doc2	Doc3
Doc1	1.000000	0.433013	0.129099
Doc2	0.433013	1.000000	0.670820
Doc3	0.129099	0.670820	1.000000

TF Vectorization

In [ ]:
```
tf_vectors = []

for doc in tokenized_docs:
    word_count = Counter(doc)
    total_words = len(doc)
    tf_vectors.append([word_count[word]/total_words for word in vocab])

tf_df = pd.DataFrame(tf_vectors, columns=vocab)
print("\nTerm Frequency (TF) Vectorization:")
display(tf_df)
```

Term Frequency (TF) Vectorization:

	a	an	branch	data	deep	field	interdisciplinary	is	learning
0	0.000	0.166667	0.000	0.166667	0.000	0.166667	0.166667	0.166667	0.00(
1	0.125	0.000000	0.000	0.125000	0.000	0.000000	0.000000	0.125000	0.12!
2	0.125	0.000000	0.125	0.000000	0.125	0.000000	0.000000	0.125000	0.25(

In [ ]:
```
# Cosine Similarity (TF)

cosine_tf = cosine_similarity(tf_df)
cosine_tf_df = pd.DataFrame(cosine_tf, columns=["Doc1", "Doc2", "Doc3"], index=[

print("\nCosine Similarity (TF):")
display(cosine_tf_df)
```

Cosine Similarity (TF):

	Doc1	Doc2	Doc3
Doc1	1.000000	0.433013	0.129099
Doc2	0.433013	1.000000	0.670820
Doc3	0.129099	0.670820	1.000000

TF-IDF Vectorization

In [ ]:
```
idf_vector = []
N = len(documents)

for word in vocab:
    df = sum([1 for doc in tokenized_docs if word in doc])
```

```
    idf = math.log(N / (1 + df))
    idf_vector.append(idf)

tf_idf_matrix = np.array(tf_vectors) * np.array(idf_vector)
tfidf_df = pd.DataFrame(tf_idf_matrix, columns=vocab)

print("\nTF-IDF Vectorization:")
display(tfidf_df)
```

```
TF-IDF Vectorization:
```

	a	an	branch	data	deep	field	interdisciplinary	is	learning
0	0.0	0.067578	0.000000	0.0	0.000000	0.067578	0.067578	-0.047947	0.0
1	0.0	0.000000	0.000000	0.0	0.000000	0.000000	0.000000	-0.035960	0.0
2	0.0	0.000000	0.050683	0.0	0.050683	0.000000	0.000000	-0.035960	0.0

In [ ]:

```
# Cosine Similarity (TF-IDF)

cosine_tfidf = cosine_similarity(tfidf_df)
cosine_tfidf_df = pd.DataFrame(cosine_tfidf, columns=["Doc1", "Doc2", "Doc3"], i

print("\nCosine Similarity (TF-IDF):")
display(cosine_tfidf_df)
```

```
Cosine Similarity (TF-IDF):
```

	Doc1	Doc2	Doc3
Doc1	1.000000	0.219349	0.169984
Doc2	0.219349	1.000000	0.259487
Doc3	0.169984	0.259487	1.000000

Plot Heatmaps

In [ ]:

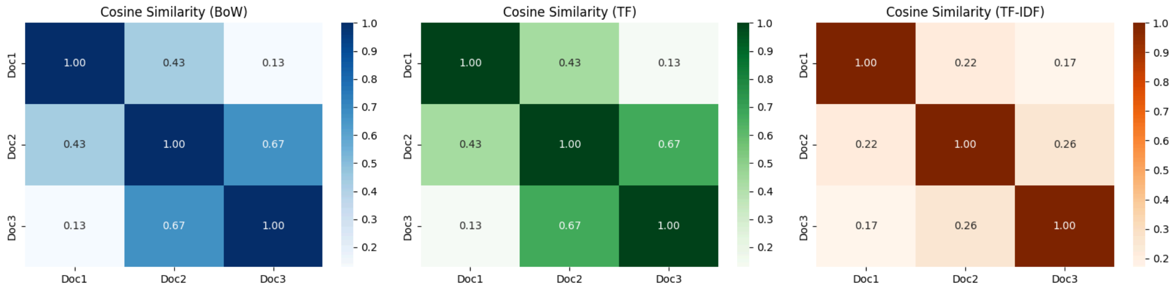
```
plt.figure(figsize=(16, 4))

plt.subplot(1, 3, 1) # Specify subplot index as 1
sns.heatmap(cosine_bow_df, annot=True, cmap="Blues", fmt=".2f")
plt.title("Cosine Similarity (BoW)")

plt.subplot(1, 3, 2) # Specify subplot index as 2
sns.heatmap(cosine_tf_df, annot=True, cmap="Greens", fmt=".2f")
plt.title("Cosine Similarity (TF)")

plt.subplot(1, 3, 3) # Specify subplot index as 3
sns.heatmap(cosine_tfidf_df, annot=True, cmap="Oranges", fmt=".2f")
plt.title("Cosine Similarity (TF-IDF)")

plt.tight_layout()
plt.show()
```


Cosine Similarity (BoW)
Cosine Similarity (TF)
Cosine Similarity (TF-IDF)
Doc1
Doc2
Doc3
1.00
0.43
0.13
0.67
0.22
0.17
0.26