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CADL4:

With a text corpus (e.g., a collection of news articles, academic papers, or social media posts):

a. Preprocess the text data (tokenization, stop word removal, etc.).

b. Apply LDA to identify topics within the corpus using a Python library (e.g., Gensim).

c. Visualize the topics and their associated words.

Document the code and the results of their LDA model in a Moodle workshop.

GitHub Code: https://github.com/arjuntanil/CADL4.git

Code:

1. Restart Runtime

```
import os, sys

os.kill(os.getpid(), 9)
```

- This line forces Google Colab (or Jupyter) to restart the Python runtime after installing or fixing dependencies.
- Useful when some libraries (like SpaCy models) require a restart.

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2. Import Libraries & Download NLTK Data

```
import nltk

nltk.download('punkt')

nltk.download('punkt_tab')

nltk.download('stopwords')

nltk.download('omw-1.4')
```

- **NLTK** provides tools for tokenization, stop words, etc.
- Downloads required datasets:
    - punkt → tokenizer model.

- stopwords → list of common words (e.g., *the, is, and*).
- omw-1.4 → WordNet lemmatizer dictionary.

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3. Load SpaCy Model

```
import spacy

nlp = spacy.load("en_core_web_sm", disable=['parser','ner'])
```

- Loads SpaCy's **English small model**.
- We disable parser + NER since we only need the **tagger + lemmatizer** for text cleaning.

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4. Import Other Libraries

```
import gensim

from gensim import corpora

from gensim.models import Phrases, LdaModel

from gensim.models.phrases import Phraser


import pyLDAvis

import pyLDAvis.gensim_models as gensimvis


import pandas as pd

import matplotlib.pyplot as plt

from nltk.tokenize import word_tokenize

from nltk.corpus import stopwords
```

- **Gensim** → used for topic modeling (LDA).
- **Phrases/Phraser** → for creating bigrams/trigrams.
- **pyLDAvis** → interactive visualization of topics.
- **matplotlib, pandas** → general visualization/data handling.

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5. Define Corpus

```
corpus = [
```

```
    "Just tried the new cafe downtown — the coffee was amazing and the ambiance perfect.",
    "Feeling blessed to have completed my first 5K run today! #fitness #goals",
    ...
]
```

- A small dataset of **10 social media posts** used as our sample corpus.

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6. Preprocessing Function

```
stop_words = set(stopwords.words('english'))


def preprocess_texts(texts, nlp_pipeline):
    processed_texts = []
    for doc in texts:
        tokens = word_tokenize(doc.lower())  # Tokenization
        tokens = [t for t in tokens if t.isalpha() and t not in stop_words and len(t) > 2]  # Remove stopwords & short tokens
        spacy_doc = nlp_pipeline(" ".join(tokens))
        lemmas = [token.lemma_ for token in spacy_doc if token.is_alpha and token.lemma_ not in stop_words and len(token.lemma_) > 2]  # Lemmatization
        processed_texts.append(lemmas)
    return processed_texts
```

- Steps inside function:
    1. **Lowercasing** all words.
    2. **Tokenization** using NLTK.
    3. Remove:
        - Non-alphabetic tokens (e.g., numbers, symbols).
        - Stop words (the, is, etc.).
        - Very short words (like *a, an*).
    4. **Lemmatization** using SpaCy → converts words to their root forms (*running → run, studies → study*).

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7. Run Preprocessing

```
processed = preprocess_texts(corpus, nlp)

print("Sample preprocessed docs:", processed[:3])
```

- Cleans the corpus.
- Example:
- "Just tried the new cafe downtown — the coffee was amazing"
- → ['try', 'new', 'cafe', 'downtown', 'coffee', 'amazing', 'ambiance', 'perfect']

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8. Create Bigrams

```
bigram = Phrases(processed, min_count=2, threshold=5)

bigram_mod = Phraser(bigram)

data_bigrams = [bigram_mod[doc] for doc in processed]
```

- **Bigrams** = word pairs (e.g., *machine learning*, *data science*).
- Captures phrases that appear together often.
- min_count=2 → phrase must appear at least twice.

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9. Dictionary + Corpus

```
id2word = corpora.Dictionary(data_bigrams)

id2word.filter_extremes(no_below=1, no_above=0.5)

gensim_corpus = [id2word.doc2bow(text) for text in data_bigrams]
```

- **Dictionary** maps each word to an ID.
- filter_extremes removes very rare or very common words.
- **Corpus (Bag of Words)** represents each document as a list of (word_id, frequency) pairs.

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10. Train LDA Model

```
num_topics = 3

lda_model = LdaModel(corpus=gensim_corpus,

                     id2word=id2word,

                     num_topics=num_topics,
```

random_state=100,

update_every=1,

passes=10,

alpha='auto')

- Builds a **Latent Dirichlet Allocation (LDA)** model.
- Parameters:
  - num_topics=3 → find 3 hidden topics.
  - passes=10 → number of iterations over data.
  - alpha='auto' → adjusts topic-document distribution automatically.

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11. Print Topics

for idx, topic in lda_model.print_topics(num_topics=num_topics, num_words=6):

print(f"Topic {idx}: {topic}")

- Prints each discovered topic and its top words.
- Example output:
- Topic 0: coffee, cafe, downtown, amazing
- Topic 1: run, fitness, goals, today
- Topic 2: climate, change, ice, melt

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12. Visualization

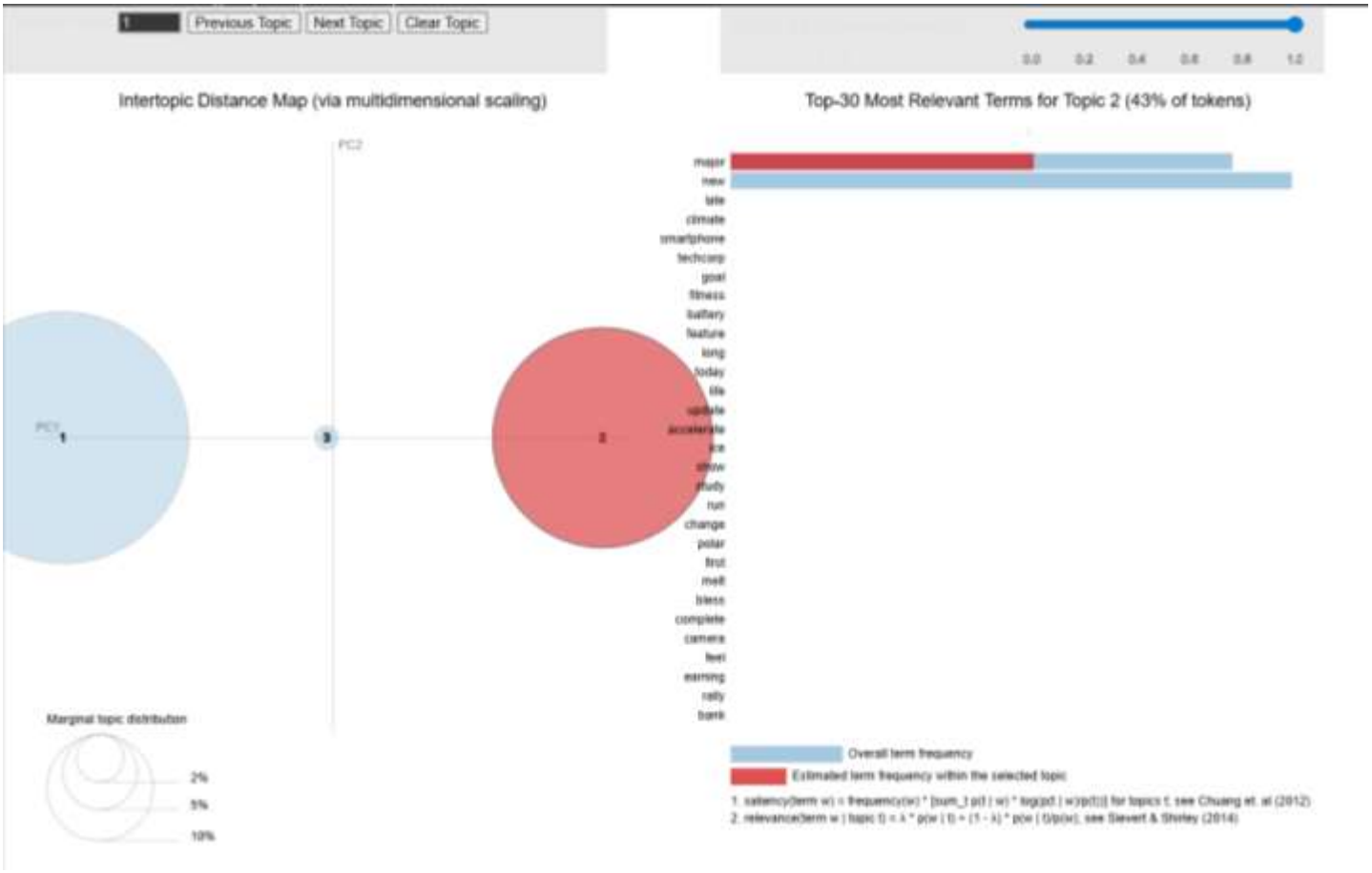
pyLDAvis.enable_notebook()

vis = gensimvis.prepare(lda_model, gensim_corpus, id2word)

vis

- Produces an **interactive visualization**:
  - Each **circle = topic**.
  - Distance between circles shows how similar topics are.
  - Right panel shows **top words per topic**.

Output :


1
Previous Topic
Next Topic
Clear Topic
0.0
0.2
0.4
0.6
0.8
1.0
Intertopic Distance Map (via multidimensional scaling)
PC2
PC1
1
2
3
Marginal topic distribution
2%
5%
10%
Top-30 Most Relevant Terms for Topic 2 (43% of tokens)
major
new
late
climate
smartphone
techcorp
goal
fitness
battery
feature
king
today
life
update
accelerate
ice
show
study
run
change
polar
first
melt
bless
complete
camera
feel
earning
rally
bank
Overall term frequency
Estimated term frequency within the selected topic
1. saliency(term w) = frequency(w) * [sum_t p(t | w) * log(p(t | w)/p(t))] for topics t; see Chuang et. al (2012)
2. relevance(term w | topic t) = λ * p(w | t) + (1 - λ) * p(w | t)/p(w); see Sievert & Shirley (2014)