BIS 420 PROGRAMMING FOR DATA SCIENCE

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CHAPTER 13 EXERCISE 13.9
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The “rank” of a word is its position in a list of words sorted by frequency: the most common word has rank 1, the second most common has rank 2, etc. Zipf’s law describes a relationship between the ranks and frequencies of words in natural languages (http: // en. wikipedia. org/ wiki/ Zipf's_ law). Specifically, it predicts that the frequency, f , of the word with rank r is:

f= cr−s where s and c are parameters that depend on the language and the text. If you take the logarithm of both sides of this equation, you get:

log f= log c−s log r. So if you plot log f versus log r, you should get a straight line with slope−s and intercept log c.

Write a program that reads a text from a file, counts word frequencies, and prints one line for each word, in descending order of frequency, with log f and log r. Use the graphing program of your choice to plot the results and check whether they form a straight line. Can you estimate the value of s?

```
import string

import math

import matplotlib.pyplot as plt


def load_book(book):

    with open('/Users/prajaktapohare/Library/CloudStorage/OneDrive-ILStateUniversity/BIS420/Week 13/book.txt', 'r', encoding='utf-8') as f:

        lines = f.readlines()

    start = 0

    end = len(lines)

    for i, line in enumerate(lines):

        if "*** START OF" in line:

            start = i + 1
        elif "*** END OF" in line:
            end = i
            break
    return ".join(lines[start:end])

def clean_text(text):
    translator = str.maketrans(", ", string.punctuation)
    return text.translate(translator).lower()

def count_words(text):
    words = text.split()
    word_count = {}
    for word in words:
        word_count[word] = word_count.get(word, 0) + 1
    return word_count

def compute_zipf(word_counts):
    sorted_words = sorted(word_counts.items(), key=lambda x: x[1], reverse=True)
    log_ranks = []
    log_freqs = []
    print(f"{'Rank':<6}{'Word':<15}{'Freq':<10}{'log(R)':<10}{'log(F)':<10}")
    print("-" * 50)
    for rank, (word, freq) in enumerate(sorted_words, start=1):
        log_r = math.log(rank)
        log_f = math.log(freq)
        log_ranks.append(log_r)
        log_freqs.append(log_f)
        if rank <= 20:
            print(f"{rank:<6}{word:<15}{freq:<10}{log_r:<10.4f}{log_f:<10.4f}")
    return log_ranks, log_freqs


def plot_zipf(log_ranks, log_freqs, book_title="Zipf's Law"):
    plt.figure(figsize=(8,6))
    plt.plot(log_ranks, log_freqs, marker='o', linestyle='-', color='blue')
    plt.title(f"Zipf's Law Plot: {book_title}")
    plt.xlabel("log(Rank)")
    plt.ylabel("log(Frequency)")
    plt.grid(True)
    plt.tight_layout()
    plt.show()



book_file = '/Users/prajaktapohare/Library/CloudStorage/OneDrive-ILStateUniversity/BIS420/Week 13/book.txt'
raw = load_book(book_file)
cleaned = clean_text(raw)
word_counts = count_words(cleaned)


log_r, log_f = compute_zipf(word_counts)
plot_zipf(log_r, log_f, book_title=book_file)
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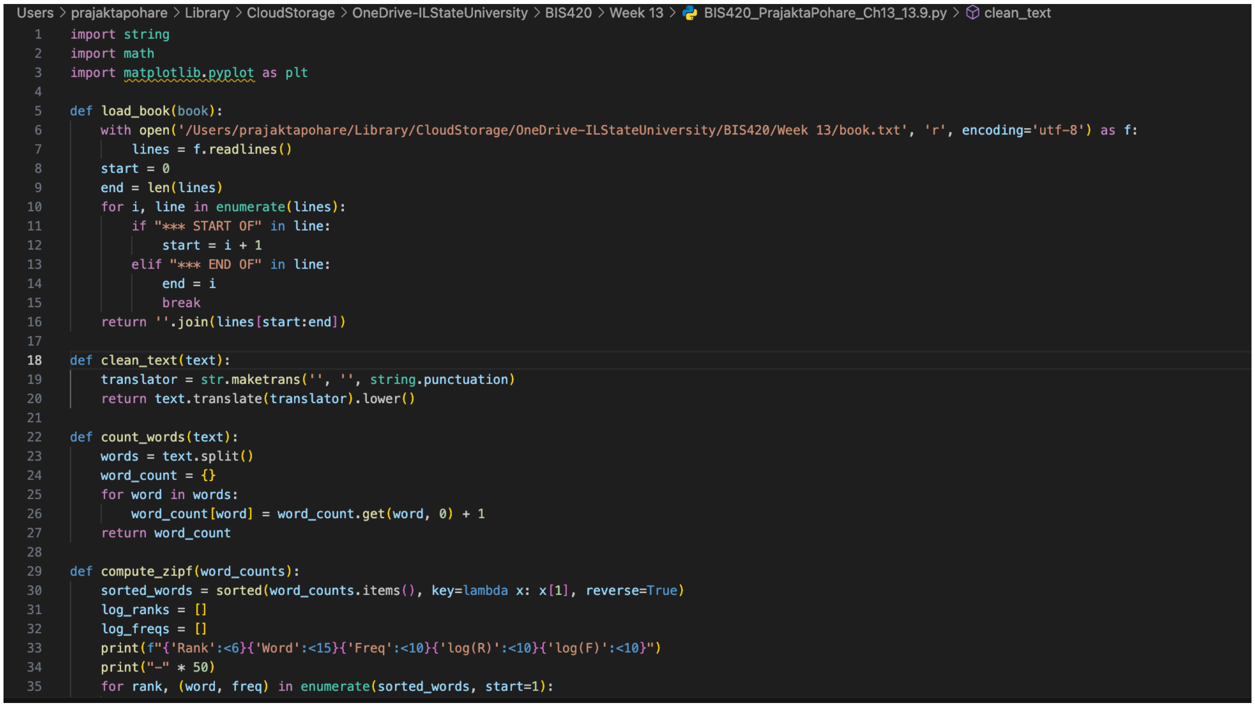

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    for i, line in enumerate(lines):
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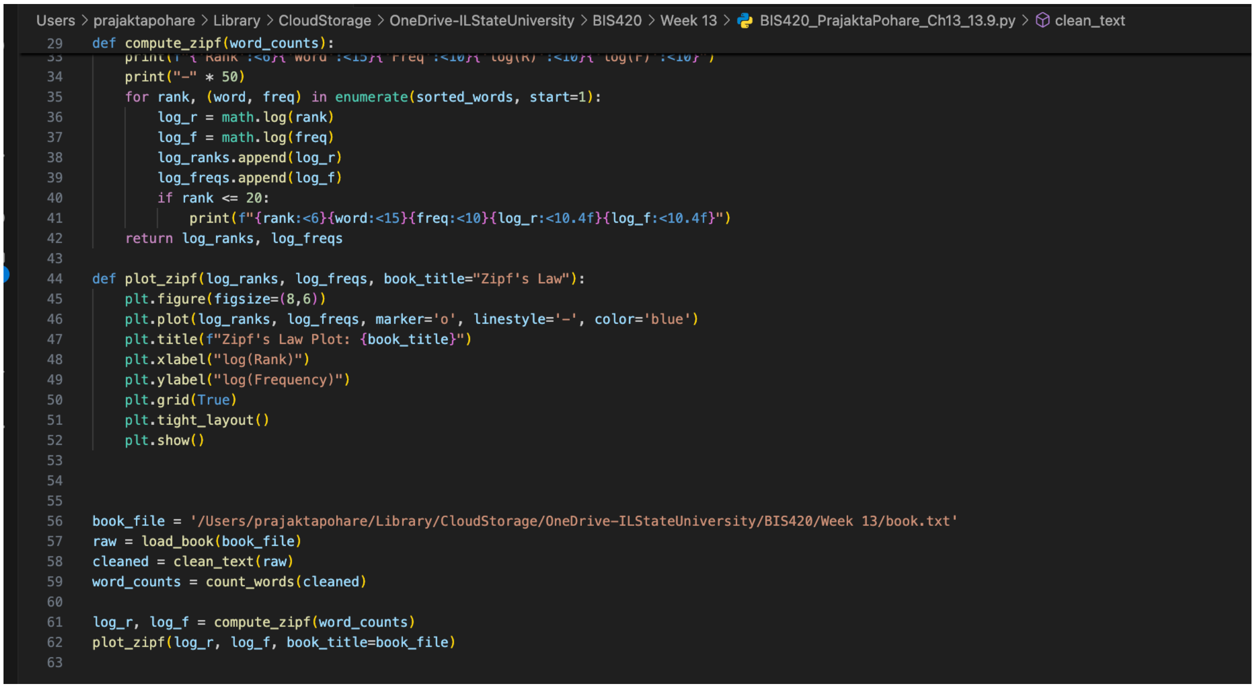

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