Discrete Structures!

CMPSC 102

Plots

ALLEGHENY COLLEGE

Key Questions and Learning Objectives

- How can I create basic statistics from text and then explain my results using values and plots?

- To remember and understand some concepts about plots, and the code used to make them from matplotlib.

Setting Up Virtual Environment

- Create a project directory

```
mkdir week12_stats
cd week12_stats
```

- Create virtual environment using Python

```
python3 -m venv myenv
# see the file tree
find . -not -path '*/\.*'
```

- Activate myenv the virtual environment

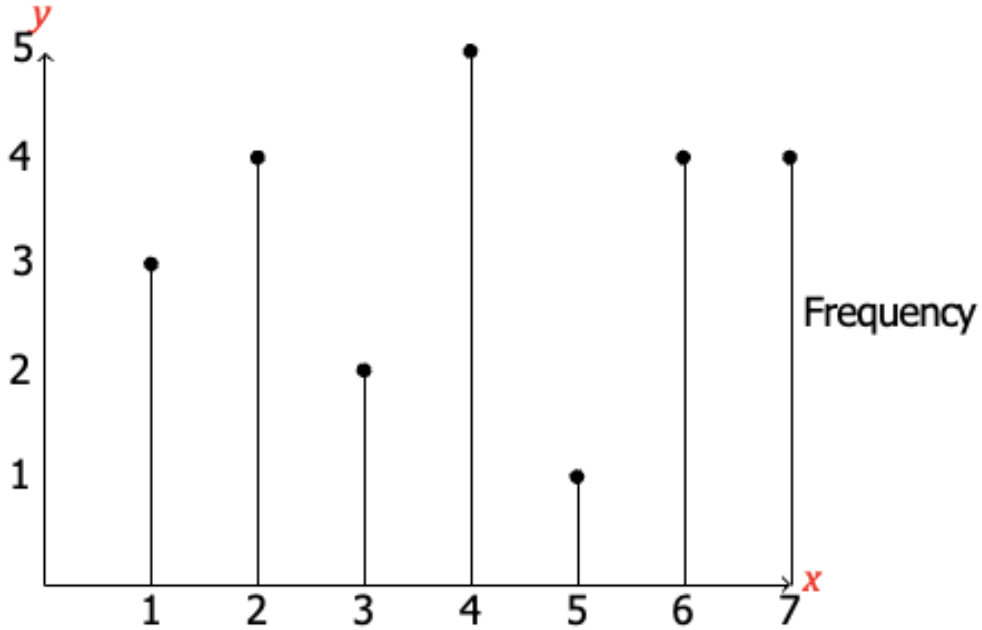
```
source myenv/bin/activate  # macOS/Linux
myenv\Scripts\activate     # Windows
```

- Install Dependencies

```
pip install matplotlib
pip install numpy
```

Frequencies

- The frequency can be understood as the number of occurrences of a particular value or range of values.



- What characters occur and how often?

Function: calculate character frequencies

- This function calculates the frequencies of individual characters in a given list of texts.
- We use Python's Counter class from the collections module.

```
import matplotlib.pyplot as plt
from collections import Counter

def calculate_character_frequencies(texts):
        # Concatenate all texts into a single string
        all_text = "".join(texts)

        # Count the frequencies of each character
        char_freq = Counter(all_text)

        return char_freq
```

Function: calculate character frequencies

```
texts = ['apple', 'banana']
result = calculate_character_frequencies(texts)
print(result)

# Counter({'a': 4, 'p': 2, 'n': 2, 'l': 1, 'e': 1, 'b': 1})
```

Function: calculate character pairs frequency

- This function converts the list elements into a blob of text for analysis of pairs of characters.

```
def calculate_character_pairs_frequency(text_list):
        # Remove any non-alphanumeric characters
        # and convert text to lowercase convert list
        # of strings to a single blob of text

        text = ""
        for i in text_list:
                text += i
        text = ''.join(filter(str.isalnum, text.lower()))
        # Generate list of character pairs (bigrams)
        pairs = [text[i:i+2] for i in range(len(text)-1)]
        # Count the frequencies of each character pair
        pairs_frequency = Counter(pairs)
        return pairs_frequency
# end of calculate_character_pairs_frequency()
```

Function: calculate character triples frequency

- This function converts the list elements into a blob of text for analysis of triplets of characters.

```
def calculate_character_triples_frequency(text_list):
        # Remove any non-alphanumeric characters and convert text to lowercase
        # convert list of strings to a single blob of text
        text = ""
        for i in text_list:
                text += i

        text = ''.join(filter(str.isalnum, text.lower()))

        # Generate list of character triples (3-grams)
        triples = [text[i:i+3] for i in range(len(text)-1)]

        # Count the frequencies of each character pair
        triples_frequency = Counter(triples)

        return triples_frequency
# end of calculate_character_triples_frequency()
```

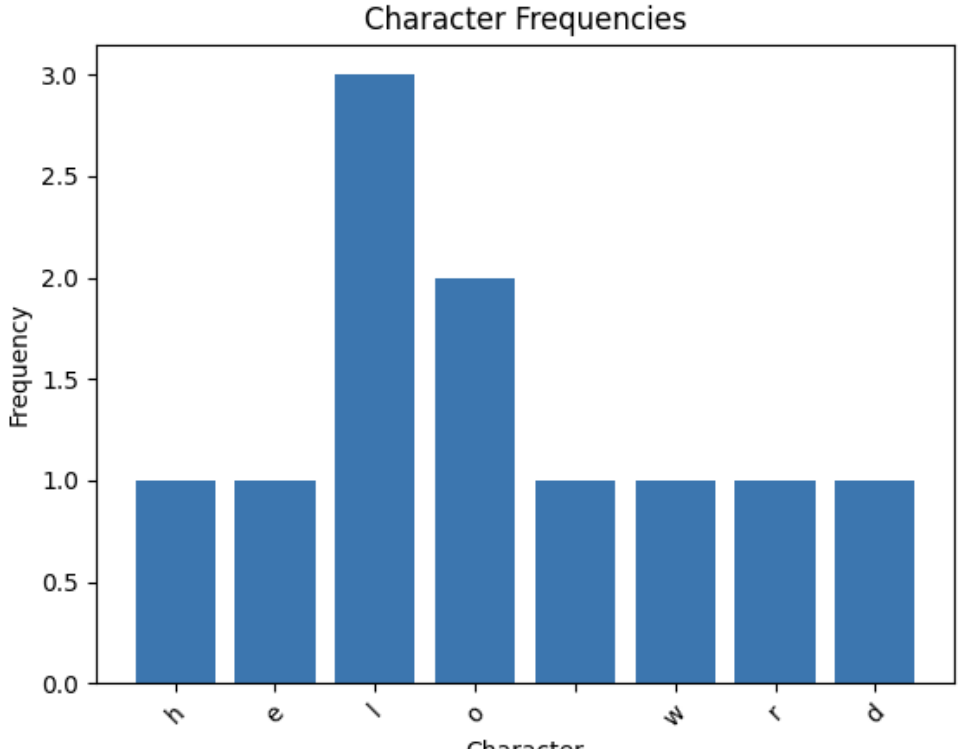
Function: plot character frequencies

- This function plots the character frequencies calculated by calculate character frequencies.

```
import matplotlib.pyplot as plt

def plot_character_frequencies(char_freq):
        # Prepare data for plotting
        characters = list(char_freq.keys())
        frequencies = list(char_freq.values())

        # Plotting
        plt.bar(characters, frequencies)
        plt.title('Character Frequencies')
        plt.xlabel('Character')
        plt.ylabel('Frequency')
        plt.xticks(rotation=45)
        plt.show()
        # end of plot_character_frequencies()
```

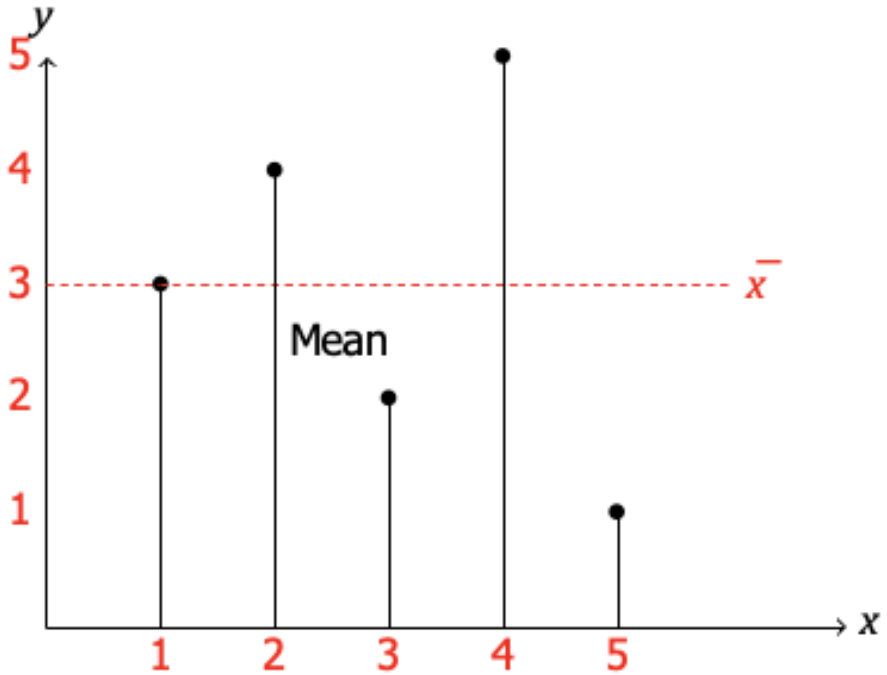
Function: plot character frequencies

```
char_freq = Counter("hello world")
plot_character_frequencies(char_freq)
```



Function: calculate mean

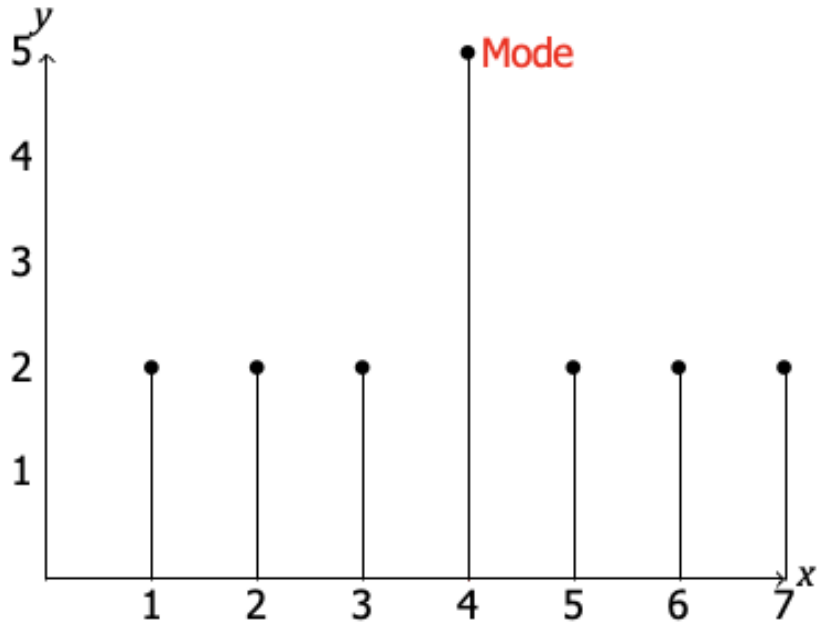
- Data points on a graph, and a dashed line representing the mean (average) of the data points




```
def calculate_mean(frequencies):
    return sum(frequencies) / len(frequencies)
```

Function: calculate mode

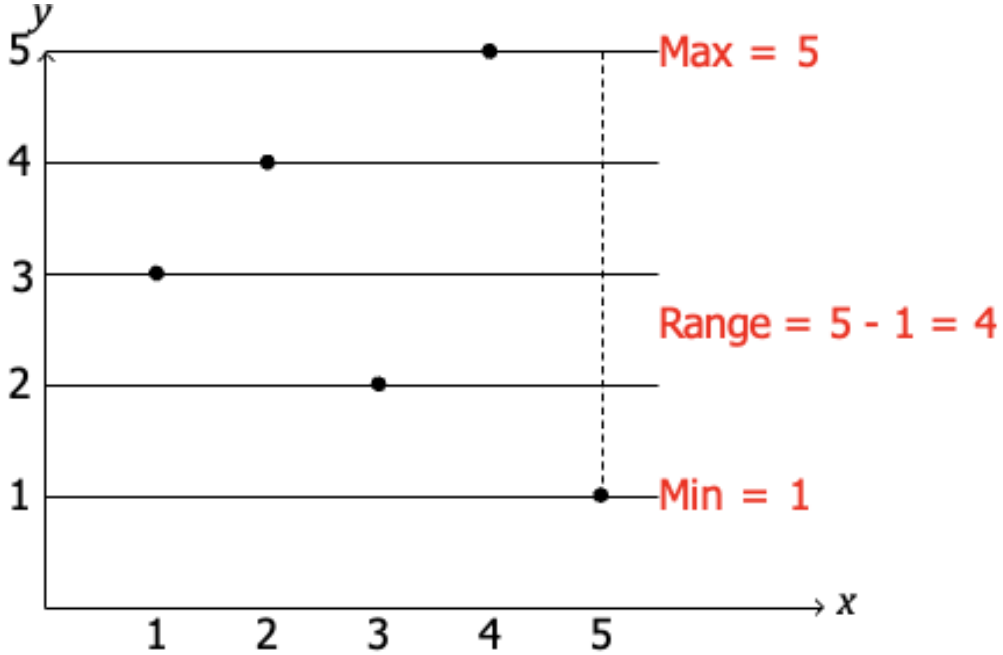
- The mode is the most commonly occurring value, labelled in the data




```
def calculate_mode(frequencies):
        mode = max(frequencies, key=frequencies.count)
        return mode
```

Function: calculate range

- Data points on a graph, and dashed lines representing the range of the data points



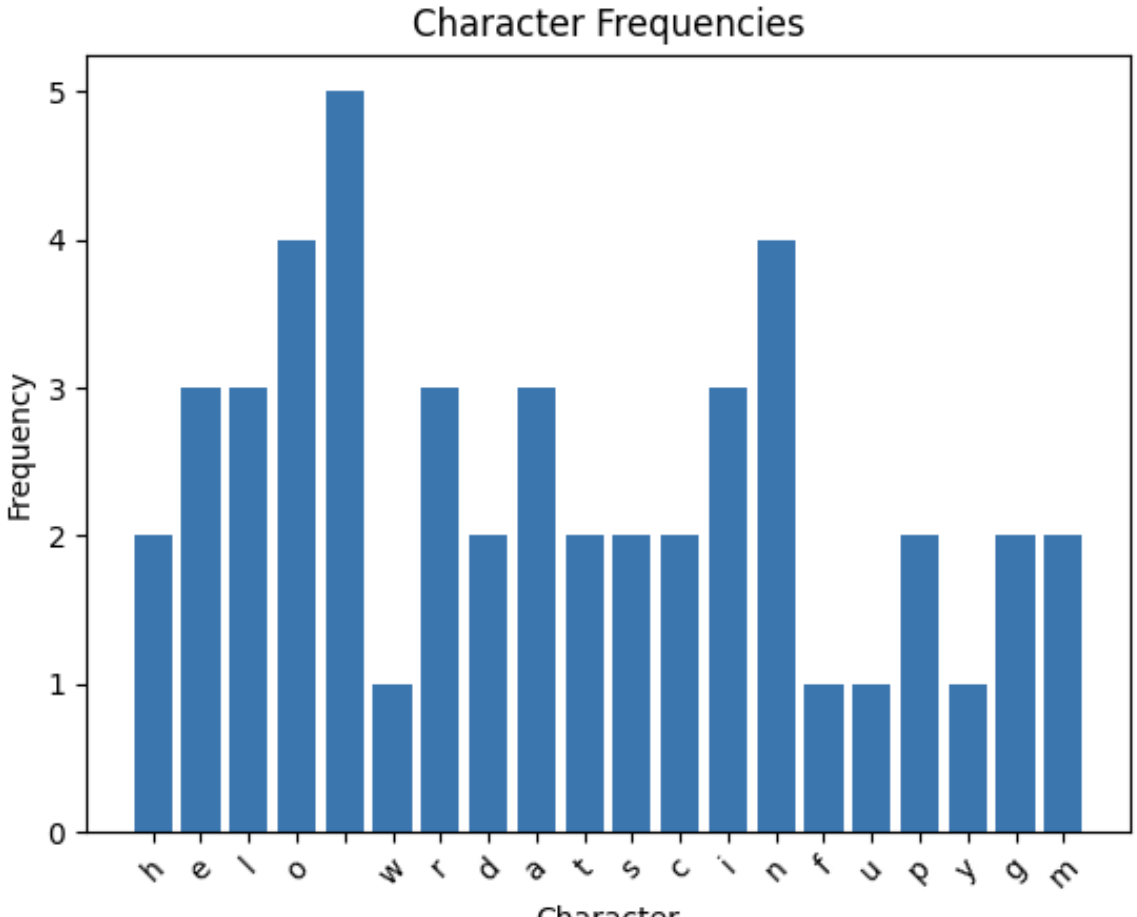

```
def calculate_range(frequencies):
        return max(frequencies) - min(frequencies)
```

Function: singles()

- This function handles the singles analysis

```
def singles(texts):

        ## singles analysis
        # Calculate character frequencies
        char_freq = calculate_character_frequencies(texts)

        # Plot character frequencies
        plot_character_frequencies(char_freq)

        # Calculate mean, mode, and range of frequencies
        frequencies = list(char_freq.values())
        mean_frequency = calculate_mean(frequencies)
        mode_frequency = calculate_mode(frequencies)
        frequency_range = calculate_range(frequencies)
        print("Mean Frequency:", mean_frequency)
        print("Mode Frequency:", mode_frequency)
        print("Frequency Range:", frequency_range)

# end of singles()
```

Function: singles()




```
example_texts = [
"hello world",
"data science is fun",
"python programming"
]

singles(example_texts)
```

Mean Frequency: 2.4
Mode Frequency: 2
Frequency Range: 4

Function: pairs()

- This function handles the pairs analysis

```
def pairs(texts):
## pairs analysis
charPair_freq = calculate_character_pairs_frequency(texts)
# Plot character frequencies
plot_character_frequencies(charPair_freq)

# Calculate mean, mode, and range of frequencies
frequencies = list(charPair_freq.values())
mean_frequency = calculate_mean(frequencies)
mode_frequency = calculate_mode(frequencies)
frequency_range = calculate_range(frequencies)
print("Mean Frequency:", mean_frequency)
print("Mode Frequency:", mode_frequency)
print("Frequency Range:", frequency_range)
# end of pairs()
```

Function: triples()

- This function handles the triples analysis

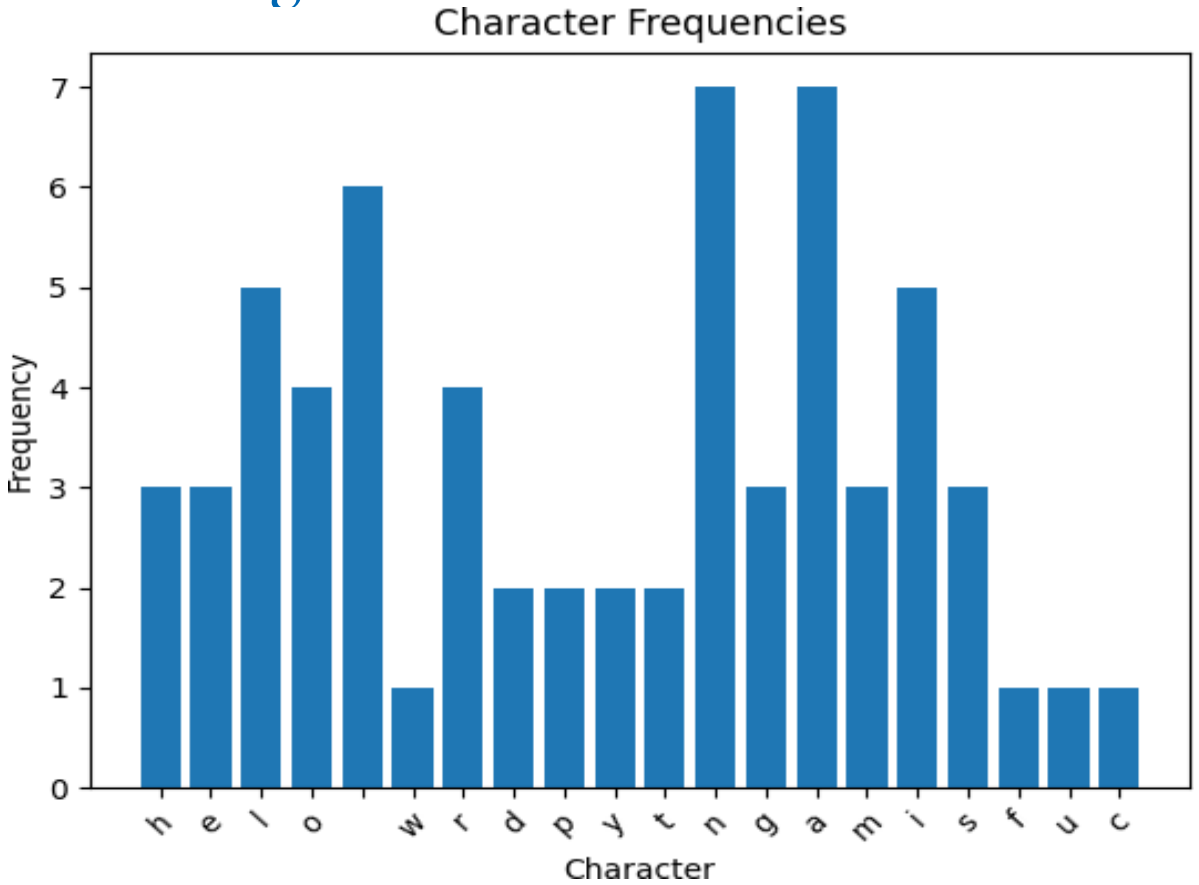
```
def triples(texts):
        ## triples analysis
        charTriples_freq = calculate_character_triples_frequency(texts)
                # Plot character frequencies
        plot_character_frequencies(charTriples_freq)

        # Calculate mean, mode, and range of frequencies
        frequencies = list(charTriples_freq.values())
        mean_frequency = calculate_mean(frequencies)
        mode_frequency = calculate_mode(frequencies)
        frequency_range = calculate_range(frequencies)

        print("Mean Frequency:", mean_frequency)
        print("Mode Frequency:", mode_frequency)
        print("Frequency Range:", frequency_range)
# end of triples()
```

Function: main()

- This function introduces the text and calls to the other functions

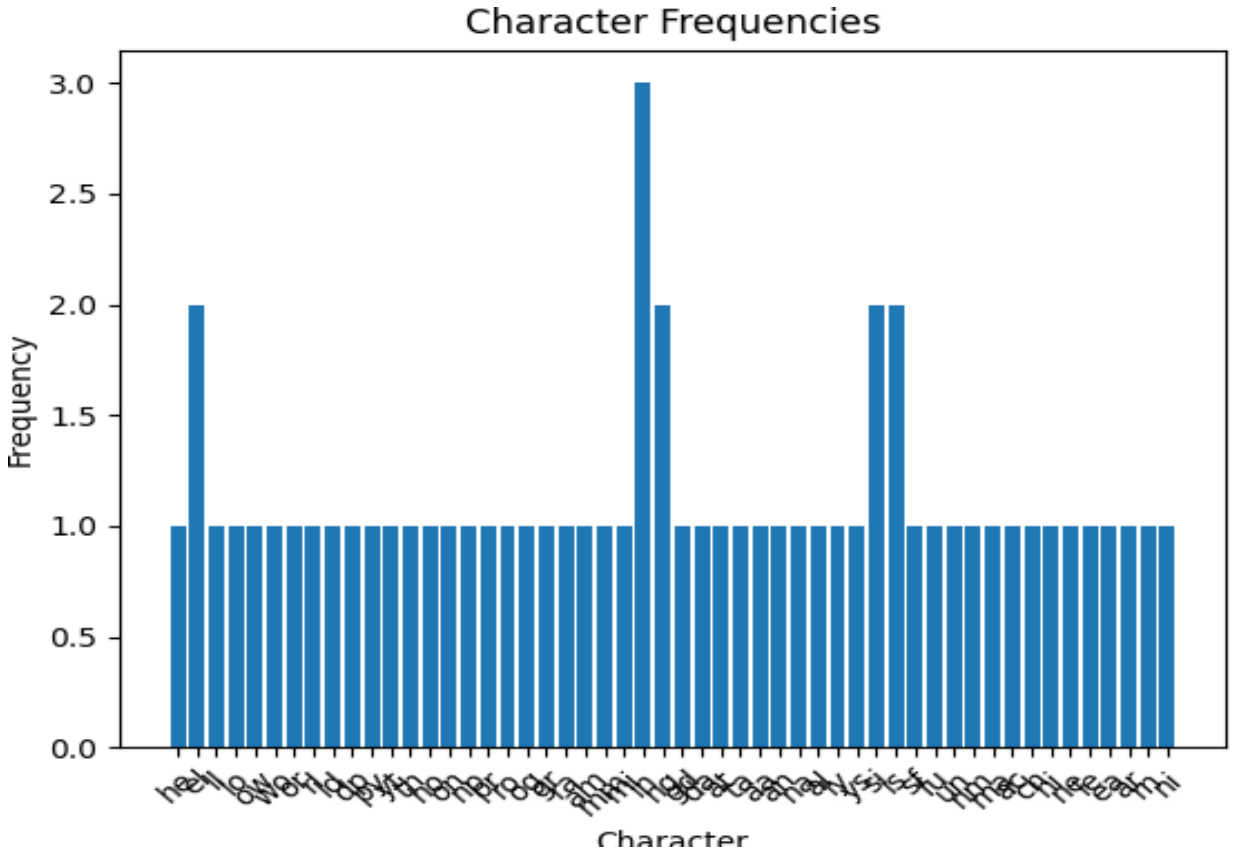
```
def main():
        texts = [
                "hello world",
                "python programming",
                "data analysis is fun",
                "machine learning"
        ]
        singles(texts)
        pairs(texts)
        triples(texts)
# end of main()
```

Output: the single characters



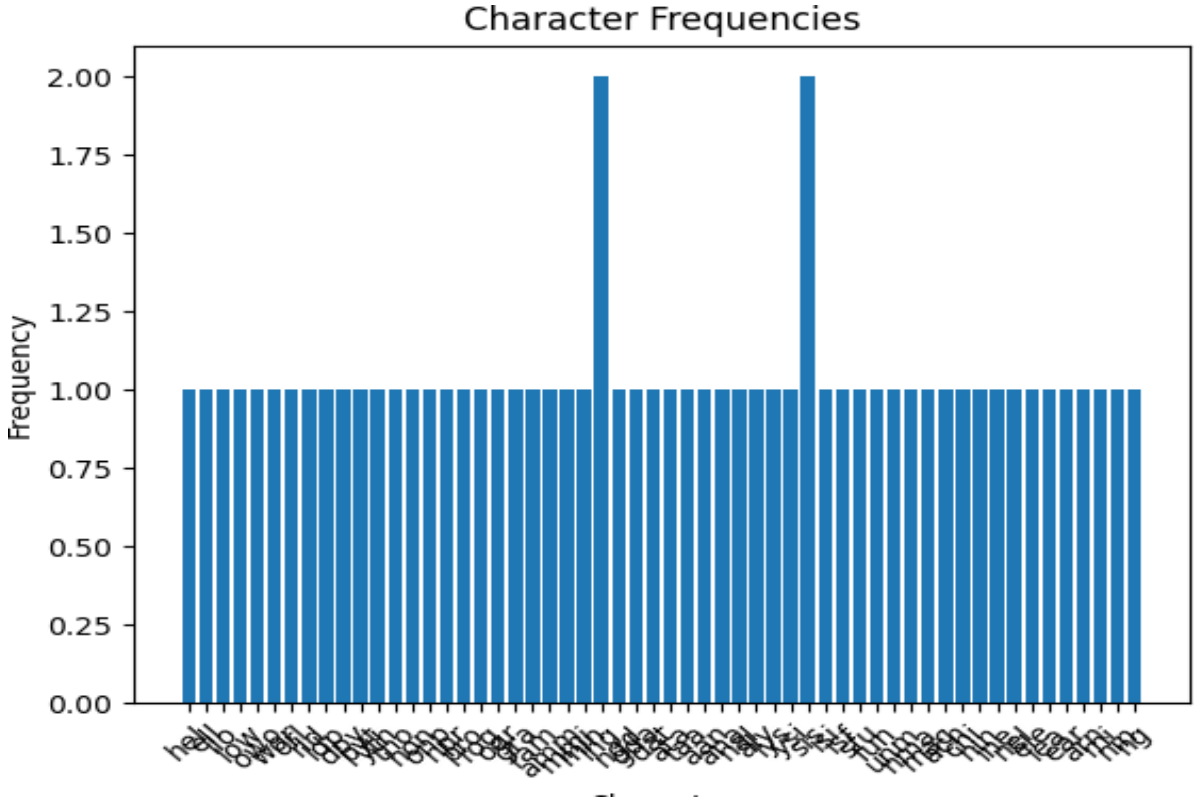
- Figure: The single characters shown as frequencies.

Output: the pairs of characters



- Figure: The pairs of characters shown as frequencies.

Output: the triplets of characters



- Figure: The triplet characters shown as frequencies.

Your Turn!

- Find some text from a news article to add to your code (note, you may need to create a large string declaration!!)
- What are the top three most common characters in English?
- Can you find English words having the following combinations:
  - {“aa”, “ea”, “th”, “zz”, “ty” }
  - {“aeo”, “eab”, “pho”, “gea”, “tyr” }