GITHUB LINK: https://github.com/Jessvcv/Algorithm-Analysis.git

Question 2:

Longest Common Substring Algorithm: logic is explained through comments

```
  public static char[] longestCommonSubstring(char[] text1, char[] text2) {
    int m = text1.length; // find the length of the first string
    int n = text2.length; // find the length of the second string
    int[][] dp = new int[m + 1][n + 1]; // DP table to store lengths of common substrings
    int maxLength = 0; // stores the length of the longest common substring
    int endIndex = 0;  // Ending index of the longest common substring in text1

    // Fill the DP table
    for (int i = 0; i < m; i++) { //iterates through the first string
      for (int j = 0; j < n; j++) { //iterates through the second string
        if (text1[i] == text2[j]) { //checks to see if characters match at the current positon
          dp[i + 1][j + 1] = dp[i][j] + 1; // Increment if characters match
          if (dp[i + 1][j + 1] > maxLength) {  //update the maxlength and endindex if a longer
common substring is found
            maxLength = dp[i + 1][j + 1];
            endIndex = i; // Track the end index in text1
          }
        } else {
          dp[i + 1][j + 1] = 0; // Reset if characters don't match
        }
      }
    }

    // If no common substring is found, return an empty char array
    if (maxLength == 0) {
      return new char[0];
    }

    // Extract the longest common substring using maxLength and endIndex
    char[] result = new char[maxLength];
    for (int i = 0; i < maxLength; i++) {
      result[i] = text1[endIndex - maxLength + 1 + i]; //copies the characters of the common
substring
    }
    return result; // returns the longest common substring as a character array
  }
```

Question 6:

1. Time Complexity of Longest Common Subsequence is O(n*m). Since it is a nested loop, we must analyze from the inside out. The body consists of an if statement which is a constant O(1). Then, the inner loop runs the length of the second string which is equal to n. The outer loop runs m times with m being the length of the first string. Since it is a nested loop, you multiply and the result is O(n*m), and we cut off the constant. In the best-case scenario, the algorithm still iterates through the words using the nested loop n*m times. The body is still constant. So Ω(m*n).

2. Time complexity of Longest Common Substring is O(n*m). The nested loop's body is constant while the inner loop runs n times. The outer loop runs m times which results in O(n*m). In the best-case scenario, the algorithm still has the time complexity of Ω(m*n). This is because it must iterate through all of the characters to check if there are any more substrings.

3. Time complexity of Not Fibonacci Sequence is O(t^2) (t stands for number of Terms) since it uses one for loop to execute the number of calculations. The body is O(t) since it calculates the next term of the sequence with terms can grow exponentially very quickly. The quick growth along with the loop makes the time complexity O(t^2). The best-case scenario still requires the loop to run which will always run the body. This means that it would be Ω(t^2).

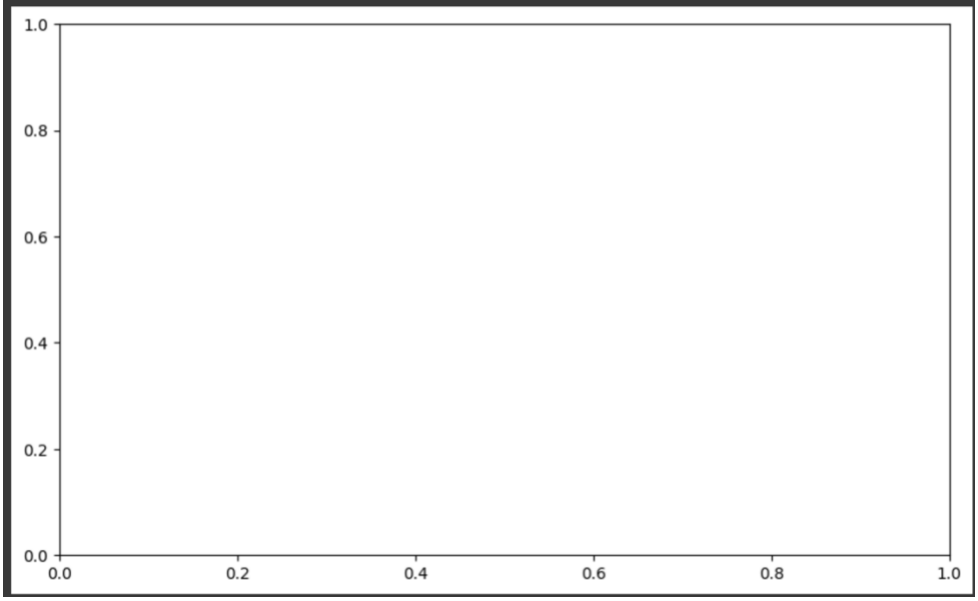
4. Time complexity of Not Fibonacci position is O(n) since the for loop is executed until the input is found. The body of the for loop is a constant because of arithmetic which results in the time complexity being O(n). The best-case scenario is Ω(n) since the loop will have to iterate through the sequence n times to compare values.

5. Time complexity of Remove Elements is O(n), n being the length of the nums array. The algorithm uses one for loop to iterate through the values to check if they are equal to the value that is going to be removed from the list. The body of the loop is O(1) while the loop is O(n). This results in the time complexity of O(n). In the best-case scenario, the loop will still have to run n times since it must check all of the values in the array to make sure. The time complexity would be Ω(n).

Extra Credit:

```python
import matplotlib.pyplot as plt
import numpy as np

# Generate the first 1000 numbers in the NotFibonacci sequence
def not_fibonacci_sequence(n):
    sequence = [0] * n
    sequence[0] = 0
    sequence[1] = 1
    for i in range(2, n):
        sequence[i] = sequence[i - 1] * 3 + sequence[i - 2] * 2
    return sequence

# Generate sequence
seq = not_fibonacci_sequence(1000)

# Plotting
plt.figure(figsize=(10, 6))
plt.plot(seq, label="NotFibonacci Sequence")
plt.xlabel("Index")
plt.ylabel("Value")
plt.title("Plot of the First 1000 Numbers in the NotFibonacci Sequence")
plt.yscale("log")  # Logarithmic scale to handle large numbers
plt.legend()
plt.show()
```

```
---------------------------------------------------------------------------
OverflowError                             Traceback (most recent call last)
<ipython-input-3-028bacaca9bb> in <cell line: 0>()
     16 # Plotting
     17 plt.figure(figsize=(10, 6))
---> 18 plt.plot(seq, label="NotFibonacci Sequence")
     19 plt.xlabel("Index")
     20 plt.ylabel("Value")

                                 6 frames
/usr/local/lib/python3.11/dist-packages/matplotlib/cbook.py in _to_unmasked_float_array(x)
   1343         return np.ma.asarray(x, float).filled(np.nan)
   1344     else:
-> 1345         return np.asarray(x, float)
   1346

OverflowError: int too large to convert to float
```



There was an overflow issue since the number grew so large to the point where it was not able to display properly. However, when I applied logarithms to the values to make it more manageable to view and address the issue of overflowing.