DISCRETE ASSIGNMENT

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Question

If $a\left(\frac{1}{b}+\frac{1}{c}\right)$, $b\left(\frac{1}{c}+\frac{1}{a}\right)$, $c\left(\frac{1}{a}+\frac{1}{b}\right)$ are in arithmetic progression (AP), prove that a, b, c are also in AP.

Theory

Common difference can be written as:

$$b\left(\frac{1}{c}+\frac{1}{a}\right)-a\left(\frac{1}{b}+\frac{1}{c}\right)=c\left(\frac{1}{a}+\frac{1}{b}\right)-b\left(\frac{1}{c}+\frac{1}{a}\right) \tag{1}$$

$$\implies (b-a)\left(\frac{1}{a}+\frac{1}{b}+\frac{1}{c}\right)=(c-b)\left(\frac{1}{a}+\frac{1}{b}+\frac{1}{c}\right) \tag{2}$$

$$\implies b-a=c-b \tag{3}$$

Hence proved that a, b, c are in AP.

Theory

parameter	value	description
$x(0)$	$a\left(\frac{1}{b}+\frac{1}{c}\right)$	First Term of given AP
d	(b - a)$\left(\frac{1}{a}+\frac{1}{b}+\frac{1}{c}\right)$	Common Difference of given AP
$x(n)$	$(x(0)+nd)u(n)$	General Term of given AP

Table: Input Parameter Table

Theory

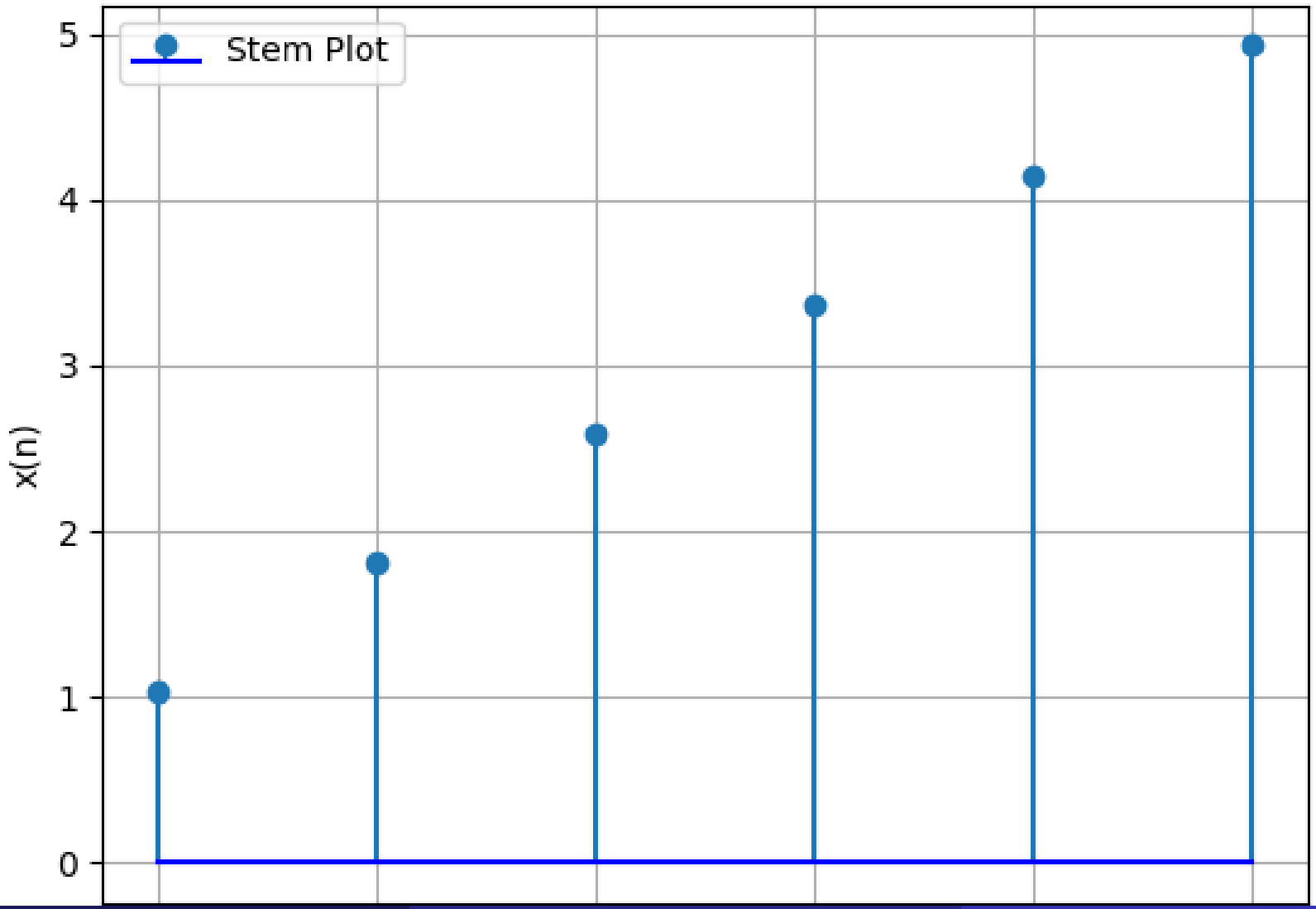
From table 1

$$X(z) = x(0)\left(\frac{1}{1-z^{-1}}\right) + d\left(\frac{z^{-1}}{(1-z^{-1})^2}\right) \tag{4}$$

$$= a\left(\frac{1}{b}+\frac{1}{c}\right)\left(\frac{1}{1-z^{-1}}\right) + (b-a)\left(\frac{1}{a}+\frac{1}{b}+\frac{1}{c}\right)\left(\frac{z^{-1}}{(1-z^{-1})^2}\right) \tag{5}$$

where $|z| > 1$

Theory



C Code

```
#include <stdio.h>
#include <math.h>

void linespace(int start, int stop, int step, int* n_values, double*
    x_values, int num_values) {
    for (int i = 0; i < num_values; ++i) {
        n_values[i] = start + i * step;
        //corresponding values of x(0) = 36.0/35 and d_x = 82.0/105
        x_values[i] = 36.0/35 + n_values[i]*82.0/105;
    }
}
int main() {
    // Define the range and step size
    int start = 0;
    int stop = 5;
    int step = 1;
```

C Code

```
// Calculate the number of values in the range
int num_values = (stop - start) / step + 1;

// Allocate arrays to store the generated values
int n_values[num_values];
double x_values[num_values];

// Call the linespace function
linespace(start, stop, step, n_values, x_values, num_values);

// Save data to a file
FILE* file = fopen("output.dat", "w");
```

C Code

```
    if (file != NULL) {
        for (int i = 0; i < num_values; ++i) {
            fprintf(file, "%d %.2lf\n", n_values[i], x_values[i]);
        }

        fclose(file);
        printf("Data saved to 'output.dat'.\n");
    } else {
        printf("Error opening file for writing.\n");
    }

    return 0;
}
```

Python Code

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

# Load data from the "output.dat" file using numpy's loadtxt
data = np.loadtxt("output.dat")
# Extract n_values and y_values from the data
n_values = data[:, 0].astype(int)
x_values = data[:, 1]

# Create a stem plot
plt.stem(n_values, x_values, linefmt='|', markerfmt='o', basefmt='b',
    label='Stem Plot')
```

Python Code

```
plt.xlabel('n')
plt.ylabel('x(n)')
plt.grid(True)
plt.legend()
plt.savefig('../figs/fig1.png')
plt.show()
```