Discrete 10.5.2.16

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Question

Q: Determine the AP whose third term is 16 and the 7th term exceeds the 5th term by 12.

Input Parameters Table

Parameter	Value	Description
$x(6) - x(4)$	12	7th term exceeds 5th by 12
$x(2)$	16	Third term
d	?	Common difference
$x(0)$	?	First term of AP
$x(n)$	$(x(0) + nd)u(n)$	General term

Table: Input parameters table

Solution

From Table 1

$$x(0) + 6d - x(0) - 4d = 12 \tag{1}$$
$$\implies 2d = 12 \tag{2}$$
$$\implies d = 6 \tag{3}$$

Also,

$$x(0) + 2d = 16 \tag{4}$$
$$\implies x(0) + 2(6) = 16 \tag{5}$$
$$\implies x(0) = 4 \tag{6}$$
$$\therefore x(n) = 6n + 4 \tag{7}$$

Solution Contd.

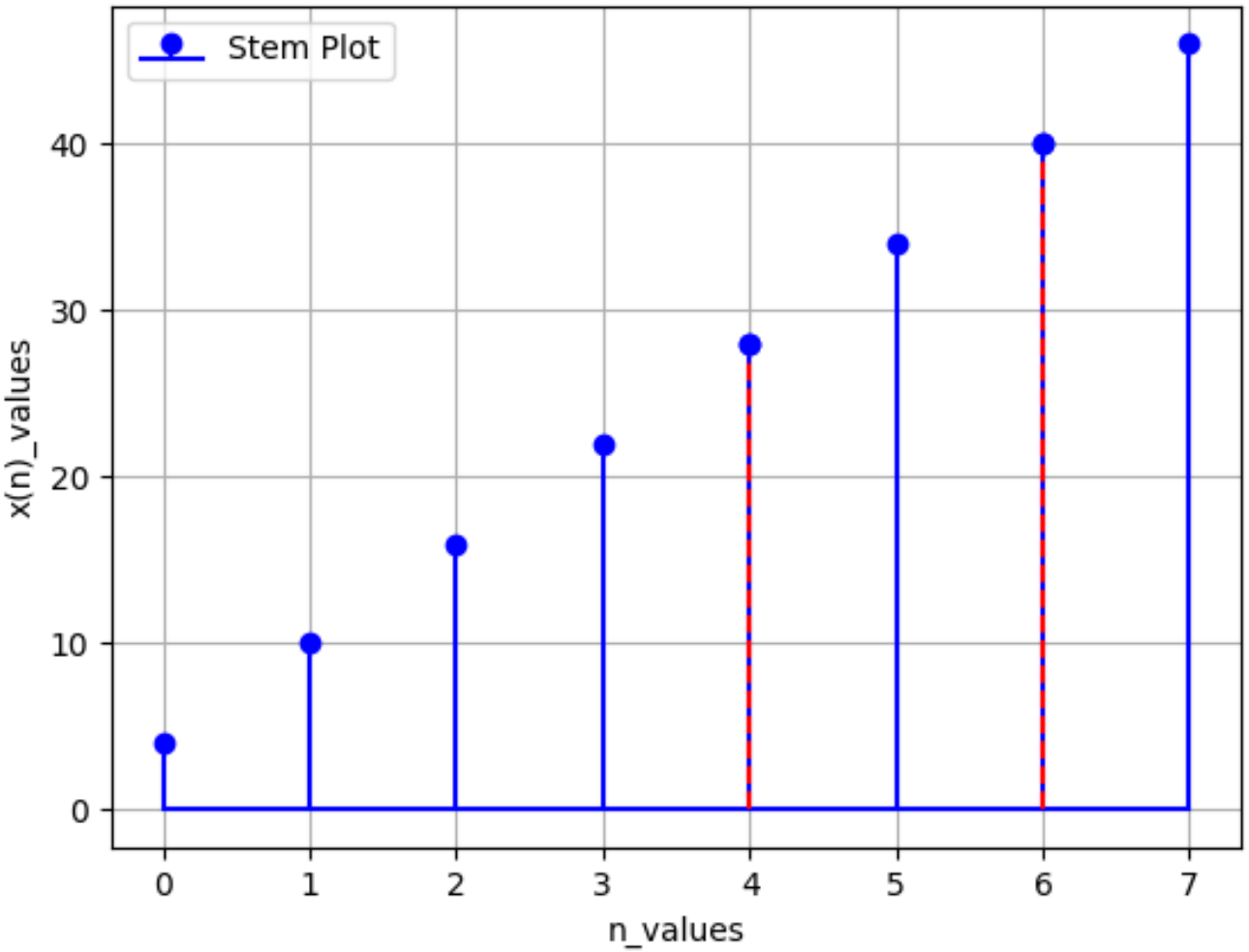
From Table 1

$$X(z) = x(0)\frac{1}{1-z^{-1}} + d\frac{z^{-1}}{(1-z^{-1})^2} \tag{8}$$

$$= 4\frac{1}{1-z^{-1}} + 6\frac{z^{-1}}{(1-z^{-1})^2} \tag{9}$$

$$= \frac{4+2z^{-1}}{(1-z^{-1})^2} \quad |z| > 1 \tag{10}$$

Plot



C code

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

void linespace(int start, int stop, int step, int* n_values, int* y_values, int num_values) {
    for (int i = 0; i < num_values; ++i) {
        n_values[i] = start + i * step;
        y_values[i] = 4 + 6*n_values[i]; // Adjust this line based on your specific calculation
    }
}

int main() {
    // Define the range and step size
    int start = 0;
    int stop = 7;
    int step = 1;

    // 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];
    int y_values[num_values];

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

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

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

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

    return 0;
}
```

Python code

```python
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)
y_values = data[:, 1].astype(int)

# Create a stem plot
plt.stem(n_values, y_values, linefmt='b-', markerfmt='bo', basefmt='b-', label='Stem Plot')
plt.stem(4,28, linefmt='r--',markerfmt='bo',basefmt='r-')
plt.stem(6,40, linefmt='r--',markerfmt='bo',basefmt='r-')

plt.xlabel('n_values')
plt.ylabel('x(n)_values')
plt.grid(True)
plt.legend()

plt.savefig('../figs/fig1.png')
plt.show()
```