Marwadi University Marwadi Chandarana Group NAAC A+	**Marwadi University** **Faculty of Engineering and Technology** **Department of Information and Communication Technology**	
Subject: DSIP (01CT1513)	Aim: Simulate cross correlation and autocorrelation on discrete time signals.	
Experiment No: 03	**Date:**	**Enrolment No: 92301733046**

Experiment-3

AIM: Simulate cross correlation and autocorrelation on discrete time signals.

Theory:

Cross-correlation and autocorrelation are mathematical operations used to measure the similarity or correlation between two signals. They are widely used in various applications, such as signal processing, image processing, and pattern recognition.

Cross-correlation measures the similarity between two signals at different time shifts. It computes the dot product of one signal with a time-shifted version of the other signal. The resulting cross-correlation signal indicates the similarity between the two signals at different time lags.

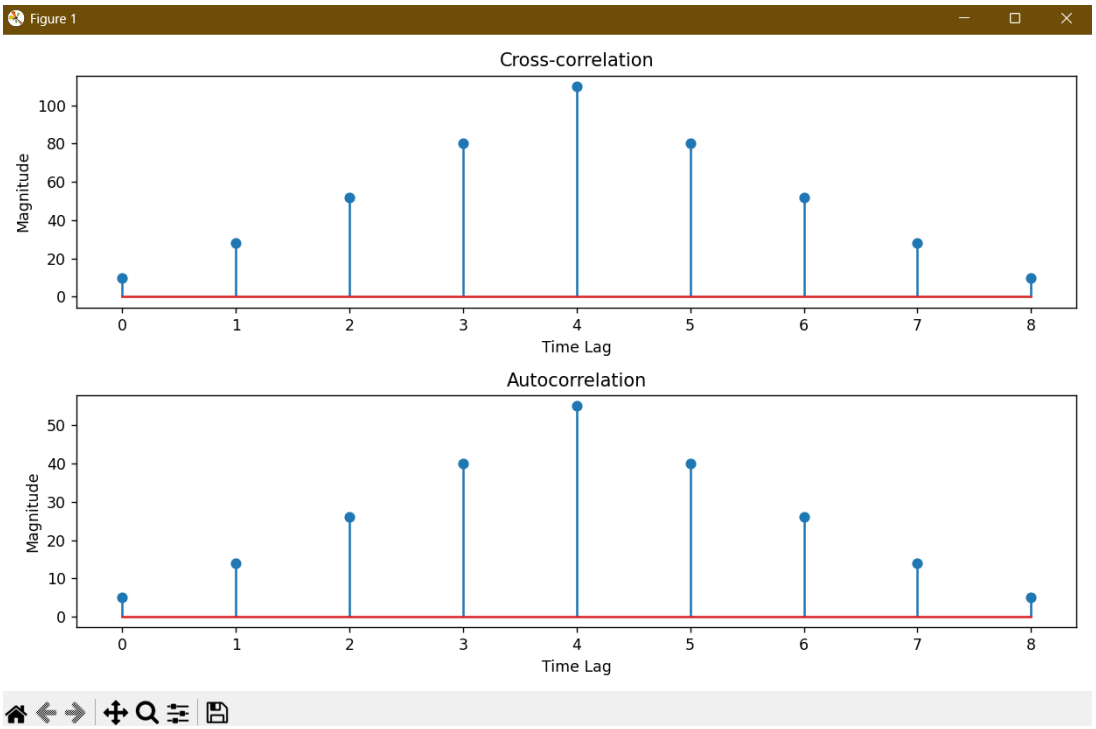
Autocorrelation, on the other hand, measures the similarity of a signal with a time-shifted version of itself. It computes the cross-correlation of a signal with itself. The autocorrelation signal shows how the signal is correlated with itself at different time lags.

Program:

```
import numpy as np
import matplotlib.pyplot as plt
 def cross_correlation(signal1, signal2):
    # Compute the cross-correlation
    cross_corr = np.correlate(signal1, signal2, mode='full')
    return cross_corr
 def autocorrelation(signal):
    # Compute the autocorrelation
    auto_corr = np.correlate(signal, signal, mode='full')
    return auto_corr
# Define the discrete-time signals
signal1 = np.array([1, 2, 3, 4, 5])
signal2 = np.array([2, 4, 6, 8, 10])
# Compute the cross-correlation
cross_corr = cross_correlation(signal1, signal2)
# Compute the autocorrelation
auto_corr = autocorrelation(signal1)
# Plot the cross-correlation and autocorrelation signals
plt.figure(figsize=(10, 6))
plt.subplot(2, 1, 1)
plt.stem(cross_corr)
```

```
plt.title('Cross-correlation')
plt.xlabel('Time Lag')
plt.ylabel('Magnitude')
plt.subplot(2, 1, 2)
plt.stem(auto_corr)
plt.title('Autocorrelation')
plt.xlabel('Time Lag')
plt.ylabel('Magnitude')
 plt.tight_layout()
plt.show()
```

Output



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Conclusion:

This experiment successfully demonstrated the simulation of cross-correlation and autocorrelation operations on discrete-time signals using Python and NumPy. By applying these techniques to sample signals, the following observations can be made:

- Cross-correlation quantifies the similarity between two different signals as a function of time lag, revealing how one signal aligns with a shifted version of another.
- Autocorrelation measures the similarity within a single signal over time lags, indicating the presence of repetitive patterns or periodicity.

The graphical outputs provide clear visual insights into how these correlation functions vary over different time lags, confirming their effectiveness for signal analysis and pattern recognition tasks in digital signal processing. This simulation thus reinforces the theoretical understanding of correlation functions and highlights their importance in practical applications.

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