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| **Experiment 2** | |
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| **AIM :** | The aim of this experiment is to study mathematical operation Correlation and measure degree of similarity between two signals. |
| **OBJECTIVE:** | 1. Write a function to find Correlation Operation<br>2. Calculate correlation of a DT signals and verify the results using mathematical formula. |
| **PROBLEM DEFINITION:** | 1. Find auto correlation of input signal and find the significance of value of output signal at n=0.<br>Let y[n] = x[n] O x[n]<br>Classify the resultant signal( Even / Odd ). Calculate the energy of the signal .<br>Q. What is the significance of value of y[0].<br><br>2. Find auto correlation of delayed input signal.<br>Let p[n]= x[n-1] O x[n-1].<br>Compare the resultant signal p[n] with y[n]. Give your conclusion.<br><br>3. Find cross correlation of input signal and delayed input signal<br>q[n] = x[n] 0 x[n-1].<br>Compare the resultant signal q[n] with p[n] and y[n]<br>Give your conclusion.<br><br>4. Find cross correlation of input signal and scaled input signal.<br>Let s[n] = x[n] O a x[n-2] where “a” is any constant.<br>Compare the resultant signals. |

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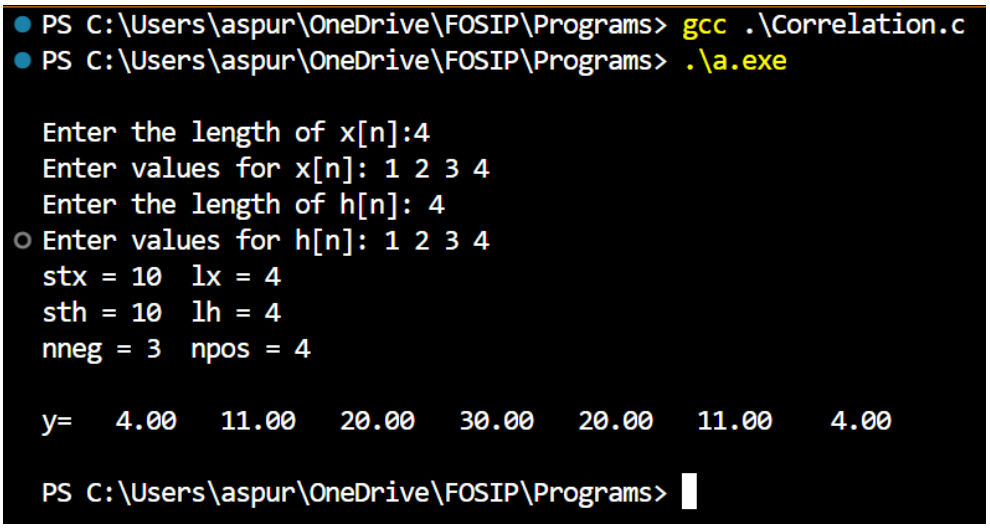
| | Give your conclusion |
| **INPUT SPECIFICATION:** | 1. Length of first Signal L and signal values.<br>2. Length of second Signal M and signal values. |
| **RESULT:** | **Case 1: To find y[n] = x[n] O x[n]**<br>Input: x[n] = {1,2,3,4}<br>Output: y[n] = {4,11,20,30,20,11,4}<br>  <br>Here, y[n] = y[-n]<br>That means, autocorrelation output signal y[n] is an even signal<br>At n=0, y [0] is Maximum value y[0] = Σ\|x(n)\|^2 i.e. Energy of Signal x[n]<br><br>**Case 2 : To find p[n] = x[n-1] O x[n-1]**<br>Input: x[n-1] = {0, 1,2,3,4}<br>Output: p[n] = {4,11,20,30,20,11,4} |

```
PS C:\Users\aspur\OneDrive\FOSIP\Programs> .\a.exe

Enter the length of x[n]:5
Enter values for x[n]: 0 1 2 3 4
Enter the length of h[n]: 5
Enter values for h[n]: 0 1 2 3 4
stx = 11  lx = 4
sth = 11  lh = 4
nneg = 3  npos = 4

y=   4.00   11.00   20.00   30.00   20.00   11.00    4.00

PS C:\Users\aspur\OneDrive\FOSIP\Programs>
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By comparing p[n] with y[n] we get, p[n] = y[n]

That means auto correlation of x[n 1] is same as auto correlation of x[n]

**Case 3 : To find q[n] = x[n] O x[n-1]**

Input: x[n] = {1,2,3,4,0}

x[n-1] ={0,1,2,3,4}

Output: q[n] = {4,11,20,30,20,11,4}

```
PS C:\Users\aspur\OneDrive\FOSIP\Programs> .\a.exe

Enter the length of x[n]:5
Enter values for x[n]: 1 2 3 4 0
Enter the length of h[n]: 5
Enter values for h[n]: 0 1 2 3 4
stx = 10  lx = 5
sth = 11  lh = 4
nneg = 4  npos = 4

y=   4.00   11.00   20.00   30.00   20.00   11.00    4.00    0.00

PS C:\Users\aspur\OneDrive\FOSIP\Programs>
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By comparing q[n] with y[n] we get, q[n] = y[n+1] <--- Advanced y[n]

**Case 4: To find r[n] = x[n] O x[n-2]**

Input: x[n] = {1,2,3,4,0,0}

x[n-2] ={0,0,1,2,3,4}

Output: r[n] = {4,11,20,30,20,11,4}

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PS C:\Users\aspur\OneDrive\FOSIP\Programs> .\a.exe

  Enter the length of x[n]:6
  Enter values for x[n]: 1 2 3 4 0 0
  Enter the length of h[n]: 6
  Enter values for h[n]: 0 0 1 2 3 4
  stx = 10  lx = 6
  sth = 12  lh = 4
  nneg = 5  npos = 4

  y=   4.00   11.00   20.00   30.00   20.00   11.00    4.00    0.00    0.00
```

By comparing r[n] with y[n]

We get, r[n] = y[n+2] <--- Advanced y[n]

**Case 5: To find s[n] = x[n] O a x[n-2]**

Input: x[n] = {1,2,3,4,0,0}

2x[n-2] ={0,0,2,4,6,8}

Output: s[n] = {8,22,40,60,40,22,8}

```
PS C:\Users\aspur\OneDrive\FOSIP\Programs> .\a.exe

  Enter the length of x[n]:6
  Enter values for x[n]: 1 2 3 4 0 0
  Enter the length of h[n]: 6
  Enter values for h[n]: 0 0 2 4 6 8
  stx = 10  lx = 6
  sth = 12  lh = 4
  nneg = 5  npos = 4

  y=   8.00   22.00   40.00   60.00   40.00   22.00    8.00    0.00    0.00

PS C:\Users\aspur\OneDrive\FOSIP\Programs>
```

By comparing s[n] with y[n]

We get, s[n] = 2 y[n+2] <--- Scaled & Advanced y[n]

**CONCLUSION:**

1. **Autocorrelation Signal Symmetry**: An autocorrelation signal is symmetric, meaning y[n] equals y[-n], which characterizes it as an EVEN signal.
2. **Autocorrelation and Delayed Inputs**: If the input signals are subjected to delay, the autocorrelation of the delayed input signal remains identical to the autocorrelation of the original, undelayed signal.

3. **Cross-Correlation and Signal Delay**: The cross-correlation of an input signal with its delayed version is equivalent to an advanced version of the autocorrelated input signal.