Experiment No: 03
Date of Experiment: 08-05-2023
Name of The Experiment: MATLAB Implementation of Auto-correlation and Cross Correlation.
Theory:
Correlation is a measure of similarity between two signals. There are two types of correlation:

i. Auto correlation
ii. Cross correlation

Auto correlation is defined as correlation of a signal with itself. Auto correlation function is a measure of similarity between a signal & its time delayed version. It is represented with R(τ). The autocorrelation of any given signal can also be computed by resorting to graphical technique. The procedure involves sliding the time-shifted version of the given signal upon itself while computing the samples at every interval. That is, if the given signal is digital, then we shift the given signal by one sample every time and overlap it with the original signal. While doing so, for every shift and overlap, we perform multiply and add.
Cross correlation is the measure of similarity between two different signals. Just as is the case with autocorrelation, cross-correlation of any two given signals can be found via graphical techniques. Here, one signal is slid upon the other while computing the samples at every interval. That is, in the case of digital signals, one signal is shifted by one sample to the right each time, at which point the sum of the product of the overlapping samples is computed.

Source Code:

1. Source code for auto correlation

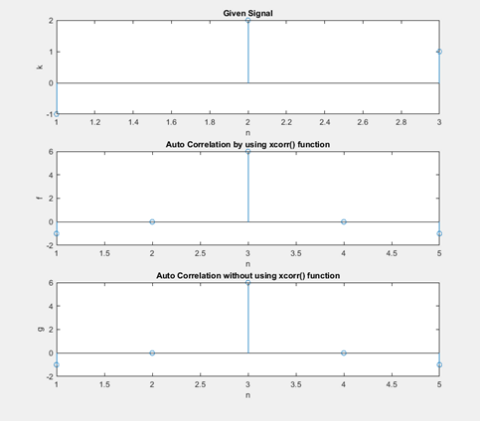
```
clc;
close all;
a = [-1 2 1];
b = [1 2 3 4];
r = xcorr(a,a);
s = xcorr(a,b);
len=length(a);
n=len*2-1;
lent=length(b);
m=len*lent-1;
f = [zeros(1,n)];
g = [zeros(1,m)];
c=1;

for i= 1:len
  for j = i:-1:1
    f(i) = f(i)+a(j)*a(len-j+1);
   end
end

for i=2:len
  for j=i:len
      k=1;
      f(c+len) = f(c+len)+a(j)*a(k);
      k=k+1;
  end
  c=c+1;
end

subplot(3,1,1)
stem(a);
title('Given Signal');
subplot(3,1,2)
stem(r);
 title('Auto Correlation by using xcorr() function');
subplot(3,1,3)
stem(f);
 title('Auto Correlation without using xcorr() function');
```

2. Source code for cross correlation

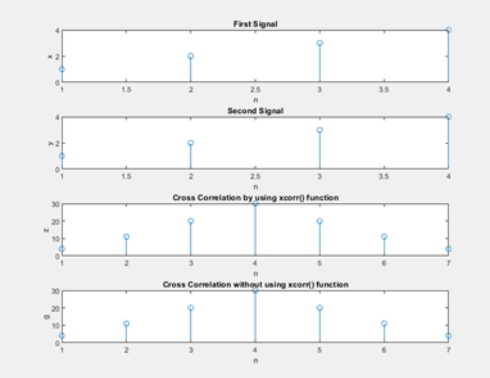
```
clc;
close all;
a = [1 2 3 4];
b = [1 2 3 4];
r = xcorr(a,a);
s = xcorr(a,b);
len=length(a)
n=len*2-1;
lent=length(b);
m=len*lent-1;
f = [zeros(1,n)];
g = [zeros(1,m)];


c=1;
for i= 1:lent
  for j = i:-1:1
    g(i) = g(i)+a(j)*b(len-j+1);
  end

end

for i=2:len
  for j=i:len
      k=1;
      g(c+lent) = g(c+lent)+a(j)*b(k);
      k=k+1;
  end
  c=c+1;
end

subplot(4,1,1)
stem(a);
title('First Signal');
subplot(4,1,2)
stem(b);
title('Second Signal');
subplot(4,1,3)
stem(s);
title('Cross Correlation by using xcorr() function');
subplot(4,1,4)
stem(g);
title('Cross Correlation without using xcorr() function');
```

Output:

1. Output of auto correlation



2. Output of cross correlation



<u>Discussion & Conclusion</u>: All the signals were generated applying codes in MATLAB. At first, the signal was generated using built in function for correlation for both auto correlation and cross correlation. Then the same signals were generated without any built in function.