

Experiment No 2

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- Batch: 7
- Branch: IT
- Subject: Foundation Of Signal Processing

Part A

Aim: The aim of this experiment is To study mathematical operation Correlation and measure degree of similarity between two signals.

Q1)

- Problem Definition:
 1. Find auto correlation of input signal and find the significance of value of output signal at $n = 0$. Let $y[n] = x[n] \circ x[n]$
 2. Classify the resultant signal(Even / Odd).
 3. Calculate the energy of the signal.
 4. What is the significance of the value of $y[0]$?
- Solution: $x[n] = \{30, 12, 20, 6, 2\}$

a. Output

```
spit@spit-ThinkCentre-M70s:~/srikanth/convolution/DSP C-Programs 2022 by TALELES$ ./correlation
Enter the length of x[n]:5
Enter values for x[n]: 30 12 20 6 2
Enter the length of h[n]: 5
Enter values for h[n]: 30 12 20 6 2
stx = 10  lx = 5
sth = 10  lh = 5
nneg = 4  npos = 5
y= 60.00  204.00  712.00  732.00  1484.00  732.00  712.00  204.00  60.00
```

- b. Since $y[n] = y[-n]$, That means, the autocorrelation output signal $y[n]$ is an EVEN signal.
- c. Energy of signal = $30^2 + 12^2 + 20^2 + 6^2 + 2^2 = 1484$.
- d. At $n=0$, y has maximum value which is equal to 1484.

Q2)

- Problem Definition: Compare the resultant signal $p[n]$ with $y[n]$. Give your conclusion.
- Solution:

```
x[n] = {0, 30, 12, 20, 6, 2}
x[n-1] = {0, 30, 12, 20, 6, 2}
```

```

splt@splt-ThinkCentre-M70s:~/srikanth/convolution/DSP C-Programs 2022 by TALELE$ ./correlation
Enter the length of x[n]:6
Enter values for x[n]: 0 30 12 20 6 2
Enter the length of h[n]: 6
Enter values for h[n]: 0 30 12 20 6 2
stx = 11   lx = 5
sth = 11   lh = 5
nneg = 4   npos = 5

y=  60.00  204.00  712.00  732.00  1484.00  732.00  712.00  204.00  60.00

```

We see that there is no change in the output if we right shift the input signal by 1 i.e. delayed signal.

Q3)

- Problem Definition: Find cross correlation of input signal and delayed input signal $q[n] = x[n] \circ x[n-1]$. Compare the resultant signal $q[n]$ with $p[n]$ and $y[n]$

Give your conclusion. Solution:

```

x[n] = {0, 30, 12, 20, 6, 2}
x[n-1] = {30, 12, 20, 6, 2, 0}

```

```

splt@splt-ThinkCentre-M70s:~/srikanth/convolution/DSP C-Programs 2022 by TALELE$ ./correlation
Enter the length of x[n]:6
Enter values for x[n]: 30 12 20 6 2 0
Enter the length of h[n]: 6
Enter values for h[n]: 0 30 12 20 6 2
stx = 10   lx = 6
sth = 11   lh = 5
nneg = 5   npos = 5

y=  60.00  204.00  712.00  732.00  1484.00  732.00  712.00  204.00  60.00  0.00

```

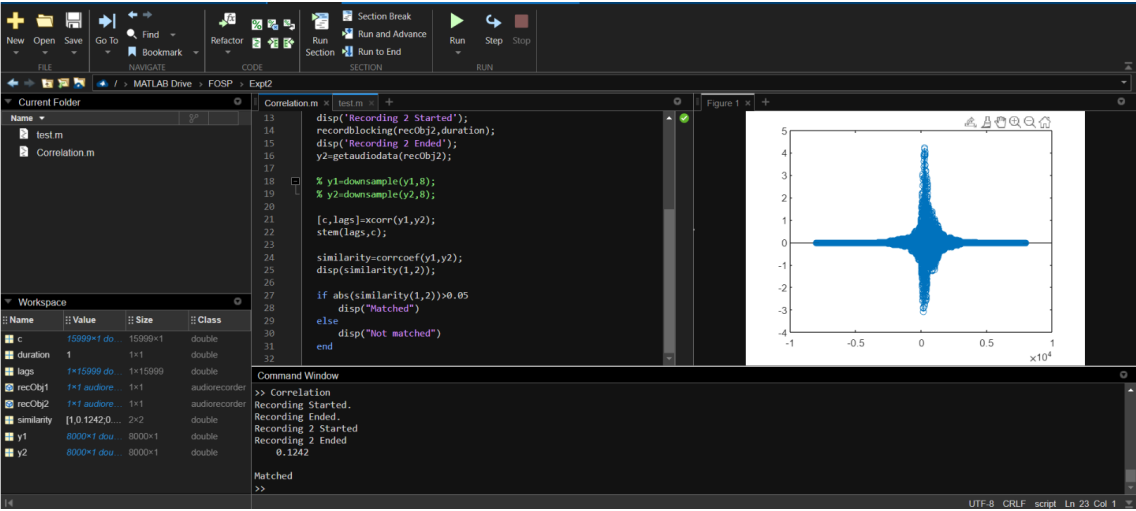
Analysis:

We notice that there is no change in the output signal but the output signal is also left shifted by 1.

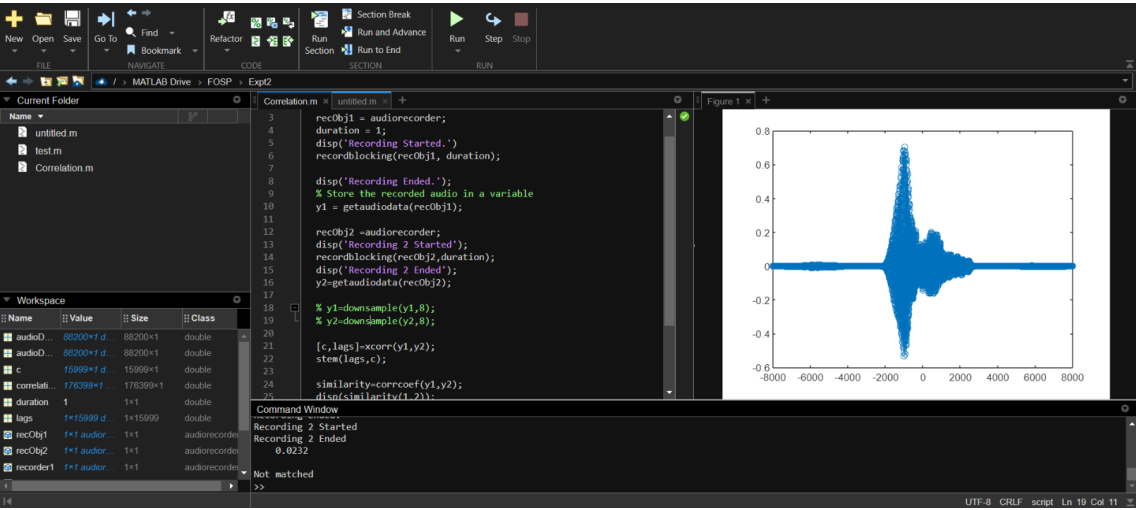
Part B

Aim: To make a program which is able to identify a person's voice and phrases using correlation. (Voice password program)

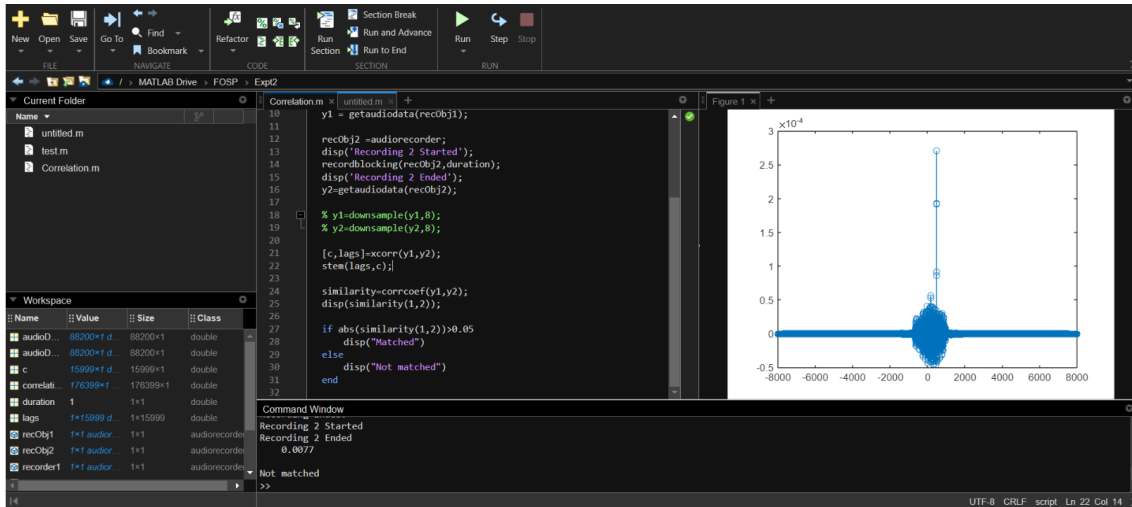
Case 1: Two audio signals of same person saying same phrase



Case 2: Two audio signals of same person saying different phrase



Case 3: Two audio signals of different person saying same phrase



Conclusion:

- Autocorrelation of a input signal remains same if we shift the signal or not since both the signals are same.
- If we take the correlation with the signal and a right shifted signal output signal is left shifted by 1.