SS EXPERIMENT LAB 3

TITLE: Perform decimation and calculate energy and power of a signal

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OBSERVATION: In this lab, I learned how to decimate and calculate energy and power using MATLAB.

1. The operation of *signal dilation* (or *decimation* or *down-sampling*) is defined by

$$y(n) = x(nM)$$

where the sequence $x(n)$ is down-sampled by an integer factor M. For example, if

$$x(n) = \{\ldots., -2, 4, \underset{\uparrow}{3}, -6, 5, -1, 8, \ldots.\}$$

then the down-sampled sequences by a $factor\ 2$ are given by

$$y(n) = \{\ldots., -2, \underset{\uparrow}{3}, 5, 8, \ldots.\}$$

Develop a MATLAB function **dnsample** that has the form to implement the above operation.

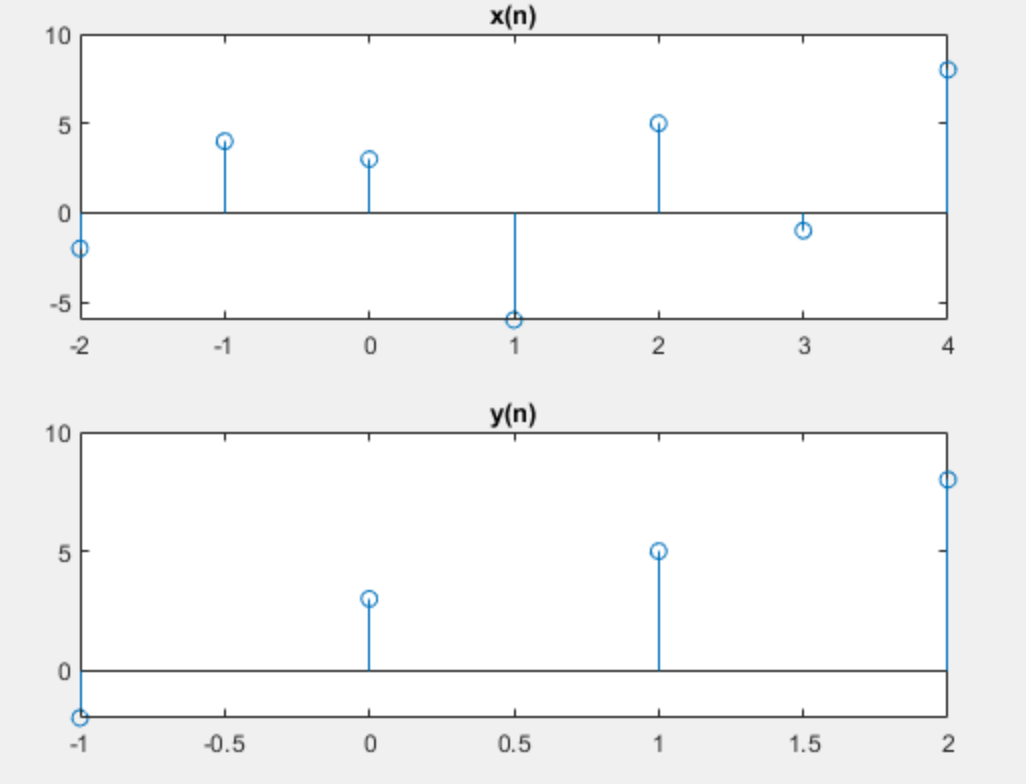
```
function [y,m] = dnsample(x,n,M)
% Downsample sequence x(n) by a factor M to obtain y(m)
```

```
n = -2:1:4;
x = [-2,4,3,-6,5,-1,8];
[y,m]= dnsample(x,n,2);

subplot(2,1,1);
stem(n,x);
title('x(n)');

subplot(2,1,2);
stem(m,y);
title('y(n)');

function [y,m]=dnsample(x,n,M)
param=n/M;
samp=fix(param)==param;
y=x(samp==1);
m=n(samp==1)/M;
end
```



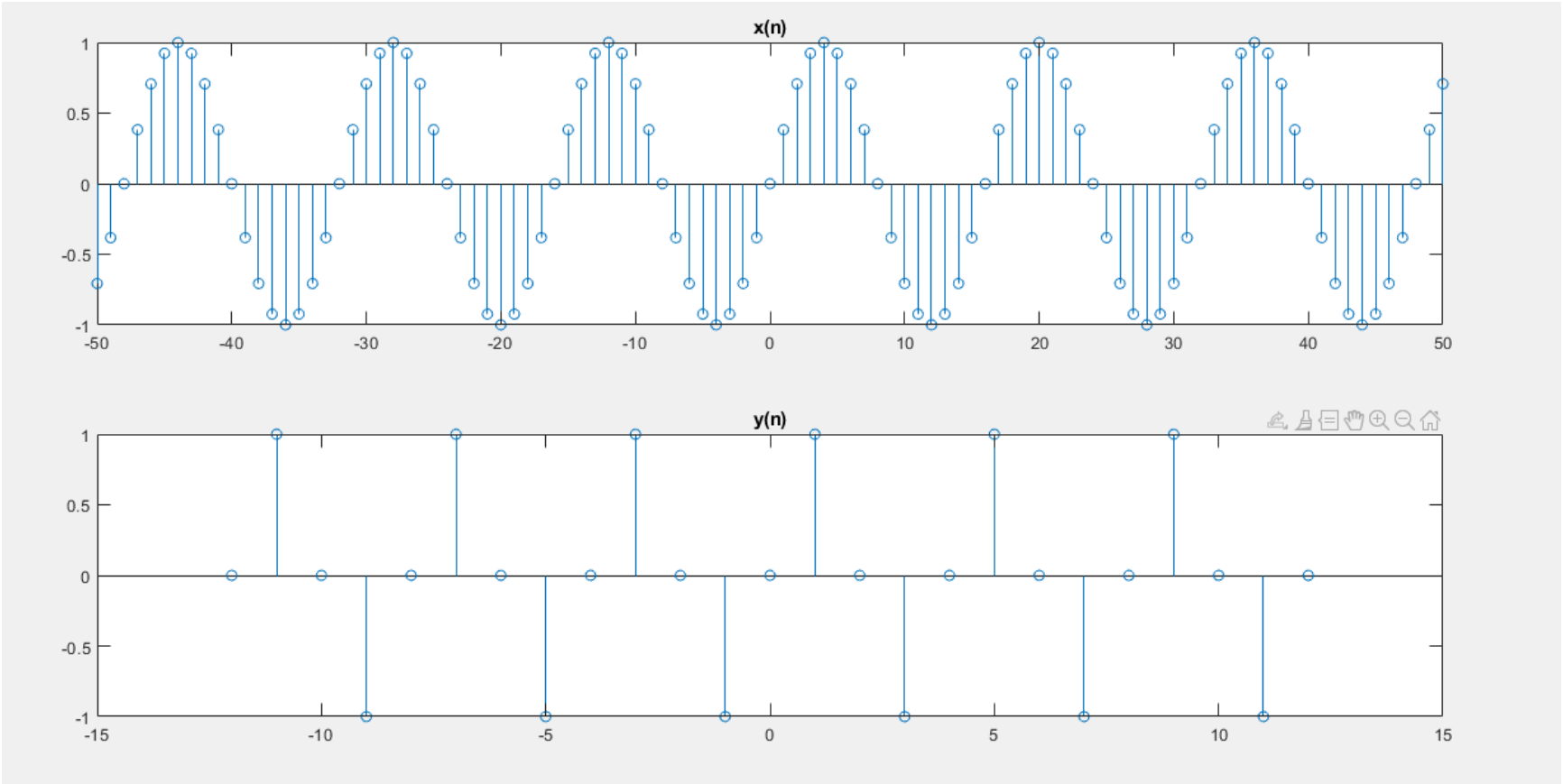
2. Generate $x(n) = \sin(0.125\pi n), -50 \leq n \leq 50$. Decimate $x(n)$ by a factor of 4 to generate $y(n)$. Plot both $x(n)$ and $y(n)$ using subplot, and comment on the effect of down-sampling on signal.

```
n = -50:1:50;
x = sin(0.125*pi*n);
[y,m]= dnsample(x,n,4);

subplot(2,1,1);
stem(n,x);
title('x(n)');

subplot(2,1,2);
stem(m,y);
title('y(n)');

function [y,m]=dnsample(x,n,M)
param=n/M;
samp=fix(param)==param;
y=x(samp==1);
m=n(samp==1)/M;
end
```


x(n)
1
0.5
0
-0.5
-1
-50
-40
-30
-20
-10
0
10
20
30
40
50
y(n)
1
0.5
0
-0.5
-1
-15
-10
-5
0
5
10
15

Q3.

For a given speech signal, perform the following operations:

a) Read/load the voice file in MATLAB using in build '$audioread$' function

```
[x, fs] = audioread('LDC93S1.wav');
% read audio file// x- speech sample, fs is the sampling frequency
```

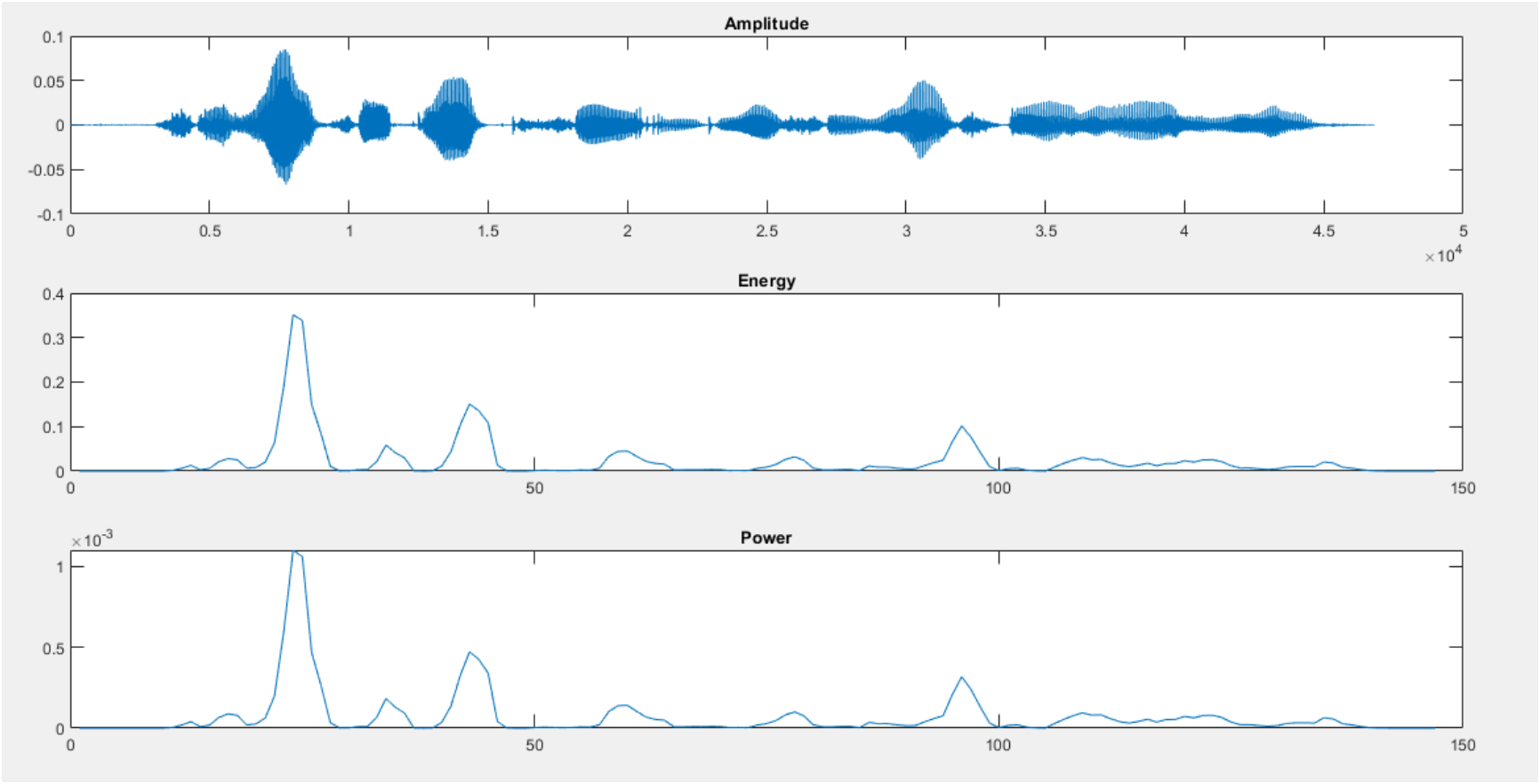
b) Write a MATLAB script (function) which *segment* the speech signal "20 ms" duration without overlapping

c) Calculate the $energy\ and\ power$ of the data available in each segment.

d) Plot the $energy\ and\ power$ of signal for each segment.

```
[x, fs] = audioread('LDC93S1.wav');
segment = 0.02;
inc = fs * segment;
[E,p]=cal(x,inc);
l1=[1:1:size(E)];
l2=[1:1:size(p)];
subplot(3,1,1);
plot(x);
title('Amplitude');
subplot(3,1,2);
plot(E);
title('Energy');
subplot(3,1,3);
plot(p);
title('Power');
function [E,p]=cal(x,inc)
    E=[];
p=[];
sum=0;
count=0;
for i=1:1:size(x)
    if(mod(i,inc)==0)
     E(end+1)=sum;
     p(end+1)=sum/count;
    sum=0;
    count=0;
    else
    sum=x(i)*x(i)+sum;
    count=count+1;
    end
end

if(mod(size(x),inc)~=0)
     E(end+1)=sum;
     p(end+1)=sum/count;
end
end
```


Amplitude
0.1
0.05
0
-0.05
-0.1
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10^4
Energy
0.4
0.3
0.2
0.1
0
0
50
100
150
Power
×10^-3
1
0.5
0
0
50
100
150