Digital Signal Processing
MATLAB HW1 - q2

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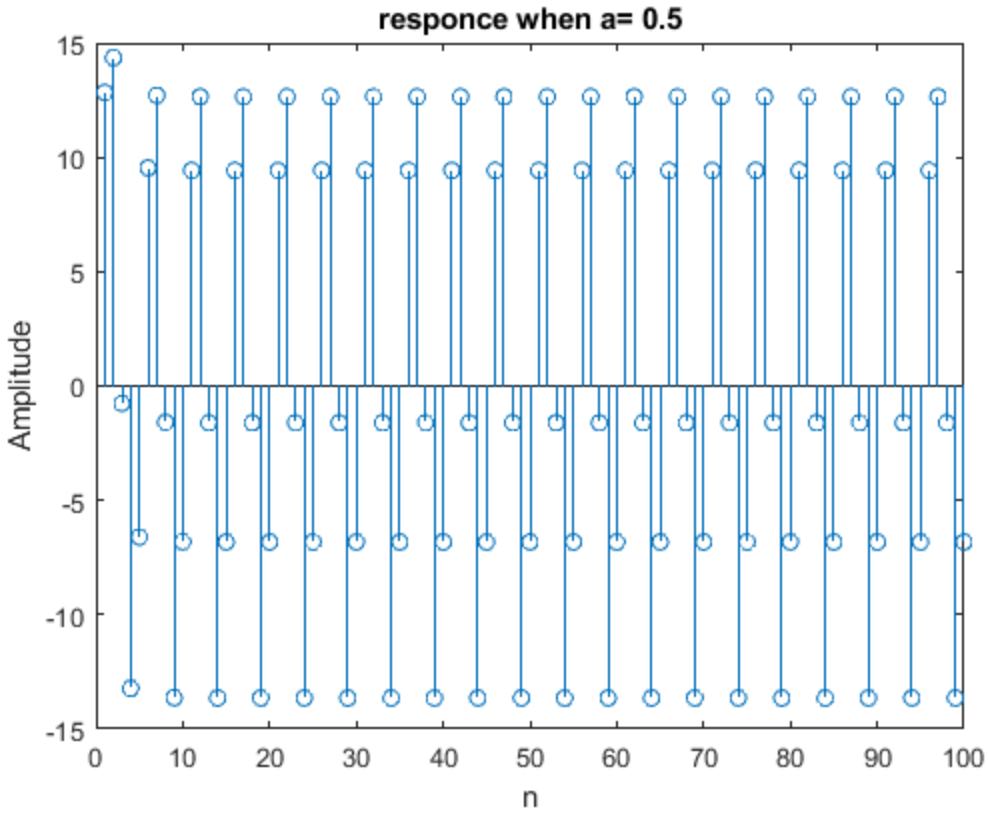
Clear recent data

```
clear; close all; clc;
```

RESPONSE OF DISCRETE-TIME SYSTEMS

part 1

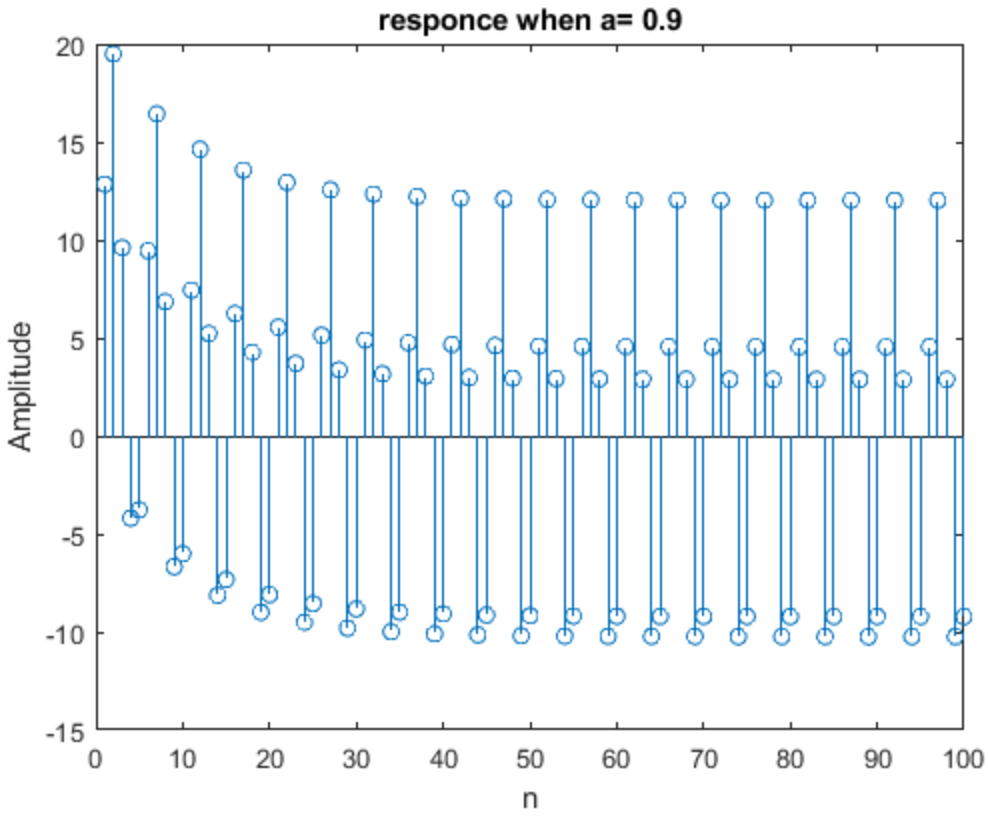
```
n = 1:100;
a_1 = 0.5;
b1 = [4.5];
a1 = [1 -a_1];
x1 = 3 * sin(2*pi*0.2*n);
y1 = filter(b1, a1, x1);
figure(1);
stem(n,y1);
title("responce when a= "+a_1);
xlabel('n');
ylabel('Amplitude');
```

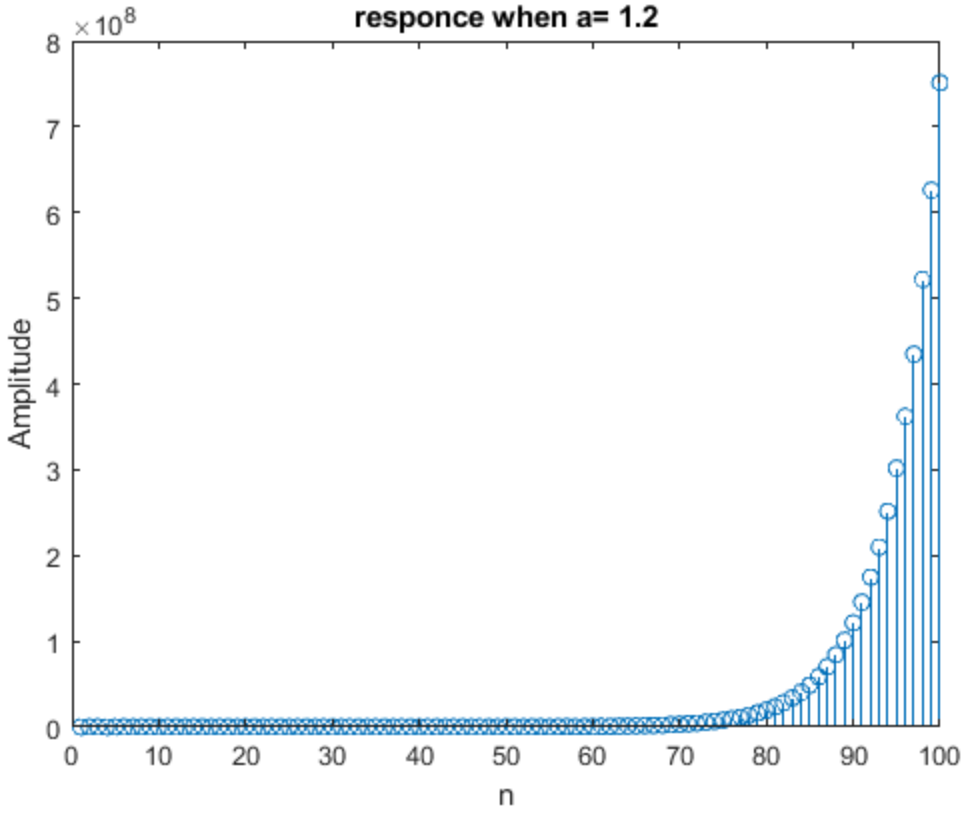


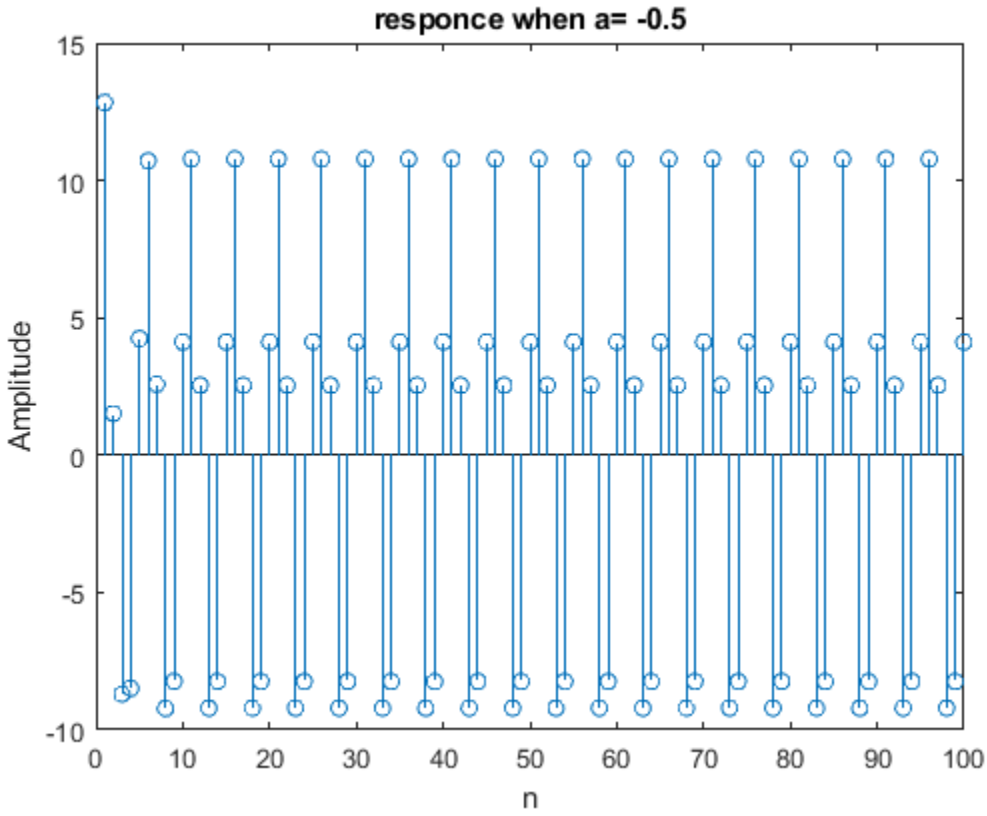
part 2

```
a_2 = 0.9;
a_3 = 1.2;
a_4 = -0.5;
a2 = [1 -a_2];
a3 = [1 -a_3];
a4 = [1 -a_4];
y2 = filter(b1, a2, x1);
y3 = filter(b1, a3, x1);
y4 = filter(b1, a4, x1);
figure(2);
stem(n,y2);
title("responce when a= "+a_2);
xlabel('n');
ylabel('Amplitude');
figure(3);
stem(n,y3);
title("responce when a= "+a_3);
xlabel('n');
ylabel('Amplitude');
figure(4);
stem(n,y4);
title("responce when a= "+a_4);
xlabel('n');
```

```
ylabel('Amplitude');
```



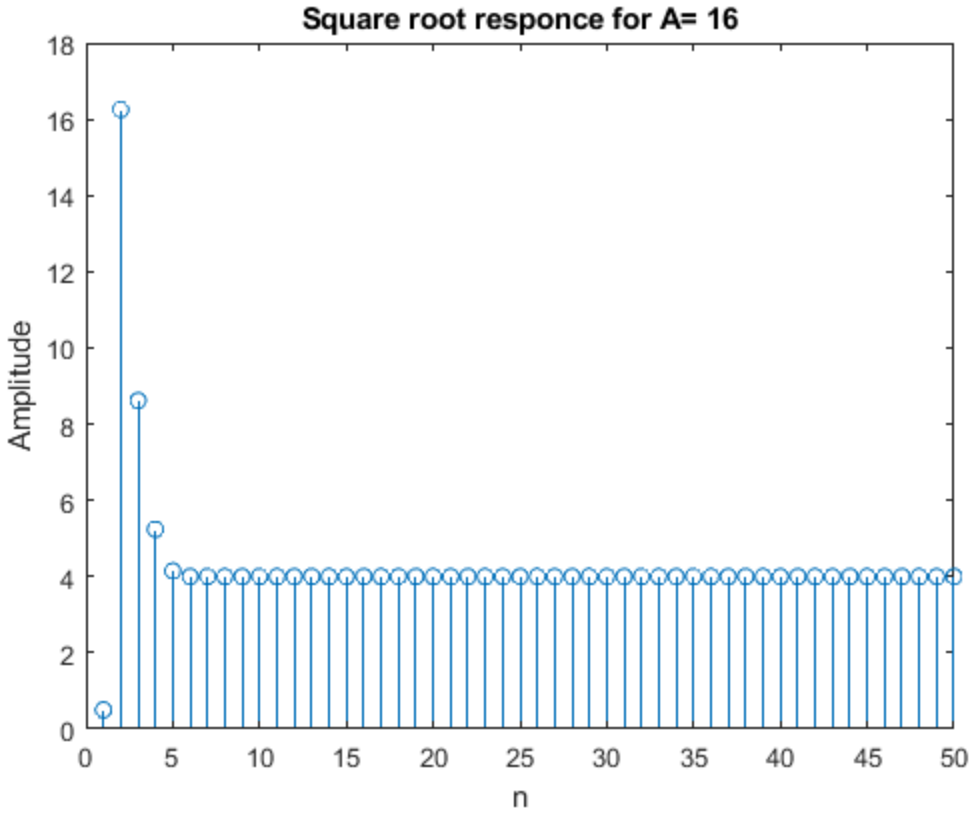

responce when a= 1.2
×10^8
Amplitude
n
0
1
2
3
4
5
6
7
8
0
10
20
30
40
50
60
70
80
90
100

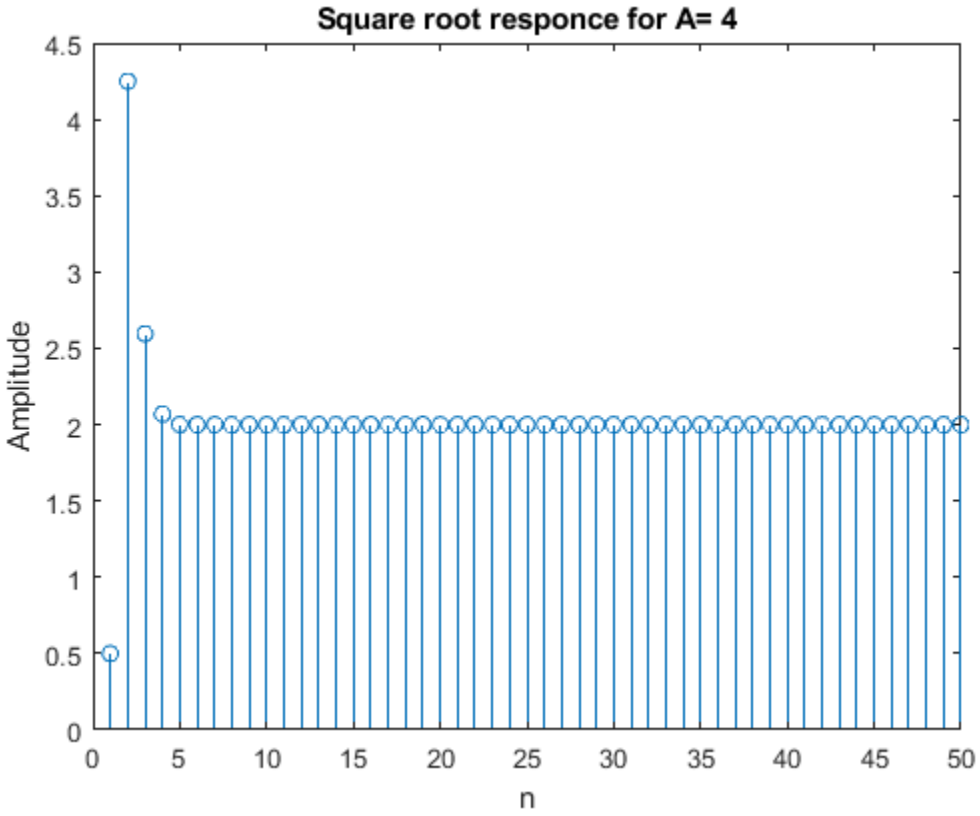

responce when a= -0.5
Amplitude
n
-10
-5
0
5
10
15
0
10
20
30
40
50
60
70
80
90
100

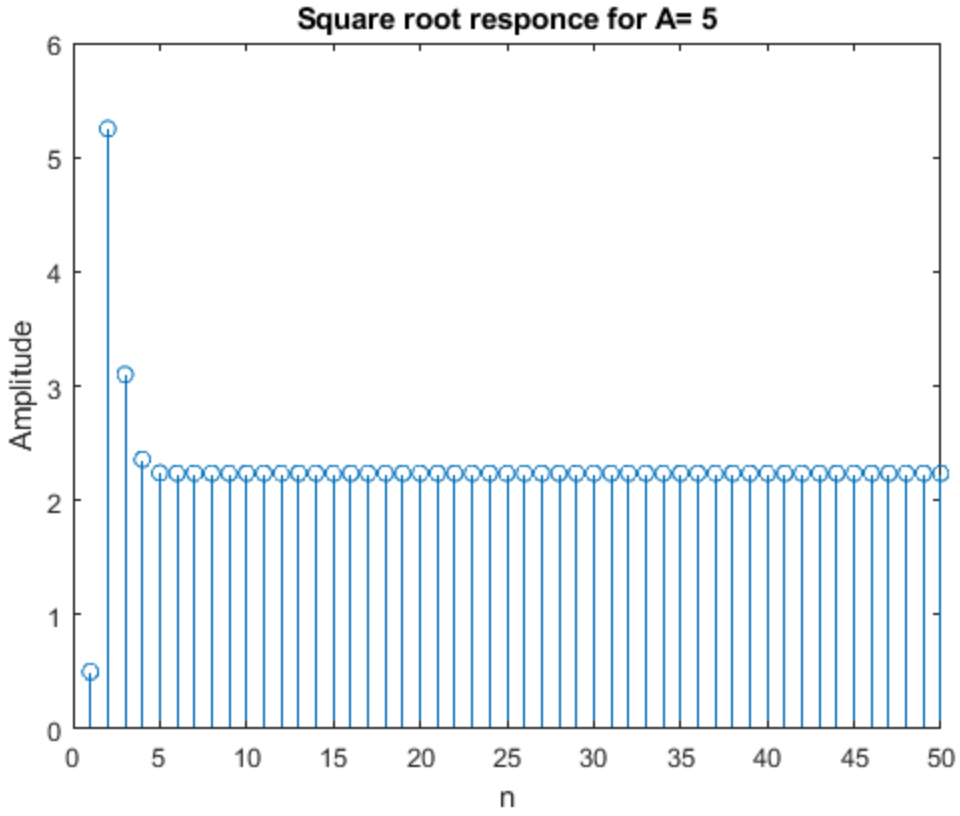
part 3

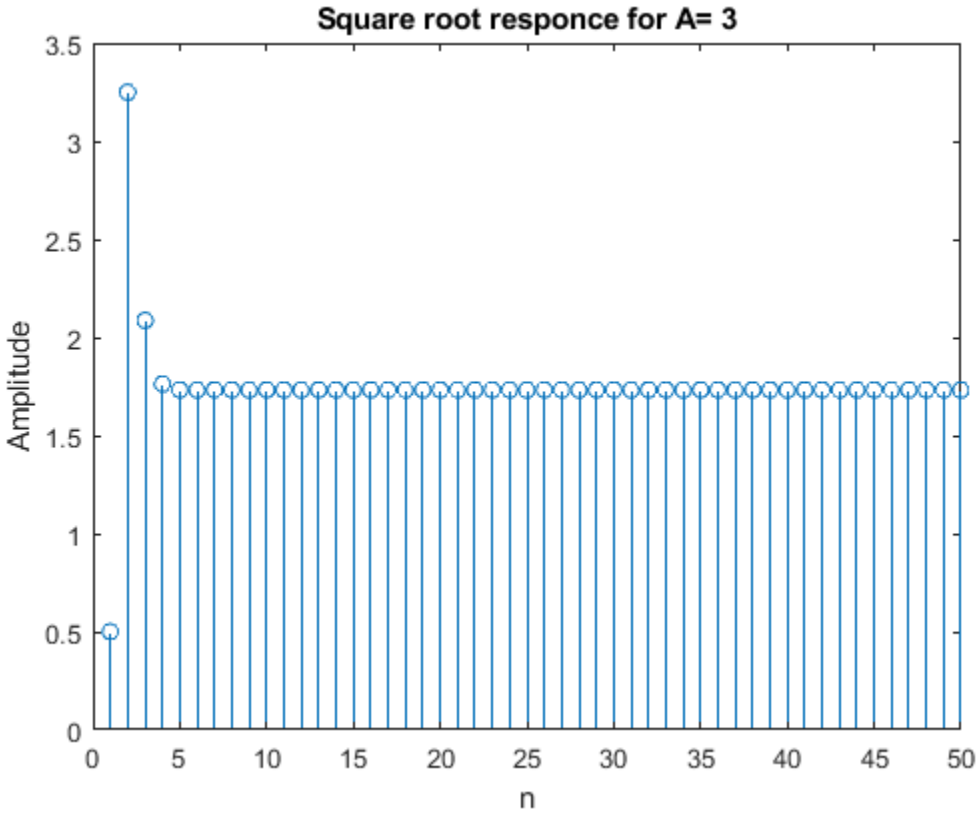
```
n2 = 1:50;
step = ones(1,50);
% stem (n,step)
A1 = 16;
A2 = 4;
A3 = 5;
A4 = 3;
x_s1 = A1 * step;
x_s2 = A2 * step;
x_s3 = A3 * step;
x_s4 = A4 * step;
y_s1 = zeros(1, 50);
y_s1(1) = 0.5;
y_s2 = y_s1;
y_s3 = y_s1;
y_s4 = y_s1;
for (i = 2:50)
    y_s1(i) = 0.5*( y_s1(i-1) + x_s1(i)/y_s1(i-1));
end
for (i = 2:50)
    y_s2(i) = 0.5*( y_s2(i-1) + x_s2(i)/y_s2(i-1));
end
for (i = 2:50)
    y_s3(i) = 0.5*( y_s3(i-1) + x_s3(i)/y_s3(i-1));
end
for (i = 2:50)
    y_s4(i) = 0.5*( y_s4(i-1) + x_s4(i)/y_s4(i-1));
end
figure(5);
stem(n2,y_s1);
title("Square root responce for A= "+A1);
xlabel('n');
ylabel('Amplitude');

figure(6);
stem(n2,y_s2);
title("Square root responce for A= "+A2);
xlabel('n');
ylabel('Amplitude');

figure(7);
stem(n2,y_s3);
title("Square root responce for A= "+A3);
xlabel('n');
ylabel('Amplitude');

figure(8);
stem(n2,y_s4);
title("Square root responce for A= "+A4);
xlabel('n');
ylabel('Amplitude');
```

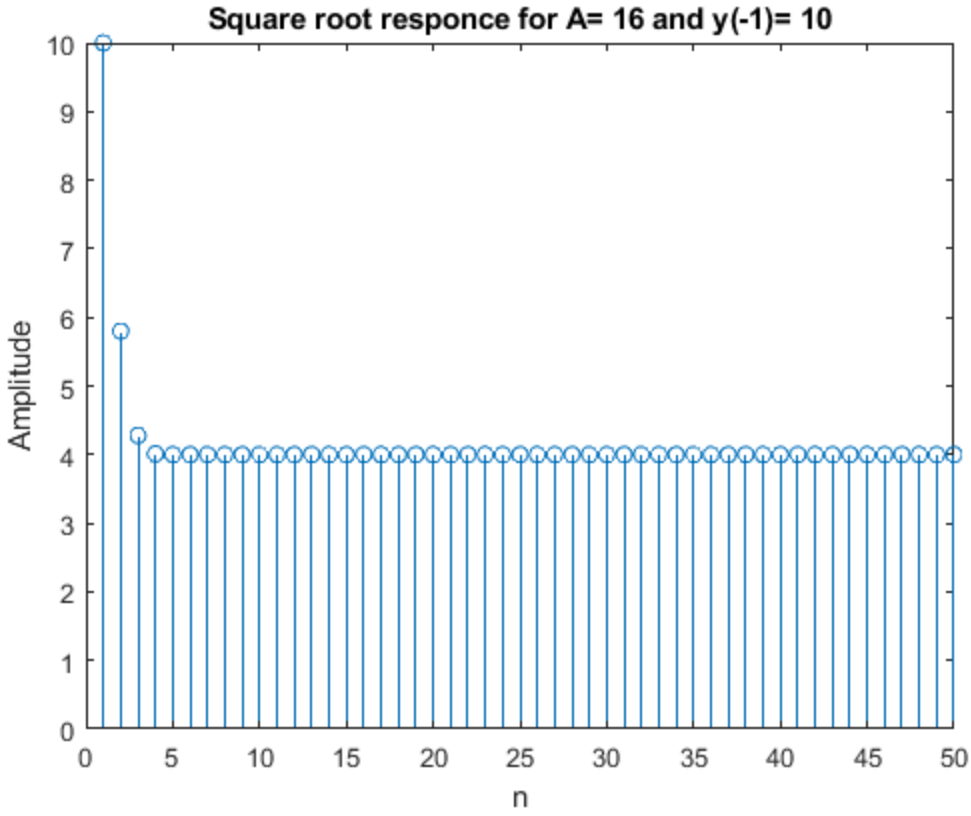
```
% Check Sensitivity to initial Value
% for A=16 let y(-1) = 10;
y_s1(1) = 10;
for (i = 2:50)
    y_s1(i) = 0.5*( y_s1(i-1) + x_s1(i)/y_s1(i-1));
end
figure(9);
stem(n2,y_s1);
title("Square root responce for A= "+A1+" and y(-1)= 10");
xlabel('n');
ylabel('Amplitude');

% let y(-1) = 0.09;
y_s1(1) = 0.09;
for (i = 2:50)
    y_s1(i) = 0.5*( y_s1(i-1) + x_s1(i)/y_s1(i-1));
end
figure(11);
stem(n2,y_s1);
title("Square root responce for A= "+A1+" and y(-1)= 0.09");
xlabel('n');
ylabel('Amplitude');

% let y(-1) = 0.0001;
y_s1(1) = 0.0001;
for (i = 2:50)
    y_s1(i) = 0.5*( y_s1(i-1) + x_s1(i)/y_s1(i-1));
end
figure(12);
stem(n2,y_s1);
title("Square root responce for A= "+A1+" and y(-1)= 0.0001");
xlabel('n');
ylabel('Amplitude');
% We see it does not converge to 4 So it is sensitive!
```

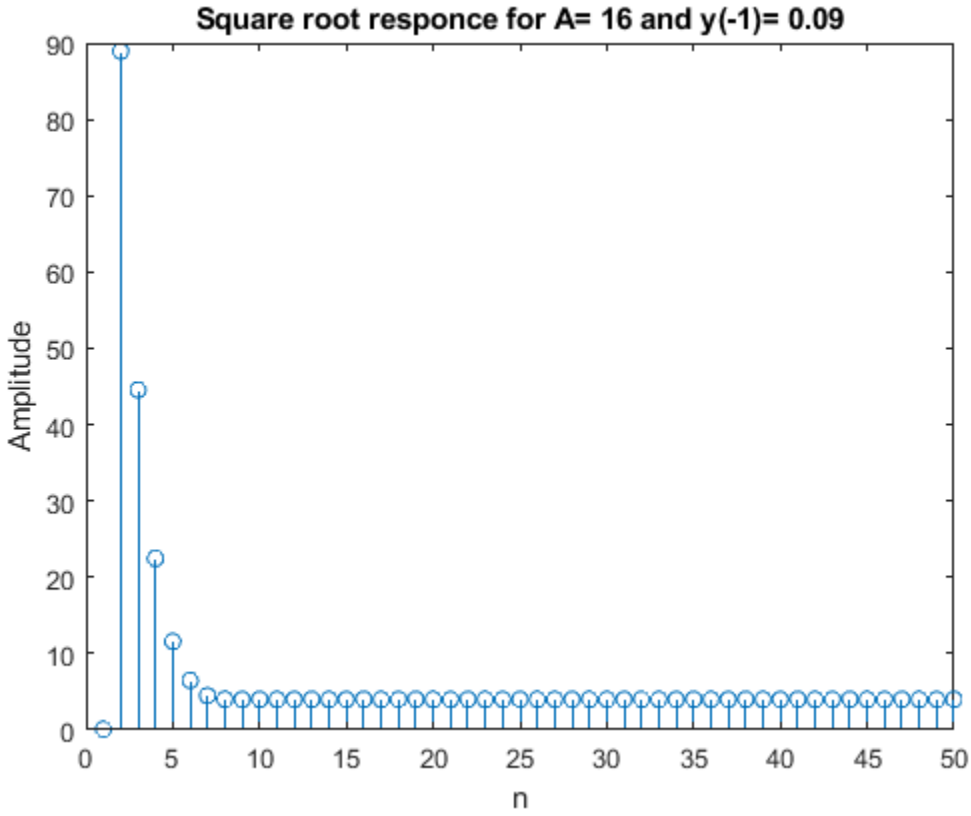

Square root responce for A= 16
Amplitude
n
0
2
4
6
8
10
12
14
16
18
0
5
10
15
20
25
30
35
40
45
50

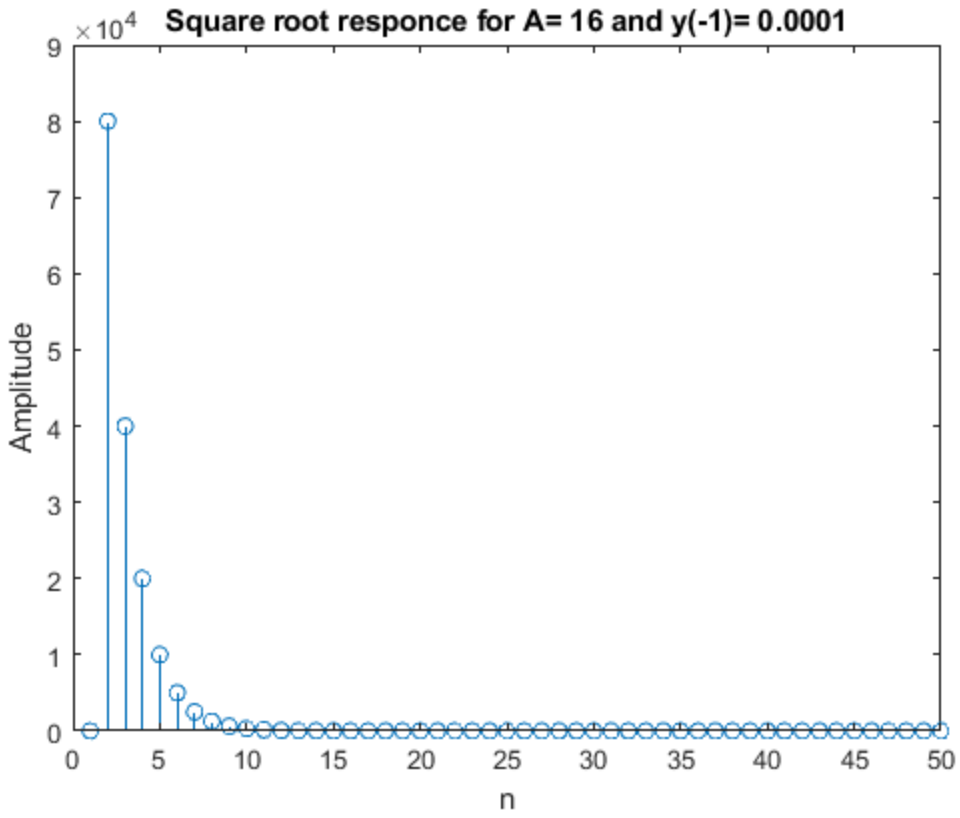

Square root responce for A= 4
Amplitude
n
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
0
5
10
15
20
25
30
35
40
45
50


Square root responce for A= 5
Amplitude
n
0
1
2
3
4
5
6
0
5
10
15
20
25
30
35
40
45
50


Square root responce for A= 3
Amplitude
n
0
0.5
1
1.5
2
2.5
3
3.5
0
5
10
15
20
25
30
35
40
45
50


Square root responce for A= 16 and y(-1)= 10
Amplitude
n
0
1
2
3
4
5
6
7
8
9
10
0
5
10
15
20
25
30
35
40
45
50


Square root responce for A= 16 and y(-1)= 0.09
Amplitude
n
0
10
20
30
40
50
60
70
80
90
0
5
10
15
20
25
30
35
40
45
50



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