EXERCISE 5.3: Use MATLAB to implement an 8-point averager and process the composite signal in Fig. 5-6(a). The output should have no sinusoidal interference in the region where the length-8 sliding window completely overlaps the input signal. Verify that this is true in the MATLAB output and then explain why this is true by considering the effect of the 8-point averager on the sinusoid alone.

McClellan, Schafer, and Yoder, *DSP First, 2e*, ISBN 0-13-065562-7.
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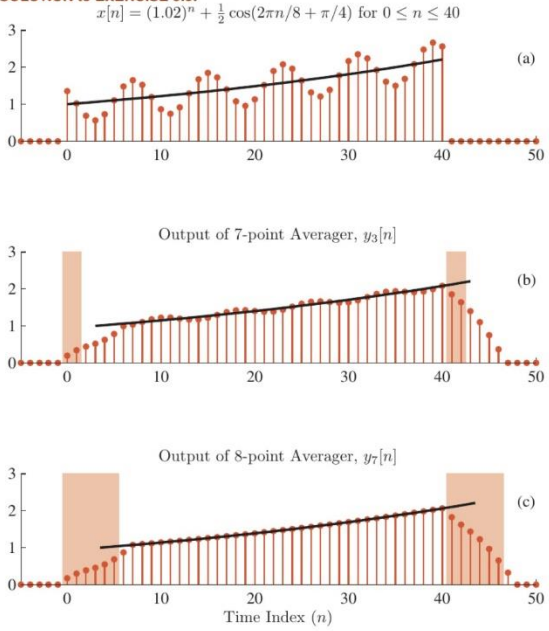
SOLUTION to EXERCISE 5.3: DSP First 2e

$x[n] = (1.02)^n + \frac{1}{2}\cos(2\pi n/8 + \pi/4)$ for $0 \le n \le 40$



Part (c) of the above figure verifies that the sinusoid is completely removed for $7 \le n \le 40$. The reason is that the period of the sinusoid is 8 and therefore the filter always averages over one period no matter the value of n. Note in (b) that the 7-point averager leaves a small sinusoidal component.

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```
Exercise 5_3  8-point moving average
%  Null out the cosine in a signal w_hat= k*2*pi/8
clc, clear all, clf
M=8
%windowSize = 8;
b=(1/M)*ones(1,M);    % b_i = 0.125 = (1/8)
a = 1;
%
% Create function
n=[0:1:40];    % 41 Points in n
x= (1.02).^n + 0.5*cos(2*pi*n/8 + pi/4);
%  w_hat = 2*pi/8   So use 8-point average with
%    zeros at k*2*pi/8  k= 1,2,3
y = filter(b,a,x);
figure(1)
subplot(2,2,1),stem(n,x),grid, title('Unfiltered signal')
subplot(2,2,2),stem(n,y),grid, title('Filtered signal, M=8')
%
subplot(2,2,3),plot(n,x),grid,title('Unfiltered signal')
subplot(2,2,4),plot(n,y),grid, title('Filtered signal, M=8')
```