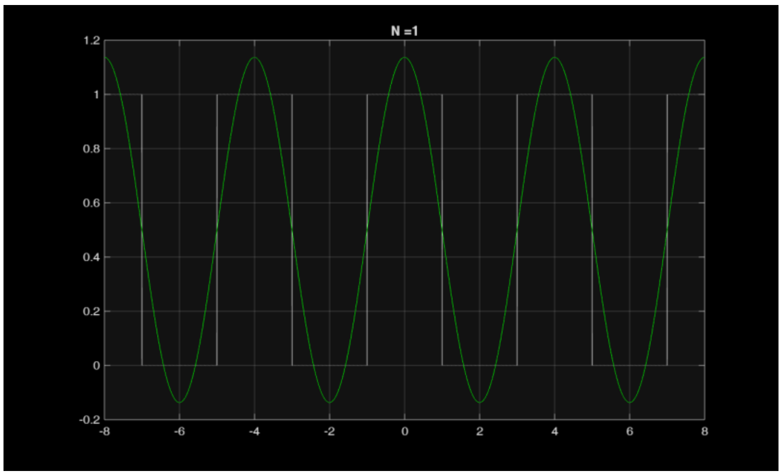
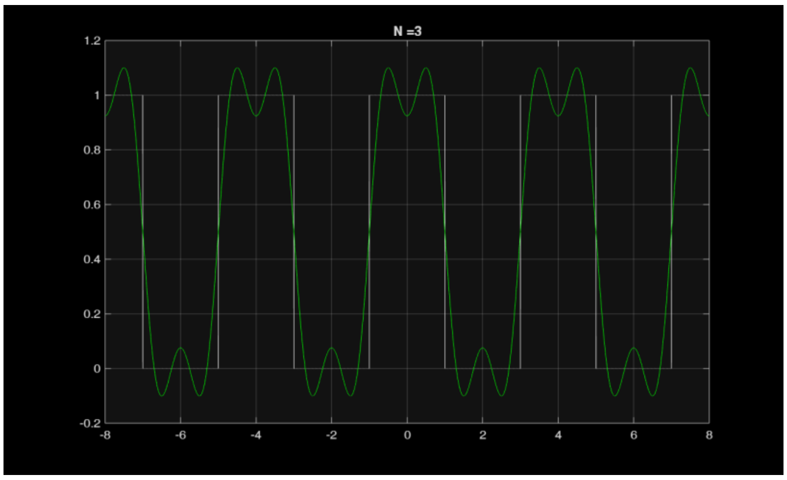
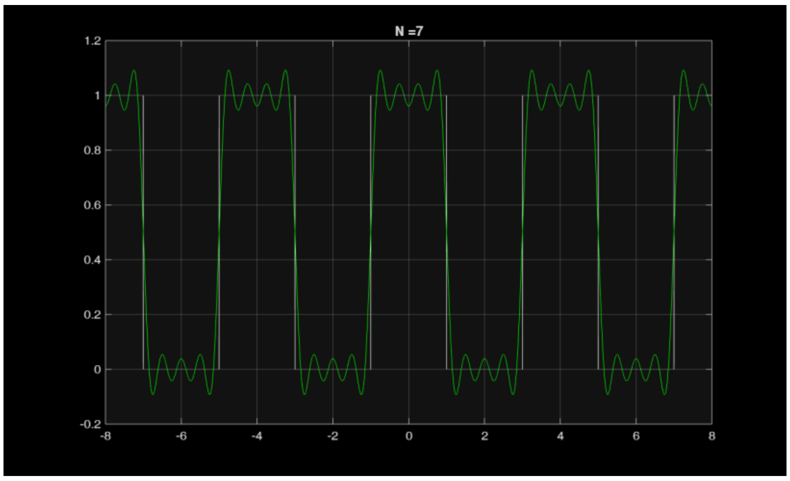
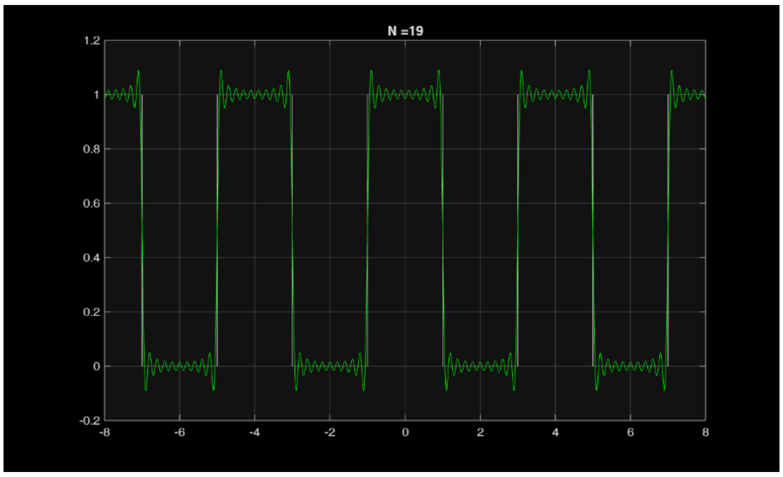
(b)

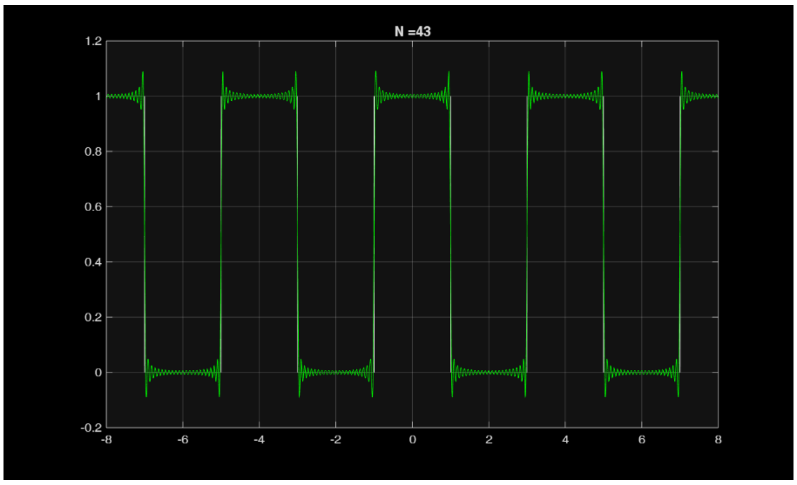
```
clear all;
close all;
function a = FourierCoefficients(k)
    % computes the coefficients 'a' based on the values in vector 'k'.
    % For each element in 'k':
    %     - If the element is zero, the corresponding 'a' value is set to 1/2.
    %     - Otherwise, the value is calculated as sin(k*pi/2)/(k*pi).
    a = zeros(size(k));
    for idx = 1:length(k)
        if k(idx) == 0
            a(idx) = 1/2;
        else
            a(idx) = sin(k(idx) * pi/2) / (k(idx) * pi);
        end
    end
end

approximations = [1, 3, 7, 19, 43, 79];
maximum_approx = max(approximations);
k_values = -maximum_approx: maximum_approx;
ak = FourierCoefficients(k_values);

N = 400; %This will determine the number of points in the time domain
t = linspace(-2*5, 2*5, 4*N*5); %t stands for the time domain, 4*N*5 points in total
%Square Wave Signal
y_single = [zeros(1, N) ones(1, 2*N) zeros(1, N)];
y = [y_single y_single y_single y_single y_single];

% plotFourier Plots the Fourier series approximation of a signal and prints the overshoot

%   Inputs:
%       j                - Index for the current approximation order.
%       t                - Time vector for plotting.
%       approximations   - Vector containing the number of terms for each approximation.
%       maximum_approx   - Maximum order of approximation (used for indexing).
%       ak               - Vector of Fourier coefficients.
%       y                - Original signal to be approximated.
%
%   The function creates a new figure, plots the original signal in white,
%   overlays the Fourier approximation in green, and displays the
%   approximation order in the title. It also prints the maximum and
%   minimum values of the approximation to the command window.
function plotFourier (j, t, approximations, maximum_approx, ak, y)
    figure();
    plot(t, y, 'w');
    hold on;
    axis([-8 8 -0.2 1.2]);
    grid on;
    x = 0.*t; % Initialize x to zero for the current approximation
    for k = -approximations(j):approximations(j) % Loop through the range of k values for the
current approximation
        x = x + real(ak(k + maximum_approx + 1) * exp(1i * k * pi/2 .* t));
    end
    plot(t, x,'g-');
    title(['N =', num2str(approximations(j))]);
    hold off;
    fprintf("maximum value for %d: %f\n", approximations(j), max(x));
    %Determine the percentage overshoot of the approximated square pulse for each of the above
partial sum approximations
    overshoot = (max(x) - 1) / 1 * 100; % Calculate the percentage overshoot
    fprintf("Percentage overshoot for N = %d: %.2f%%\n\n", approximations(j), overshoot);

end

%Creating Graphs for all approximations
for j = 1: length(approximations)
    plotFourier (j , t, approximations, maximum_approx, ak, y);
end
```

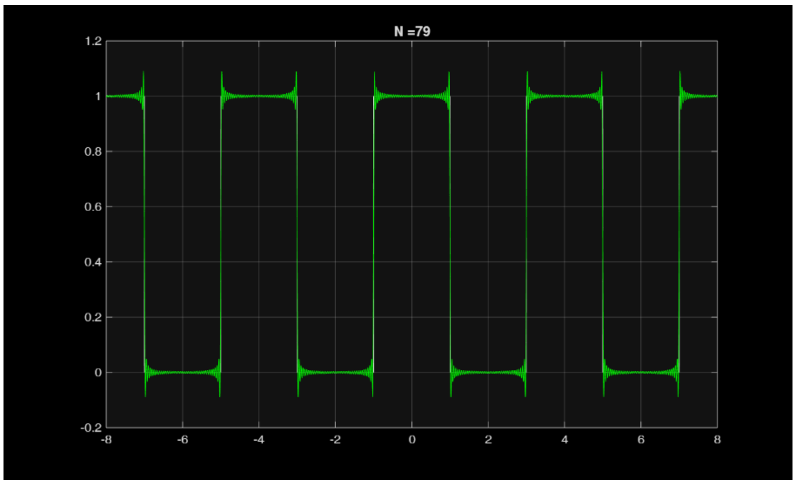





N =7
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-8
-6
-4
-2
0
2
4
6
8


N =19
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-8
-6
-4
-2
0
2
4
6
8


N =43
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-8
-6
-4
-2
0
2
4
6
8


N =79
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-8
-6
-4
-2
0
2
4
6
8

(c)
Formula used :

$$overshoot = \frac{\max(x) - 1}{1} \times 100\%$$

maximum value for 1: 1.136620
Percentage overshoot for N = 1: 13.66%

maximum value for 3: 1.100211
Percentage overshoot for N = 3: 10.02%

maximum value for 7: 1.092112
Percentage overshoot for N = 7: 9.21%

maximum value for 19: 1.089906
Percentage overshoot for N = 19: 8.99%

maximum value for 43: 1.089568
Percentage overshoot for N = 43: 8.96%

maximum value for 79: 1.089503
Percentage overshoot for N = 79: 8.95%