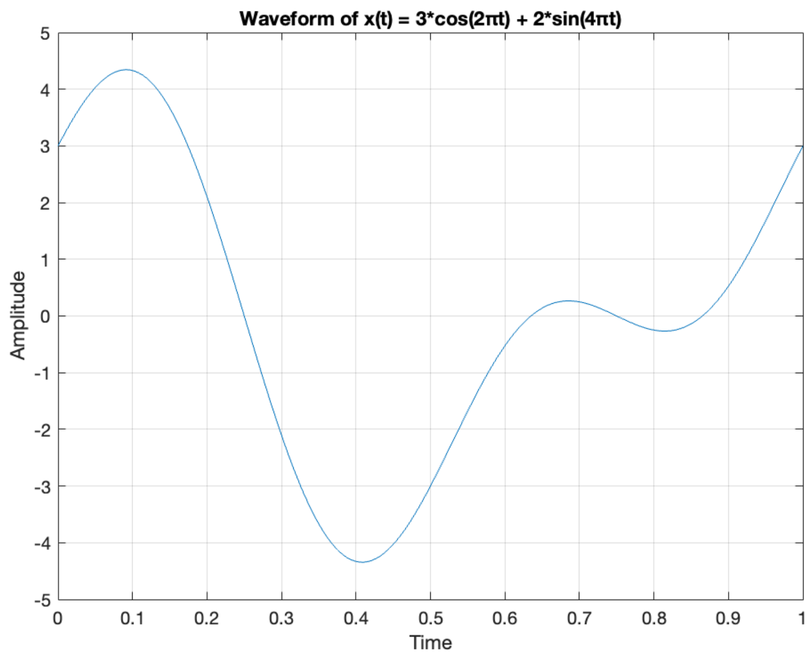
Problem 1: Continuous-Time Signals and Systems

Consider a continuous-time signal x(t) = 3cos(2*pi*t) + 2sin(4*pi*t).

1. Sketch the waveform of x(t) over one period.



Codes	Comments
t = linspace(0, 1, 1000);	%Define the borders zero to one period.
x = 3*cos(2*pi*t) + 2*sin(4*pi*t);	%Assign function to x.
plot(t, x);	%Method for used graph draw.
xlabel('Time');	%X label name of the graph.
ylabel('Amplitude');	% Y label name of the graph.
title('Waveform of x(t) = 3*cos(2*pi*t) + 2*sin(4*pi*t)');	%Name of the graph.
grid on;	%Activate grid.

2. Determine the frequency components present in x (t).

The given function is a trigonometric function. Therefore a period of trigonometric functions is 360 degrees = 2pi. When we divide the degree parameter in the trigonometric function by the period, we get the frequency. In the end, calculate the frequencies of 2 different trigonometric functions of our function separately.

1-) x(t) = 3 cos(2*pi*t) + 2 sin(4*pi*t)

2-) Frequency of 3cos(2*pi*t) is 2*pi / 2*pi = **1Hz**

3-) Frequency of 2sin(4*pi*t) is 4*pi / 2*pi = **2Hz**

3. Compute the average power of x (t) over one period.

```
x = @(t) 3*cos(2*pi*t) + 2*sin(4*pi*t); %Define function.
t_min = 0;                              % Define lower border.
t_max = 1;                              % Define upper border.
N = 100000;                             % Define sensitivity.
t = linspace(t_min, t_max, N);          % Combine parameters.
x_t = x(t);                             % Calculate function and assign to variable.
power_average = mean(abs(x_t).^2); % Calculate power average.
disp(['Power average: ', num2str(power_average)]); % Print result. Result is (6.5)
```

Problem 2: Discrete-Time Signals and Systems

Given the discrete-time signal x (n) = {1, -2, 3, -4, 5}:

1. Determine the length of the signal.

```
x = [1, -2, 3, -4, 5];                  % Define the array.
signal_length = length(x);              %Calculate the length of signal.
disp(['Length of Discrete Time Signal: ', num2str(signal_length)]); %Printing.
```
result is **(5)**

2. Find the value of x[3].

```
x = [1, -2, 3, -4, 5];                  %Define the array.
x_3 = x(3);                             % Find third value of array.
disp(['x[3] = ', num2str(x_3)]);  % Printing. Result is (3).
```

3. Compute the sum of all elements in the signal.

```
x = [1, -2, 3, -4, 5];                  % Define the array.
total_sum = sum(x);                     % Calculate sum of elements.
disp(['Sum of all elements in signal', num2str(total_sum)]);%Printing. Result (3).
```

4. Calculate the energy of the signal.

```
x = [1, -2, 3, -4, 5];                         % Define the array.
energy = sum(x.^2);                            % Calculate energy of signal.
disp(['Energy of the signal ', num2str(energy)]);  % Printing. Result is (55).
```

Not: I got the formulas from the first week's presentation.

- The time average of total energy is $\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} |x(t)|^2 \, dt$ and referred to as average power of $x(t)$ over $t_1 \le t \le t_2$
- Similarly, total energy of a DT signal $x[n]$ over $n_1 \le n \le n_2$ is $\sum_{n_1}^{n_2} |x[n]|^2$