

Assignment 0

MATLAB & Git

Instructions:

- All the questions are compulsory
 - The questions contain both theory and practical (MATLAB coding) parts
 - The submission format (on GitHub) is as follows:
 - **Theory** - PDF file containing the handwritten theory assignment solutions
 - **Code** - folder containing all the codes
 - **Images** - folder that contains all the images
 - The naming convention for the code and image files is, q<qn no.> - <sub-part no.>
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Question 1: Matrix multiplication

Write a MATLAB script to initialise the following 3 matrices and compute their product.

$$A = \begin{bmatrix} 3 & 7 \\ 11 & 5 \\ 4 & 10 \end{bmatrix} \quad B = \begin{bmatrix} 4 & 7 \\ 3 & 3 \end{bmatrix} \quad C = \begin{bmatrix} 11 & 21 & 9 \\ 13 & 17 & 6 \end{bmatrix}$$

Your code must display all 3 inputs followed by the output ($D = A \times B \times C$).

Question 2: Kinematics

Define a time duration from $t = 0$ to $t = 5$ with some suitable sampling frequency.

Consider an object moving along the x-axis with an acceleration $a = -2t + 5 \text{ m/s}^2$. Calculate the velocity and position of this object as functions of time using the equations of motion. The initial velocity of the object is $v_0 = 2 \text{ m/s}$ and its initial position is $x_0 = 5 \text{ m}$.

Plot the position, velocity and acceleration of this object as a function of time in a single plot, using different colours/patterns for the different curves and also include a legend for reference.

Question 3: Convolution

We all know that the output of an LTI system is the input signal convolved with the impulse response of the system. Suppose the impulse response of the given system is as shown in Fig. 1.

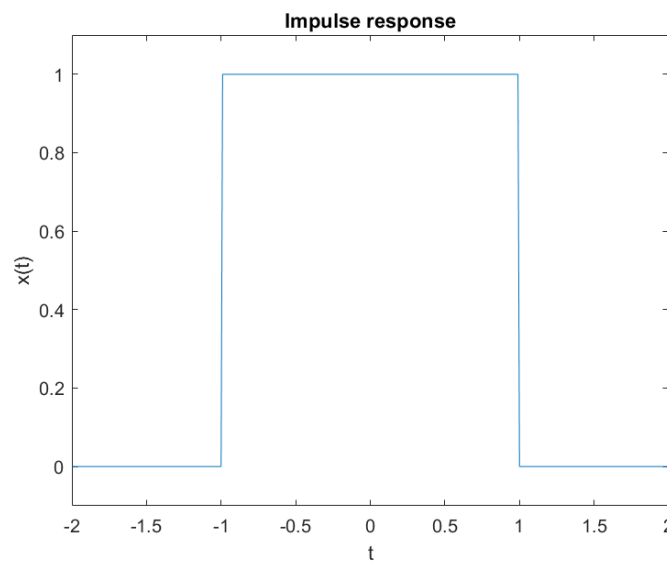


Figure 1: Continuous-time impulse response of the system

Write a MATLAB function to implement continuous-time convolution, called `convolve()`

that takes in the time duration t and two signals defined on t and returns the convolution result.

Then call this function to find the output of the system to the following inputs:

1. $x(t) = \text{rect}(t)$ (same as the impulse response)
2. $x(t) = \sin(t)$
3. $x(t) = \begin{cases} \frac{t+1}{2} & -1 \leq t \leq 1 \\ 0 & \text{else} \end{cases}$.

Make a 2×2 subplot figure, with the impulse response in the top-left and the system outputs of the 3 above given signals in the other 3 tiles. Label your subplots properly.