

Name: *Solutions*

1. Compute the convolution $a * b$ where $a = (0.1, 0.3, 0.2)$ and where $b = (1, 0, 2)$.

$$\begin{matrix} (0.1, 0.3, 0.2) \\ (2, 0, 1) \end{matrix} \rightarrow \begin{bmatrix} 1 \cdot 0.1 \\ 1 \cdot 0.3 \\ 2 \cdot 0.1 + 1 \cdot 0.2 \\ 2 \cdot 0.3 \\ 2 \cdot 0.2 \end{bmatrix} = \begin{bmatrix} 0.1 \\ 0.3 \\ 0.4 \\ 0.6 \\ 0.4 \end{bmatrix}$$

or

$$\begin{bmatrix} 0.1 & 0 & 0 \\ 0.3 & 0.1 & 0 \\ 0.2 & 0.3 & 0.1 \\ 0 & 0.2 & 0.3 \\ 0 & 0 & 0.2 \end{bmatrix} \begin{bmatrix} 1 \\ 0 \\ 2 \end{bmatrix} = \begin{bmatrix} 0.1 \\ 0.3 \\ 0.4 \\ 0.6 \\ 0.4 \end{bmatrix}$$

2. In this problem we represent polynomials as a vector of coefficients. For example, $p(t) = c_1 + c_2t + c_3t^2$ is represented by the vector $c = (c_1, c_2, c_3)$.

Determine a matrix D such that if $p(t) = c_1 + c_2t + c_3t^2$ is a quadratic polynomial, then $d = Dc$ is the coefficients of the derivative polynomial $p'(t) = d_1 + d_2t$.

$$c_1 + c_2t + c_3t^2 \rightarrow c_2 + 2c_3t$$

\uparrow
 d_1

\uparrow
 d_2

$$D = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 2 \end{bmatrix}$$

$$D \begin{bmatrix} c_1 \\ c_2 \\ c_3 \end{bmatrix} = \begin{bmatrix} c_2 \\ 2c_3 \end{bmatrix} \quad \checkmark$$

\uparrow
 $\begin{bmatrix} d_1 \\ d_2 \end{bmatrix}$