

## Mathematical expressions

1. Vectors  $\mathbf{u}$ ,  $\mathbf{a}$  and  $\mathbf{b}$ :

$$\mathbf{u} = \begin{pmatrix} -2 \\ -1 \end{pmatrix} \quad \mathbf{a} = \begin{pmatrix} -3 \\ 1 \end{pmatrix} \quad \mathbf{b} = \begin{pmatrix} 1 \\ 3 \end{pmatrix} \quad (1)$$

$$\mathbf{u} = \alpha \mathbf{a} + \beta \mathbf{b} \quad \text{Norm: } \|\mathbf{u}\|.$$

$$\hat{\mathbf{u}} = \lambda \mathbf{a} = \frac{\langle \mathbf{a}, \mathbf{u} \rangle}{\langle \mathbf{a}, \mathbf{a} \rangle} \mathbf{a} = \frac{\begin{pmatrix} -3 \\ 1 \end{pmatrix} \cdot \begin{pmatrix} -2 \\ -1 \end{pmatrix}}{\begin{pmatrix} -3 \\ 1 \end{pmatrix} \cdot \begin{pmatrix} -3 \\ 1 \end{pmatrix}} \mathbf{a} = \frac{5}{10} \mathbf{a} = \frac{1}{2} \mathbf{a} = \begin{pmatrix} -1.5 \\ 0.5 \end{pmatrix} \quad (2)$$

2. Matrices

$$\begin{pmatrix} 1 & 3+2i \\ 3-2i & 4 \end{pmatrix} \det \mathbf{A} = \begin{vmatrix} 3 & 4 & 7 \\ 2 & -2 & 1 \\ 1 & 2 & 5 \end{vmatrix} \begin{vmatrix} x & 1 & 1 \\ 1 & x & 1 \\ 1 & 1 & x \end{vmatrix} = (x-1)^2(x+2)$$

3.  $a_1 \geq 0$       $p(x) = p_0 + p_1x + p_2x^2 + p_3x^3 + p_4x^4 + p_5x^5$

4. Transformations:

$$T : \mathbb{R}^3 \rightarrow \mathbb{R}^2 \quad \text{where } T \begin{pmatrix} a_1 \\ a_2 \\ a_3 \end{pmatrix} = \begin{pmatrix} a_1 a_2 \\ a_1 a_3 \end{pmatrix}$$

$$T : P_3 \rightarrow M_{22} \quad \text{where } T(a_0 + a_1x + a_2x^2 + a_3x^3) = \begin{pmatrix} a_1 & a_2 \\ a_3 & a_1 - a_0 \end{pmatrix}$$