Matrices

G V V Sharma[*]

CONTENTS

Abstract—This manual provides a simple introduction to linear forms like lines and planes, based on the NCERT textbooks from Class 6-12.

1 DEFINITIONS

1.1 Two Dimensions

1.1.1. The equation of a line is given by

$$\mathbf{n}^\top \mathbf{x} = c \qquad (1.1.1.1)$$

where $\mathbf{n}$ is the normal vector of the line.

1.1.2. The parametric equation of a line is given by

$$vecx = \mathbf{A} + \lambda\mathbf{m} \qquad (1.1.2.1)$$

where $\mathbf{m}$ is the direction vector of the line.

1.1.3. The distance from a point $\mathbf{P}$ to the line in (1.1.1.1) is given by

$$d = \frac{\left|\mathbf{n}^\top \mathbf{P} - c\right|}{\|\mathbf{n}\|} \qquad (1.1.3.1)$$

1.1.4. The distance from the origin to the line in (1.1.1.1) is given by

$$d = \frac{|c|}{\|\mathbf{n}\|} \qquad (1.1.4.1)$$

1.1.5. The equation of the line perpendicular to (1.1.1.1) and passing through the point $\mathbf{P}$ is given by

$$\mathbf{m}^\top (\mathbf{x} - \mathbf{P}) = 0 \qquad (1.1.5.1)$$

1.1.6. The foot of the perpendicular from $\mathbf{P}$ to the line in (1.1.1.1) is given by

$$\begin{pmatrix} \mathbf{m} & \mathbf{n} \end{pmatrix}^\top \mathbf{x} = \begin{pmatrix} \mathbf{m}^T\mathbf{P} \\ c \end{pmatrix} \qquad (1.1.6.1)$$

*The author is with the Department of Electrical Engineering, Indian Institute of Technology, Hyderabad 502285 India e-mail: gadepall@iith.ac.in. All content in this manual is released under GNU GPL. Free and open source.

1.2 Three Dimensions

1.2.1. The equation of a line is given by (1.1.2.1)

1.2.2. The equation of a plane is given by (1.1.1.1)

1.2.3. The distance from the origin to the line in (1.1.1.1) is given by

$$d = \frac{|c|}{\|\mathbf{n}\|} \qquad (1.2.3.1)$$

1.2.4. The equation of the line perpendicular to (1.1.1.1) and passing through the point $\mathbf{P}$ is given by

$$\mathbf{m}^\top (\mathbf{x} - \mathbf{P}) = 0 \qquad (1.2.4.1)$$

1.2.5. The foot of the perpendicular from $\mathbf{P}$ to the line in (1.1.1.1) is given by

$$\begin{pmatrix} \mathbf{m} & \mathbf{n} \end{pmatrix}^\top \mathbf{x} = \begin{pmatrix} \mathbf{m}^T\mathbf{P} \\ c \end{pmatrix} \qquad (1.2.5.1)$$