

## Fundamental Mathematics for Robotics Homework Set #06-1, Dr.T

[1] Given a vector matrix equation:  $M\vec{v} = \vec{u}$  with the following two vectors and a matrix.  $\vec{v} = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$ ,  $\vec{u} = \begin{bmatrix} e \\ k \end{bmatrix}$  and  $M = \begin{bmatrix} a & b & c \\ f & g & h \end{bmatrix}$ , where  $a, b, c, e, f, g, h,$  and  $k$  are scalars.

- (a) Write the corresponding set of linear simultaneous equations.
- (b) (Extra) Can you solve this set of equations? (Remember, you need to explain!)

[2] Given the following set of simultaneous equations.

$$ax + by = c$$

$$ex + fy = g$$

$$hx + ky = m$$

- (a) Write a vector matrix equation of the form  $H\vec{p} = \vec{q}$  corresponding to this set of simultaneous equations, i.e., define two vectors  $\vec{p}$  and  $\vec{q}$  and a matrix H.

[3] Given the following matrices:

$$A = \begin{bmatrix} -3 & -2 \\ 7 & 5 \end{bmatrix}, B = \begin{bmatrix} -1 \\ 7 \end{bmatrix}, C = [2 \quad 1], D = [1]$$

Compute the following quantities if possible.

- (a)  $2B + C^T$  (b)  $AB$  (c)  $A^2B$  (d)  $AB + C^T$  (e)  $CA$  (f)  $B^T - CA$  (g)  $BC$
- (h)  $-2A + BC$  (i)  $CB$  (j)  $CB - D$  (k)  $A(BC)$  (l)  $(AB)C$  (m)  $xA$  (n)  $xI - A$
- (o) (Extra) Make up 2 combinations of those matrices that are different from the above and compute them.

[4] (Extra) Show that  $(MN)^T = N^T M^T$  using 2x2 matrices  $M = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$  and  $N = \begin{bmatrix} p & q \\ r & s \end{bmatrix}$ .