**Department of Aerospace Engineering**

**AE602 Mathematics for Aerospace Engineers**

**Assignment No. 1**

* 1. For the equations $x+y=4, 2x-2y=4,$ draw the row picture (two intersecting lines) and the column picture (combination of two columns equal to the column vector $\left(4, 4\right)$ on the right side).
	2. Solve the nonsingular triangular system

$$\begin{matrix}u+v+w=b\_{1}\\v+w=b\_{2}\\w=b\_{3}\end{matrix}$$

Show that your solution gives a linear combination of the columns that equals the column on the right.

**1.3** Describe the intersection of the three planes $u+v+w+z=6$ and $u+w+z=4$ and $u+w=2$ (all in 4-dimensional space). Is it a line or a point or an empty set? What is the intersection if the fourth plane $u=-1$ is included?

**1.4** Sketch the three lines

$$\begin{matrix}x+2y=2\\x- y=2\\y=1\end{matrix}$$

Can the three equations be solved simultaneously? What happens to the figure if all right hand sides are zero? Is there any nonzero choice of right hand sides which allows the three lines to intersect at the same point and the three equations to have a solution?

**1.5** Explain why the system

$$\begin{matrix}u+ v+ w=2\\u+2v+3w=1\\v+2w=0\end{matrix}$$

is singular, by finding a combination of the three equations that adds up to$ 0=1$. What value should replace the last zero on the right side, to allow the equations to have solutions and what is one of the solutions?

**1.6** The column picture for the previous exercise is

$$u\left[\begin{matrix}1\\1\\0\end{matrix}\right]+v\left[\begin{matrix}1\\2\\1\end{matrix}\right]+w\left[\begin{matrix}1\\3\\2\end{matrix}\right]=b$$

Show that the three columns on the left lie in the same plane, by expressing the third column as a combination of the first two. What are all the solutions $(u,v,w)$ if $b$ is the zero vector $(0,0,0)$?

**1.7** The equations

$$\begin{matrix}kx+2y=0\\2x+ky=0\end{matrix}$$

are certain to have the solution$ x=y=0$. For which values of $k$ is there a whole line of solutions?

**1.8** Solve the system and find the pivots when

 $\begin{matrix}2u- v =0\\-u+2v- w =0\\\begin{matrix}-v+2w- z=0\\- w+2z=5\end{matrix}\end{matrix}$

*

You may carry the right side as a fifth column (and omit writing $u,v,w,z$ until the solution at the end).

**1.9** Apply elimination to the system

$$u+v+w=-2$$

$$3u+3v-w=6$$

$$u-v+w=-1$$

When a zero arises in the pivot position, exchange that equation for the one below it and proceed. What coefficient of $v$ in the third equation, in place of the present$-1$, would make it impossible to proceed and force elimination to break down?

**1.10** Use elimination to solve

 $\begin{matrix}u+ v+ w= 6\\u+2v+2w=11\\2u+ 3v-4w= 3\end{matrix}$ and $\begin{matrix}u+ v+ w= 7\\u+2v+2w=10\\2u+3v-4w= 3\end{matrix}$