## CS 210N: Numerical and Scientific Computing

## Tutorial – 7

1. If one of the vectors in  $v_1, v_2, \dots, v_k$  is zero, are these vectors linearly independent?

2. (a) If 
$$A = \begin{bmatrix} 3 & 4 & 2 \\ 0 & 1 & 5 \\ 0 & 0 & 2 \end{bmatrix}$$
. Are the columns of A linearly independent?

- 3. Check whether the rows of A are linearly independent?
- 4. Decide the dependence or independence of
  - a. (1,1,2), (1,2,1), (3,1,1)
  - b.  $e_1 e_2, e_2 e_3, e_3 e_4, e_4 e_1$ , where  $e_1, e_2, e_3, e_4$  are columns of identity matrix in  $\Re^4$ .
- 5. Describe the four fundamental subspaces associated with

$$\begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

6. Find the dimension and a basis for the four fundamental subspaces of

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

- 7. Find the length and the inner product of  $\mathbf{x} = (1,4,0,2)^T$  and  $\mathbf{y} = (2,-2,1,3)^T$ .
- 8. Which pairs are orthogonal among the vectors:

$$\mathbf{v}_{1} = \begin{bmatrix} 1 \\ 2 \\ -2 \\ 1 \end{bmatrix}, \quad \mathbf{v}_{2} = \begin{bmatrix} 4 \\ 0 \\ 4 \\ 0 \end{bmatrix}, \quad \mathbf{v}_{3} = \begin{bmatrix} 1 \\ -1 \\ -1 \\ -1 \\ -1 \end{bmatrix}, ?$$

- 9. Do the vectors (1,1,3), (2,3,6) and (1,4,3) form a basis of  $\Re^3$ ?
- 10. Find all vectors which are perpendicular to (1,4,4,1) and (2,9,8,2).