## CS 210N: Numerical and Scientific Computing

## Tutorial - 7

1. If one of the vectors in $\boldsymbol{v}_{1}, \boldsymbol{v}_{2}, \ldots \boldsymbol{v}_{\boldsymbol{k}}$ is zero, are these vectors linearly independent?
2. (a) If $\boldsymbol{A}=\left[\begin{array}{lll}3 & 4 & 2 \\ 0 & 1 & 5 \\ 0 & 0 & 2\end{array}\right]$. 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. $\boldsymbol{e}_{1}-\boldsymbol{e}_{2}, \boldsymbol{e}_{2}-\boldsymbol{e}_{3}, \boldsymbol{e}_{3}-\boldsymbol{e}_{4}, \boldsymbol{e}_{4}-\boldsymbol{e}_{1}$, where $\boldsymbol{e}_{1}, \boldsymbol{e}_{2}, \boldsymbol{e}_{3}, \boldsymbol{e}_{4}$ are columns of identity matrix in $\mathfrak{R}^{4}$.
5. Describe the four fundamental subspaces associated with

$$
\left[\begin{array}{llll}
0 & 1 & 0 & 0 \\
0 & 0 & 1 & 0 \\
0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0
\end{array}\right]
$$

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

$$
\boldsymbol{A}=\left[\begin{array}{llll}
1 & 2 & 0 & 1 \\
0 & 1 & 1 & 0 \\
1 & 2 & 0 & 1
\end{array}\right]
$$

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

$$
\boldsymbol{v}_{1}=\left[\begin{array}{c}
1 \\
2 \\
-2 \\
1
\end{array}\right], \boldsymbol{v}_{2}=\left[\begin{array}{l}
4 \\
0 \\
4 \\
0
\end{array}\right], \boldsymbol{v}_{3}=\left[\begin{array}{c}
1 \\
-1 \\
-1 \\
-1
\end{array}\right], ?
$$

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