

## Lecture 5: Worksheet

- 1 Find the row reduced echelon form of the following augmented matrix:

$$\left[ \begin{array}{ccc|c} 0 & 0 & 1 & 3 \\ 2 & 2 & 2 & 1 \\ 2 & 2 & 6 & 0 \end{array} \right]$$

- 2 Row reduce the following matrix:

$$\left[ \begin{array}{ccc} 1 & 1 & 1 \\ 2 & 2 & 2 \\ 3 & 3 & 3 \\ 4 & 4 & 4 \\ 5 & 5 & 5 \\ 6 & 6 & 6 \end{array} \right]$$

- 3 Without doing the row reduction, how many rows containing only 0's do you at least have?

$$\left[ \begin{array}{ccc} 6 & 1 & 2 \\ 2 & 2 & 2 \\ 3 & 4 & 3 \\ 1 & 6 & 4 \\ 5 & 2 & 5 \\ 1 & 6 & 6 \\ 1 & 1 & 6 \\ 5 & 6 & 0 \\ 1 & 8 & 1 \end{array} \right]$$

- 4 Row reduce the following matrix

$$\begin{bmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\ 0 & 0 & 0 & 2 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix}.$$

- 5 Which matrices are in row reduced echelon form?

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

$$\begin{bmatrix} 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 \end{bmatrix} \qquad \begin{bmatrix} 0 & 0 & 2 & 2 \\ 1 & 1 & 1 & 1 \end{bmatrix}$$

$$\begin{bmatrix} 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix} \qquad \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 2 \end{bmatrix}$$

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

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

if a row has nonzero entries, then the first nonzero entry is 1.  
 if a column contains a leading 1, then the other column entries are 0.  
 if a row has a leading 1, then every row above has a leading 1 to the left.