

# Assignment 10

Subhasish Saikia  
AI20MTECH14001

## Abstract

This document explains the procedure of determining the rank of the given matrix.

Download latex-tikz codes from

<https://github.com/subhasishsaikia22/EE5609–Matrix–theory>

## 1 PROBLEM

What is the rank of the following matrix?

$$\begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 2 & 2 & 2 & 2 \\ 1 & 2 & 3 & 3 & 3 \\ 1 & 2 & 3 & 4 & 4 \\ 1 & 2 & 3 & 4 & 5 \end{pmatrix}$$

- 1) 2
- 2) 3
- 3) 4
- 4) 5

## 2 EXPLANATION

<b>Rank of a matrix</b>	<p>The rank of the given matrix is determine by reducing it to row reduced echelon form. A matrix is in row echelon form if:</p> <ul style="list-style-type: none"> <li>&gt;all rows consisting of only zeroes are at the bottom.</li> <li>&gt;the leading coefficient of a nonzero row is always strictly to the right of the leading coefficient of the row above it</li> </ul>
-------------------------	---

TABLE 1: Definition

## 3 SOLUTION

---

<b>Given</b>	$\begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 2 & 2 & 2 & 2 \\ 1 & 2 & 3 & 3 & 3 \\ 1 & 2 & 3 & 4 & 4 \\ 1 & 2 & 3 & 4 & 5 \end{pmatrix} \xleftrightarrow[R_2=R_2-R_1]{R_3=R_3-R_1} \begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 0 & 1 & 1 & 1 & 1 \\ 0 & 1 & 2 & 2 & 2 \\ 1 & 2 & 3 & 4 & 4 \\ 1 & 2 & 3 & 4 & 5 \end{pmatrix} \quad (3.0.1)$	
	$\xleftrightarrow[R_4=R_4-R_1]{R_5=R_5-R_1} \begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 0 & 1 & 1 & 1 & 1 \\ 0 & 1 & 2 & 2 & 2 \\ 0 & 1 & 2 & 3 & 3 \\ 0 & 1 & 2 & 3 & 4 \end{pmatrix} \xleftrightarrow[R_5=R_5-R_4]{R_4=R_4-R_3} \begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 0 & 1 & 1 & 1 & 1 \\ 0 & 1 & 2 & 2 & 2 \\ 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix} \quad (3.0.2)$	
	$\xleftrightarrow[R_4=R_4-R_5]{R_3=R_3-R_3} \begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 0 & 1 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix} \xleftrightarrow[R_2=R_2-R_3]{R_3=R_3-R_4-R_5} \begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix} \quad (3.0.3)$	
	$\xleftrightarrow{R_1=R_1-R_2-R_3-R_4-R_5} \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix} \quad (3.0.4)$	
Thus the rank of the given matrix is 5		

TABLE 2: RREF and Rank

## 4 SOLUTION

Option	Solution	True/ False
1	2	False
2	3	False
3	4	False
4	5	True

TABLE 3: correct option