

# Assignment 2

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Download all python codes from

<https://github.com/narasimha-123/EE4013/tree/main/Assignment-2/codes>

and latex-tikz codes from

<https://github.com/narasimha-123/EE4013/tree/main/Assignment-2/figs>

## 1 PROBLEM

Check whether three points

$$A = \begin{pmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{pmatrix}, B = \begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{pmatrix}, C = \begin{pmatrix} z_1 \\ z_2 \\ \vdots \\ z_n \end{pmatrix}$$

are collinear or not.

## 2 SOLUTION

We can say that three points are collinear if there exists a  $\lambda$  such that it satisfies the condition that is

$$\overrightarrow{AB} = \lambda \overrightarrow{AC} \quad (2.0.1)$$

because then we can say that the direction ratios of three vectors A,B,C are proportional which implies that the three points A, B and C are collinear. i.e., if they are of form

$$\begin{pmatrix} x_1 - y_1 \\ x_2 - y_2 \\ \vdots \\ x_n - y_n \end{pmatrix} = \lambda \begin{pmatrix} x_1 - z_1 \\ x_2 - z_2 \\ \vdots \\ x_n - z_n \end{pmatrix}$$

This method to check whether points are collinear can be extended to "m" points.

let  $A_1, A_2, A_3, \dots, A_m$  be the m points

The idea is same, First we take three points of the m points and check if the direction ratios of three vectors are proportional. If they are proportional that implies that the three points are

collinear.

So, We check the proportionality of direction ratios for different combination of 3 points each time. If in all the cases the direction ratios of three vectors are proportional, then we can say that all points are collinear. i.e., they satisfy the condition

$$\overrightarrow{A_i A_{i+1}} = \lambda \overrightarrow{A_i A_{i+2}} \quad (2.0.2)$$

$\forall i \in 0, 1, 2, \dots, m-2$

The code to check collinearity is found in

`./codes/ee18btech11046.c`

## 3 EXAMPLE

Check whether points

$$A = \begin{pmatrix} 1 \\ 2 \\ 7 \end{pmatrix}, B = \begin{pmatrix} 2 \\ 6 \\ 3 \end{pmatrix}, C = \begin{pmatrix} 3 \\ 10 \\ -1 \end{pmatrix}$$

are collinear or not.

## 4 SOLUTION FOR EXAMPLE

We can say that the points are collinear if the three points A, B, C satisfy the above condition

$$\overrightarrow{AB} = \lambda \overrightarrow{AC} \quad (4.0.1)$$

Now,

$$\overrightarrow{AB} = \begin{pmatrix} -1 \\ -4 \\ 4 \end{pmatrix} \quad (4.0.2)$$

and

$$\overrightarrow{AC} = \begin{pmatrix} -2 \\ -8 \\ 8 \end{pmatrix} \quad (4.0.3)$$

We can see that  $\overrightarrow{AC}$  can be written as

$$\overrightarrow{AC} = 2 \begin{pmatrix} -1 \\ -4 \\ 4 \end{pmatrix} \quad (4.0.4)$$

$$\overrightarrow{AC} = 2 \overrightarrow{AB} \quad (4.0.5)$$

which is of form

$$\overrightarrow{AB} = \lambda \overrightarrow{AC} \quad (4.0.6)$$

where  $\lambda$  is equal to  $\frac{1}{2}$ .

Since the direction ratios of the given points A, B, C are proportional, We can say that the given points are Collinear.

## 5 VERIFICATION

We plotted the given three points in 3d-plotting using python. The points in 3d-plane are as shown below.

The code to generate the python plot for the three is found in

```
./codes/ee18btech11046.py
```

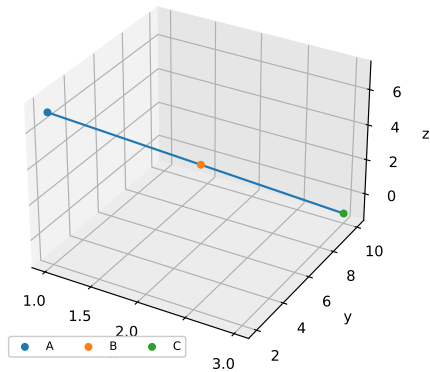


Fig. 0: 3D plot of given points

From the figure we can see that the three given points are on same line. Therefore the given points are collinear.