EE4013 Assignment-1

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Download all codes from

```
https://github.com/dks2000dks/IIT−Hyderabad−
    Semester−Courses/tree/master/EE4013/
    Assignment2/codes
```

and latex-tikz codes from

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https://github.com/dks2000dks/IIT−Hyderabad−
    Semester−Courses/tree/master/EE4013/
    Assignment2
```

1 Problem

Show that the points $\mathbf{A} = \begin{pmatrix} 1 \\ 2 \\ 7 \end{pmatrix}$, $\mathbf{B} = \begin{pmatrix} 2 \\ 6 \\ 3 \end{pmatrix}$ and $\mathbf{C} = \begin{pmatrix} 3 \\ 10 \\ -1 \end{pmatrix}$ are collinear.

2 Solution

We know that if points A, B, C are collinear then,

$$\mathbf{CA} = \lambda \times \mathbf{BA} \tag{2.0.1}$$

So,

$$\mathbf{CA} = \begin{pmatrix} 2 \\ 8 \\ -8 \end{pmatrix} \tag{2.0.2}$$

$$\mathbf{BA} = \begin{pmatrix} 1 \\ 4 \\ -4 \end{pmatrix} \tag{2.0.3}$$

$$CA = 2 \times BA \tag{2.0.4}$$

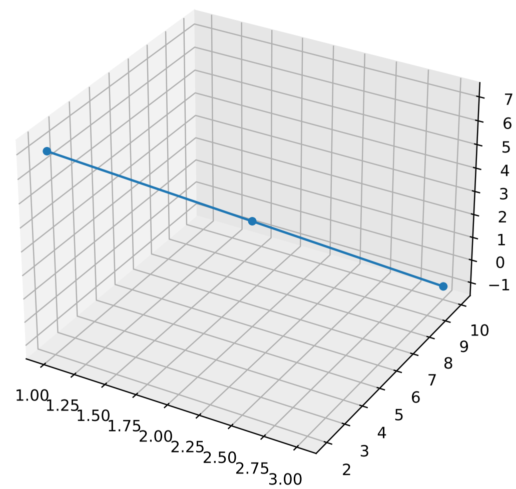
The above can be rewritten as follows by comparing each component of both the vectors **CA** and **BA**

$$\frac{3-1}{2-1} = \frac{10-2}{6-2} = \frac{-1-7}{3-7} = 2 \tag{2.0.5}$$

So, it can be concluded that the points $\mathbf{A} = \begin{pmatrix} 1 \\ 2 \\ 7 \end{pmatrix}$, $\mathbf{B} = \begin{pmatrix} 2 \\ 6 \\ 3 \end{pmatrix}$ and $\mathbf{C} = \begin{pmatrix} 3 \\ 10 \\ -1 \end{pmatrix}$ are collinear.

3 Verification

Verifying that **A**, **B** and **C** are collinear by plotting them.



4 Generalizing Solution

Let $\mathbf{A}_i = \begin{pmatrix} x_{i,0} \\ x_{i,1} \\ \vdots \\ x_{i,n-1} \end{pmatrix}$ be an n dimensional vector and it represents i^{th} point where $i \in \{0, 1, 2, .., m-1\}$. The objective is to check whether these m-points are collinear or not.

For all the m-points to be collinear any three points among m-points A_i, A_j and A_k should be collinear i.e $\mathbf{A}_k\mathbf{A}_i = \lambda \times \mathbf{A}_j\mathbf{A}_i$.

$$\mathbf{A}_k\mathbf{A}_i = \begin{pmatrix} x_{k,0} - x_{i,0} \\ x_{k,1} - x_{i,1} \\ \vdots \\ x_{k,n-1} - x_{i,n-1} \end{pmatrix} \tag{4.0.1}$$

$$\mathbf{A}_j\mathbf{A}_i = \begin{pmatrix} x_{j,0} - x_{i,0} \\ x_{j,1} - x_{i,1} \\ \vdots \\ x_{j,n-1} - x_{i,n-1} \end{pmatrix} \tag{4.0.2}$$

$$\begin{pmatrix} x_{k,0} - x_{i,0} \\ x_{k,1} - x_{i,1} \\ \vdots \\ x_{k,n-1} - x_{i,n-1} \end{pmatrix} = \lambda \begin{pmatrix} x_{j,0} - x_{i,0} \\ x_{j,1} - x_{i,1} \\ \vdots \\ x_{j,n-1} - x_{i,n-1} \end{pmatrix} \tag{4.0.3}$$

It can be rewritten as:

$$\frac{x_{k,0} - x_{i,0}}{x_{j,0} - x_{i,0}} = \frac{x_{k,1} - x_{i,1}}{x_{j,1} - x_{i,1}} = \ldots = \frac{x_{k,n-1} - x_{i,n-1}}{x_{j,n-1} - x_{i,n-1}} = \lambda \tag{4.0.4}$$

So, if all m-points satisfy the above condition it can be concluded that all the points are collinear.