1.9.14

AI25btech11014-Suhas

29th August, 2025

Question

Show that the points $\mathbf{A} = \begin{pmatrix} 2 \\ 3 \\ -4 \end{pmatrix}$, $\mathbf{B} = \begin{pmatrix} 1 \\ -2 \\ 3 \end{pmatrix}$, $\mathbf{C} = \begin{pmatrix} 3 \\ 8 \\ -11 \end{pmatrix}$ are collinear.

Theoretical Solution

Compute direction vectors:

$$\mathbf{B}-\mathbf{A}=\begin{pmatrix}1\\-2\\3\end{pmatrix}-\begin{pmatrix}2\\3\\-4\end{pmatrix}=\begin{pmatrix}-1\\-5\\7\end{pmatrix} \tag{1}$$

$$\mathbf{C}-\mathbf{A}=\begin{pmatrix}3\\8\\-11\end{pmatrix}-\begin{pmatrix}2\\3\\-4\end{pmatrix}=\begin{pmatrix}1\\5\\-7\end{pmatrix} \tag{2}$$

Matrix Construction

Form matrix M with direction vectors as rows:

$$M = \begin{pmatrix} -1 & -5 & 7 \\ 1 & 5 & -7 \end{pmatrix} \tag{3}$$

We will perform row operations to determine the rank.

Row Operations

Swap rows:

$$\begin{pmatrix} 1 & 5 & -7 \\ -1 & -5 & 7 \end{pmatrix} \tag{4}$$

Apply $R_2 \to R_2 + R_1$:

$$\begin{pmatrix} 1 & 5 & -7 \\ 0 & 0 & 0 \end{pmatrix} \tag{5}$$

Conclusion

Only one non-zero row remains:

$$\text{Rank}(M) = 1 \tag{6}$$

Therefore, the vectors are linearly dependent.

Hence, the points are collinear.

C Code - Direct Solve

```c
#include <stdio.h>

int main() {
    float M[2][3] = {
        {-1, -5, 7},
        {1, 5, -7}
    };

    for (int i = 0; i < 3; i++)
        M[1][i] += M[0][i];

    if (M[1][0] == 0 && M[1][1] == 0 && M[1][2] == 0)
        printf("Points are collinear\n");
    else
        printf("Points are not collinear\n");
}
```

C Code - Function for .so

```c
#include <stdio.h>

int check_collinear() {
    float M[2][3] = {
        {-1, -5, 7},
        {1, 5, -7}
    };

    for (int i = 0; i < 3; i++)
        M[1][i] += M[0][i];

    return (M[1][0] == 0 && M[1][1] == 0 && M[1][2] == 0);
}
```

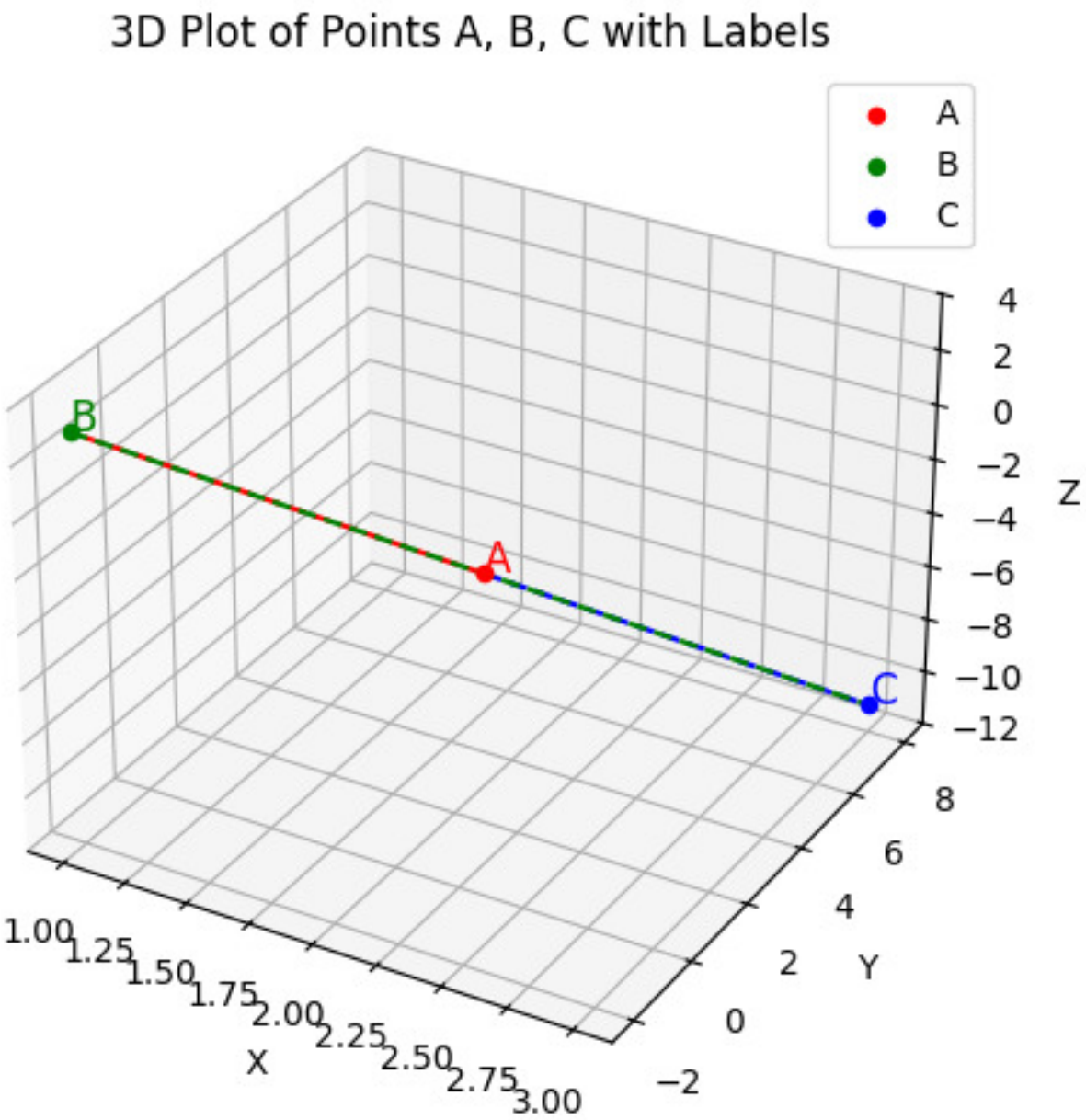
Python Code - Shared Output

```
import ctypes

lib = ctypes.CDLL("./libcollinear.so")
lib.check_collinear.restype = ctypes.c_int

result = lib.check_collinear()
if result == 1:
    print("Points A, B, C are collinear")
else:
    print("Points are not collinear")
```

Plot


3D Plot of Points A, B, C with Labels
A
B
C
B
A
C
4
2
0
−2
−4
−6
−8
−10
−12
Z
8
6
4
2
0
−2
Y
1.00
1.25
1.50
1.75
2.00
2.25
2.50
2.75
3.00
X