Problem 1.5.13

EE25BTECH11025-Vishwambhar

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Problem Statement

Find the ratio in which the Y axis divides the line segment joining the points $\mathbf{A}\,(-1,-4)$ and $\mathbf{B}\,(5,-6)$. Also find the coordinates of the point of intersection.

Variables used

Variable	**characteristic**
C	point of intersection of the line segment and y-axis
x	x-coordinate of the point **C**
y	y-coordinate of point **C**
m	Slope of line segment joining **A** and **B**

Slope(m)

Slope of line segment joining **A** and **B**:

$$m = \frac{(-6) - (-4)}{5 - (-1)} \tag{3.1}$$

$$m = \left(\frac{-1}{3}\right) \tag{3.2}$$

Obtaining Point

The point of intersection of the given line segment and the Y-axis is:

$$\begin{pmatrix} 1 & 3 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} -13 \\ 0 \end{pmatrix} \tag{3.3}$$

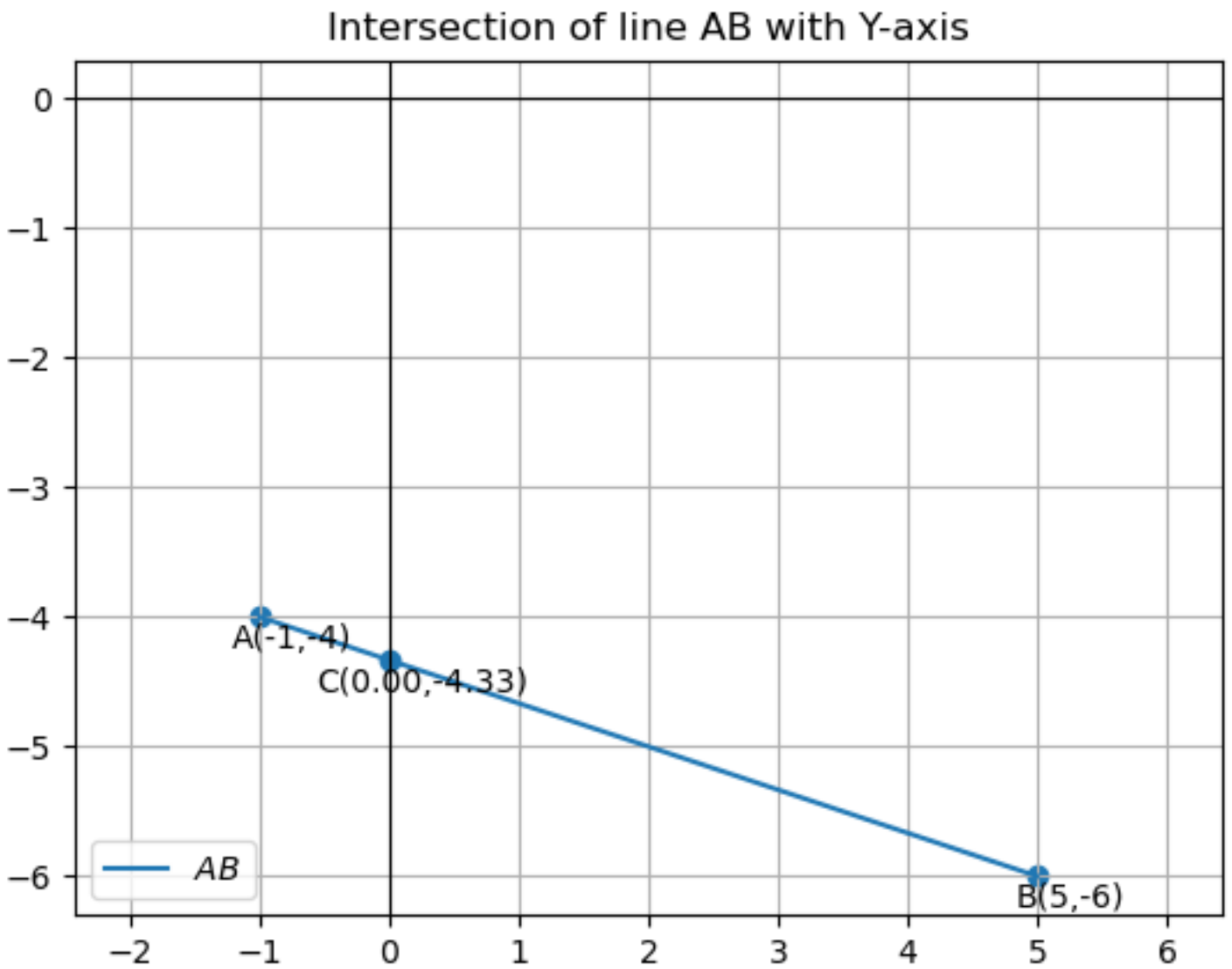
$$\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 0 \\ (\frac{-13}{3}) \end{pmatrix} \tag{3.4}$$

Ratio

The ratio in which the Y-axis divides the given line segment is:

$$\frac{AC}{CB} = \frac{1}{5} \tag{3.5}$$

Plot


Intersection of line AB with Y-axis
0
−1
−2
−3
−4
−5
−6
−2
−1
0
1
2
3
4
5
6
A(-1,-4)
C(0.00,-4.33)
B(5,-6)
AB

C Code for assigning matrices

```c
#include <stdio.h>
#include <math.h>
#include <stdlib.h>
#include "libs/matfun.h"
#include "libs/geofun.h"

int main(){
        int n=2;
        double **A, **b, **A_inv, **x;

        A=createMat(n,n);
        b=createMat(n,1);
        x=createMat(n,1);


        A[0][0]=1; A[0][1]=1;
        A[1][0]=3; A[1][1]=0;

        b[0][0]= -13;
        b[1][0]= 0;
```

C Code for finding inverse of a matrix and also the point of intersection

```
    A_inv = Matinv(A,n);
x=Matmul(A_inv,b,n,n,1);
printf("Solution of Ax=b:\n");
    for(int i=0;i<n;i++){
            printf("x[%d]=%.2f\n", i+1, x[i][0]);
    }
```

C Code for storing values in a file

```
FILE *file=fopen("values.dat", "w");
        if(file==NULL){
                printf("Error opening file!\n");
                return 1;
        }
        fprintf(file, "The point of intersection of the line
            segment and the Y-axis is:\n");
                fprintf(file, "x-coordinate y-coordinate\n");
                fprintf(file, " %.2f %.2f",x[0][0], x[1][0]);
        fclose(file);
        printf("Results have been written to values.dat\n");
        freeMat(A,n);
        freeMat(b,n);
        freeMat(A_inv,n);
        freeMat(x,n);
        return 0;
}
```

Python Code for Plotting

```
import sys
import numpy as np
import matplotlib.pyplot as plt

# Add your workspace path (adjust if needed)
sys.path.insert(0, '/home/ganachari-vishwmabhar/Downloads/codes/
    CoordGeo')

# Local imports
from line.funcs import line_gen

# Read intersection point from values.dat (skip first two rows if
     it has header)
data = np.loadtxt("values.dat", skiprows=2)
xc, yc = data[0], data[1]
C = np.array([xc, yc]).reshape(-1, 1)
```

Python Code for Plotting

```
# Given points
A = np.array([-1, -4]).reshape(-1, 1)
B = np.array([5, -6]).reshape(-1, 1)

# Generate line AB using helper function
x_AB = line_gen(A, B)

# ---- Plotting ----
plt.plot(x_AB[0, :], x_AB[1, :], label='$AB$')

# Collect points
tri_coords = np.block([A, B, C])
plt.scatter(tri_coords[0, :], tri_coords[1, :])

# Labels
vert_labels = ['A(-1,-4)', 'B(5,-6)', f'C({xc:.2f},{yc:.2f})']
```

Python Code for Plotting

```
for i, txt in enumerate(vert_labels):
    x, y = tri_coords[:, i]
    plt.annotate(txt, (x, y),
                 textcoords="offset points",
                 xytext=(10, -10),
                 ha='center')

# Axes styling
plt.axhline(0, color='black', linewidth=0.8)
plt.axvline(0, color='black', linewidth=0.8)
plt.grid(True)
plt.axis('equal')
plt.legend()
plt.title("Intersection of line AB with Y-axis")

# Save & Show
plt.savefig('../figs/fig1.png')
plt.show()
```