MATRIX THEORY-MATGEO PRESENTATION

EE24BTECH11008 - ASLIN GARVASIS

Question

If $\mathbf{A}\left(\frac{a}{3}, 4\right)$ is the midpoint of the line segment joining the points $\mathbf{B}\left(-6, 5\right)$ and $\mathbf{C}\left(-2, 3\right)$, then the value of a is

CBSE $(10 - 2021)$

Solution: Table

Variable	Description
$\mathbf{B}(-6,5)$	coordinates of first point
$\mathbf{C}(-2,3)$	coordinates of second point
$\mathbf{A}$	midpoint of $\mathbf{B}$ and $\mathbf{C}$
k	ratio in which $\mathbf{c}$ divides the line joining AB
$\frac{\mathbf{C}+k\mathbf{B}}{k+1}$	section formula

Table: Variables Used

Theory

$$\mathbf{A} = \frac{k\mathbf{C} + \mathbf{B}}{k+1} \tag{1}$$

Theory

where k is the ratio which **A** divides **B** and **C**, here k=1 ($\because$ midpoint)

Theory

$$\implies \mathbf{A} = \frac{\mathbf{B} + \mathbf{C}}{2} \tag{2}$$

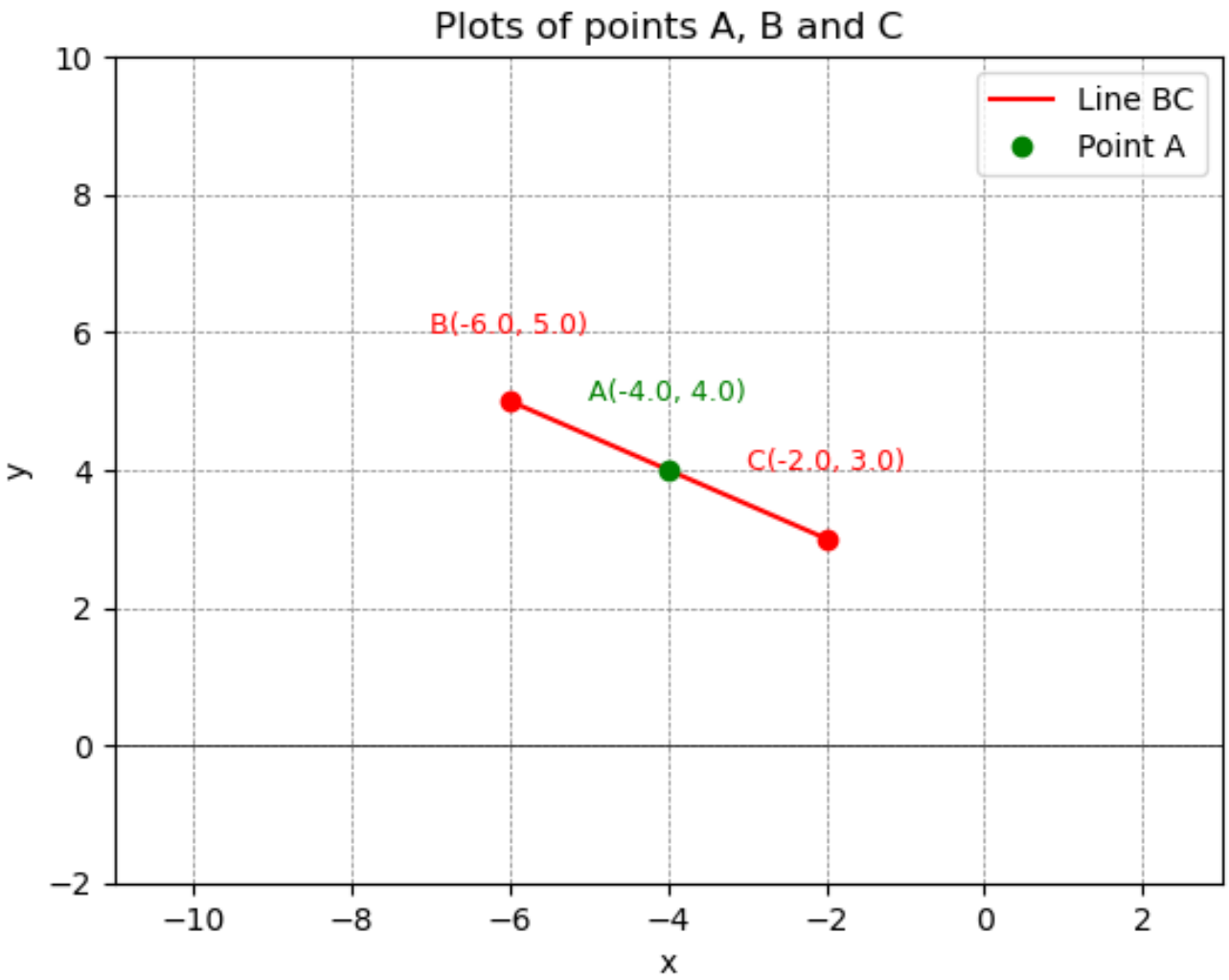
$$\implies \mathbf{A} = \frac{\begin{pmatrix} -6 \\ 5 \end{pmatrix} + \begin{pmatrix} -2 \\ 3 \end{pmatrix}}{2} = \frac{\begin{pmatrix} -8 \\ 8 \end{pmatrix}}{2} = \begin{pmatrix} -4 \\ 4 \end{pmatrix} \tag{3}$$

$$\because \mathbf{A} = \begin{pmatrix} \frac{a}{3} \\ 4 \end{pmatrix} \tag{4}$$

$$\implies a = -4 \times 3 \tag{5}$$

$$\implies a = -12 \tag{6}$$

Simulation


Plots of points A, B and C
Line BC
Point A
B(-6.0, 5.0)
A(-4.0, 4.0)
C(-2.0, 3.0)
10
8
6
4
2
0
−2
y
−10
−8
−6
−4
−2
0
2
x

C-code

```c
#include <stdio.h>

int main() {
    FILE *file = fopen("points.txt", "w");
    if (file == NULL) {
        printf("Error opening file!\n");
        return 1;
    }

    // Define the points
    int x1 = -6, y1 = 5;
    int x2 = -2, y2 = 3;
```

C-code

```
    fprintf(file, "Point 1: (%d, %d)\n", x1, y1);
    fprintf(file, "Point 2: (%d, %d)\n", x2, y2);

    // Close the file
    fclose(file);

    return 0;
}
```

Output in points.txt

$$\begin{aligned} \text{Point} \quad & 1 : (-6, 5) \\ \text{Point} \quad & 2 : (-2, 3) \end{aligned}$$

Python code

```
import sys
#for path to external scripts
sys.path.insert(0, '/home/matgeo/codes/CoordGeo')
#path to my scripts

import numpy as np
import numpy.linalg as LA
import matplotlib.pyplot as plt
import matplotlib.image as mpimg

#local imports
from line.funcs import *
```

Python code

```
# Read the points from the file
with open('points.txt', 'r') as file:
    lines = file.readlines()

# Extract the coordinates
point1_str = lines[0].strip().split(': ')[1]
# Get the string after 'Point 1 : '
point2_str = lines[1].strip().split(': ')[1]
# Get the string after 'Point 2 : '

# Convert the string coordinates to tuples
# Use eval to convert string to tuple
x1, y1 = eval(point1_str)
x2, y2 = eval(point2_str)
```

Python code

```
B=np.array([x1,y1]).reshape(-1,1)
C=np.array([x2,y2]).reshape(-1,1)
A=np.array([(x1+x2)/2,(y1+y2)/2]).reshape(-1,1)
# generation of line
x_BC = line_gen(B,C)
# plotting line
plt.plot(x_BC[0,:],x_BC[1,:],label='$BC$')
#Labeling the coordinates
colors = np.arange(1,4)
tri_coords = np.block([[A,B,C]])
plt.scatter(tri_coords[0,:], tri_coords[1,:], c=colors)
vert_labels = ['A','B','C']
```

Python code

```
for i, txt in enumerate(vert_labels):
#plt.annotate(txt, # this is the text

    ↪  plt.annotate(f'{txt}\n({tri_coords[0,i]:.2f},{tri_coords[
           (tri_coords[0,i], tri_coords[1,i]),
           # this is the point to label
           textcoords="offset points",
           # how to position the text
           xytext=(25,5),
           # distance from text to points (x,y)
           ha='center')
           # horizontal alignment can be left, right or center
```

Python code

```
# use set_position
ax = plt.gca()
ax.spines['top'].set_color('none')
ax.spines['left'].set_position('zero')
ax.spines['right'].set_color('none')
ax.spines['bottom'].set_position('zero')
'''
ax.spines['left'].set_visible(False)
ax.spines['right'].set_visible(False)
ax.spines['top'].set_visible(False)
ax.spines['bottom'].set_visible(False)
plt.xlabel('£x£')
plt.ylabel('£y£')
plt.legend(loc='best')
'''
plt.grid()
plt.axis('equal')
plt.show()
```