Matgeo Presentation - Problem 1.6.13

ee25btech11063 - Vejith

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Question

The points $(0, 5)$,$(0, -9)$ and $(3, 6)$ are not collinear.

Description

Solution:

point	Name
$\begin{pmatrix} 0 \\ 5 \end{pmatrix}$	vector **A**
$\begin{pmatrix} 0 \\ -9 \end{pmatrix}$	vector **B**
$\begin{pmatrix} 3 \\ 6 \end{pmatrix}$	vector **C**

Table: Variables Used

3 points are collinear if the rank of collinearity matrix is 1.Rank of matrix is1

(0.1)

means no.of rows with non zero entries is 1.

Solution

The collinearity matrix is given by (0.2)

$$\begin{pmatrix} \mathbf{B}-\mathbf{A} & \mathbf{C}-\mathbf{A} \end{pmatrix}^T = \begin{pmatrix} 0 & -14 \\ 3 & 1 \end{pmatrix} \tag{0.3}$$

(0.4)

$$\begin{pmatrix} 0 & -14 \\ 3 & 1 \end{pmatrix} \xrightarrow{R_1 \leftrightarrow R_2} \begin{pmatrix} 3 & 1 \\ 0 & -14 \end{pmatrix} \tag{0.5}$$

(0.6)

conclusion

The above matrix now is in row echelon form.Rank of a matix in echelon form is number of non zero rows.so,The rank of the above collinearity matrix is 2

$\implies$ given 3 points A,B,C are not collinear.

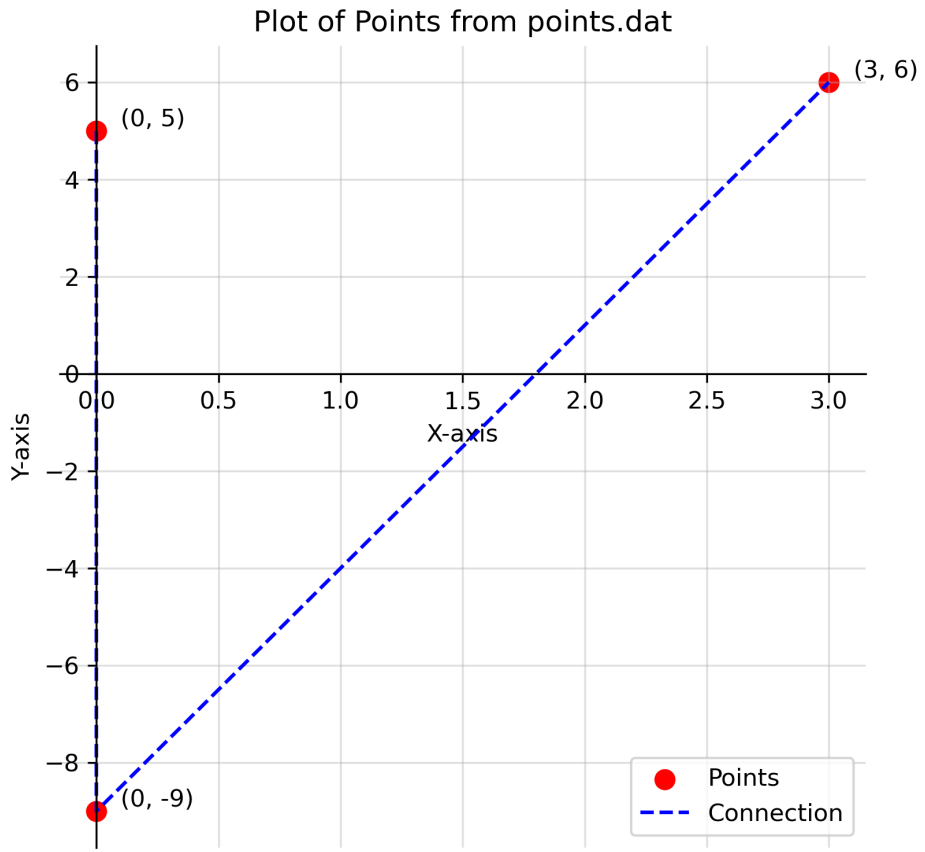

Figure: A,B,C are not collinear

C Code: points.c

```c
#include <stdio.h>

int main() {
  FILE *fp;

  // -------------------
  // Question 1.6.13
  // -------------------


  fp = fopen("points.dat", "w");
  fprintf(fp, "%d,%d,%d\n", 0, 5, 0); // A
  fprintf(fp, "%d,%d,%d\n", 0, -9, 0); // B
  fprintf(fp, "%d,%d,%d\n", 3, 6, 0); // C
  fclose(fp);
  return 0;
  }
```

Python: call_c.py

```
import subprocess

# Compile the C program
subprocess.run(["gcc", "points.c", "-o", "points"])

# Run the compiled C program
result = subprocess.run(["./points"], capture_output=True, text=True)

# Print the output from the C program
print(result.stdout)
```

Python: plot.py

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

# Load the file, using comma as delimiter
points = np.loadtxt("points.dat", delimiter=",")

# Take only the first two columns (x, y)
x = points[:, 0]
y = points[:, 1]

# --- Plot ---
plt.figure(figsize=(6, 6))
plt.scatter(x, y, color="red", s=60, label="Points")
plt.plot(x, y, linestyle="--", color="blue", label="Connection")

# Annotate each point
for xi, yi in zip(x, y):
    plt.text(xi + 0.1, yi + 0.1, f"({xi:g}, {yi:g})")

# Axes setup
ax = plt.gca()
ax.spines["left"].set_position("zero")
ax.spines["bottom"].set_position("zero")
ax.spines["right"].set_color("none")
ax.spines["top"].set_color("none")

plt.xlabel("X-axis")
plt.ylabel("Y-axis")
plt.title("Plot of Points from points.dat")
plt.grid(True, alpha=0.4)
plt.legend()

# Save the figure
```

Python: plot.py

```
plt.savefig("points_plot.png", dpi=300, bbox_inches="tight")

# Show the figure
plt.show()
```