MatGeo Assignment 1.2.14

AI25BTECH11008
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The fourth vertex D of a parallelogram $ABCD$ whose three vertices are $A(-2, 3)$, $B(6, 7)$ and $C(8, 3)$ is

We solve this using **vector algebra**.
We are given three vertices of a parallelogram:

$$A(-2, 3), \ B(6, 7), \ C(8, 3).$$

In a parallelogram, opposite sides are parallel and equal.
Thus, the fourth vertex is obtained as:

$$\mathbf{D} = \mathbf{A} + \mathbf{C} - \mathbf{B}.$$

Theoretical Solution

Substitute the given values:

$$\mathbf{D} = \begin{pmatrix} -2 \\ 3 \end{pmatrix} + \begin{pmatrix} 8 \\ 3 \end{pmatrix} - \begin{pmatrix} 6 \\ 7 \end{pmatrix}$$

$$= \begin{pmatrix} 0 \\ -1 \end{pmatrix}$$

$$\therefore \ D(0, -1)$$

C-code (Vector Algebra Method)

```c
#include <stdio.h>

int main() {
    // Given vertices
    int x1 , y1 ; // A
    int x2 , y2 ; // B
    int x3 , y3 ; // C
    int x, y; // D (to be calculated)

    printf("Enter coordinates of A: ");
    scanf("%d %d", &x1, &y1);

    printf("Enter coordinates of B: ");
    scanf("%d %d", &x2, &y2);

    printf("Enter coordinates of C: ");
    scanf("%d %d", &x3, &y3);

    // Using vector algebra property: D = A + C - B
```
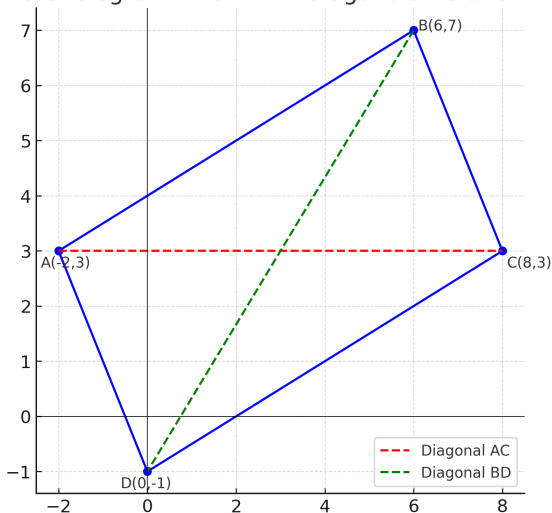
Plot

Parallelogram ABCD with diagonals AC and BD

Python code for plot

```python
import matplotlib.pyplot as plt

# Given points
A = (-2, 3)
B = (6, 7)
C = (8, 3)
D = (0, -1) # calculated fourth vertex

# Plotting the parallelogram
x_coords = [A[0], B[0], C[0], D[0], A[0]]
y_coords = [A[1], B[1], C[1], D[1], A[1]]

plt.figure(figsize=(6,6))
plt.plot(x_coords, y_coords, 'b-o')

# Plot diagonals
plt.plot([A[0], C[0]], [A[1], C[1]], 'r--', label='Diagonal AC')
plt.plot([B[0], D[0]], [B[1], D[1]], 'g--', label='Diagonal BD')
```

```python
# Label points
plt.text(A[0]-0.4, A[1]-0.3, 'A(-2,3)', fontsize=10)
plt.text(B[0]+0.1, B[1], 'B(6,7)', fontsize=10)
plt.text(C[0]+0.1, C[1]-0.3, 'C(8,3)', fontsize=10)
plt.text(D[0]-0.6, D[1]-0.3, 'D(0,-1)', fontsize=10)

# Axes and grid
plt.axhline(0, color='black', linewidth=0.5)
plt.axvline(0, color='black', linewidth=0.5)
plt.grid(True, linestyle='--', alpha=0.5)

# Title and legend
plt.legend()
plt.title("Parallelogram ABCD with diagonals AC and BD")

plt.show()
```

From the figure it is clearly verified that the vector algebra solution matches with the computational solution.