2.7.13

EE25BTECH11001 - Aarush Dilawri

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Question

Question:
Given vertices $\mathbf{A}(-4,-5)$, $\mathbf{B}(-1,-6)$, $\mathbf{C}(-5,7)$ and $\mathbf{D}(4,5)$ of a quadrilateral. Find the area of quadrilateral $ABCD$.

Solution

Given vertices $\mathbf{A} = \begin{pmatrix} -4 \\ -5 \end{pmatrix}$, $\mathbf{B} = \begin{pmatrix} -1 \\ -6 \end{pmatrix}$, $\mathbf{C} = \begin{pmatrix} -5 \\ 7 \end{pmatrix}$, $\mathbf{D} = \begin{pmatrix} 4 \\ 5 \end{pmatrix}$.

We split the quadrilateral into triangles $\triangle ABC$ and $\triangle ACD$ and add them to get the answer.

Area of $\triangle ABC$

$$\text{Area}_{ABC} = \frac{1}{2} \left\| (\mathbf{B} - \mathbf{A}) \times (\mathbf{C} - \mathbf{A}) \right\| = 17.5 \tag{1}$$

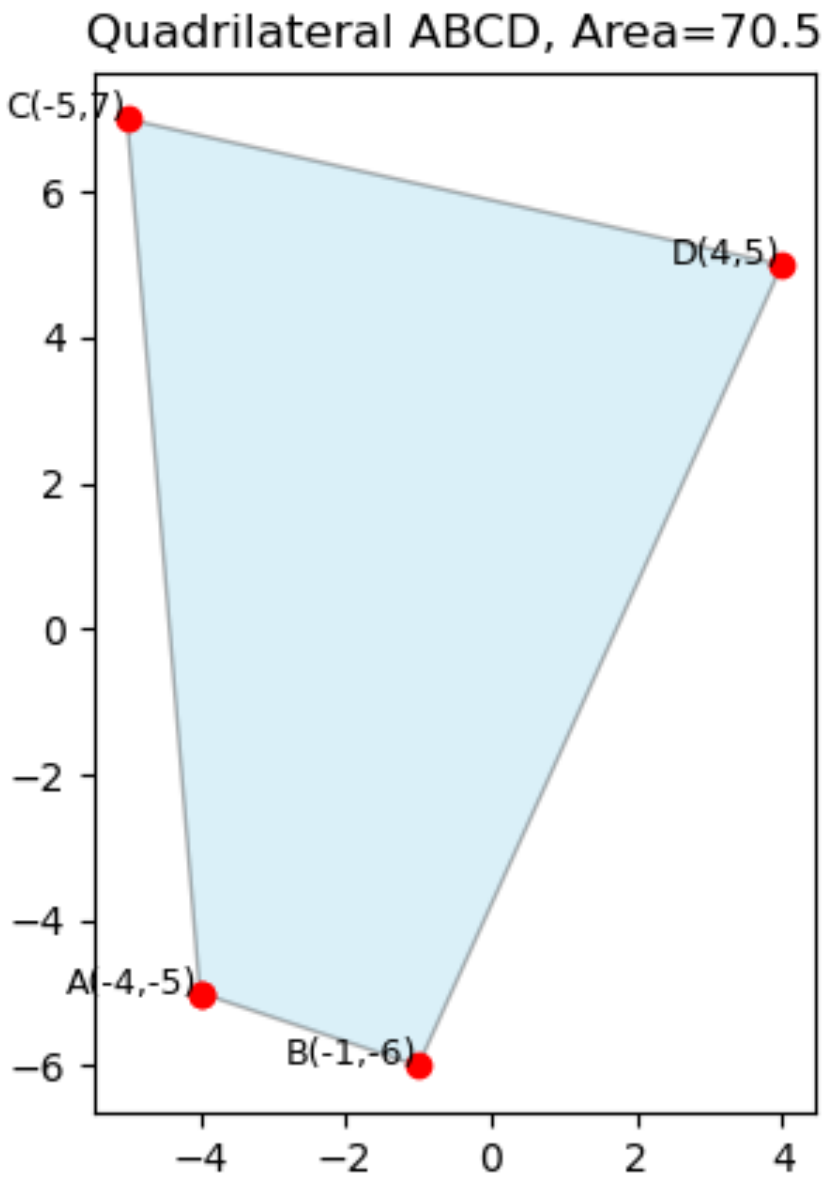
Area of $\triangle ACD$

$$\text{Area}_{ACD} = \frac{1}{2} \left\| (\mathbf{C} - \mathbf{A}) \times (\mathbf{D} - \mathbf{A}) \right\| = 53 \tag{2}$$

Total Area

$$\text{Area}_{ABCD} = \text{Area}_{ABC} + \text{Area}_{ACD} = 70.5 \tag{3}$$

Figure



C Code (code.c)

```c
#include <stdio.h>
#include <math.h>

double triangle_area(double x1, double y1,
                     double x2, double y2,
                     double x3, double y3) {
    return 0.5 * fabs(x1*(y2-y3) + x2*(y3-y1) + x3*(y1-y2));
}

double area_of_quadrilateral(double x1, double y1,
                             double x2, double y2,
                             double x3, double y3,
                             double x4, double y4) {
    double area1 = triangle_area(x1,y1,x2,y2,x3,y3);
    double area2 = triangle_area(x1,y1,x3,y3,x4,y4);
    return area1 + area2;
}
```

Python Code (code.py)

```
import matplotlib.pyplot as plt

def triangle_area(x1,y1,x2,y2,x3,y3):
    return 0.5 * abs(x1*(y2-y3) + x2*(y3-y1) + x3*(y1-y2))

x1, y1 = -4, -5 # A
x2, y2 = -1, -6 # B
x3, y3 = -5, 7 # C
x4, y4 = 4, 5 # D

area = triangle_area(x1,y1,x2,y2,x3,y3) + triangle_area(x1,y1,x3,y3,x4,y4)
print("Area:", area)

xs = [x1, x2, x3, x4, x1]
ys = [y1, y2, y3, y4, y1]
```

Python Code (code.py)

```
plt.fill(xs, ys, alpha=0.3, edgecolor='black')
plt.scatter([x1,x2,x3,x4],[y1,y2,y3,y4],color='red')

points = {"A": (x1,y1), "B": (x2,y2), "C": (x3,y3), "D": (x4,y4)}
for p, (x, y) in points.items():
    plt.text(x, y, f"{p}{(x,y)}")

plt.title(f"Quadrilateral ABCD, Area={area}")
plt.show()
```

Python Code (nativecode.py)

```
import ctypes
import matplotlib.pyplot as plt

lib = ctypes.CDLL("./code.so")
lib.area_of_quadrilateral.argtypes = [ctypes.c_double, ctypes.c_double,
                                      ctypes.c_double, ctypes.c_double,
                                      ctypes.c_double, ctypes.c_double,
                                      ctypes.c_double, ctypes.c_double]
lib.area_of_quadrilateral.restype = ctypes.c_double
x1, y1 = -4, -5 # A
x2, y2 = -1, -6 # B
x3, y3 = -5, 7 # C
x4, y4 = 4, 5 # D
area = lib.area_of_quadrilateral(x1,y1,x2,y2,x3,y3,x4,y4)
print("Area:", area)
```

Python Code (nativecode.py)

```
xs = [x1, x2, x3, x4, x1]
ys = [y1, y2, y3, y4, y1]

plt.fill(xs, ys, alpha=0.3, edgecolor='black')
plt.scatter([x1,x2,x3,x4],[y1,y2,y3,y4],color='red')

points = {"A": (x1,y1), "B": (x2,y2), "C": (x3,y3), "D": (x4,y4)}
for p, (x, y) in points.items():
    plt.text(x, y, f"{p}{(x,y)}")

plt.title(f"Quadrilateral ABCD, Area={area}")
plt.show()
```