## 2.7.31

EE25BTECH11019 - Darji Vivek M.

# Question

Find the area of triangle $ABC$, whose vertices are

$$A(2, 5), \quad B(4, 7), \quad C(6, 2).$$

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# Given Data

$$\mathbf{A} = \begin{bmatrix} 2 \\ 5 \end{bmatrix}, \quad \mathbf{B} = \begin{bmatrix} 4 \\ 7 \end{bmatrix}, \quad \mathbf{C} = \begin{bmatrix} 6 \\ 2 \end{bmatrix}$$

$$\mathbf{A} - \mathbf{B} = \begin{bmatrix} -2 \\ -2 \end{bmatrix}, \quad \mathbf{A} - \mathbf{C} = \begin{bmatrix} -4 \\ 3 \end{bmatrix}$$

## Solution

Area of triangle $ABC$:

$$\Delta \; = \; \frac{1}{2}\left|(\mathbf{A}-\mathbf{B})_1(\mathbf{A}-\mathbf{C})_2 - (\mathbf{A}-\mathbf{B})_2(\mathbf{A}-\mathbf{C})_1\right|.$$

Substitute $(\mathbf{A}-\mathbf{B}) = (-2,-2)$ and $(\mathbf{A}-\mathbf{C}) = (-4,3)$:

$$\Delta = \frac{1}{2}\left|(-2)(3) - (-2)(-4)\right| = \frac{1}{2}\left|-6-8\right| = \frac{1}{2}\cdot 14 = 7.$$

$$\therefore \quad \text{Area of } \triangle ABC = 7.$$

# C Code Implementation

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

// Function to compute area of triangle from 3 points
double triangle_area(double x1, double y1,
                     double x2, double y2,
                     double x3, double y3) {
    double det = x1*(y2 - y3) - y1*(x2 - x3) + (x2*y3
        - y2*x3);
    return fabs(det) / 2.0;
}
```

# C Code Implementation

```c
int main() {
    double A[2] = {2, 5};
    double B[2] = {4, 7};
    double C[2] = {6, 2};

    double area = triangle_area(A[0], A[1], B[0], B
        [1], C[0], C[1]);
    printf("Area of triangle ABC = %.2f\n", area);
    return 0;
}
```

# Python code

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

# Points
A = np.array([2, 5])
B = np.array([4, 7])
C = np.array([6, 2])

# Area using determinant method
matrix = np.array([
    [A[0], A[1], 1],
    [B[0], B[1], 1],
    [C[0], C[1], 1]
])
area = 0.5 * abs(np.linalg.det(matrix))
print(f"Area of triangle ABC = {area:.2f}")
```

# Python code

```python
1  # Plot triangle
2  x_coords = [A[0], B[0], C[0], A[0]]
3  y_coords = [A[1], B[1], C[1], A[1]]
4
5  plt.plot(x_coords, y_coords, 'b-', label='Triangle ABC
      ')
6  plt.scatter([A[0], B[0], C[0]], [A[1], B[1], C[1]],
      color='red')
7
8  # Annotate points
9  labels = ['A(2,5)', 'B(4,7)', 'C(6,2)']
10 for (x, y), label in zip([A, B, C], labels):
11     plt.annotate(label, (x, y), textcoords="offset
          points", xytext=(5,5), ha='center')
```

# Python code(plots)

```
1 plt.title("Triangle ABC")
2 plt.xlabel("x")
3 plt.ylabel("y")
4 plt.grid(True)
5 plt.axis('equal')
6 plt.legend()
7 plt.savefig("triangle.png")
8 plt.show()
```
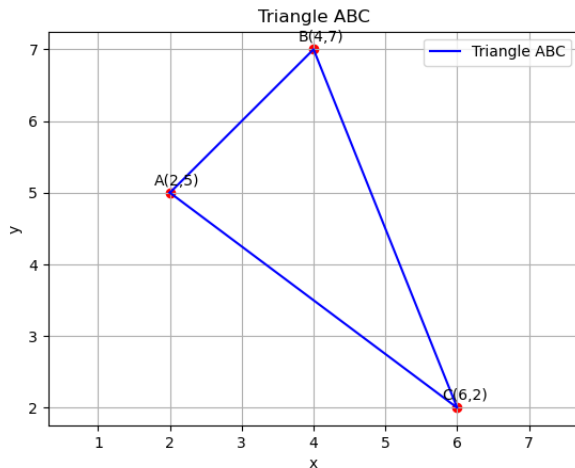
# Python Output and Plot



Figure: Triangle *ABC* with vertices A(2,5), B(4,7), C(6,2)