Construction of triangle

AI24BTECH11006 - Bugada Roopansha

IIT Hyderabad

November 6, 2024

Question

Construct a right triangle when one side is 3.5 cm, and the sum of the other side and the hypotenuse is 5.5 cm.

Solution: Parameters

Segment	**Norm**	**Angles**
$\|\|AB\|\|$	3.5	$\angle C$
$\|\|BC\|\|$	Distance between B and C	$\angle A = 90°$
$\|\|AC\|\|$	Distance between C and A	$\angle B$

Table: Input parameters

Solution:

Given:

$$c = 3.5\,\text{cm}, \quad a + b = 5.5\,\text{cm}, \quad \angle A = 90^\circ$$

Using the cosine formula in $\triangle ABC$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

$$\implies (5.5 - b)^2 = b^2 + c^2 - 2bc\cos A$$

Solution: Further Calculations

Expanding and solving the equation :

$$\implies b \approx 2.5cm$$

The coordinates of $\triangle ABC$ can then be expressed as:

$$C = b \begin{bmatrix} \sin A \\ \cos A \end{bmatrix}, \quad A = 0 \quad B = \begin{bmatrix} 0 \\ c \end{bmatrix}$$

C-Code

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

int main() {
    // Given values
    double a = 3.5;          // One side of the triangle
    double sum_bc = 5.5;     // Sum of the other side and the hypotenuse

    // Variables to hold the lengths of the other side and the hypotenuse
    double b, c;

    // Calculate the other side (b) and the hypotenuse (c)
    b = (pow(sum_bc, 2) - pow(a, 2)) / (2 * sum_bc);
    c = sum_bc - b;


```

C-Code

```
1       // Calculate the endpoints
2         double Ax = 0.0, Ay = 0.0;           // Vertex A
3         double Bx = 0.0, By = a;              // Vertex B
4         double Cx = b, Cy = 0.0;              // Vertex C
5
6         // Open a file for writing
7         FILE *file = fopen("data.txt", "w");
8         if (file == NULL) {
9             printf("Error opening file!\n");
10            return 1;
11        }
12
13        // Write the endpoints to the file
14        fprintf(file, "Endpoints of the triangle:\n");
15        fprintf(file, "A (0.00, 0.00)\n");
16        fprintf(file, "B (0.00, %.2f)\n", By);
17        fprintf(file, "C (%.3f, 0.00)\n", Cx);
18
19
```

C-Code

```
    // Close the file
      fclose(file);

      // Output to console (optional)
      printf("Endpoints saved to data.txt\n");
      printf("A (%.2f, %.2f)\n", Ax, Ay);
      printf("B (%.2f, %.2f)\n", Bx, By);
      printf("C (%.3f, %.2f)\n", Cx, Cy);

      return 0;
}
```

Python Code

```
1     import numpy as np
2   import matplotlib.pyplot as plt
3
4   # Function to read coordinates from 'data.txt'
5   def read_coordinates(filename='data.txt'):
6       coordinates = {}
7       with open(filename, 'r') as file:
8           for line in file:
9               line = line.strip()  # Remove any
                ↪  leading/trailing whitespace
10              if line:  # Skip empty lines
11                  try:
12                      point, coords = line.split(' ', 1)  #
                        ↪  Split into point and coordinates
13                      coords = coords.strip('()')  # Remove
                        ↪  parentheses
14                      x, y = map(float, coords.split(','))
                        ↪  # Split by ',' and convert to
                        ↪  floats
15
```

Python Code

```
1
2                           coordinates[point] = np.array([x,
                            ↪  y]).reshape(-1, 1)
3                       except ValueError as e:
4                           print(f"Error processing line:
                            ↪  {line}. Error: {e}")
5       return coordinates
6
7   # Read triangle vertices from 'data.txt'
8   vertices = read_coordinates()
9
10  # Check if vertices were read correctly
11  if not vertices:
12      print("No vertices found. Exiting.")
13      exit()
14
15  # Extract points A, B, and C from the vertices
16  A = vertices['A']
17  B = vertices['B']
```

Python Code

```
1
2   C = vertices['C']
3
4   # Function to generate the line between two points
5   def line_gen(P, Q):
6       return np.hstack((P, Q))
7
8   # Generate lines for the triangle sides
9   x_AB = line_gen(A, B)
10  x_BC = line_gen(B, C)
11  x_CA = line_gen(C, A)
12
13  # Plotting the triangle sides
14  plt.plot(x_AB[0, :], x_AB[1, :], label='AB')
15  plt.plot(x_BC[0, :], x_BC[1, :], label='BC')
16  plt.plot(x_CA[0, :], x_CA[1, :], label='CA')
17
```

Python Code

```
# Scatter plot of the vertices
plt.scatter(A[0], A[1], color='red', zorder=5)
plt.scatter(B[0], B[1], color='red', zorder=5)
plt.scatter(C[0], C[1], color='red', zorder=5)
# Label the vertices with coordinates
plt.text(A[0] + 0.1, A[1], f'A {A.flatten()}',
    ↪  fontsize=12, ha='center')
plt.text(B[0] + 0.1, B[1], f'B {B.flatten()}',
    ↪  fontsize=12, ha='center')
plt.text(C[0] + 0.1, C[1], f'C {C.flatten()}',
    ↪  fontsize=12, ha='center')
# Set equal scaling and labels
plt.axis('equal')
plt.xlabel('x')
plt.ylabel('y')
plt.grid(True)
plt.legend()
plt.title('Triangle ABC with Coordinates')
# Show the plot
plt.show()
```

Diagram

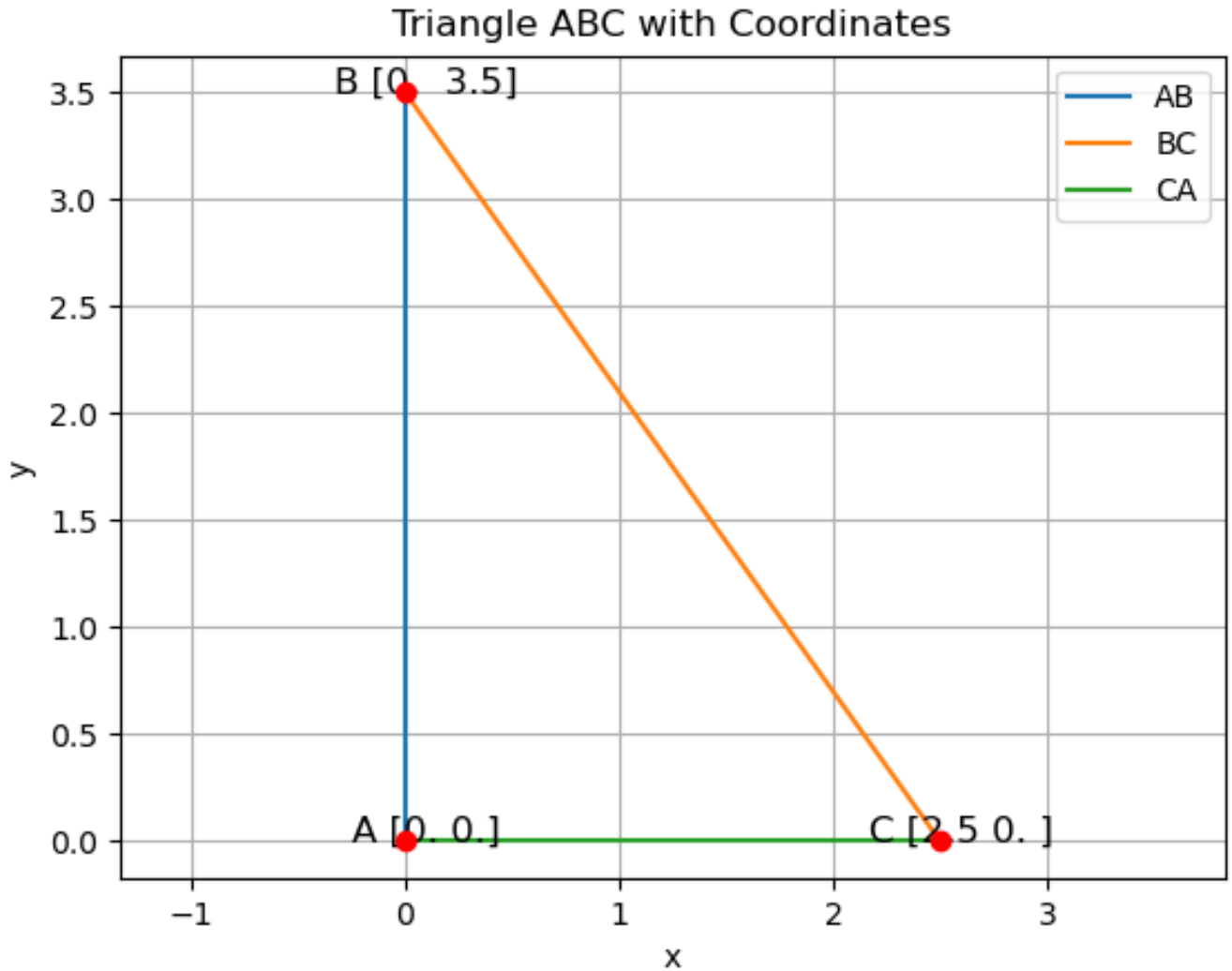

Figure: Right triangle with c= 3.5 cm , a+b= 5.5 cm and $\angle A = 90°$.