Problem 2.10.20.

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Question

Question: Construct a right triangle in which the sides, (other than the hypotenuse) are of length 6 cm and 8 cm.

Solution

Using the section formula, the midpoint **M** of the side BC is

$$\mathbf{M} = \frac{\mathbf{B} + \mathbf{C}}{2} = \frac{1}{2} \begin{bmatrix} -4 \\ 9 \end{bmatrix} + \frac{1}{2} \begin{bmatrix} -2 \\ -1 \end{bmatrix} = \begin{bmatrix} -3 \\ 4 \end{bmatrix}.$$

The median passes through points **A**$(2, 5)$ and **M**$(-3, 4)$. The direction vector is

$$\mathbf{d} = \mathbf{M} - \mathbf{A} = \begin{bmatrix} -3 - 2 \\ 4 - 5 \end{bmatrix} = \begin{bmatrix} -5 \\ -1 \end{bmatrix}.$$

Following the matrix approach:

$$\begin{pmatrix} -5 & -1 \end{pmatrix} \mathbf{x} = c,$$

where c is found by substituting point **A**$(2, 5)$:

$$-5 \times 2 - 1 \times 5 = -10 - 5 = -15.$$

Thus, the equation of the median is

$$-5x - y = -15,$$

Solution

or equivalently,

$$5x + y = 15.$$

Therefore, equation of required line is :

$$\boxed{5x + y = 15}$$
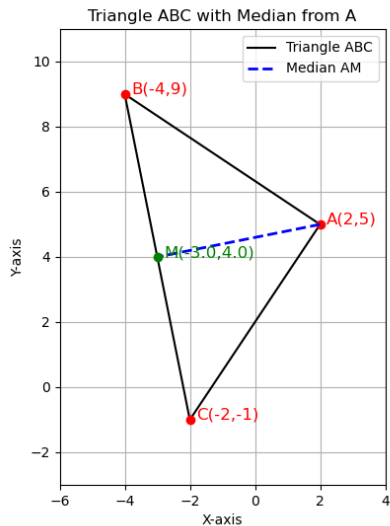
Graph

Figure: Vector Representation

C Code

```c
#include <stdio.h>
#include "trianglefun.h"

int main() {
    // Vertices of triangle
    int Ax = 2, Ay = 5;
    int Bx = -4, By = 9;
    int Cx = -2, Cy = -1;

    char equation[50];

    // Calculate the median equation and store as string
    median_equation(Ax, Ay, Bx, By, Cx, Cy, equation);

    // Print the equation
    printf("Equation of the median from A: %s\n", equation);

    return 0;
}
```

Python Code for Plotting

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

# Vertices of the triangle
A = np.array([2, 5])
B = np.array([-4, 9])
C = np.array([-2, -1])

# Calculate midpoint M of BC
M = (B + C) / 2

# Plot triangle
plt.figure(figsize=(6,6))
triangle_points = np.array([A, B, C, A])
plt.plot(triangle_points[:,0], triangle_points[:,1], 'k-', label=
    'Triangle ABC')

# Plot vertices
plt.plot(A[0], A[1], 'ro')
```

Python Code for Plotting

```python
plt.plot(B[0], B[1], 'ro')
plt.plot(C[0], C[1], 'ro')

# Label vertices
plt.text(A[0]+0.2, A[1], 'A(2,5)', fontsize=12, color='red')
plt.text(B[0]+0.2, B[1], 'B(-4,9)', fontsize=12, color='red')
plt.text(C[0]+0.2, C[1], 'C(-2,-1)', fontsize=12, color='red')

# Plot median from A to midpoint M
plt.plot([A[0], M[0]], [A[1], M[1]], 'b--', linewidth=2, label='
    Median AM')

# Label midpoint M
plt.plot(M[0], M[1], 'go')
plt.text(M[0]+0.2, M[1], f'M({M[0]:.1f},{M[1]:.1f})', fontsize
    =12, color='green')

# Position to place equation on the median line midpoint
mid_x = (A[0] + M[0]) / 2
```

Python Code for Plotting

```python
mid_y = (A[1] + M[1]) / 2

# Settings
plt.gca().set_aspect('equal', adjustable='box')
plt.grid(True)
plt.legend()
plt.title('Triangle ABC with Median from A')
plt.xlabel('X-axis')
plt.ylabel('Y-axis')
plt.xlim(-6, 4)
plt.ylim(-3, 11)

# Save the figure as PNG
filename = 'triangle_median_eqonline.png'
plt.savefig(filename)
plt.close()
```