4.3.50

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Question

Find the equation of the lines which makes intercepts -3 and 2 on the x and y axes respectively

solution

Given that line passes through points $(-3, 0)$ and $(0, 2)$
Let

Vector	*coordinate*
A	$(-3, 0)$
B	$(0, 2)$

As equation of line is given by

$$\mathbf{n}^\top \mathbf{x} = 1 \tag{1}$$

Solution

So, for **A**

$$\mathbf{n}^\top \begin{pmatrix} -3 \\ 0 \end{pmatrix} = 1 \tag{2}$$

for **B**

$$\mathbf{n}^\top \begin{pmatrix} 0 \\ 2 \end{pmatrix} = 1 \tag{3}$$

$$\tag{4}$$

Solution

From 2 and 3

$$\begin{pmatrix} -3 & 0 \\ 0 & 2 \end{pmatrix} \mathbf{n} = \begin{pmatrix} 1 \\ 1 \end{pmatrix} \tag{5}$$

In augmented matrix form

$$\left[\begin{array}{cc|c} -3 & 0 & 1 \\ 0 & 2 & 1 \end{array}\right] \tag{6}$$

Divide Row 1 by 3

$$\left[\begin{array}{cc|c} -1 & 0 & \frac{1}{3} \\ 0 & 2 & 1 \end{array}\right] \tag{7}$$

Solution

Divide Row 2 by 2

$$\left[\begin{array}{cc|c} -1 & 0 & \frac{1}{3} \\ 0 & 1 & \frac{1}{2} \end{array}\right] \tag{8}$$

$$\mathbf{n} = \begin{pmatrix} \frac{-1}{3} \\ \frac{1}{2} \end{pmatrix} \tag{9}$$

So from 1 Equation of line is $\begin{pmatrix} \frac{-1}{3} \\ \frac{1}{2} \end{pmatrix}$x=1

C Code

```c
#include <stdio.h>
int main() {
    // Given: line passes through A(-3, 0) and B(0, 2)
    float A[2] = {-3.0, 0.0};
    float B[2] = {0.0, 2.0};
    // We want to find normal vector n = (a, b) such that:
    // n^T * A = 1 => a*(-3) + b*0 = 1 => -3a = 1 => a = -1/3
    // n^T * B = 1 => a*0 + b*2 = 1 => 2b = 1 => b = 1/2
    float a = -1.0 / 3.0;
    float b = 1.0 / 2.0;
```

C Code

```
printf("Given Points:\n");
    printf("A = (%.1f, %.1f)\n", A[0], A[1]);
    printf("B = (%.1f, %.1f)\n\n", B[0], B[1]);
    printf("Normal Vector n = (a, b) = (%.2f, %.2f)\n", a, b);
    // Equation of line in dot product form: a*x + b*y = 1
    printf("\nEquation of line in dot product form:\n");
    printf("%.2fx + %.2fy = 1\n", a, b);
    // Convert to standard form: Multiply both sides by LCM(3,2)
        = 6
    // Original: -x/3 + y/2 = 1
    // Multiply by 6: -2x + 3y = 6 --> Standard form: 2x - 3y + 6
        = 0
```

C Code

```c
int A_coeff = 2;
    int B_coeff = -3;
    int C_coeff = 6;
    printf("\nEquation of line in standard form:\n");
    printf("%dx ", A_coeff);
    if (B_coeff < 0)
        printf("- %dy ", -B_coeff);
    else
        printf("+ %dy ", B_coeff);
    if (C_coeff < 0)
        printf("- %d = 0\n", -C_coeff);
    else
        printf("+ %d = 0\n", C_coeff);
    return 0;
}
```

Python Code

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

# Line equation: -2x + 3y = 6
# Solve for y: y = (2x + 6)/3

# Define x values for plotting
x = np.linspace(-10, 10, 400)
y = (2 * x + 6) / 3

# Find intercepts
# X-intercept: set y = 0  -2x = 6  x = -3  A = (-3, 0)
# Y-intercept: set x = 0  3y = 6  y = 2  B = (0, 2)
A = (-3, 0)
B = (0, 2)
```

Python Code

```
  # Plot the line
plt.plot(x, y, label='Line: -2x + 3y = 6', color='blue')

# Mark the intercepts
plt.scatter(*A, color='red', zorder=5)
plt.scatter(*B, color='green', zorder=5)

# Annotate the points
plt.text(A[0]-1, A[1]-0.5, f'A {A}', color='red', fontsize=12)
plt.text(B[0]+0.2, B[1]+0.2, f'B {B}', color='green', fontsize
    =12)

# Axes lines
plt.axhline(0, color='black', linewidth=1)
plt.axvline(0, color='black', linewidth=1)
```

Python Code

```
# Graph settings
plt.title('Graph of the Line -2x + 3y = 6')
plt.xlabel('x-axis')
plt.ylabel('y-axis')
plt.grid(True)
plt.legend()
plt.axis('equal')
plt.xlim(-10, 10)
plt.ylim(-10, 10)

# Show the plot
plt.show()
```

C and Python Code

```
 import ctypes
import os

# Load the shared object file
lib_path = os.path.abspath("liblineeq.so")
lib = ctypes.CDLL(lib_path)

# Define the function's argument types
lib.line_from_intercepts.argtypes = [ctypes.c_double, ctypes.
    c_double]

# Optional: Define the return type (void function, so None)
lib.line_from_intercepts.restype = None
```

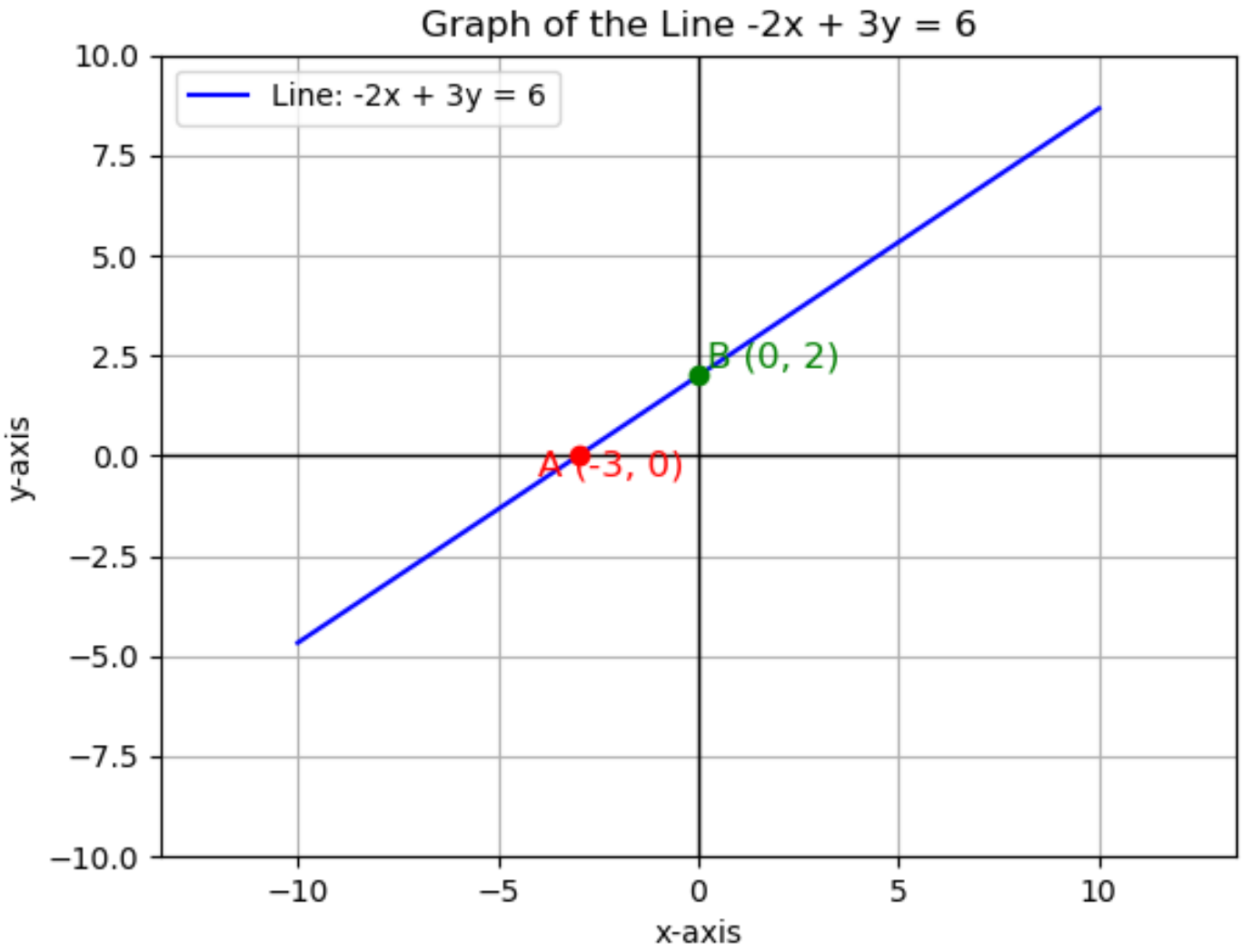
C and Python Code

```
 # Example intercepts
x_intercept = -3.0
y_intercept = 2.0

print("Calling C function from Python with:")
print(f" X-intercept = {x_intercept}")
print(f" Y-intercept = {y_intercept}\n")

# Call the function
lib.line_from_intercepts(x_intercept, y_intercept)
```

Plot


Graph of the Line -2x + 3y = 6
Line: -2x + 3y = 6
B (0, 2)
A (-3, 0)
y-axis
x-axis
10.0
7.5
5.0
2.5
0.0
−2.5
−5.0
−7.5
−10.0
−10
−5
0
5
10