Problem 4.12.49

Sujal Rajani

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Question

QUESTION

The planes $2x - y + 4z = 5$ and $5x - 2.5y + 10z = 6$ are

(a) Perpendicular

(b) Parallel

(c) intersect y axis

(d) pass through (0,0,5/4)

Solution

SOLUTION

we are rewritting the equation of the planes :

$$2x - y + 4z = 5, c_1 = 5; 2x - y + 4z = 2.4, c_2 = 2.4.$$

there normal vectors are same . so we are taking n_1 as normal vector of the planes .

$$\mathbf{n_1} = \begin{pmatrix} 2 \\ -1 \\ 4 \end{pmatrix}$$

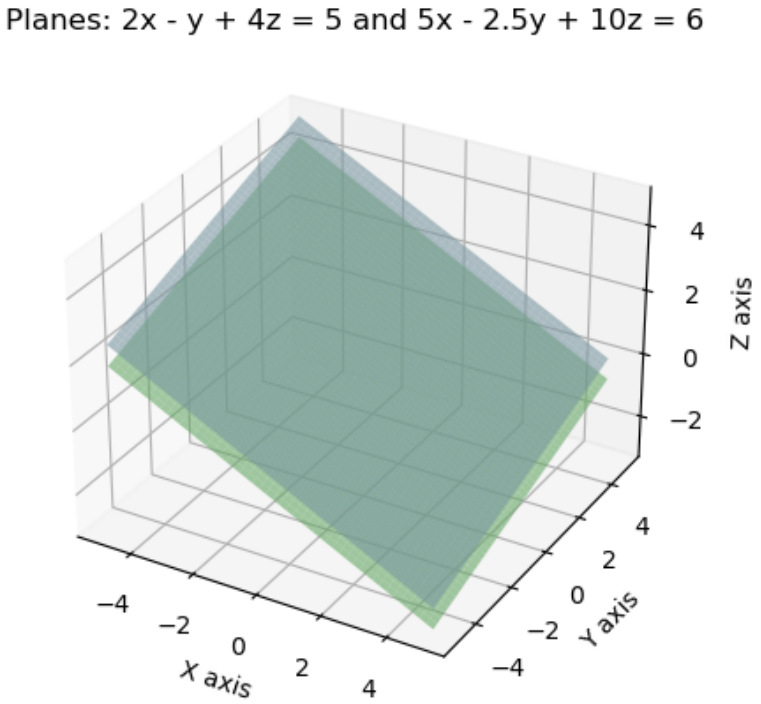
as the value of c_1 and c_2 is different and normal vector same means they are different plane but are parallel to each other .

solution

yes they are intersecting y axis:

$$x_1 = 0, z_1 = 0, y_1 = -5.$$
$$x_2 = 0, z_2 = 0, y_2 = -2.4.$$

plane $2x - y + 4z = 5$ is satisfying the point (0,0,5/4).
plane $2x - y + 4z = 2.4$ is not satisfying the point (0,0,5/4)


Planes: 2x - y + 4z = 5 and 5x - 2.5y + 10z = 6
X axis
Y axis
Z axis
−4
−2
0
2
4
−4
−2
0
2
4
4
2
0
−2

C Code

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

int main() {
    // Coordinates for A, B
    int x1 = 1, y1 = 3;
    int x2 = 0, y2 = 0;

    // Calculate slope and intercept
    float m = (float)(y2 - y1) / (x2 - x1); // Slope
    float c = y1 - m * x1; // Intercept
    printf("Equation of line AB: y = %.2fx + %.2f\n", m, c);
```

C Code

```c
    // Area of triangle formula in coordinates:
    // Area = (1/2) * |x1(y2-y3) + x2(y3-y1) + x3(y1-y2)|
    // Let D(k,0) = (x3, y3)
    int y3 = 0;
    float area_target = 3.0;
    // Substitute:
    // area = 0.5 * |1*(0-0) + 0*(0-3) + k*(3-0)|
    // = 0.5 * |3*k|
    // Set 0.5 * |3*k| = 3 => |k| = 2
    float k1 = 2.0, k2 = -2.0;

    printf("Possible values of k for D(k,0): %.2f and %.2f\n", k1
        , k2);

    return 0;
}
```

Python Code for Plotting

```
import numpy as np
import matplotlib.pyplot as plt
from line.funcs import *
# from triangle.funcs import *
# from conics.funcs import circ_gen
# if using termux
import subprocess
import shlex
# end if
```

Python Code for Plotting

```
# Triangle vertices
A = np.array([1,3]).reshape(-1,1)
B = np.array([0,0]).reshape(-1,1)
D = np.array([2,0]).reshape(-1,1)
D' = np.array([-2,0]).reshape(-1,1
coords = np.block([[A,B,D,D']])
# Generate triangle sides
AB = line_gen(A,B)
BD = line_gen(B,D)
DA = line_gen(D,A)
BD' = line_gen(B,D')
D'A = line_gen(D',A)
```

Python Code for Plotting

```
# Plot sides
plt.plot(AB[0,:],AB[1,:], label='AB')
plt.plot(BD[0,:],BD[1,:], label='BD')
plt.plot(DA[0,:],DA[1,:], label='DA')
plt.plot(BD'[0,:],BD'[1,:], label='BD'')
plt.plot(D'A[0,:],D'A[1,:], label='D'A)
```

Python Code for Plotting

```
# Scatter vertices
plt.scatter(coords[0,:],coords[1,:])
plt.text(A[0],A[1],"A(1,3)")
plt.text(B[0],B[1],"B(0,0)")
plt.text(D[0],D[1],"D(2,0)")
plt.text(D'[0],D'[1],"D'(-2,0)")
# Styling
plt.xlabel('$x$')
plt.ylabel('$y$')
plt.legend(loc='best')
plt.grid(True)
plt.axis('equal')

plt.savefig('../figs/triangle.png')
plt.show()
```