# 4.10.22

EE25BTECH11020 - Darsh Pankaj Gajare

Question:
Find the equation of the plane through the intersection of the planes $\mathbf{r}\cdot\left(\hat{i}+3\hat{j}\right)-6=0$ and $\mathbf{r}\cdot\left(3\hat{i}-\hat{j}-4\hat{k}\right)=0$,whose perpendicular distance from origin is unity.
**Solution:**

TABLE I

| | |
|---|---|
| $\mathbf{n_1}$ | $\begin{pmatrix}1\\3\\0\end{pmatrix}$ |
| $\mathbf{n_1}$ | $\begin{pmatrix}3\\-1\\-4\end{pmatrix}$ |

**Solution:** The given planes are

$$\mathbf{x}^\top\mathbf{n}_1-6=0 \tag{1}$$
$$\mathbf{x}^\top\mathbf{n}_2=0 \tag{2}$$

Let the required plane be

$$\mathbf{x}^\top\left(\mathbf{n}_1+\lambda\mathbf{n}_2\right)-6=0 \tag{3}$$

the normal vector is

$$\mathbf{n}=\mathbf{n}_1+\lambda\mathbf{n}_2 \tag{4}$$

$$\|\mathbf{n}\|^2=\mathbf{n}^\top\mathbf{n}=\mathbf{n}_1^\top\mathbf{n}_1+2\lambda\mathbf{n}_1^\top\mathbf{n}_2+\lambda^2\mathbf{n}_2^\top\mathbf{n}_2 \tag{5}$$

Perpendicular distance from origin is

$$\frac{|-6|}{\|\mathbf{n}\|}=1 \tag{6}$$
$$\|\mathbf{n}\|=6 \tag{7}$$

Hence,

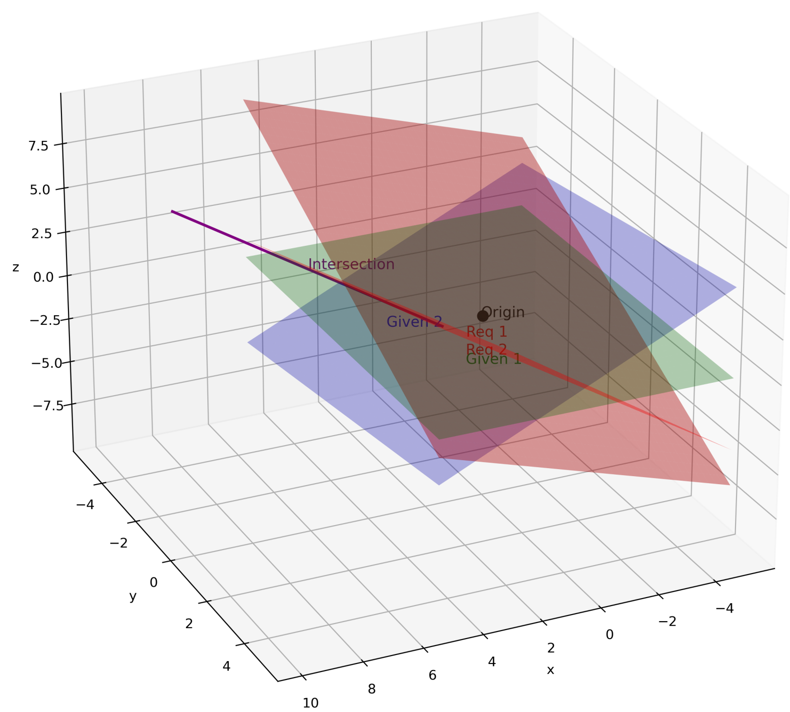
$$\mathbf{n}_1^\top\mathbf{n}_1+2\lambda\mathbf{n}_1^\top\mathbf{n}_2+\lambda^2\mathbf{n}_2^\top\mathbf{n}_2=36 \tag{8}$$

$$10+26\lambda^2=36 \tag{9}$$
$$\lambda=\pm1 \tag{10}$$

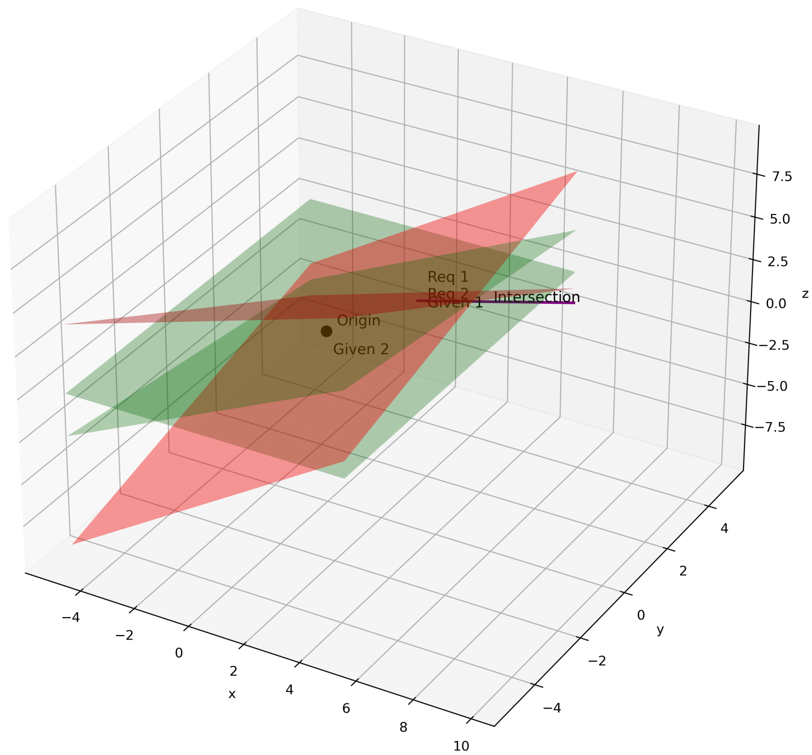
Thus, the required planes are

$$\begin{pmatrix}2\\1\\-2\end{pmatrix}^\top\mathbf{x}=3 \tag{11}$$
$$\begin{pmatrix}1\\-2\\-2\end{pmatrix}^\top\mathbf{x}=-3 \tag{12}$$

Plot using C libraries:




Plot using Python:


Req 1
Req 2
Given 1
Intersection
Origin
Given 2
x
y
z
−4
−2
0
2
4
6
8
10
7.5
5.0
2.5
0.0
−2.5
−5.0
−7.5