1.11.13

AI25BTECH11011-VARUN

October 6, 2025

Question

If a line makes angles 90°,135°,45° with the x, y and z axes respectively,find its direction cosines.

Theoretical Solution

The direction cosines of a vector **A** making α, β and γ angles with x,y and z axes respectively is,

$$\mathbf{A} = \begin{pmatrix} \cos\alpha \\ \cos\beta \\ \cos\gamma \end{pmatrix} \tag{1}$$

Then, the direction vector is,

$$\mathbf{A} = \begin{pmatrix} \cos 90^\circ \\ \cos 135^\circ \\ \cos 45^\circ \end{pmatrix} \tag{2}$$

$$\mathbf{A} = \begin{pmatrix} 0 \\ -\frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{pmatrix} \tag{3}$$

main C Code

```c
#include <stdio.h>

void find_direction_cosines(int alpha_deg, int beta_deg, int
    gamma_deg, double *l, double *m, double *n);

int main(){
    double l, m, n;
    find_direction_cosines(90, 135, 45, &l, &m, &n);
    printf("Direction cosines:\nl = %.4lf\nm = %.4lf\nn = %.4lf\n
        ", l, m, n);
    return 0;
}
```

C Code

```c
#include <math.h>

double degree(int n){
    double d = (n * M_PI) / 180;
    return d;
}

void find_direction_cosines(int alpha_deg, int beta_deg, int
    gamma_deg, double *l, double *m, double *n) {
    *l = cos(degree(alpha_deg));
    *m = cos(degree(beta_deg));
    *n = cos(degree(gamma_deg));
}
```

Python Code

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

lib = ctypes.CDLL('./libdirection.so')
lib.find_direction_cosines.argtypes = [
    ctypes.c_int, ctypes.c_int, ctypes.c_int,
    ctypes.POINTER(ctypes.c_double), ctypes.POINTER(ctypes.
        c_double), ctypes.POINTER(ctypes.c_double)
]

l = ctypes.c_double()
m = ctypes.c_double()
n = ctypes.c_double()

lib.find_direction_cosines(90, 135, 45, ctypes.byref(l), ctypes.
    byref(m), ctypes.byref(n))
```

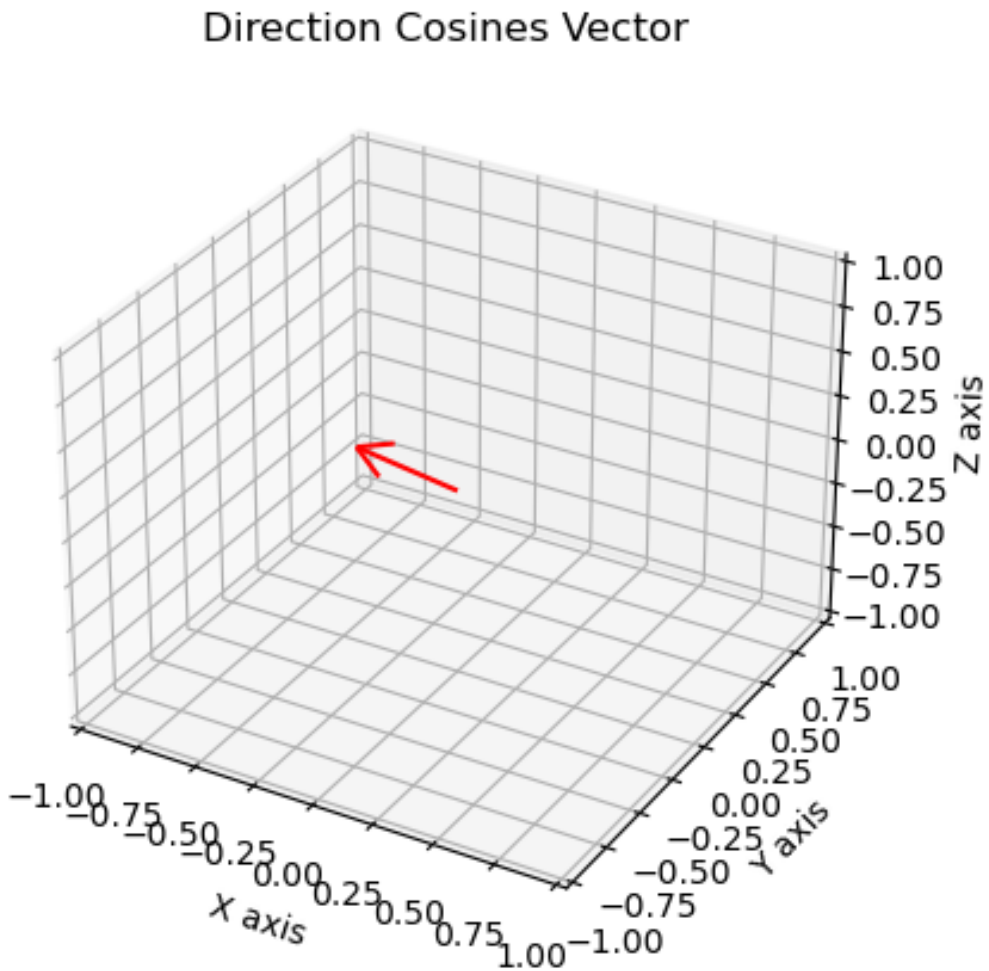
Python Code

```
print(f"Direction cosines:\nl = {l.value}\nm = {m.value}\nn = {n.
    value}")

fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')

origin = np.array([0, 0, 0])
vector = np.array([l.value, m.value, n.value])

ax.quiver(origin[0], origin[1], origin[2],
          vector[0], vector[1], vector[2],
          length=1, normalize=True, color='red')
ax.set_xlim([-1, 1])
ax.set_ylim([-1, 1])
ax.set_zlim([-1, 1])
ax.set_xlabel('X axis')
ax.set_ylabel('Y axis')
ax.set_zlabel('Z axis')
```

Python Code

```
ax.set_title('Direction Cosines Vector')
plt.savefig("/home/gara-varun-kumar/ee1030-2025/ai25btech11011/
    matgeo/1.11.13/figs/Fig 1.png")
plt.show()
```

Plot


Direction Cosines Vector
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
Z axis
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
Y axis
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
X axis