

1.4.21

EE25BTECH11006 - ADUDOTLA SRIVIDYA

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Question

Find the coordinates of the point which divides the line segment joining $(1, -2, 3)$, $(3, 4, -5)$ in the ratio

- ☐ 2 : 3 internally
- ☐ 2 : 3 externally

Given Information

Given vector A:

$$\begin{pmatrix} 1 \\ -2 \\ 3 \end{pmatrix} \quad (1)$$

Given vector B:

$$\begin{pmatrix} 3 \\ 4 \\ -5 \end{pmatrix} \quad (2)$$

Required Formulae

Internal division:

$$\mathbf{P} = \frac{kB + A}{k + 1} \quad (3)$$

External division:

$$\mathbf{Q} = \frac{kB - A}{k - 1} \quad (4)$$

$$\mathbf{P} = \frac{\frac{2}{3} \begin{pmatrix} 3 \\ 4 \\ -5 \end{pmatrix} + \begin{pmatrix} 1 \\ -2 \\ 3 \end{pmatrix}}{\frac{5}{3}} \quad (5)$$

$$\mathbf{P} = \frac{\begin{pmatrix} 2 \\ 8 \\ 3 \\ -10 \\ 3 \end{pmatrix} + \begin{pmatrix} 1 \\ -2 \\ 3 \end{pmatrix}}{\frac{5}{3}} = \frac{\begin{pmatrix} 3 \\ 2 \\ 3 \\ -1 \\ 3 \end{pmatrix}}{\frac{5}{3}} = \begin{pmatrix} \frac{9}{5} \\ \frac{2}{5} \\ \frac{3}{5} \\ \frac{-1}{5} \\ \frac{3}{5} \end{pmatrix} \quad (6)$$

$$\mathbf{Q} = \frac{\frac{2}{3} \begin{pmatrix} 3 \\ 4 \\ -5 \end{pmatrix} - \begin{pmatrix} 1 \\ -2 \\ 3 \end{pmatrix}}{\frac{5}{3}} \quad (7)$$

$$\mathbf{Q} = \frac{\begin{pmatrix} 2 \\ 8 \\ 3 \\ -10 \\ 3 \end{pmatrix} - \begin{pmatrix} 1 \\ -2 \\ 3 \end{pmatrix}}{\frac{-1}{3}} = \frac{\begin{pmatrix} 1 \\ 14 \\ 3 \\ -19 \\ 3 \end{pmatrix}}{\frac{-1}{3}} = \begin{pmatrix} -3 \\ -14 \\ 19 \end{pmatrix} \quad (8)$$

Python Code-Plot

```
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
A = (1, -2, 3)
B = (3, 4, -5)
P = (
    (2*B[0] + 3*A[0]) / 5,
    (2*B[1] + 3*A[1]) / 5,
    (2*B[2] + 3*A[2]) / 5
)
Q = (
    (2*B[0] - 3*A[0]) / (2-3),
    (2*B[1] - 3*A[1]) / (2-3),
    (2*B[2] - 3*A[2]) / (2-3)
)
print("Internal Division Point:", P)
print("External Division Point:", Q)
```

Python Code-Plot

```
fig = plt.figure(figsize=(8,8))
ax = fig.add_subplot(111, projection='3d')
ax.plot([A[0], B[0]], [A[1], B[1]], [A[2], B[2]], color='blue')
def plot_point(pt, label, color):
    ax.scatter(*pt, color=color, s=60)
    ax.text(pt[0], pt[1], pt[2], f"{label}{pt}", fontsize=10)
plot_point(A, "A", "red")
plot_point(B, "B", "red")
plot_point(P, "P", "green")
plot_point(Q, "Q", "purple")
ax.set_xlabel('X-axis')
ax.set_ylabel('Y-axis')
ax.set_zlabel('Z-axis')
ax.set_title('3D Division of Line Segment')
```


Python Code-Plot

```
ax.set_xlim(-4, 4)
ax.set_ylim(-15, 5)
ax.set_zlim(-5, 19)

plt.savefig("Figs/graph.png")
plt.show()
```

Python ctypes Call

```
import ctypes

lib = ctypes.CDLL('./mat1.so')

lib.sectionFormula.argtypes = [
    ctypes.POINTER(ctypes.c_float),
    ctypes.POINTER(ctypes.c_float),
    ctypes.c_float,
    ctypes.c_float,
    ctypes.POINTER(ctypes.c_float)
]
```

Python ctypes Call

```
lib.sectionFormula.restype = None
lib.sectionFormulaExternal.argtypes = [
    ctypes.POINTER(ctypes.c_float),
    ctypes.POINTER(ctypes.c_float),
    ctypes.c_float,
    ctypes.c_float,
    ctypes.POINTER(ctypes.c_float)
]
lib.sectionFormulaExternal.restype = None
p1 = (ctypes.c_float * 3)(1.0, -2.0, 3.0)
p2 = (ctypes.c_float * 3)(3.0, 4.0, -5.0)
res_internal = (ctypes.c_float * 3)()
res_external = (ctypes.c_float * 3)()
m = 2.0
n = 3.0
```

Python ctypes Call

```
1 lib.sectionFormula(p1, p2, m, n, res_internal)
2 lib.sectionFormulaExternal(p1, p2, m, n, res_external)
3
4 print("Internal division (2:3): [{:.2f}, {:.2f}, {:.2f}]"
5       .format(
6         res_internal[0], res_internal[1], res_internal[2]
7       ))
8
9 print("External division (2:3): [{:.2f}, {:.2f}, {:.2f}]"
10      .format(
11        res_external[0], res_external[1], res_external[2]
12      ))
```

```
void sectionFormula(float p1[3], float p2[3], float m, float n,
float res[3]) {
    res[0] = (m * p2[0] + n * p1[0]) / (m + n);
    res[1] = (m * p2[1] + n * p1[1]) / (m + n);
    res[2] = (m * p2[2] + n * p1[2]) / (m + n);
}

void sectionFormulaExternal(float p1[3], float p2[3], float m,
float n, float res[3]) {
    res[0] = (m * p2[0] - n * p1[0]) / (m - n);
    res[1] = (m * p2[1] - n * p1[1]) / (m - n);
    res[2] = (m * p2[2] - n * p1[2]) / (m - n);
}
```

3D Division of Line Segment

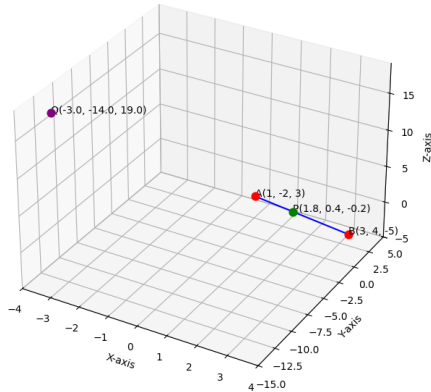


Figure: 3D Plot of points A, B, P, Q