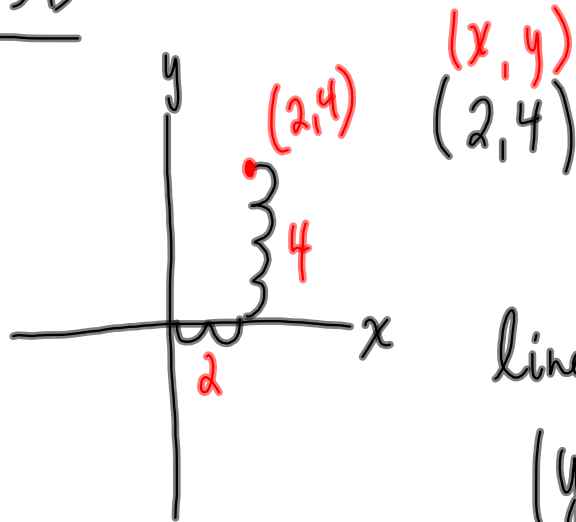


Graphing in 3D

Recall 2D:

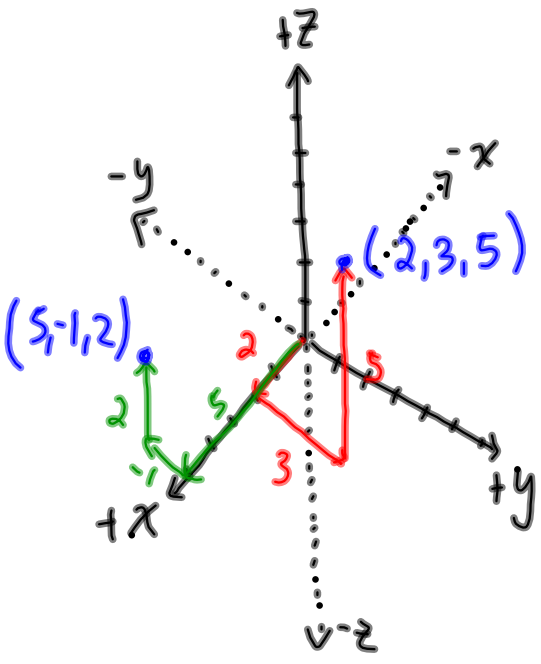


linear equation

$$(y = mx + b)$$

↑ slope  
↑ y-int.  
 $\left(\frac{\Delta y}{\Delta x}\right)$

Now consider 3D:



Plot  $(x, y, z)$   
 $(2, 3, 5)$  ← ordered triplet

$$(5, -1, 2)$$

$$z = ax + by + c$$

↑ x-slope    ↑ y-slope  
↑ z-int.  
(slope intercept form of a plane)

\* need to have 3 pts to find the equation of the plane.

Example - sketch  $2x + 3y - 4z = 24$

Find the  $x$ ,  $y$ , and  $z$  intercepts.

$x$  intercept  
( $y=0, z=0$ )

$$2x + 3y - 4z = 24$$

$$2x + 3(\cancel{0}) - 4(\cancel{0}) = 24$$

$$\frac{2x}{2} = \frac{24}{2}$$

$$\boxed{x = 12}$$

$y$  intercept  
( $x=0, z=0$ )

$$2x + 3y - 4z = 24$$

$$2(\cancel{0}) + 3y - 4(\cancel{0}) = 24$$

$$\frac{3y}{3} = \frac{24}{3}$$

$$\boxed{y = 8}$$

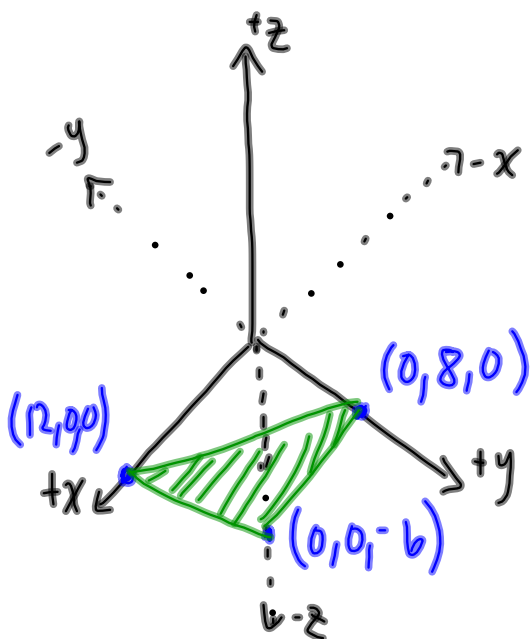
$z$  intercept  
( $x=0, y=0$ )

$$2x + 3y - 4z = 24$$

$$2(\cancel{0}) + 3(\cancel{0}) - 4z = 24$$

$$\frac{-4z}{-4} = \frac{24}{-4}$$

$$\boxed{z = -6}$$



Example - Sketch  $2x + 3y = 12 - 4z$

x-intercept  
(y=0, z=0)

$$2x + 3y = 12 - 4z$$

$$2x + 3(0) = 12 - 4(0)$$

$$2x = 12$$

$$\boxed{x=6}$$

y-intercept  
(x=0, z=0)

$$2x + 3y = 12 - 4z$$

$$2(0) + 3y = 12 - 4(0)$$

$$3y = 12$$

$$\boxed{y=4}$$

z-intercept  
(x=0, y=0)

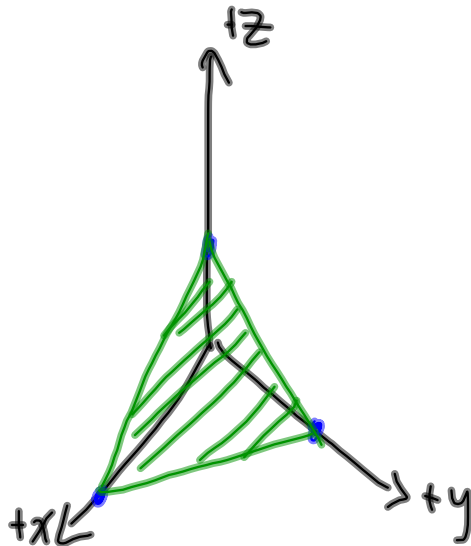
$$2x + 3y = 12 - 4z$$

$$2(0) + 3(0) = 12 - 4z$$

$$0 = 12 - 4z$$

$$4z = 12$$

$$\boxed{z=3}$$



Find the equation of a plane given 3 points:

$(2, 3, 8), (0, 5, 10), (0, 2, 0)$  ← NOTE: You need 3 pts to find the equation of a plane.

x, y, z

Slope-intercept form:  $z = ax + by + c$

$(2, 3, 8)$      $8 = a(2) + b(3) + c \Rightarrow 2a + 3b + c = 8$

$(0, 5, 10)$      $10 = a(0) + b(5) + c \Rightarrow 5b + c = 10$

$(0, 2, 0)$      $0 = a(0) + b(2) + c \Rightarrow 2b + c = 0$

Using Matrices:

$$\begin{bmatrix} 2 & 3 & 1 \\ 0 & 5 & 1 \\ 0 & 2 & 1 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 8 \\ 10 \\ 0 \end{bmatrix}$$

```
[[2.333333333 ]
 [3.333333333 ]
 [-6.666666667]]
Ans+Frac
[[7/3 ]
 [10/3 ]
 [-20/3]]
```

$Ax = B$

$X = A^{-1}B$

$$\begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 7/3 \\ 10/3 \\ -20/3 \end{bmatrix}$$

The equation of the plane is:

$z = ax + by + c$

$z = \frac{7}{3}x + \frac{10}{3}y - \frac{20}{3}$