4.2.23

EE25BTECH11020 - Darsh Pankaj Gajare

September 21, 2025

Question:
Show that two lines $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ where $b_1b_2 \neq 0$ are perpendicular if $a_1a_2 - b_1b_2 = 0$.
Solution:

Table

$\mathbf{n_1}$	$\begin{pmatrix} a_1 \\ b_1 \end{pmatrix}$
$\mathbf{n_2}$	$\begin{pmatrix} a_2 \\ b_2 \end{pmatrix}$

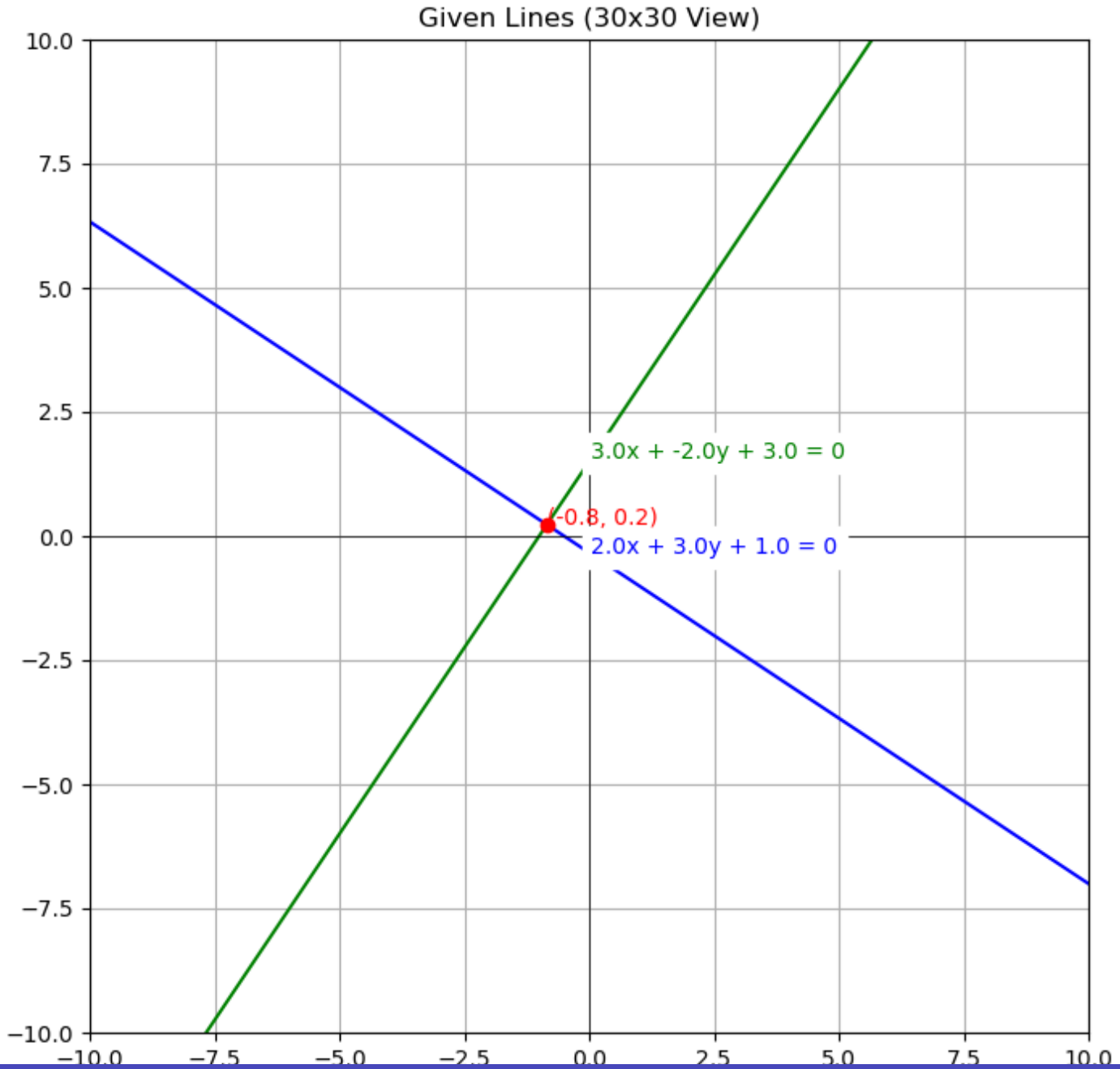
For the lines to be perpendicular, their normals must be orthogonal:

$$\mathbf{n_1}^\top \mathbf{n_2} = 0 \tag{0.1}$$

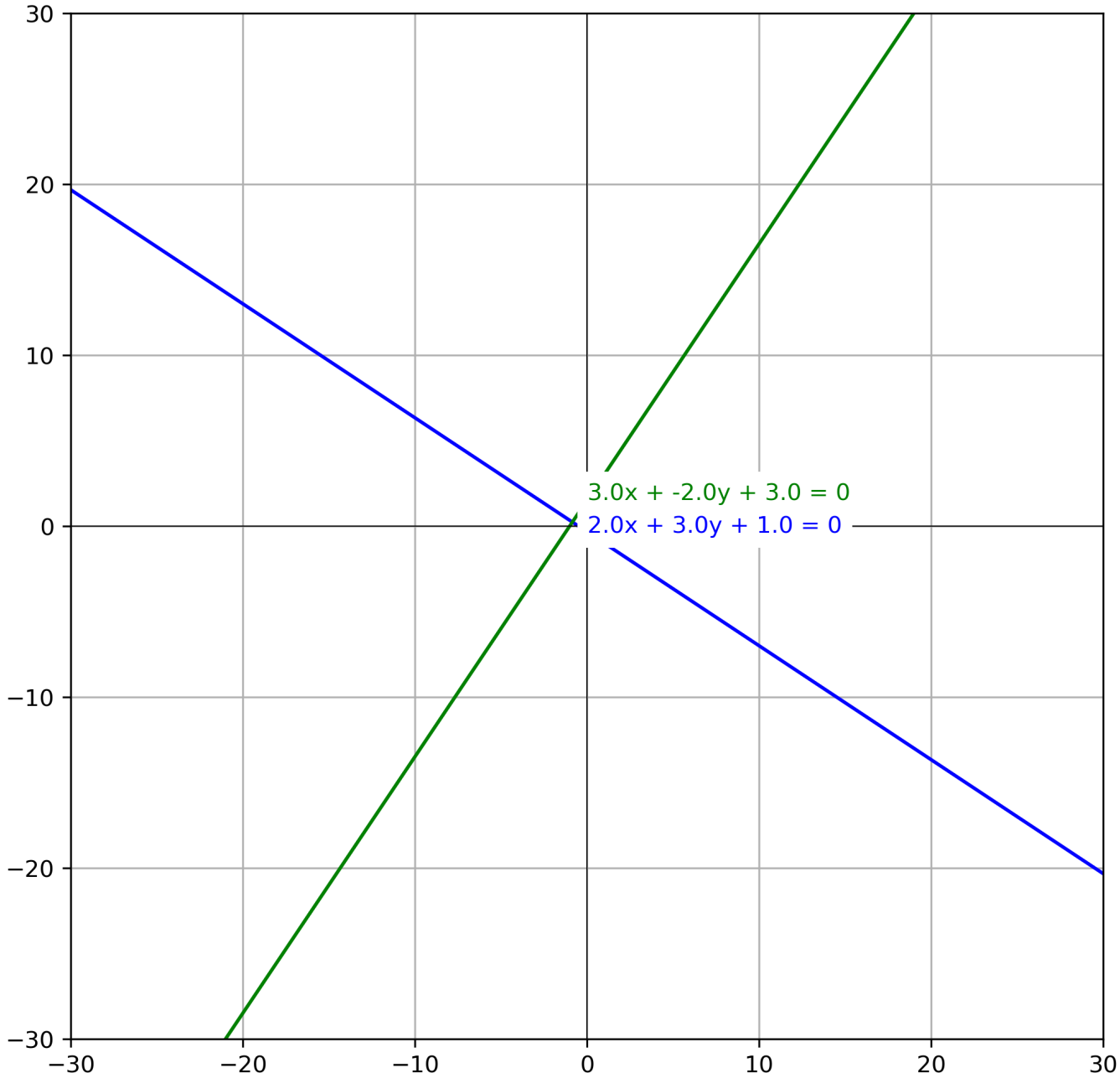
Evaluating the product,

$$\begin{pmatrix} a_1 & b_1 \end{pmatrix} \begin{pmatrix} a_2 \\ b_2 \end{pmatrix} = 0 \tag{0.2}$$

Example: Let us assume the values $a_1 = 2$, $a_2 = 3$, $b_1 = 3$, $b_2 = 2$, $c_1 = 2$ and $c_2 = 3$ Plot using C libraries:


Given Lines (30x30 View)
10.0
7.5
5.0
2.5
0.0
−2.5
−5.0
−7.5
−10.0
−10.0
−7.5
−5.0
−2.5
0.0
2.5
5.0
7.5
10.0
3.0x + -2.0y + 3.0 = 0
(-0.8, 0.2)
2.0x + 3.0y + 1.0 = 0

Plot using Python:


3.0x + -2.0y + 3.0 = 0
2.0x + 3.0y + 1.0 = 0
30
20
10
0
−10
−20
−30
−30
−20
−10
0
10
20
30