

1-1.6-25

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Question: Three points $\mathbf{P}(h \ k)$, $\mathbf{Q}(x_1 \ y_1)$ and $\mathbf{R}(x_2 \ y_2)$ lie on a line. Show that

$$\frac{h - x_1}{y_2 - y_1} = \frac{k - y_1}{x_2 - x_1}$$

Solution: Given:

Point	x	y
P	h	k
Q	x_1	y_1
R	x_2	y_2

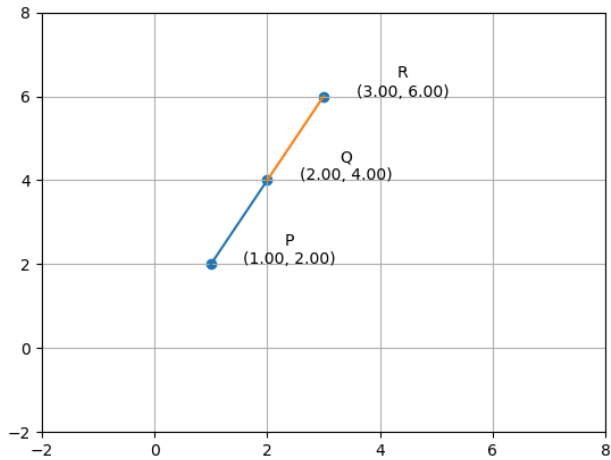
Since the points P, Q, R are collinear, The matrix $(P - Q \ R - Q)$ must have rank 1.

$$(P - Q \ R - Q)^T = \begin{pmatrix} h - x_1 & x_2 - x_1 \\ y - y_1 & y_2 - y_1 \end{pmatrix}$$

$$\begin{aligned} \text{Using } R_2 &\leftarrow R_2 - \frac{k - y_1}{h - x_1} R_1 \\ &= \begin{pmatrix} h - x_1 & x_2 - x_1 \\ 0 & y_2 - y_1 - \frac{(k - y_1)(x_2 - x_1)}{h - x_1} \end{pmatrix} \end{aligned}$$

Since matrix has rank 1, we can say

$$\begin{aligned} y_2 - y_1 - \frac{(k - y_1)(x_2 - x_1)}{h - x_1} &= 0 \\ \frac{h - x_1}{y_2 - y_1} &= \frac{k - y_1}{x_2 - x_1} \end{aligned}$$



Console Output:

```
/mnt/D/C1/EE1030/Question_3/Codes$ python3 main.py
```

Taking point P to be:

```
[[1.]
```

```
[2.]]
```

Taking point Q to be:

```
[[2.]
```

```
[4.]]
```

Taking point R to be:

```
[[3.]
```

```
[6.]]
```

Calculated LHS to be: 2.0

Calculated RHS to be: 2.0

Code for this plot can be found at:

Codes/main.py

Codes/main.c