· Find $q_1, q_2, q_3$ (orthonormal)
from $a, b, c$ (columns of $A$).
Then write $A$ as $QR$
($Q$ orthogonal, $R$ upper triangular)

$$A = \begin{array}{c} \begin{array}{ccc} a & b & c \end{array} \\ \begin{bmatrix} 1 & 2 & 4 \\ 0 & 0 & 5 \\ 0 & 3 & 6 \end{bmatrix} \end{array}$$

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→ Take $q_1$ (Start with $a$ and make it orthonormal to $q_1$)

i.

$\Rightarrow q_1 = \frac{a}{1} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$ $a = 1 q_1$

→ $q_2$: (Need to subtract projection

of b onto $q_1$)

$3q_2$ $\qquad 2$

$$q_2 = b - \frac{(b \cdot q_1)\, q_1}{\|q_1\| = 1}$$

$$q_2' = \begin{bmatrix} 2 \\ 0 \\ 3 \end{bmatrix} - 2\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 3 \end{bmatrix}$$

- why $q_2'$ => because even though

dot product of $\begin{bmatrix} 0 \\ 0 \\ 3 \end{bmatrix}$ & $\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} = [0]$

length is not $= \underline{1}$

$$\therefore\ q_2 = \frac{q_2}{3} = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

$$\overset{5q_3}{q_3'} = c - \overset{4}{(c \cdot q_1)}\, q_1 - \overset{6}{(c \cdot q_2)}\, q_2$$

$$= \begin{bmatrix} 4 \\ 5 \\ 6 \end{bmatrix} - 4\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} - 6\begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} 0 \\ 5 \\ 0 \end{bmatrix}$$

$$q_3 = \frac{q_3'}{\|q_3'\|} = \frac{q_3'}{5} = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$$

②

$$A = Q\, R$$

upper trianguler

$$\begin{bmatrix} 1 & 2 & 4 \\ 0 & 0 & 5 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 2 & 4 \\ 0 & 3 & 6 \end{bmatrix}$$

$$\begin{bmatrix} 0 & 3 & 6 \end{bmatrix} \begin{bmatrix} 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} 0 & 0 & 5 \end{bmatrix}$$

$$\begin{array}{ccc} a & b & c \end{array} \qquad \begin{array}{ccc} q_1 & q_2 & q_3 \end{array}$$

$$\left.\begin{aligned} -a &= 1q_1 + 0q_2 + 0q_3 \\ -b &= 2q_1 + 3q_2 + 0q_3 \\ -c &= 4q_1 + 6q_2 + 5q_3 \end{aligned}\right\} \text{see orange}$$