1)

$$A = \begin{pmatrix} 1 & -2 & 3 \\ -5 & 4 & 1 \\ 2 & -1 & 3 \end{pmatrix} \qquad b = \begin{pmatrix} 1 \\ 9 \\ 5 \end{pmatrix}$$

$$Ax = b \qquad QRx = b \qquad Rx = Q^T b$$

$$H_1 = I_3 - 2\hat{u}\hat{u}^T$$

$$H_1 = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} - 2 \frac{1}{30} \cdot \begin{pmatrix} 1 \\ -5 \\ 2 \end{pmatrix} \cdot \begin{pmatrix} 1 & -5 & 2 \end{pmatrix}$$

$$= \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} - \frac{1}{15} \cdot \begin{pmatrix} 1 & -5 & 2 \\ -5 & 25 & -10 \\ 2 & -10 & 4 \end{pmatrix} = \begin{pmatrix} 14/15 & 1/3 & -2/15 \\ 1/3 & -2/3 & 2/3 \\ -2/15 & 2/3 & 11/15 \end{pmatrix}$$

QR - Zerlegung

$$A = \begin{pmatrix} 1 & -2 & 3 \\ -5 & 4 & 1 \\ 2 & -1 & 3 \end{pmatrix}$$

$$b = \begin{pmatrix} 1 \\ 9 \\ 5 \end{pmatrix}$$

$$V_1 = \begin{pmatrix} 1 \\ -5 \\ 2 \end{pmatrix} + \sqrt{30} \cdot \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} = \begin{pmatrix} 1 + \sqrt{30} \\ -5 \\ 2 \end{pmatrix}$$

$$u_1 = \frac{V_1}{|V_1|} = \frac{1}{8.4234} \cdot \begin{matrix} 0.769 \\ -0.594 \\ 0.237 \end{matrix}$$