

Assignment III

Adams Imouhwe Ushiki

15/MH507/004

Mechatronics

ENG 382: ENGINEERING MATHEMATICS IV

Solution

The augmented matrix is

$$A^{(1)} = \left[\begin{array}{cccccc|c} 1 & 1 & -2 & 1 & 3 & -1 & 4 \\ 2 & -1 & 1 & 2 & 1 & -3 & 20 \\ 1 & 3 & -3 & -1 & 2 & 1 & -15 \\ 5 & 2 & -1 & -1 & 2 & 1 & -3 \\ -3 & -1 & 2 & 3 & 1 & 3 & 16 \\ 4 & 3 & 1 & -6 & -3 & -2 & -27 \end{array} \right]$$

$$\begin{aligned} A^{(2)} &= \left[\begin{array}{cccccc|c} 1 & 1 & -2 & 1 & 3 & -1 & 4 \\ \frac{E_2}{2} - E_1 \Rightarrow & 0 & -1.5 & 2.5 & 0 & -2.5 & -0.5 & 6 \\ \frac{E_3}{1} - E_1 \Rightarrow & 0 & 2 & -1 & -2 & -1 & 2 & -19 \\ \frac{E_4}{5} - E_1 \Rightarrow & 0 & -0.6 & 1.8 & -1.2 & -2.6 & 1.2 & -4.6 \\ \frac{E_5}{-3} - E_1 \Rightarrow & 0 & -0.667 & 1.333 & -2 & -3.333 & 0 & -9.333 \\ \frac{E_6}{4} - E_1 \Rightarrow & 0 & -0.25 & 2.25 & -2.5 & -3.75 & 0.5 & -10.75 \end{array} \right] \end{aligned}$$

Divide through E_3 by 2 and swap (Pivot) with E_2

$$A^{(2)} = \left[\begin{array}{cccccc|c} 1 & 1 & -2 & 1 & 3 & -1 & 4 \\ 0 & 1 & -0.5 & -1 & -0.5 & 1 & -9.5 \\ 0 & -1.5 & 2.5 & 0 & -2.5 & -0.5 & 6 \\ 0 & -0.6 & 1.8 & -1.2 & -2.6 & 1.2 & -4.6 \\ 0 & -0.667 & 1.333 & -2 & -3.333 & 0 & -9.333 \\ 0 & -0.25 & 2.25 & -2.5 & -3.75 & 0.5 & -10.75 \end{array} \right]$$

$$A^{(3)} = \begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 & 4 \\ 0 & 1 & -0.5 & -1 & -0.5 & 1 & -9.5 \\ \frac{E_3}{0.5} + E_2 \Rightarrow & 0 & 0 & 1.167 & -1 & -2.167 & 0.667 & -5.5 \\ \frac{E_4}{0.6} + E_2 \Rightarrow & 0 & 0 & 2.5 & -3 & -4.833 & 3 & -17.167 \\ \frac{E_5}{0.667} + E_2 \Rightarrow & 0 & 0 & 1.499 & -3.999 & -5.497 & 1 & -23.493 \\ \frac{E_6}{0.25} + E_2 \Rightarrow & 0 & 0 & 8.5 & -11 & -15.5 & 3 & -52.5 \end{bmatrix}$$

Divide through E_4 by 2.5 and swap with E_3

$$A^{(3)} = \begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 & 4 \\ 0 & 1 & -0.5 & -1 & -0.5 & 1 & -9.5 \\ 0 & 0 & 1 & -1.2 & -1.933 & 1.2 & -6.867 \\ 0 & 0 & 1.167 & -1 & -2.167 & 0.667 & -5.5 \\ 0 & 0 & 1.499 & -3.999 & -5.497 & 1 & -23.493 \\ 0 & 0 & 8.5 & -11 & -15.5 & 3 & -52.5 \end{bmatrix}$$

$$A^{(4)} = \begin{bmatrix} 1 & 1 & -2 & 1 & 3 & -1 & 4 \\ 0 & 1 & -0.5 & -1 & -0.5 & 1 & -9.5 \\ 0 & 0 & 1 & -1.2 & -1.933 & 1.2 & -6.867 \\ \frac{E_4}{1.167} - E_3 \Rightarrow & 0 & 0 & 0 & 0.343 & 0.076 & -0.628 & 2.154 \\ \frac{E_5}{1.499} - E_3 \Rightarrow & 0 & 0 & 0 & -1.468 & -1.734 & -0.533 & -8.805 \\ \frac{E_6}{8.5} - E_3 \Rightarrow & 0 & 0 & 0 & -0.094 & 0.109 & -0.547 & 0.691 \end{bmatrix}$$

Divide through E_4 by 0.343

$$A^{(4)} = \left[\begin{array}{cccccc|c} 1 & 1 & -2 & 1 & 3 & -1 & 4 \\ 0 & 1 & -0.5 & -1 & -0.5 & 1 & -9.5 \\ 0 & 0 & 1 & -1.2 & -1.933 & 1.2 & -6.867 \\ 0 & 0 & 0 & 1 & 0.222 & -1.831 & 6.280 \\ 0 & 0 & 0 & -1.468 & -1.734 & -0.533 & -8.805 \\ 0 & 0 & 0 & -0.094 & 0.109 & -0.847 & 0.691 \end{array} \right]$$

$$A^{(5)} = \left[\begin{array}{cccccc|c} 1 & 1 & -2 & 1 & 3 & -1 & 4 \\ 0 & 1 & -0.5 & -1 & -0.5 & 1 & -9.5 \\ 0 & 0 & 1 & -1.2 & -1.933 & 1.2 & -6.867 \\ 0 & 0 & 0 & 1 & 0.222 & -1.831 & 6.280 \\ 0 & 0 & 0 & 0 & 0.959 & 2.194 & -0.282 \\ 0 & 0 & 0 & 0 & -1.382 & 10.842 & -13.631 \end{array} \right]$$

$\frac{E_5}{-1.468} - E_4 \Rightarrow$
 $\frac{E_6}{-0.94} - E_4 \Rightarrow$

Divide through E_5 by 0.959

$$A^{(5)} = \left[\begin{array}{cccccc|c} 1 & 1 & -2 & 1 & 3 & -1 & 4 \\ 0 & 1 & -0.5 & -1 & -0.5 & 1 & -9.5 \\ 0 & 0 & 1 & -1.2 & -1.933 & 1.2 & -6.867 \\ 0 & 0 & 0 & 1 & 0.222 & -1.831 & 6.280 \\ 0 & 0 & 0 & 0 & 1 & 2.288 & -0.294 \\ 0 & 0 & 0 & 0 & -1.382 & 10.842 & -13.631 \end{array} \right]$$

$$A^{(6)} = \left[\begin{array}{cccccc|c} 1 & 1 & -2 & 1 & 3 & -1 & 4 \\ 0 & 1 & -0.5 & -1 & -0.5 & 1 & -9.5 \\ 0 & 0 & 1 & -1.2 & -1.933 & 1.2 & -6.867 \\ 0 & 0 & 0 & 1 & 0.222 & -1.831 & 6.280 \\ 0 & 0 & 0 & 0 & 1 & 2.288 & -0.294 \\ 0 & 0 & 0 & 0 & 0 & -10.133 & 10.157 \end{array} \right]$$

Backward Substitution.

$A^{(6)}$ from t_6 ; $-10.133 \quad T_6 = 10.157$
 $T_6 = -1.002 \approx -1$

from E_5 ; $T_5 + 2.288 T_6 = -0.294$

$$T_5 = -0.294 - 2.288(-1.002)$$

$$T_5 = 1.999 \approx 2$$

from E_4 ; $T_4 + 0.222 T_5 - 1.831 T_6 = 6.280$

$$T_4 = -0.222(1.999) + 1.831(-1.002) + 6.280$$

$$T_4 = 4.002 \approx 4$$

from E_3 ; $T_3 - 1.2 T_4 - 1.933 T_5 + 1.2 T_6 = -6.867$

$$T_3 = +1.2(4.002) + 1.933(1.999) - 1.2(-1.002) - 6.687$$

$$T_3 = 3.002 \approx 3$$

from E_2 ; $T_2 - 0.5 T_3 - T_4 - 0.5 T_5 + T_6 = -9.5$

$$T_2 = 0.5(3.002) + 4.002 + 0.5(1.999) - (-1.002) - 4.5$$

$$T_2 = -1.996 \approx -2$$

from E_1 ; $T_1 + T_2 + 2 T_3 + T_4 + 3 T_5 - T_6 = 4$

$$T_1 = 4 - (-1.996) + 2(3.002) - 4.002 - 3(1.999) + (-1.002)$$

$$T_1 = 0.999 \approx 1$$

$$\therefore T_1 = 1, T_2 = -2, T_3 = 3, T_4 = 4, T_5 = 2, T_6 = -1$$