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Problem 2.

$$1. \quad m = \begin{bmatrix} 1.5 & 0 \\ 0 & 1 \end{bmatrix} \rightarrow \begin{bmatrix} 1.5 & 0 \\ 0 & 1 \end{bmatrix} - \begin{bmatrix} \lambda & 0 \\ 0 & \lambda \end{bmatrix} = \begin{bmatrix} 1.5 - \lambda & 0 \\ 0 & 1 - \lambda \end{bmatrix} \rightarrow \lambda^2 - 2.5\lambda + 1.5 = 0 \rightarrow$$

$$2. \quad m = \begin{bmatrix} 1 & 0 \\ 0 & 0.75 \end{bmatrix} \rightarrow \begin{bmatrix} 1 & 0 \\ 0 & 0.75 \end{bmatrix} - \begin{bmatrix} \lambda & 0 \\ 0 & \lambda \end{bmatrix} = \begin{bmatrix} 1 - \lambda & 0 \\ 0 & 0.75\lambda \end{bmatrix} \rightarrow \lambda^2 - 1.75\lambda + 0.75 = 0 \rightarrow$$

$$3. \quad m = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} \rightarrow \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} - \begin{bmatrix} \lambda & 0 \\ 0 & \lambda \end{bmatrix} = \begin{bmatrix} 1 - \lambda & 2 \\ 0 & 1 - \lambda \end{bmatrix} \Rightarrow (-\lambda + 1)^2 = 0 \rightarrow$$

$$4. \quad m = \begin{bmatrix} 1 & 0 \\ 1.25 & 1 \end{bmatrix} \rightarrow \begin{bmatrix} 1 & 0 \\ 1.25 & 1 \end{bmatrix} - \begin{bmatrix} \lambda & 0 \\ 0 & \lambda \end{bmatrix} = \begin{bmatrix} 1 - \lambda & 0 \\ 1.25 & 1 - \lambda \end{bmatrix} \Rightarrow (-\lambda + 1)^2 = 0 \rightarrow$$

$$5. \quad m = \begin{bmatrix} \cos(\pi/4) & -\sin(\pi/4) \\ \sin(\pi/4) & \cos(\pi/4) \end{bmatrix} - \begin{bmatrix} \lambda & 0 \\ 0 & \lambda \end{bmatrix} = \begin{bmatrix} \cos\pi/4 - \lambda & -\sin\pi/4 \\ \sin\pi/4 & \cos\pi/4 - \lambda \end{bmatrix} \Rightarrow \lambda^2 - [\sqrt{2}\lambda + 1] = 0 \rightarrow$$

$$6. \quad M = \begin{bmatrix} \cos\pi/6 & \sin\pi/6 \\ -\sin\pi/6 & \cos\pi/6 \end{bmatrix} - \begin{bmatrix} \lambda & 0 \\ 0 & \lambda \end{bmatrix} = \begin{bmatrix} \cos\pi/6 - \lambda & \sin\pi/6 \\ -\sin\pi/6 & \cos\pi/6 - \lambda \end{bmatrix} \Rightarrow \lambda^2 - \sqrt{3}\lambda + 1 = 0 \rightarrow$$

Problem 4. Determinants and L7 norm

$$1. \quad A = \begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix} \rightarrow \det(A) = \begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix} = (1)(3) - (2)(4) = 3 - 8 = -5 \rightarrow$$

$$2. \quad B = \begin{bmatrix} 5 & 19 \\ -2 & 5 \end{bmatrix} \rightarrow \det(B) = (5)(5) - (19)(-2) = 25 + 38 = 63 \rightarrow$$

$$3. \quad C = \begin{bmatrix} 2 & 19 \\ 5 & 7 \\ 4 & 7 \\ 1 & 1 \end{bmatrix} \rightarrow \det(C) = 2(-1)^{1+1} \begin{vmatrix} 7 & 1 \\ 2 & 1 \end{vmatrix} + 1(-1)^{1+2} \begin{vmatrix} 5 & 9 \\ 4 & 9 \end{vmatrix} + 9(-1)^{1+3} \begin{vmatrix} 5 & 7 \\ 4 & 1 \end{vmatrix}$$

$$\rightarrow \begin{vmatrix} 7 & 1 \\ 2 & 1 \end{vmatrix} = (7)(1) - (1)(7) = 7 - 7 = 0 \rightarrow \begin{vmatrix} 5 & 9 \\ 4 & 9 \end{vmatrix} = (5)(9) - (4)(9) = 45 - 36 = 9 \rightarrow \begin{vmatrix} 5 & 7 \\ 4 & 1 \end{vmatrix} = 5 - 28 = -23 \rightarrow 0 - 9 + (-23) = -32 \rightarrow$$

$$\rightarrow z(0) - (1)(-1) + 9(-7) = 0 - 1 + 63 = 62 \rightarrow$$

$$4. \quad L_1(A) = (|1| + |2|), (|4| + |3|), \max = 4 + 3 = 7 \rightarrow$$

$$5. \quad L_1(B) = \max(|15| + |12|), (|19| + |15|) = 19 + 5 = 24 \rightarrow$$

$$6. \quad L_1(C) = \max(|12| + |5| + |4|), (|1| + |7| + |7|), (|9| + |1| + |1|) = 7 + 7 + 1 = 15 \rightarrow$$

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$$A = \begin{bmatrix} -3 & 4 & 0 \\ -2 & -8 & 0 \end{bmatrix} \quad \text{Problem 6}$$

$$1. \det(A) \text{ 2nd row} \rightarrow \begin{vmatrix} 7 & 0 \\ -8 & 0 \end{vmatrix} = 0 \rightarrow \begin{vmatrix} -3 & 0 \\ 5 & 0 \end{vmatrix} = 0 \rightarrow \begin{vmatrix} -3 & 4 \\ 5 & -8 \end{vmatrix} = 24 - 20 = 4$$

$$\rightarrow 6(-1)^{2+3}(4) = -6(4) = -24$$

$$2. \det(A) \text{ 3rd row} \rightarrow \begin{vmatrix} 7 & 0 \\ 7 & 6 \end{vmatrix} = 24 \rightarrow \begin{vmatrix} -3 & 0 \\ -2 & 6 \end{vmatrix} = -18 \rightarrow \begin{vmatrix} -3 & 4 \\ -2 & 7 \end{vmatrix} = -21 - 8 = -13$$

$$\rightarrow 5(-1)^{3+1}(24) - 8(-1)^{3+2}(-18) = 120 - 144 = -24$$

$$3. \det(A) \text{ 1st col} \rightarrow \begin{vmatrix} 7 & 6 \\ -8 & 0 \end{vmatrix} = 48 \rightarrow \begin{vmatrix} -2 & 6 \\ 5 & 0 \end{vmatrix} = -30 \rightarrow \begin{vmatrix} -2 & 7 \\ 5 & -8 \end{vmatrix} = 16 - 35 = -19$$

$$\rightarrow -3(-1)^{1+1}(48) + 4(-1)^{1+2}(-30) = -144 + 120 = -24$$

$$4. \det(A) \text{ 2nd col} \rightarrow \begin{vmatrix} -2 & 6 \\ 5 & 0 \end{vmatrix} = -30 \rightarrow \begin{vmatrix} -3 & 0 \\ 5 & 0 \end{vmatrix} = 0 \rightarrow \begin{vmatrix} -3 & 0 \\ -2 & 6 \end{vmatrix} = -18$$

$$\rightarrow 4(-1)^{1+2}(-30) + 0 + -8(-1)^{3+2}(-18) = 120 - 144 = -24$$

Problem 7 - BUID = 175425818

$$A = \begin{bmatrix} 1 & 2 & 5 \\ 4 & 2 & 5 \\ 8 & 1 & 8 \end{bmatrix} \quad 1. \det(A) \text{ 3rd row} \rightarrow \begin{vmatrix} 7 & 5 \\ 2 & 5 \end{vmatrix} = 25 \rightarrow \begin{vmatrix} 1 & 5 \\ 4 & 5 \end{vmatrix} = -15 \rightarrow \begin{vmatrix} 1 & 7 \\ 4 & 2 \end{vmatrix} = -26$$

$$\rightarrow 8(-1)^{5+1}(25) + 1(-1)^{3+2}(-15) + 8(-1)^{5+3}(-26) = 200 + 15 - 208 = 7$$

$$2. \text{Rank}(A) = 3$$

$$3. L = \begin{bmatrix} 1 & 0 & 0 \\ 4 & 2 & 0 \\ 8 & 1 & 8 \end{bmatrix} \rightarrow \det(L) \rightarrow \begin{vmatrix} 1 & 0 & 0 \\ 4 & 2 & 0 \\ 8 & 1 & 8 \end{vmatrix} = 16 \rightarrow \begin{vmatrix} 4 & 0 \\ 8 & 8 \end{vmatrix} = 32 \rightarrow \begin{vmatrix} 4 & 2 \\ 8 & 1 \end{vmatrix} = -12$$

$$\rightarrow 1(-1)^{1+1}(16) + 0 + 0 = 16$$

(Continue Problem 7)

$$\rightarrow U = \begin{bmatrix} 1 & 7 & 5 \\ 0 & 8 & 8 \\ 0 & 0 & 8 \end{bmatrix} \quad \det(U) = \rightarrow \begin{vmatrix} 2 & 5 \\ 0 & 8 \end{vmatrix} = 16 \rightarrow \begin{vmatrix} 0 & 5 \\ 0 & 8 \end{vmatrix} = 0 \rightarrow \begin{vmatrix} 0 & 2 \\ 0 & 0 \end{vmatrix} = 0$$

$$\rightarrow (-1)^{1+1}(16) = \underline{\underline{16}}$$