linear and non-linear transformation

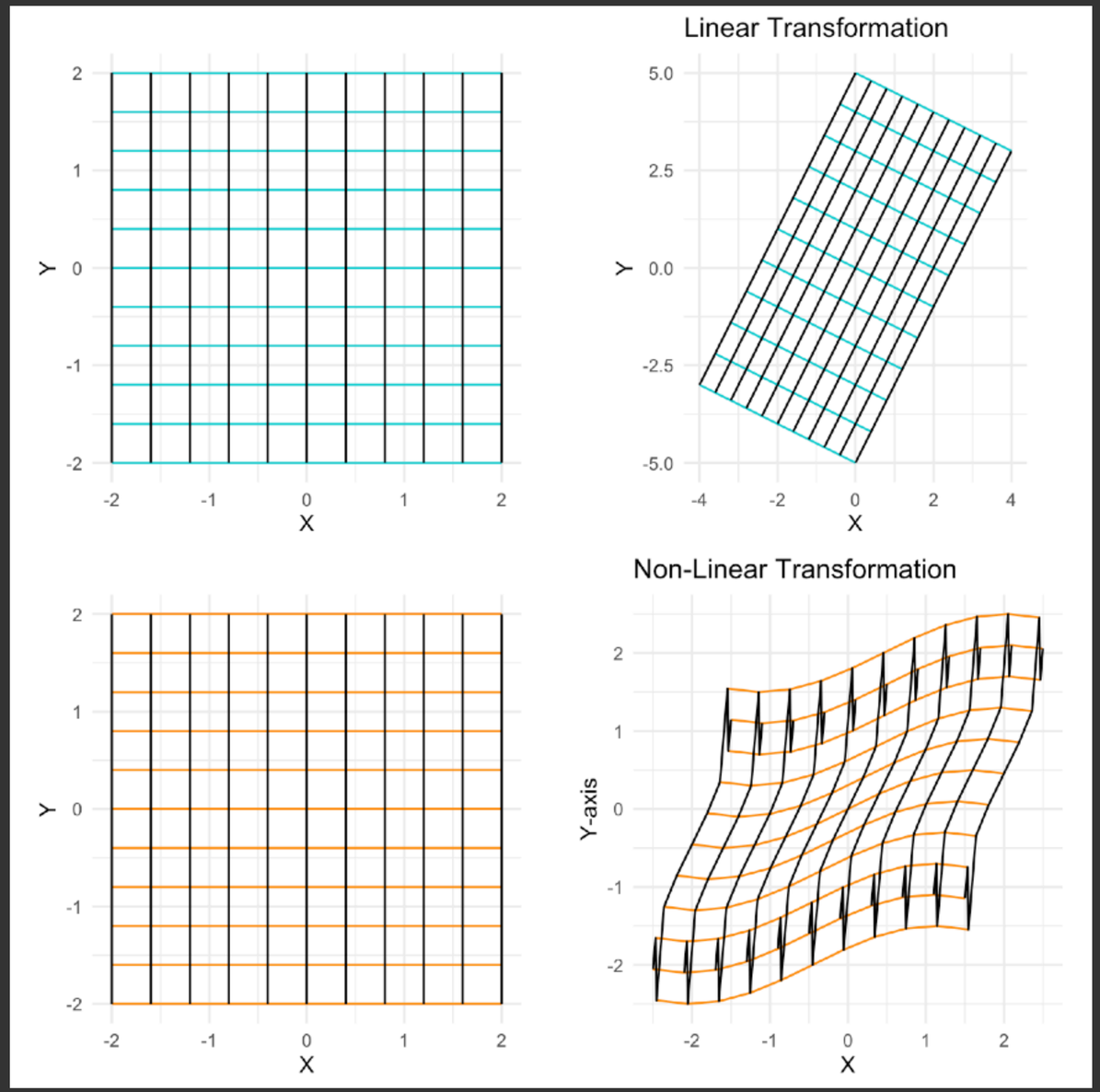
Linear:

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = A \cdot \begin{bmatrix} x \\ y \end{bmatrix} \text{ where } A = \begin{bmatrix} 1 & 1 \\ -1 & 2 \end{bmatrix}$$

Non-Linear:

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} f(x,y) \\ g(x,y) \end{bmatrix} = \begin{bmatrix} x + 0.5\sin(y) \\ y + 0.5\sin(x) \end{bmatrix}$$

but locally linear when we zoom in!



the Jacobian

example

Let f be a transformation from $\mathbb{R}^2$ to $\mathbb{R}^2$ with the following Jacobian matrix:

$$J = \begin{bmatrix} 3x^2 - 4 & 0 \\ 0 & 3y^2 - 4 \end{bmatrix}$$

What is the determinant of f? How will f stretch or squish the space around the point $(1, -1)$?