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Lecture-8

* Non Square matrices as transformations between dimensions:

$$\rightarrow \begin{bmatrix} \overset{\text{where } \hat{i} \text{ lands}}{} 2 & \overset{\text{where } \hat{j} \text{ lands}}{} 0 \\ -1 & 1 \\ -2 & 1 \end{bmatrix} \quad \text{Maps 2D to 3D}$$

Span of Columns

$\Updownarrow$

"Column Space"

This 3×2 matrix is a 2D plane slicing through the origin of 3D space. But matrix is still full rank since the number of dimensions in this column space is equal to the number of dimensions of input space.

$$\rightarrow \overbrace{\begin{bmatrix} 3 & 1 & 4 \\ 1 & 5 & 9 \end{bmatrix}}^{\text{3 basis vectors}} \Big\} \text{2 co-ordinates for each landing spot}$$

$\therefore$ This 2×3 matrix is transformation from 3D space to 2D plane

→ Transformation from 2D to 1D

$$\underbrace{\begin{bmatrix}2\\7\end{bmatrix}}_{2D} \quad L(\vec{v}) \Rightarrow \underbrace{[1.8]}_{1D}$$

1D space is the number line.

Normally in transformations, linearity is maintained because the grids are parallel, evenly spaced and the origin is always fixed.

For 2D to 1D transformation, linearity can be checked by imagining a line of evenly spaced dots in 2D space must remain evenly spaced when they are mapped on the number line.

Transformation matrix = $\begin{array}{cc} \hat{i} & \hat{j} \\ \left[\,1\right. & \left.2\,\right] \end{array}$ (2D to 1D)