

# Linear Transformation I

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Lecture 6

**Function:**  $f(x) = x^2$

$$f : \underbrace{\quad R \quad}_{\text{domain of a function (all inputs)}} \rightarrow \underbrace{\quad R \quad}_{\text{Co-domain (all possible outputs)}} \quad (1)$$

If  $x$  is in the domain  $f(x)$  is the image of  $x$  under  $f$ . If  $s$  is a subset of the domain  $f(s)$  is the image of  $s$  under  $f$ :

$$f(s) = \{f(x) | x \in s\} \rightarrow \text{the image of the whole domain is the range of } f. \quad (2)$$

$$\begin{aligned} f(x) &= x^2 \\ s &= [1, 2] \rightarrow -1 \leq x \leq 2 \\ f(s) &= [0, 4] \\ f(-1) &= 1, f(0) = 0 \\ f\left(-\frac{1}{2}\right) &= \frac{1}{4} \end{aligned}$$

$$T : X \rightarrow Y$$

$T$  is a linear transformation if it satisfies

1.  $T(\vec{u} + \vec{v}) = T(\vec{u}) + T(\vec{v})$
2.  $T(c\vec{u}) = cT(\vec{u})$

**Linear Transformation II**  
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$$T(\vec{u} + \vec{v}) = T(\vec{u}) + T(\vec{v})$$

$$T(c\vec{u}) = cT(\vec{u})$$

$$T : \mathbb{R}^n \rightarrow \mathbb{R} \quad T(\vec{u})$$