

A, B sets, $f: A \rightarrow B$

f injective $\Leftrightarrow \left(\forall x_1, x_2 \in A \text{ with } f(x_1) = f(x_2) \Rightarrow x_1 = x_2 \right) \Leftrightarrow$

$$\Leftrightarrow \forall x_1, x_2 \in A, x_1 \neq x_2 \Rightarrow f(x_1) \neq f(x_2)$$

G_1, G_2 groups, $f \in \text{Hom}(G_1, G_2)$ " f is a group homomorphism"

f injective $\Leftrightarrow \text{Ker } f = \{e_{G_1}\}$

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f surjective $\Leftrightarrow \text{Im } f = B \Leftrightarrow \forall b \in B \exists a \in A: f(a) = b$

f bijective $\Leftrightarrow f$ injective and f surjective \Leftrightarrow

$$\Leftrightarrow \exists g: B \rightarrow A: f \circ g = \text{id}_B, g \circ f = \text{id}_A$$

• canonical vector space over K : K^n