



# FUNCTION

$$f(x) = x^2 + 3 \leftarrow$$

$f(x)$

$$y = x * x$$

$$z = y + 3$$

return z

$$\rightarrow \{(0, 3), (1, 4), (2, 7), (3, 12), (4, 19), \dots\}$$

in      out

$$(0) \rightarrow (3) \rightarrow (12)$$

$$(1) \rightarrow (4) \rightarrow (19)$$

$$(2) \rightarrow (7)$$

subroutine - side effects  
- state

Domain of a function

Set of values used as input

$$\text{int } f(\text{int } x)$$

Co-domain

Set of values used as output

Range

set of values actually produced

$$\text{Range} \subseteq \text{Co-domain}$$

$$g(x) = \sqrt{x}$$

codom

$\mathbb{N}$

$$(0, 0), (1, 1), (4, 2), (9, 3)$$

dom

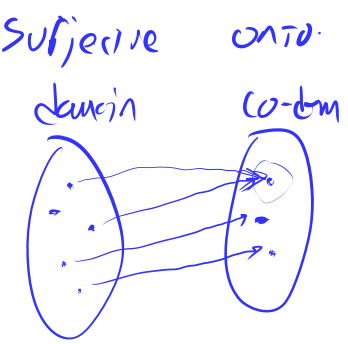
$\mathbb{N}$

Total: all domain elem work

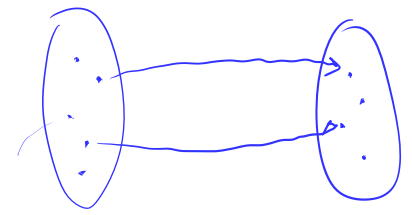
Partial: Some domain elem work

Surjective or onto

$$\text{Co-domain} = \text{Range}$$



injective 1-1

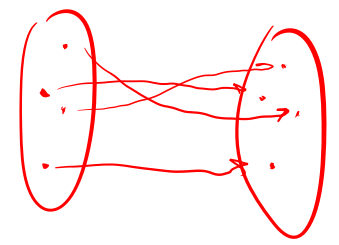
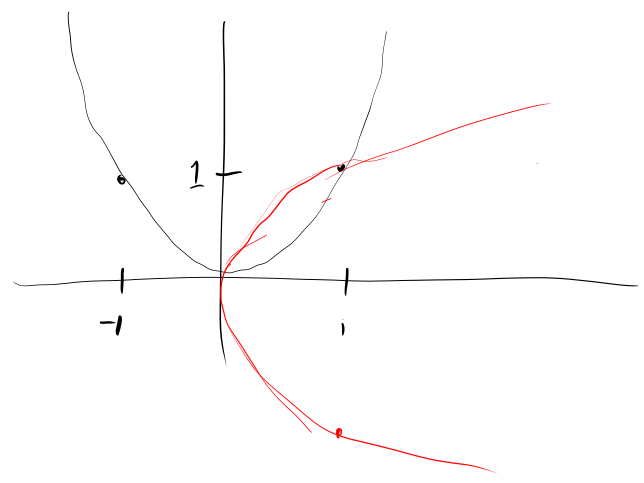


$$\forall x, y \in D, x \neq y \rightarrow f(x) \neq f(y)$$

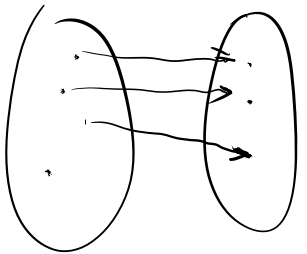
correspondence  
 in reverse  
 bijection

- total
- surjective
- injective

$$f(x) = x^2$$

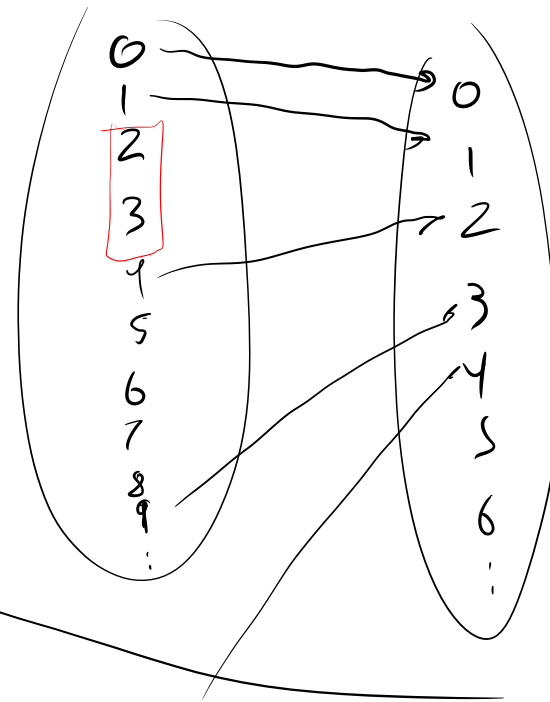


Surjective    injective    not surjective

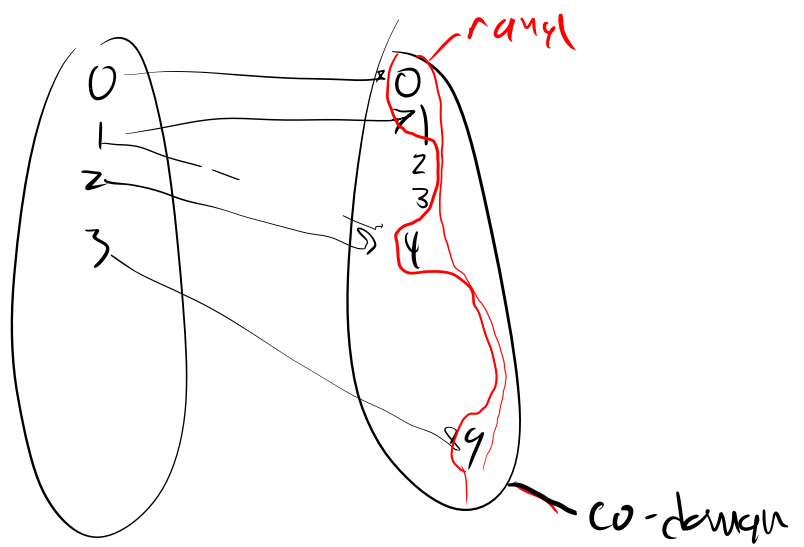


$$D, C = \mathbb{N}$$

$$f(x) = \sqrt{x}$$



$$f(x) = x^2 \quad D, C = \mathbb{N}$$



$f(a, b, c)$

if (a) return b

else return c

domain:  $\{T, \perp\} \times B \times C$

codomain:  $B \cup C$

$$f(x, y) = 2x + y$$

$$(0, 0) \rightarrow 0$$

$$(0, 1) \rightarrow 1$$

$$(1, 1) \rightarrow 3$$

domain:  $\mathbb{Z} \times \mathbb{Z}$

$\{(0, 0, 0), (0, 1, 1), (1, 1, 3)\}$