

one rule, one output for every input: domain, range and the shapes that follow

Function, Domain, Co-domain, Range

- a function $f:A \rightarrow B$ sends each x in A to exactly one y in B , $y=f(x)$
- A is the **domain** of f , B the **co-domain**, y is the image of x
- range** = $f(A)$: every y actually hit, always a subset of the co-domain
- vertical line test**: no vertical line may cut the graph of a function twice
- horizontal line test**: no horizontal line may cut the graph twice, so f is one-one

One-one and onto

- one-one (injective)**: different elements of A have different images, $f(a)=f(b) \Rightarrow a=b$
- onto (surjective)**: every y in B is the image of some x in A , so $f(A)=B$
- range of $f = f(A) \subset$ co-domain of f , with equality exactly when f is onto

The four combinations

one-one, not onto

every arrow lands on a different target, but some targets are unused

one-one and onto

a bijection: every target hit exactly once

onto, not one-one

every target is hit, but some target is hit twice

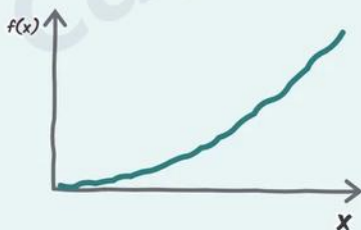
neither one-one nor onto

some target unused, another hit more than once

Worked: evaluating a function *

Q. if $f(x)=2x^2-3x+4$, find $f(7)$ and $f(-2t)$

- $f(7)=2(7)^2-3(7)+4=2(49)-21+4$
- $=98-21+4=81$
- $f(-2t)=2(-2t)^2-3(-2t)+4=2(4t^2)+6t+4$



the rising arm of $f(x)=2x^2-3x+4$: past its vertex it climbs steeply, so $f(7)$ is large

Answer $f(7)=81$, $f(-2t)=8t^2+6t+4$

Six ways to represent a function

- verbal**: a sentence describing the rule, e.g. output exceeds twice the input by 1
- arrow/Venn diagram**: domain and range as two ovals joined by arrows
- ordered pairs**: pairs like $(2,5), (3,7), (4,9), (5,11)$; domain is the 1st entries, range the 2nd
- rule/formula**: $y=f(x)=2x+1$, with a stated domain
- tabular**: a two-row table of x and y values
- graphical**: domain is the graph's projection on the X -axis, range its projection on the Y -axis