Functions

Lists generalised

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Functions

$$f : S \to T$$

- Relates an element $f(x) \in T$ for every $x \in S$
- S is called the domain
- T is sometimes called the codomain
- The range R_f of f is
  - set of values ever assumed by $f(x)$
  - $R_f = \{f(x) : x \in S\}$
  - $R_f \subset T$ (subset of T)

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A Programmer's View

Functions

Methods and functions in programming are in principle functions.

- Input arguments in $S(= S_1 \times \ldots \times S_n)$
- Return value in T
- Data types are sets

The list as a function

A list of k elements from an n-set T.

$$\boxed{L = [x_1, x_2, \ldots, x_k]}$$

- Indexing gives us a map $i \mapsto x_i$
  - i.e. function $L : \mathbb{N}_n \to T$
  - $\mathbb{N}_n = \{1, 2, \ldots, k\}$ is the natural numbers up to k inclusive

Lists share key properties with the set of natural numbers.

Counting possible functions

How many different functions $f : X \to Y$ exist from the k-set X to the n-set Y?

1.	x_1	
2.	x_2	
3.	x_3	
4.	x_4	
$\vdots$		
k	x_k	

- Write the elements of X as a list
  - arbitrary order
- Count as we did for a list
  1. You have k slots to fill.
  2. Each slot gives you n options.
  3. Use the *Product Principle*

Exercise

You are going to hand out k distinctly coloured balloons at a birthday party of n children. In how many ways can the k balloons be distributed to the n children, with no limit on the number of balloons a single child may receive?