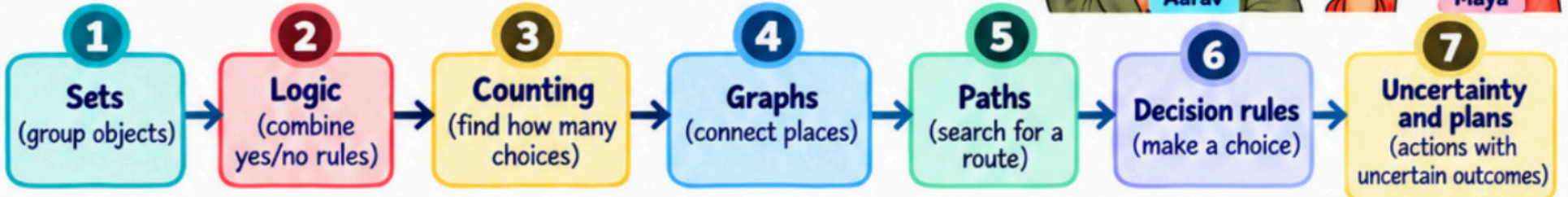


Discrete mathematics: the whole map

A journey through counting, structures and decisions.

What does discrete mean?

Separate choices we can count, such as four shirts.

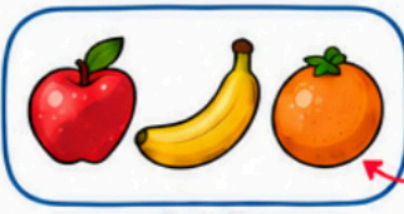


1 Sets: group objects

A **set** is a collection of distinct objects.

Example: fruits

$F = \{\text{apple, banana, orange}\}$



Set F

Each fruit is an element of the set. We list each item once.

2 Logic: combine yes/no rules

A **statement** is a sentence that is either true or false. We can combine statements using logic words.

Example: at the library

p : I have a library card. (true)

q : It is Monday. (false)

p AND q : both must be true.

true AND false = **false**

p OR q : at least one must be true.

true OR false = **true**

Logic lets us make clear yes/no rules from simple statements.

3 Counting: find how many choices

Counting tells us how many ways we can make a choice.

Example: choose a t-shirt



There are 4 choices.

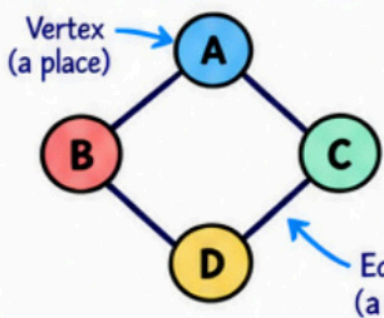
We count each possible choice once.

There are four possible T-shirt choices.

4 Graphs: connect places

A **graph** is a set of places (**vertices**) and connections (**edges**) between them.

Example: a simple map



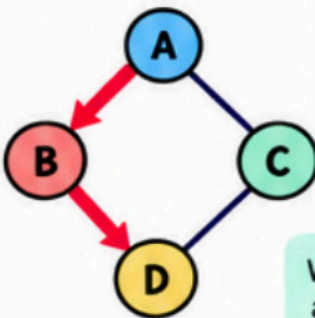
This graph has 4 vertices (A, B, C, D) and 4 edges.

Edge (a connection)

5 Paths: search for a route

A **path** is a sequence of connected vertices.

Example: a route from A to D



A path from A to D can be: $A \rightarrow B \rightarrow D$. Each step follows an edge.

We can search for a path to get from one place to another.

6 Decision rules: make a choice

A **decision rule** tells us what to do based on a condition.

Example: simple rule



The rule gives a clear action for each possible answer.

7 Uncertainty and plans: actions with uncertain outcomes

Sometimes we do not know what will happen. We can still plan by thinking about the possible outcomes.

Example: tomorrow's weather



Sunny (possible)



Rainy (possible)

We do not know which will happen, but we can plan for both.

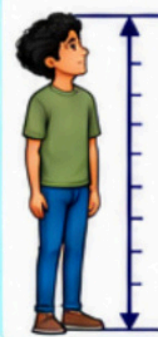
Can we plan when the outcome is uncertain?

Yes. We consider outcomes.

Discrete vs continuous

Discrete: separate, countable choices. Example: 4 t-shirts (a whole-number count).

Continuous: a measurement that can take any value in a range. Example: height can be 1.62 m, 1.623 m, 1.6235 m, and so on.



Height can be any value in a range, not just a count.

For example: 1.62 m, 1.623 m, 1.6235 m, and so on.