Monadic Interface

Unit Transformation

Wraps the input in a one-element block

wrap

Unit is a natural transformation.
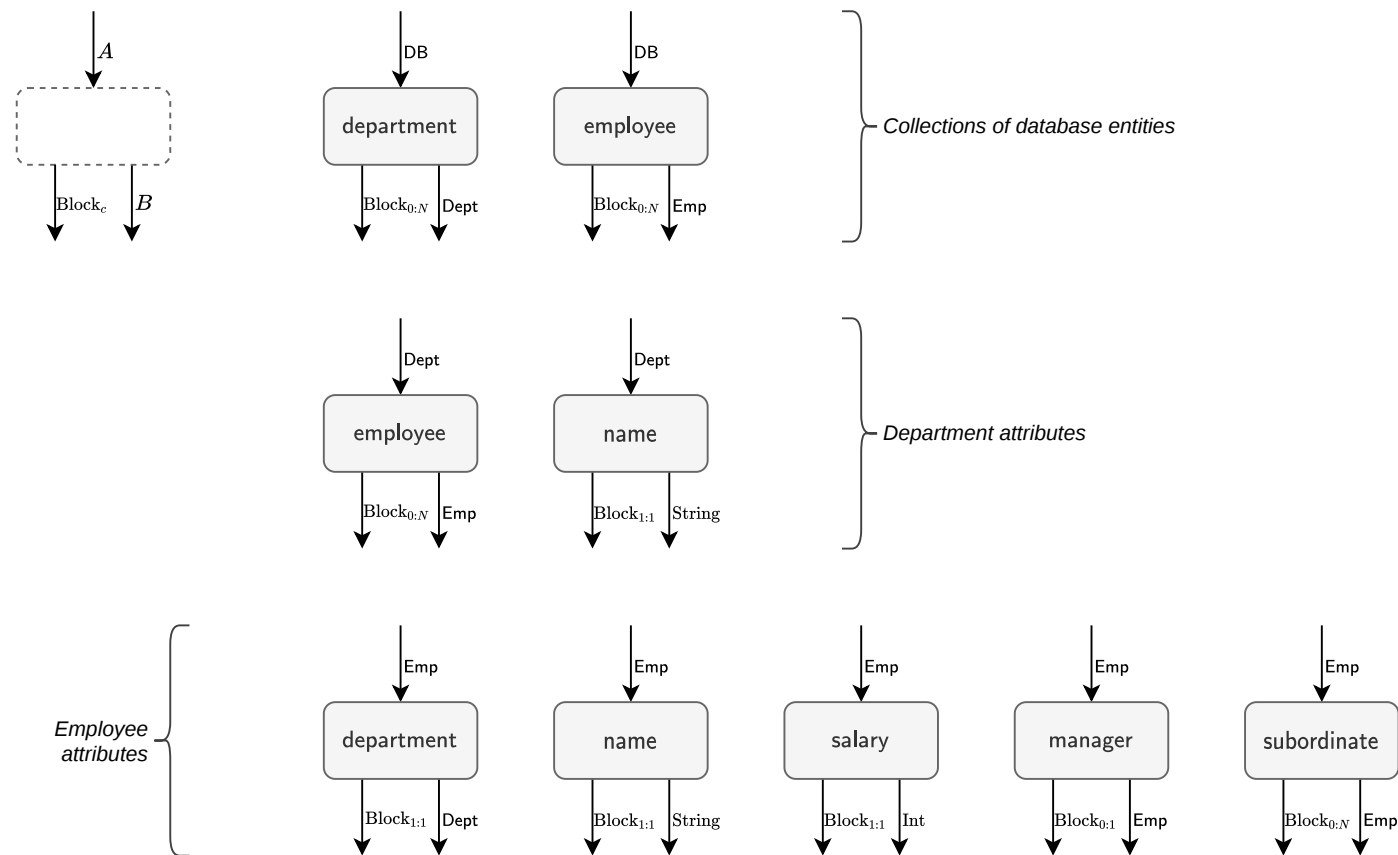

Indeed, for any $f : A \to B$,

$$\text{chain\_of}(f, \text{wrap}) \equiv \text{chain\_of}(\text{wrap}, \text{with\_elements}(f))$$

Using Unit Transformation

Unit transformation can adapt any regular transformation
to the monadic interface.

A

f

B

1

$Block_c$

A

1

f

$Block_c$

B

A

$Block_c$

B

Monadic Interface: Examples

A

Block_c B

DB

department

$\text{Block}_{0:N}$ Dept

DB

employee

$\text{Block}_{0:N}$ Emp

$\left.\right\}$ *Collections of database entities*

Dept

employee

$\text{Block}_{0:N}$ Emp

Dept

name

$\text{Block}_{1:1}$ String

$\left.\right\}$ *Department attributes*

Employee attributes $\left\{\right.$

Emp

department

$\text{Block}_{1:1}$ Dept

Emp

name

$\text{Block}_{1:1}$ String

Emp

salary

$\text{Block}_{1:1}$ Int

Emp

manager

$\text{Block}_{0:1}$ Emp

Emp

subordinate

$\text{Block}_{0:N}$ Emp

Composition Challenge

Two monadic transformations
can be composed.

Dept

employee

$\text{Block}_{0:N}$ Emp

Emp

manager

$\text{Block}_{0:1}$ Emp

Dept

employee

Emp

manager

$\text{Block}_{0:N}$ $\text{Block}_{0:1}$ Emp

$\mathrm{chain\_of}(\mathbf{employee}, \mathrm{with\_elements}(\mathbf{manager}))$

But the composition
does not satisfy
the monadic interface.

A

$\mathbf{X}$

Block_c B

Multiplication Transformation

$$\mathrm{Block}_{c_1} \quad \mathrm{Block}_{c_2} \quad A$$

*

$$\mathrm{Block}_{c_1 \sqcup c_2} \quad A$$

Flattens nested blocks

flatten

It is easy to check that the multiplication is a natural transformation.

$$\mathrm{Block}_{c_1} \quad \mathrm{Block}_{c_2} \quad A$$

*

$$\mathrm{Block}_{c_1 \sqcup c_2} \quad A$$

$$\mathrm{Block}_{c_1} \quad \mathrm{Block}_{c_2}$$

*

$$A$$

$$\mathrm{Block}_{c_1 \sqcup c_2}$$

Using Multiplication Transformation

Multiplication can be used to combine two monadic transformations into a new monadic transformation.

$$\mathrm{chain\_of}(\mathbf{employee}, \mathrm{with\_elements}(\mathbf{manager}), \mathrm{flatten})$$

Monad

In general, a *monad* is a functor wire which posesses
two special natural transformations: unit and multiplication.

Monadic transformation is a transformation
with the following shape.