

# Transformation



A transformation  $f$   
maps any input of type  $A$   
to the output of type  $B$ .

# Composition



Transformations with compatible input and output can be composed.

# Composition is a Transformation



Crucially, composition of transformations is again a transformation.

# Composition Combinator



Composition `chain_of([], [])`  
is a transformation combinator  
with two arguments.

## Example: Composition



## Counter-example: Plural Component



We cannot compose these transformations because their input and output do not quite match.

## Counter-example: Optional Component



Even so, the input and the output share a common component, which suggests there should be a way to compose these transformations.

# Idea: Unbundle the Wire



Attaching a transformation to the object wire indicates that the transformation is applied to all element of the collection.



# Block Type

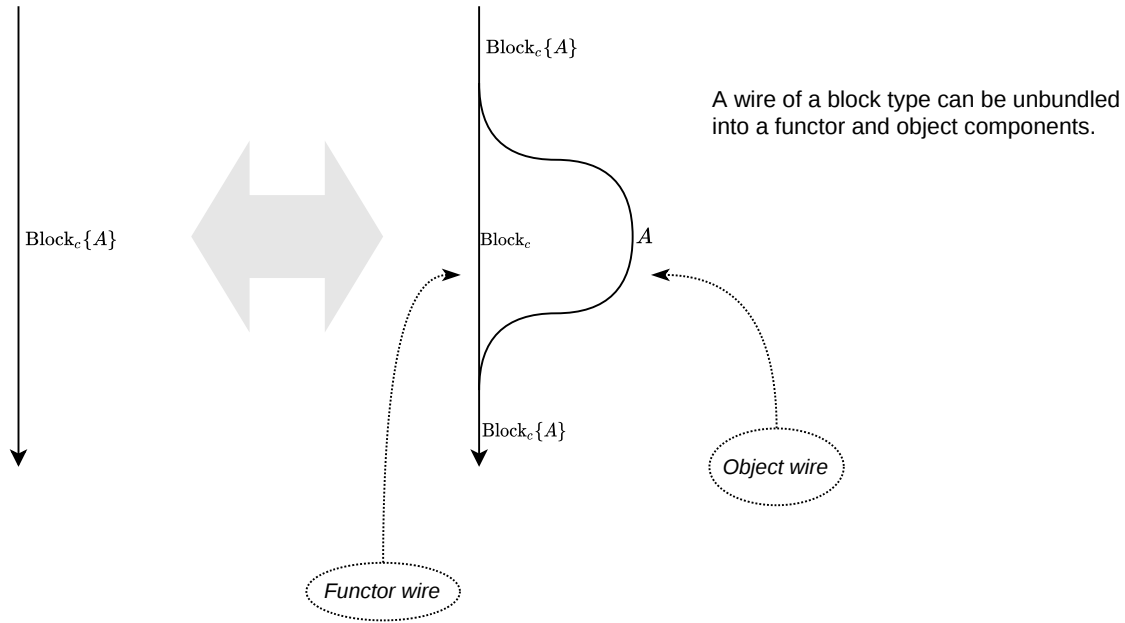
A block is a collection of homogeneous elements.



Cardinality is a constraint on the number of elements in a block.



# Unbundling



# Object Transformation



Any compatible transformation  
can be applied to the object wire,  
which indicates that the transformation  
is applied to every element of the block.

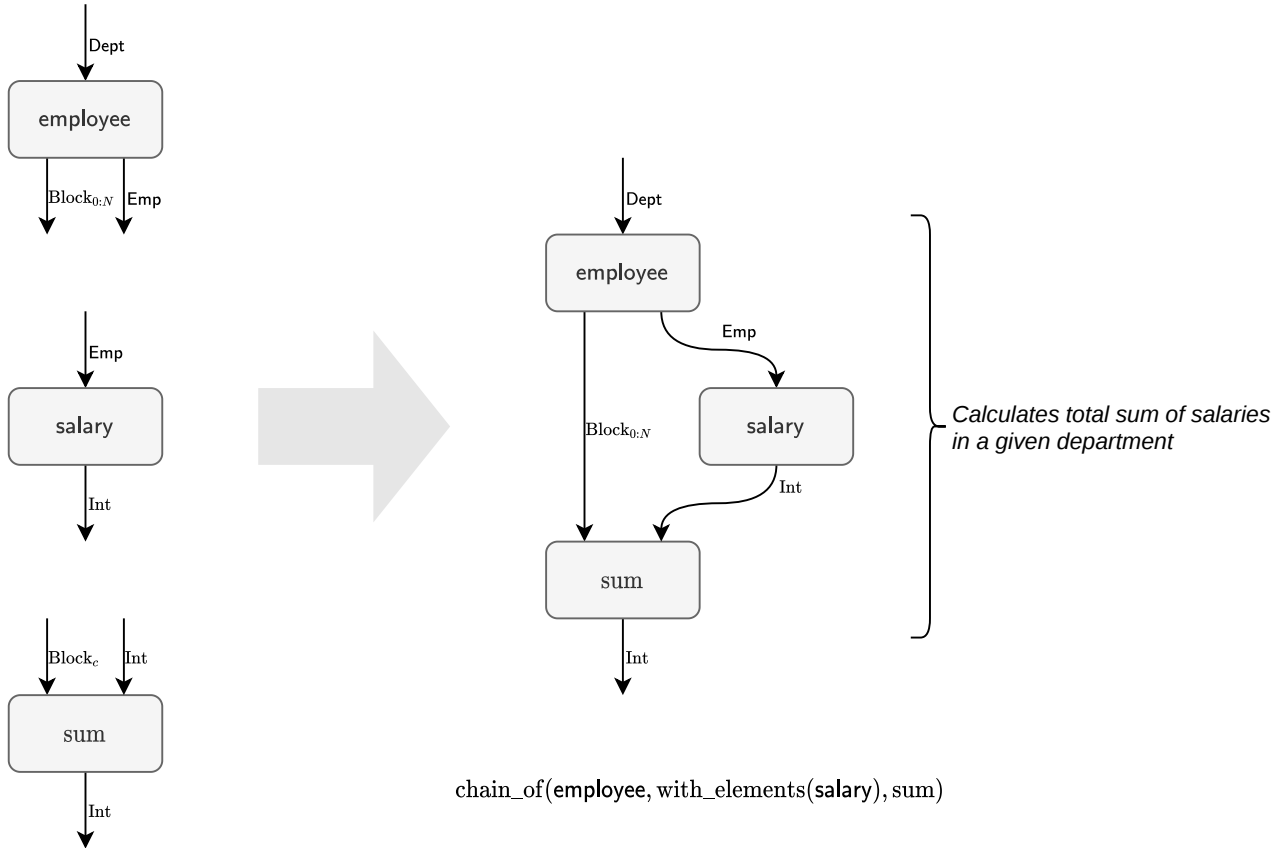
# Multiwired Transformations



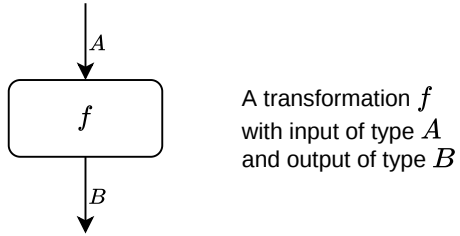
# Example: Multiwired Transformations



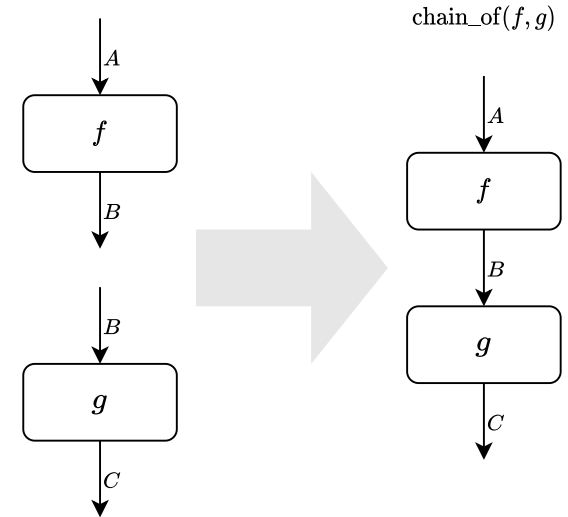
# Example: Multiwired Composition



## 1. Transformation



## 2. Composition



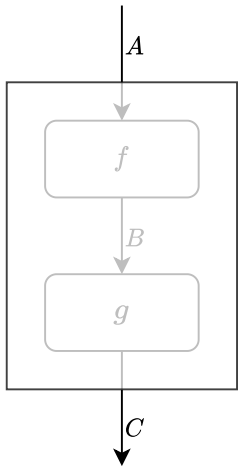
Transformations with compatible input and output can be composed

## 3. Composition is a Transformation

## 4. Composition Combinator

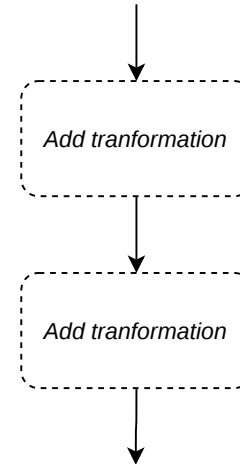






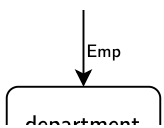
Trivially (but crucially),  
a composition of transformations  
is again a transformation

chain\_of(`[], []`)



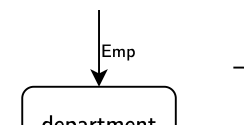
Composition is a transformation combinator  
with two placeholders

## 5. Example: Components of a Composition

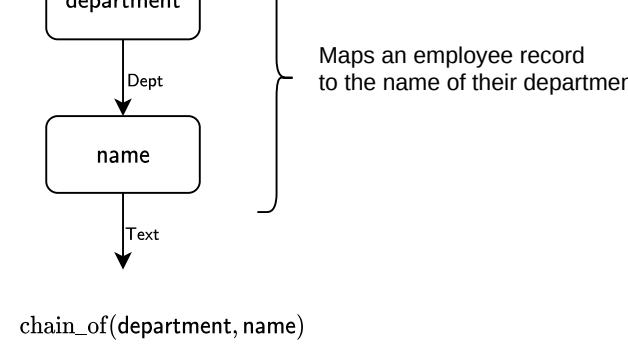
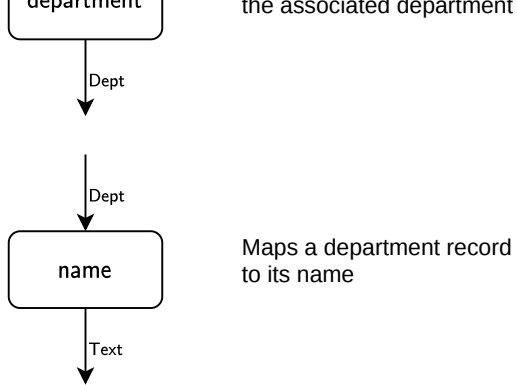


Maps an employee to

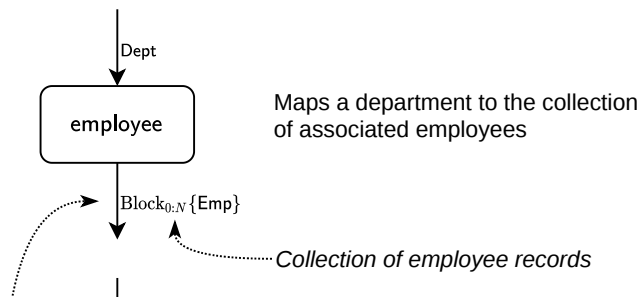
## 6. Example: Composition



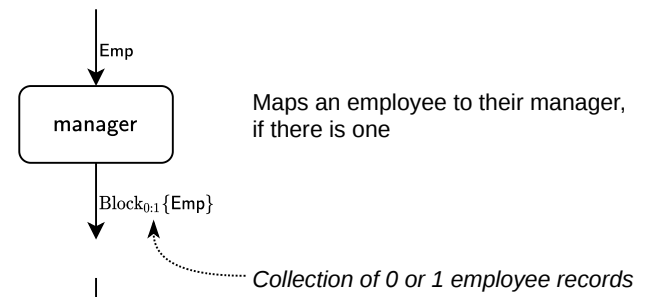




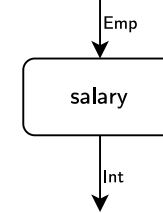
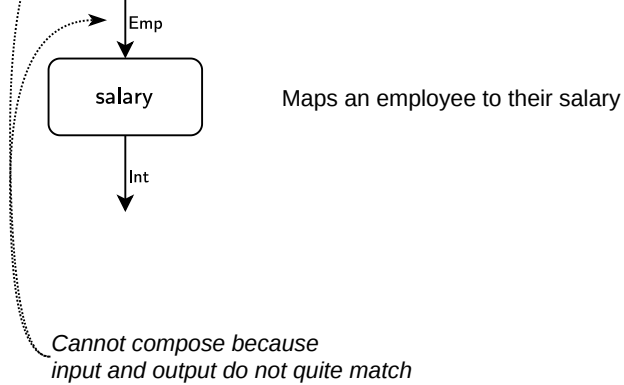
## 7. Counter-example: Plural Component



## 8. Counter-example: Optional

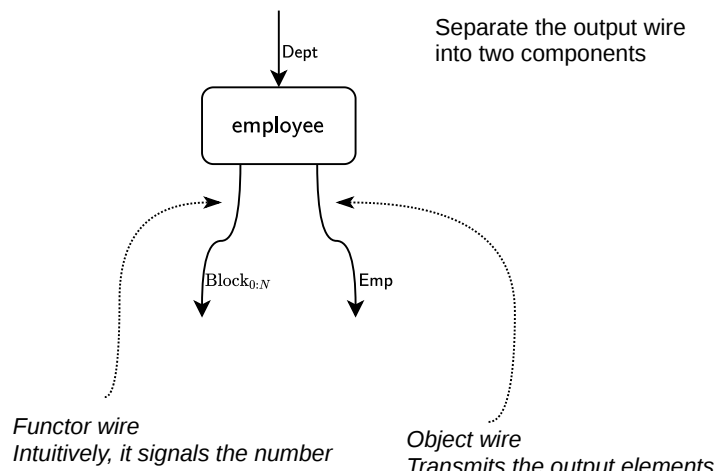


## Component

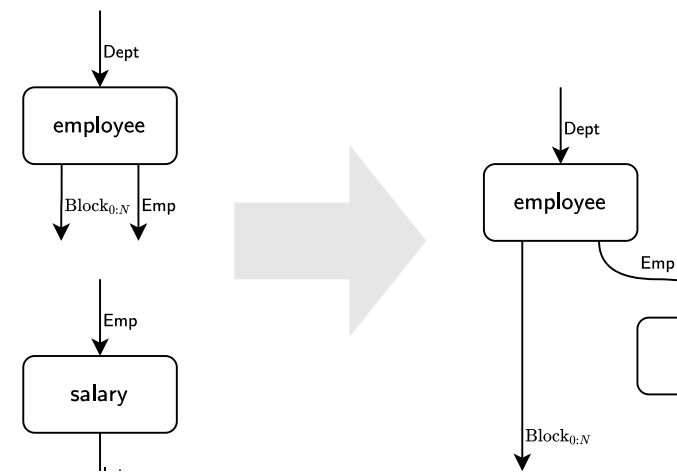


Can we represent composition of these transformations with an intuitive diagrammatic notation?

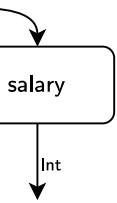
## 9. Idea: Unbundle the Wire



## 10. Idea: Compose Using the



# Object Wire



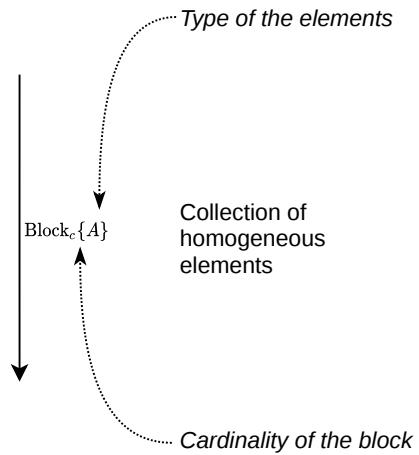
of output elements

transmits the output elements

Int  
↓

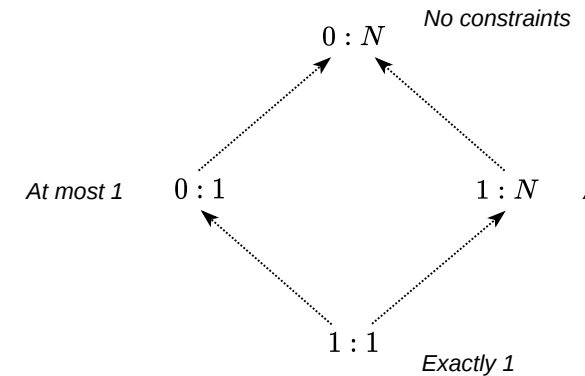
Attaching a transformation to the object wire indicates that the transformation is applied to each element of the collection

## 11. Block Type



## 12. Cardinality

Cardinality is a constraint on the number of elements

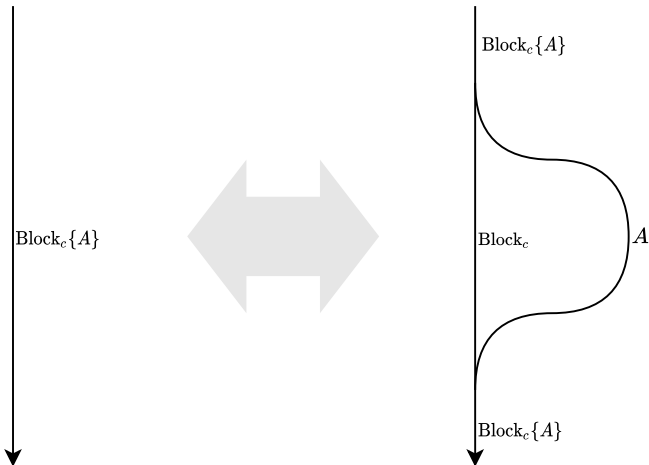


ents in a block

*At least 1*

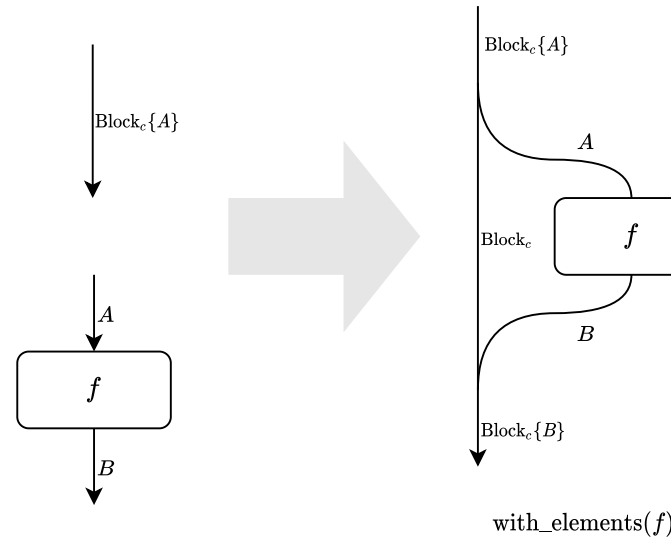


## 13. Unbundling



We can unbundle a wire of a block type into a functor and object components

## 14. Object Transformation



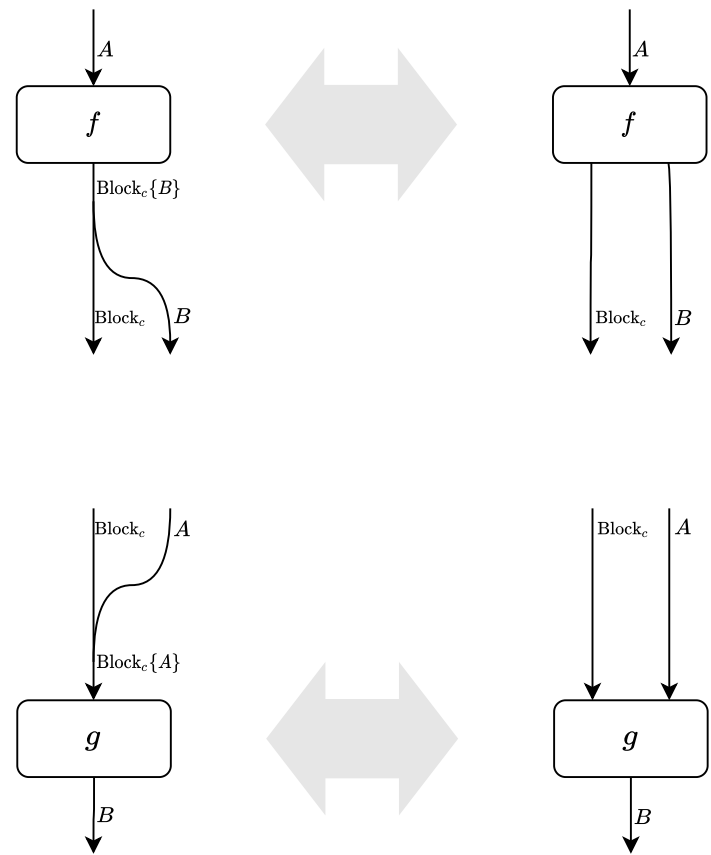
Then any compatible transformation can be applied to the object which indicates that the transformation is applied to every element of the block



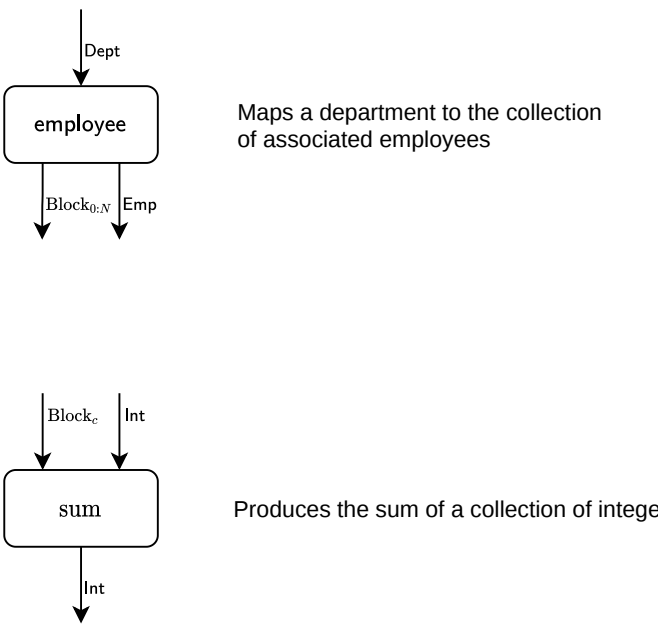
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13. Multiwired transformations



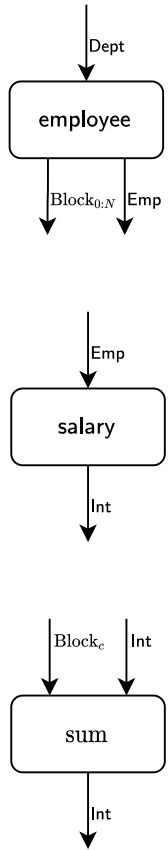
14. Example: Multiwired Trans



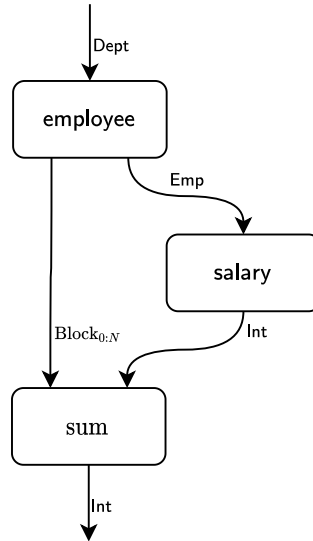
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## 14. Example: Multiwired Composition

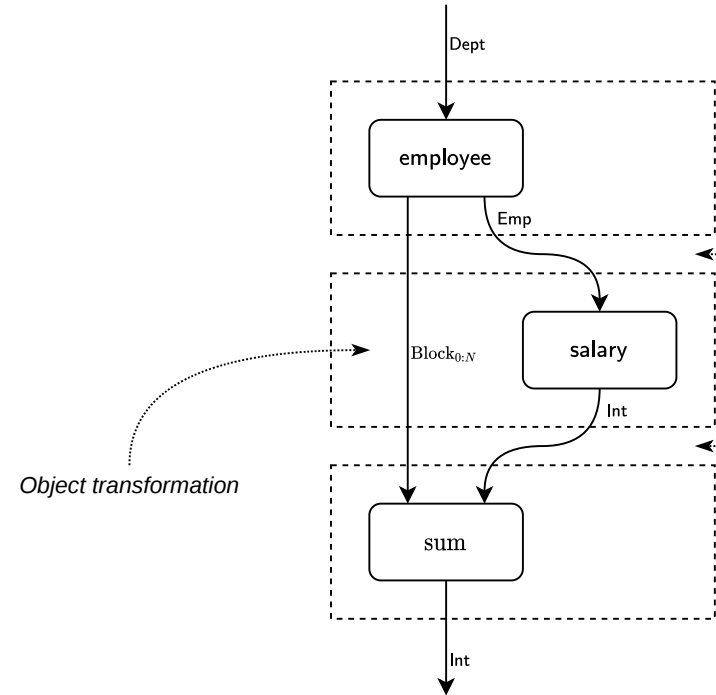


Total sum of salaries in a given department

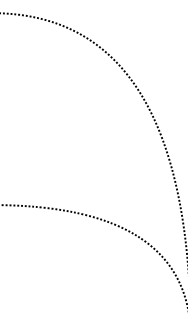
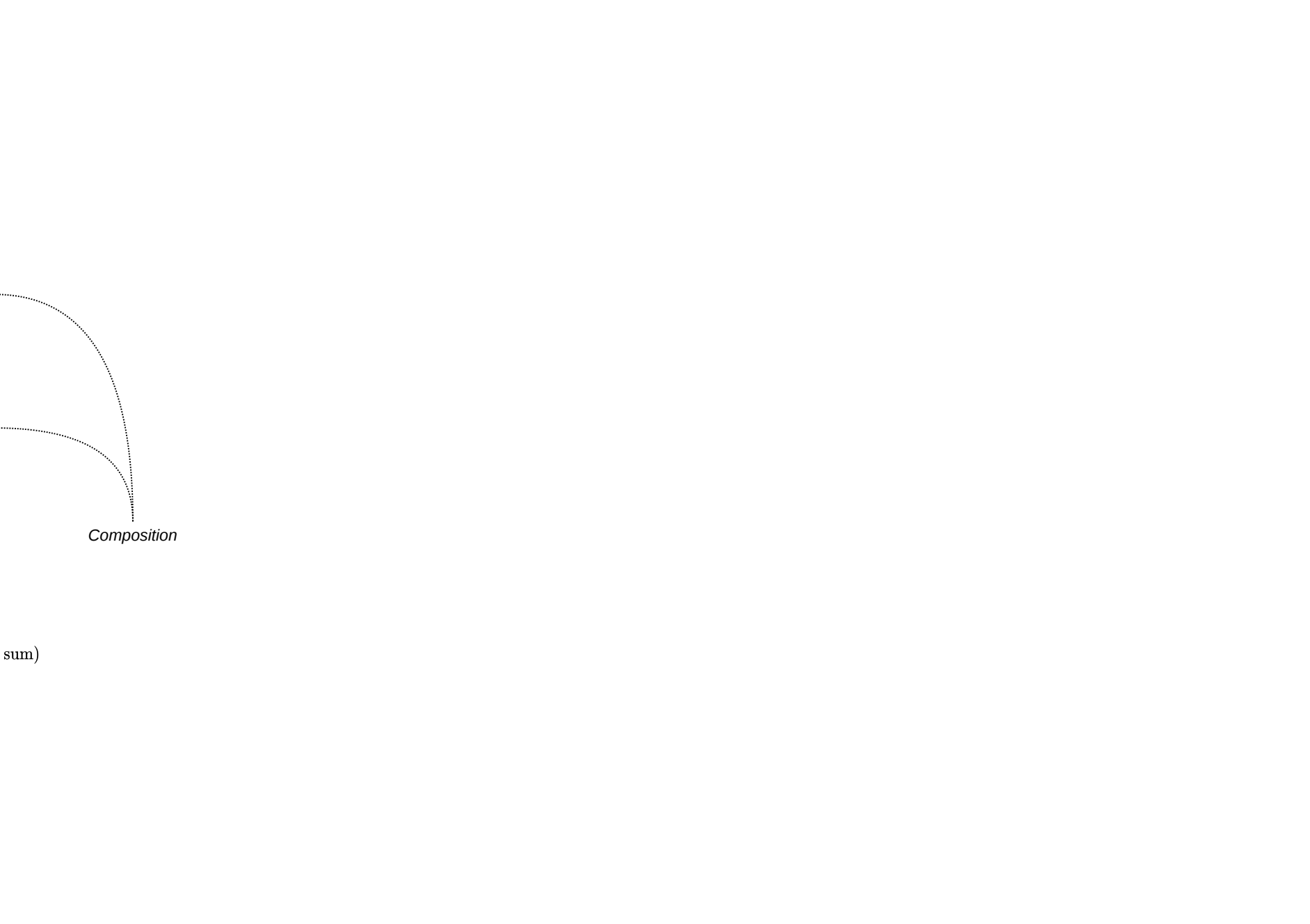


`chain_of(employee, with_elements(salary), sum)`

## 15. Example: Details



`chain_of(employee, with_elements(salary),`



*Composition*

sum)