Introduction to OCL

Bernhard Beckert

UNIVERSITÄT KOBLENZ-LANDAU

Object Constraint Language

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- Why? Because UML is not enough!

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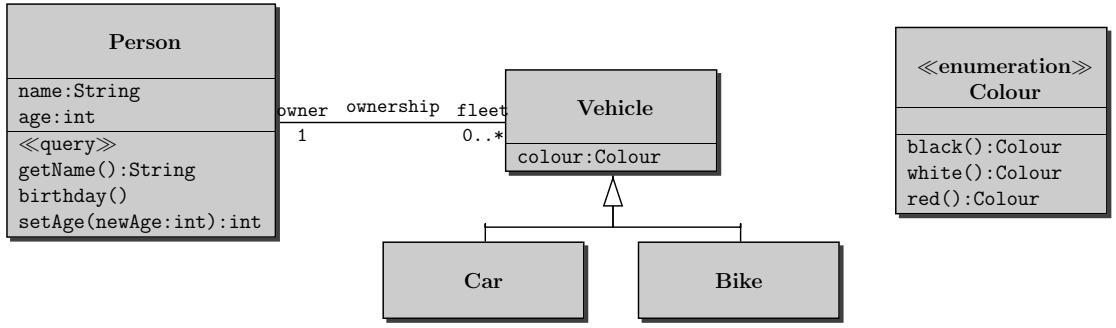
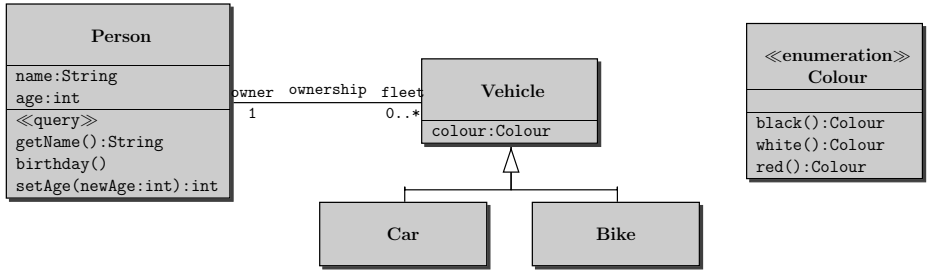


- **Possible number of owners a car can have**
- **Required age of car owners**
- **Requirement that a person may own at most one black car**

Some OCL examples I



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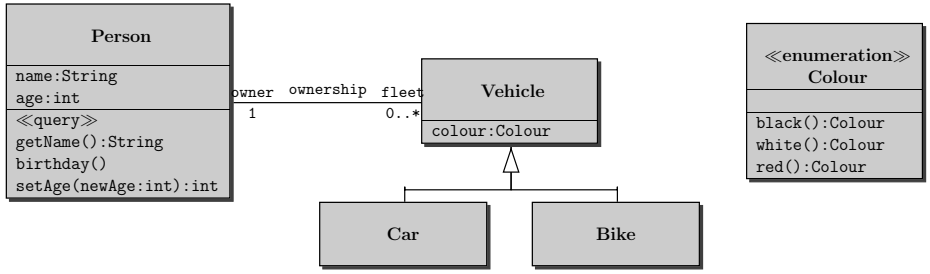

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inv: self. owner. age $>=$ 18

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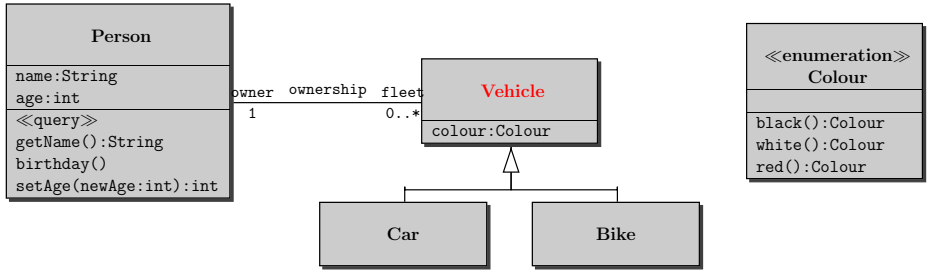

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context **Vehicle**
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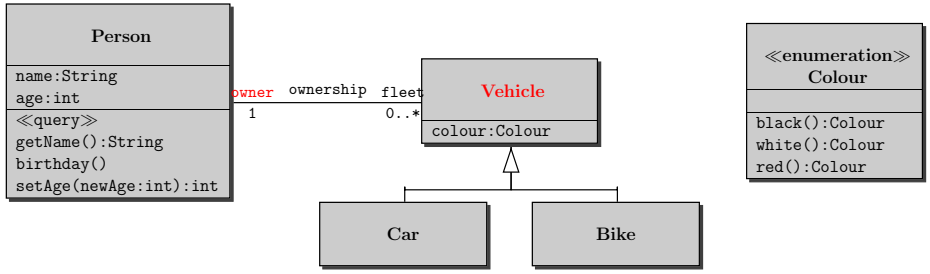

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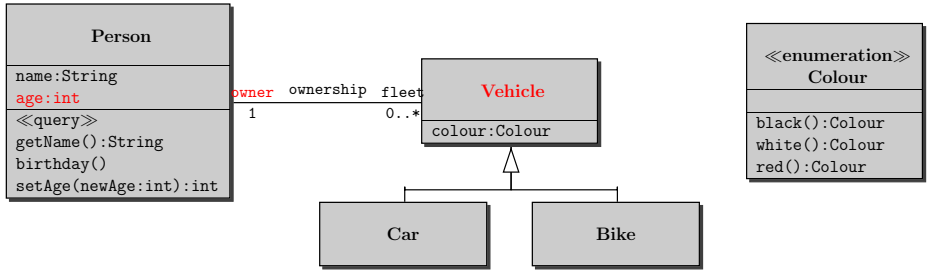

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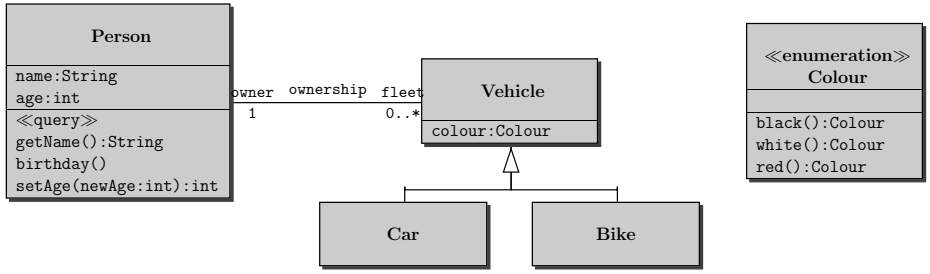

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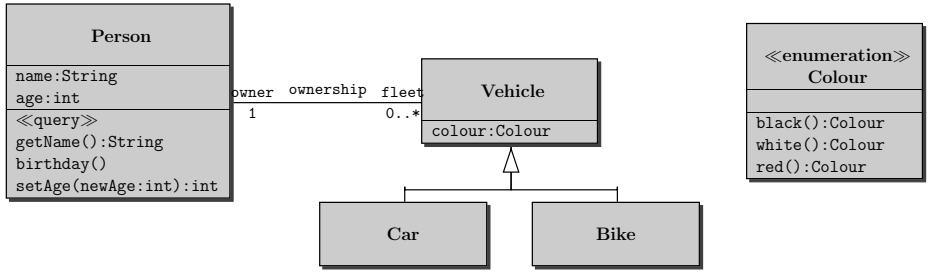

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What does this mean, instead?

context Person
inv: self.age $>=$ 18

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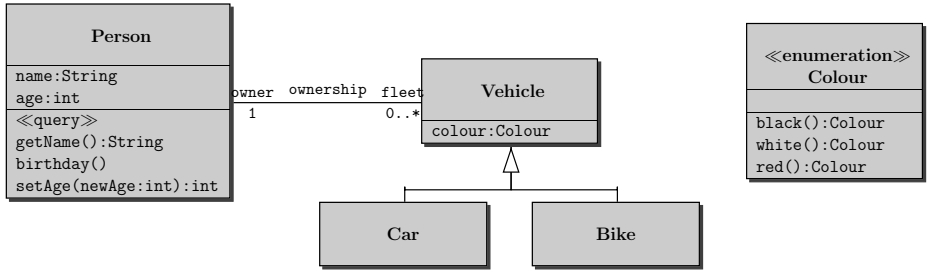

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"A car owner must be at least 18 years old":

context Car
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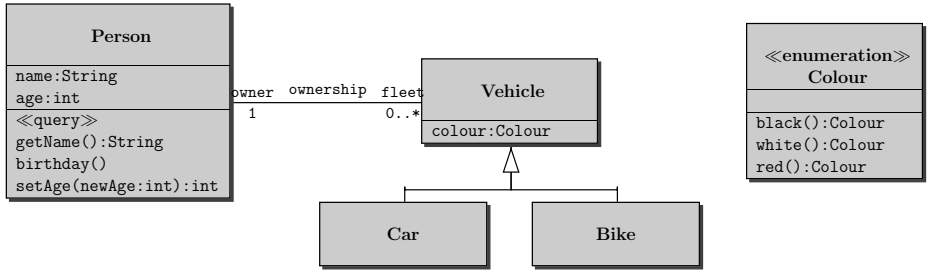

“Nobody has more than 3 vehicles”:

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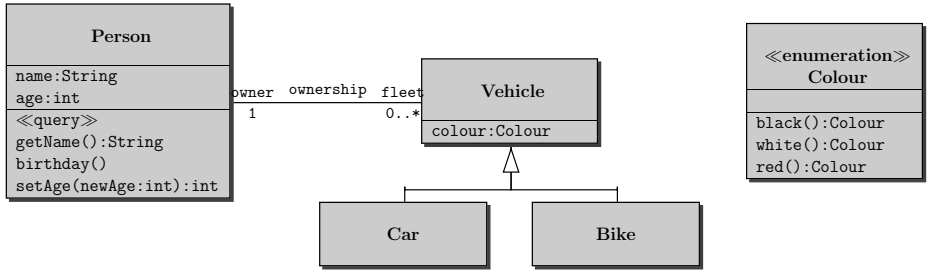
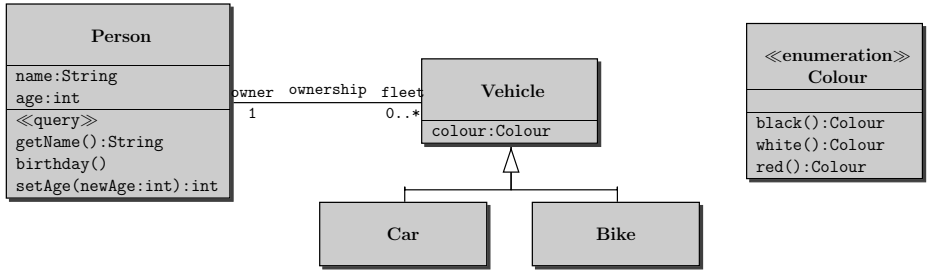


“Nobody has more than 3 vehicles”:

```
context  Person
inv:     self.fleet->size <= 3
```

or change multiplicity

Some OCL examples II



“All cars of a person are black”:

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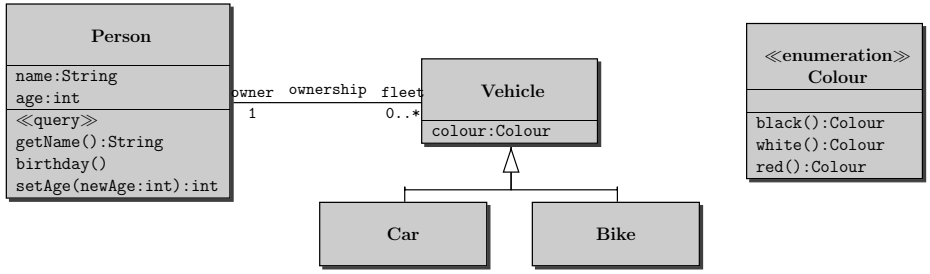

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context   Person
inv:      self.fleet->forAll(v | v.colour = #black)
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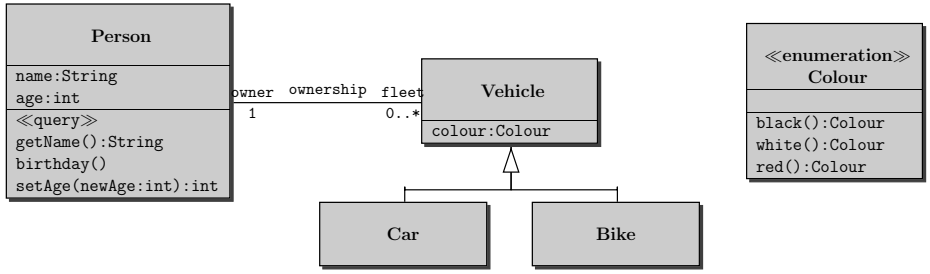

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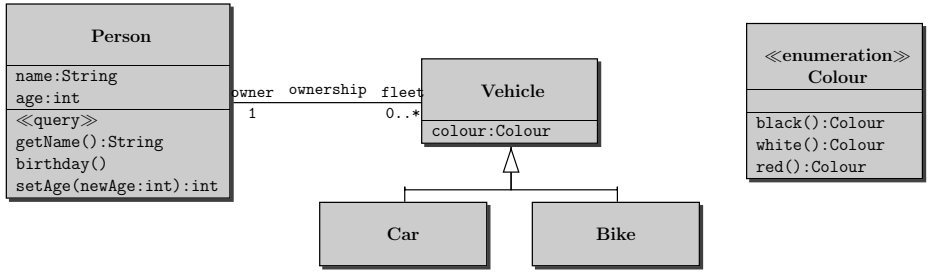

"All cars of a person are black":

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context   Person
inv:      self.fleet->forAll(v | v.colour = #black)
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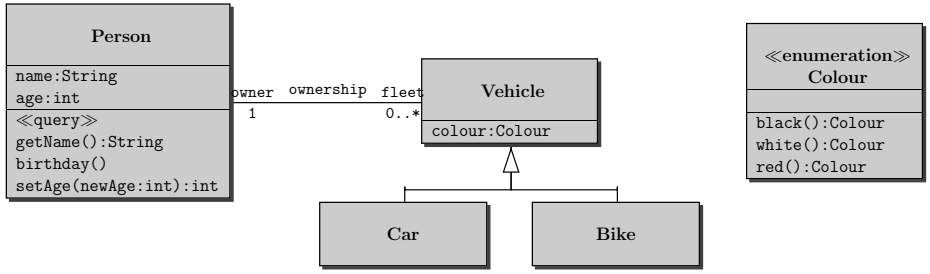
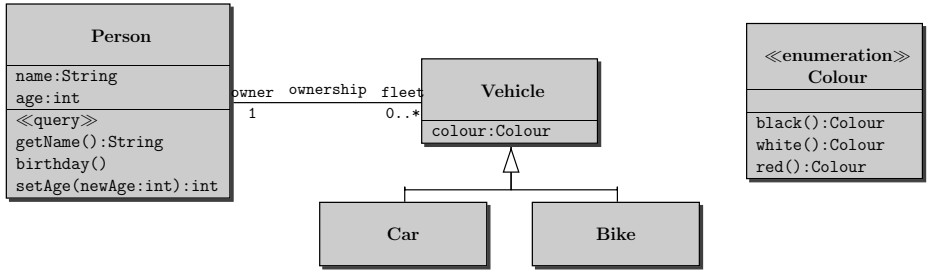
Some OCL examples III — iterate



What does this mean?

```
context   Person
inv:      self.fleet->iterate(v; acc:Integer=0
                              | if (v.colour=#black)
                              then acc + 1 else acc endif) <=3
```

Some OCL examples IV — oclIsKindOf



context Person
inv: age<18 implies self.fleet->forAll(v | not v.oclIsKindOf(Car))

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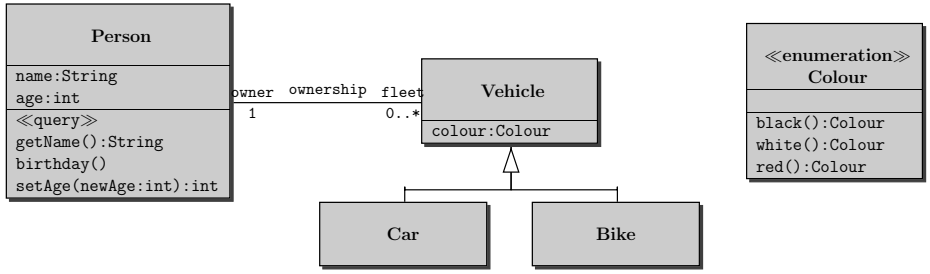

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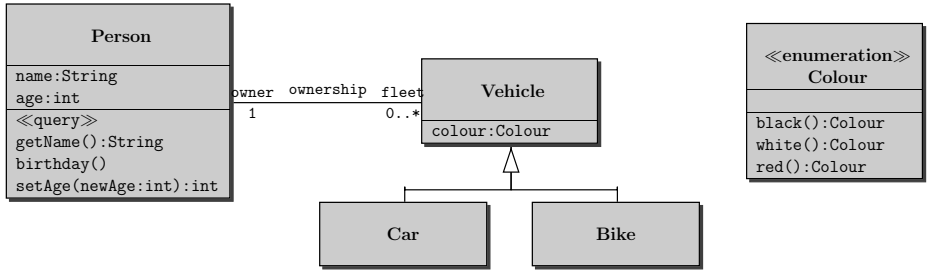

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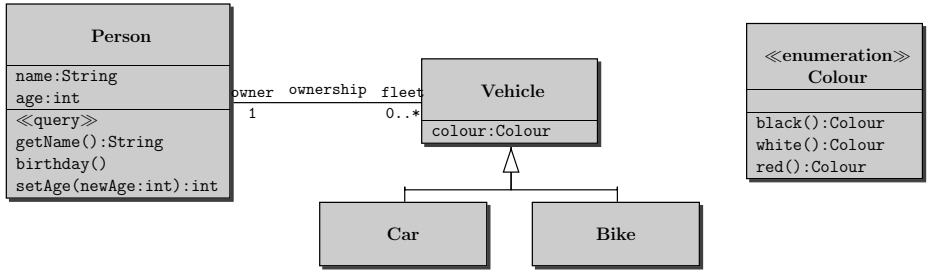

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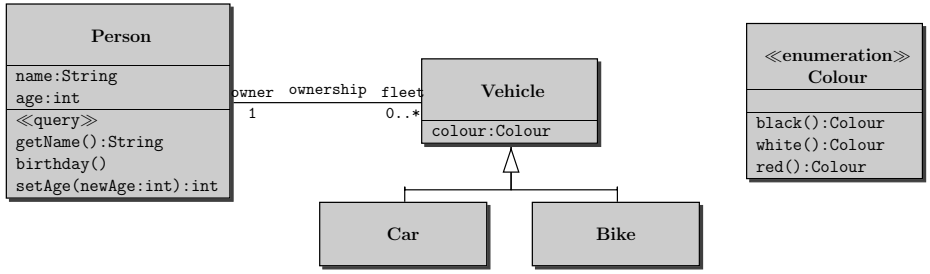
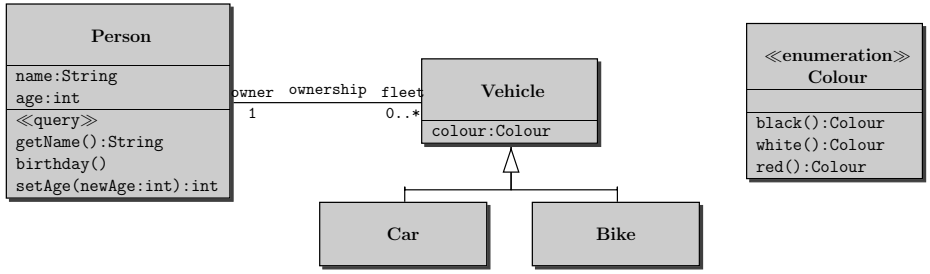
Logical Junctors: and, or, not, implies, if. . . then. . . else. . . endif, =

Some OCL examples V — allInstances



context Car
inv: Car.allInstances()->exists(c | c.colour=#red)

Some OCL examples V — allInstances



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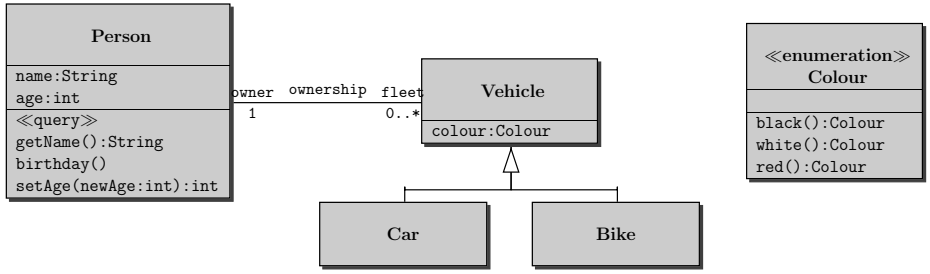
“There is a red car.”

OCL pre-/post conditions — Examples



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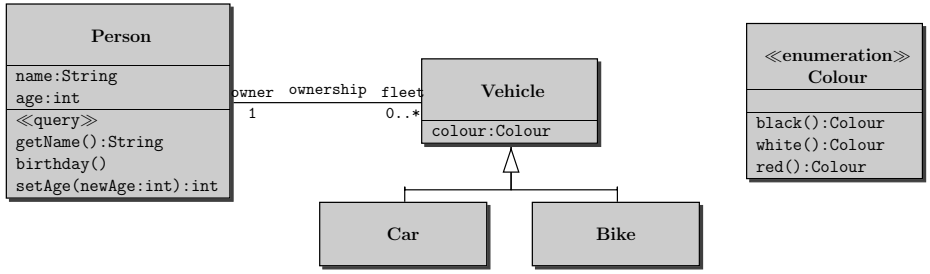

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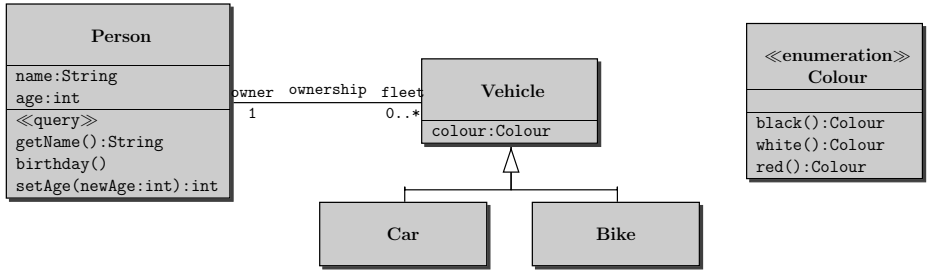

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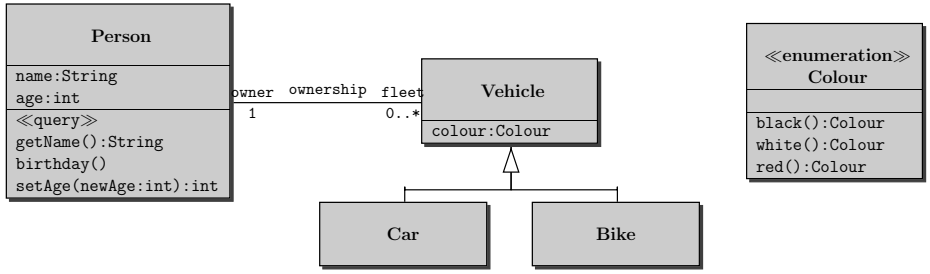
OCL can also specify operations:

"If setAge(. . .) is called with a non-negative argument then the argument becomes the new value of the attribute age."

context Person::setAge(newAge:int)
pre: newAge >= 0
post: self.age = newAge

OCL pre-/post conditions — Examples



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OCL can also specify operations:

“Calling birthday() increments the age of a person by 1.”

context Person::birthday()
post: self.age = self.age@pre + 1

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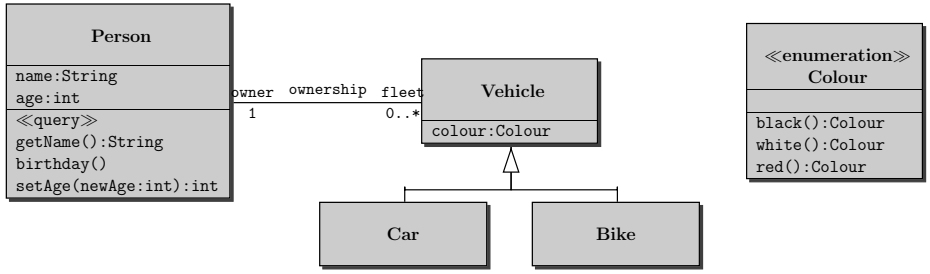

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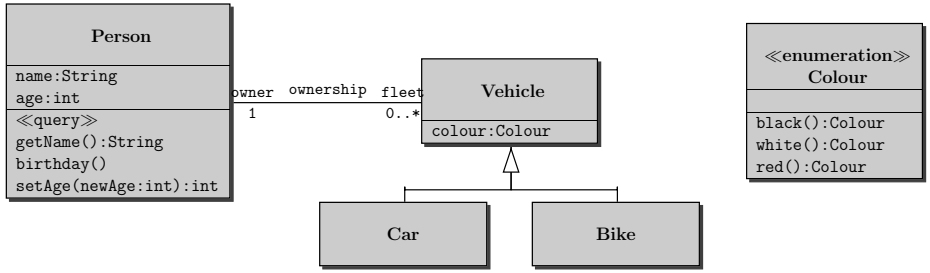
OCL can also specify operations:

“Calling getName() delivers the value of the attribute name.”

context Person::getName()
post: result = name

Queries



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Only these operations can be used within an OCL expression.

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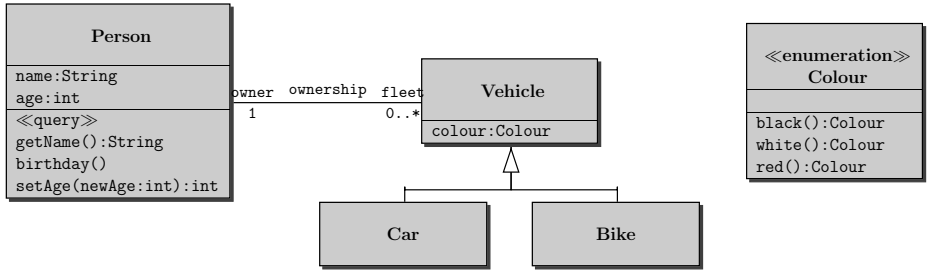

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“Calling getName() delivers the value of the attribute name.”

```
context   Person
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- **OCL is used to specify invariants of objects and pre- and post conditions of operations. Makes UML (class) diagrams more precise.**

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- OCL attribute accesses “navigate” through UML class diagram.
- “context” specifies about which elements we are talking.
- “self” indicates the current object. “result” the return value.

OCL Basics (cont.)

- **OCL can talk about collections (here: sets).**

  Operations on collections: –>

  Example operations: select, forAll, iterate

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- **“iterate” can simulate all other operations on collections.**

- **Queries (= side-effect-free operations) can be used in OCL expressions.**

OCL in TogetherCC/KeY

TogetherCC cannot process OCL constraints. It is however possible to specify textual invariants and pre- and post conditions.

With the KeY extensions to TogetherCC syntax (type) checks of OCL constraints are possible.

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(represented by a UML object diagram)

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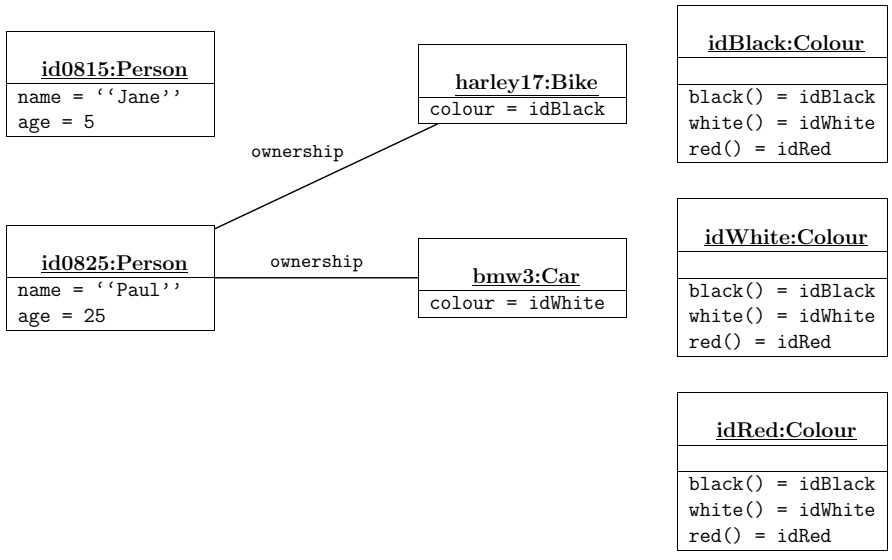

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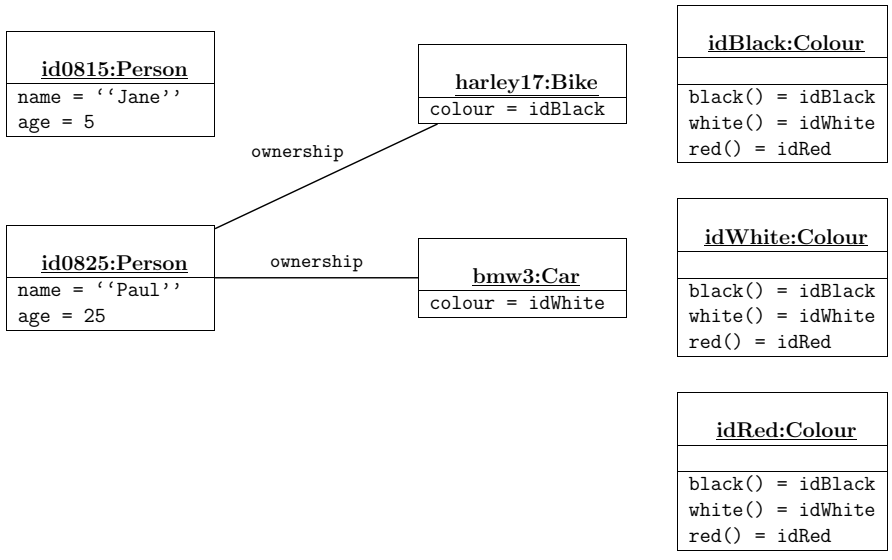

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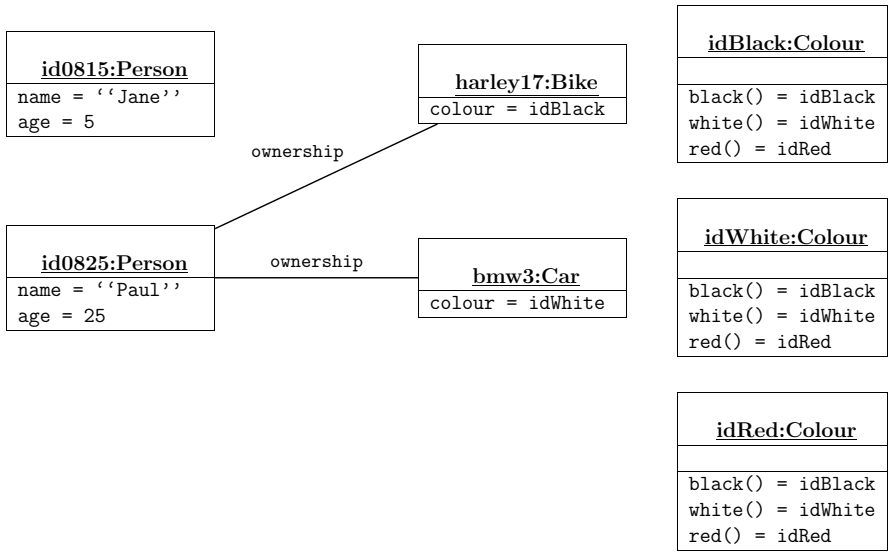

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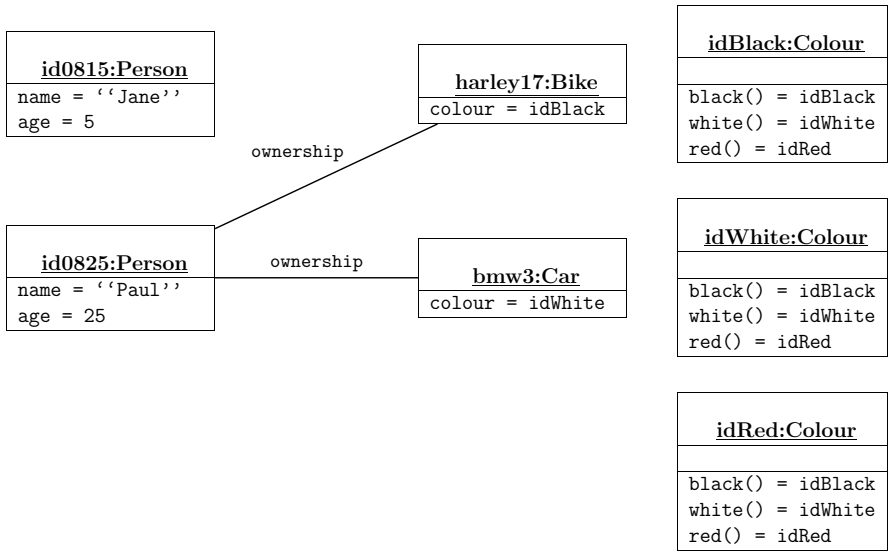

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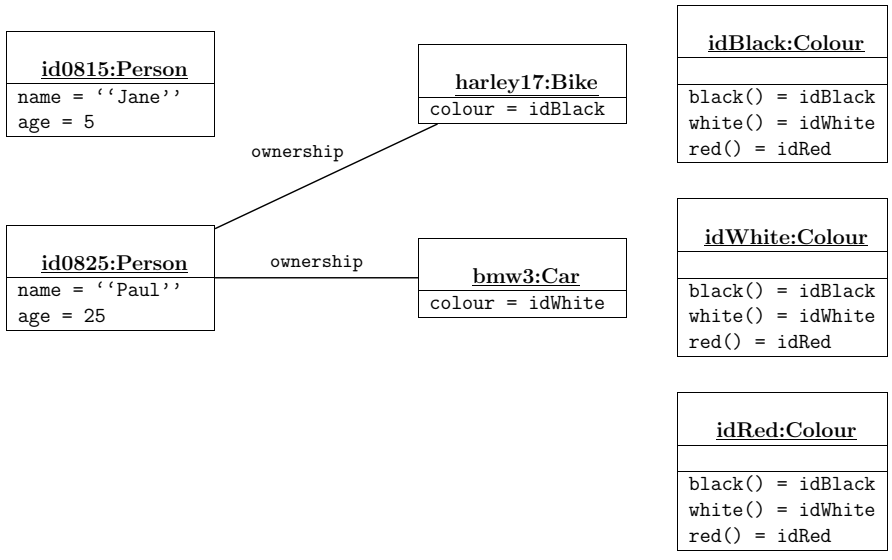

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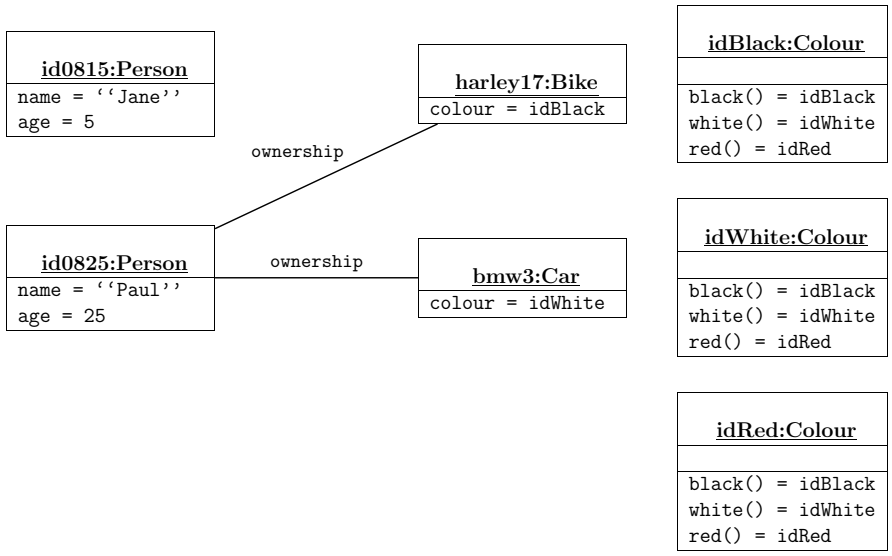

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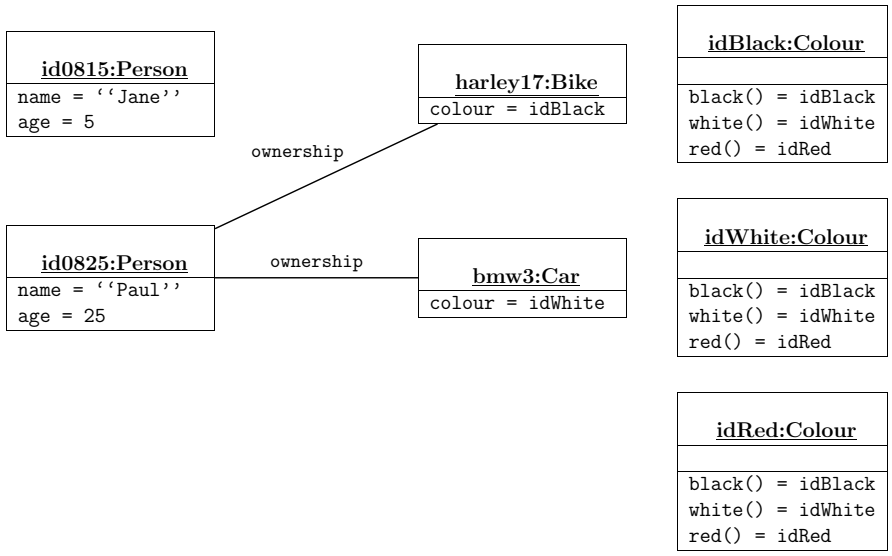

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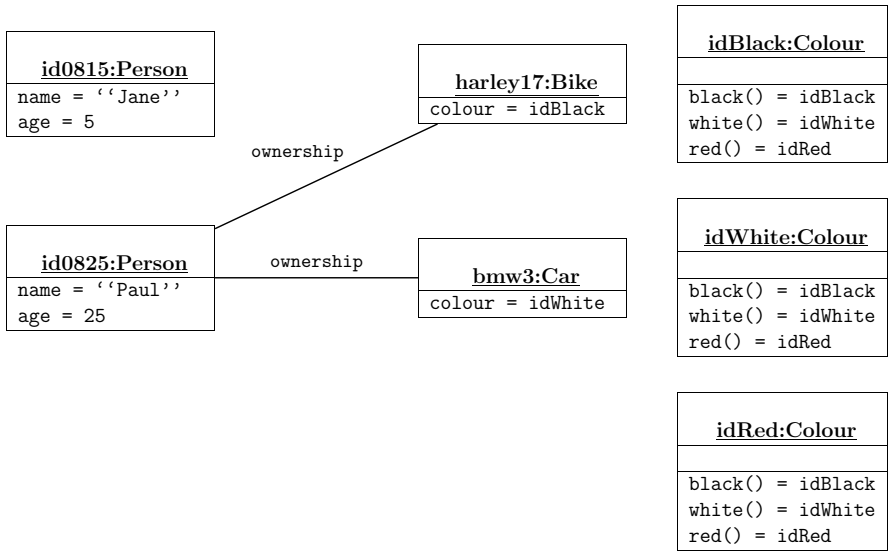

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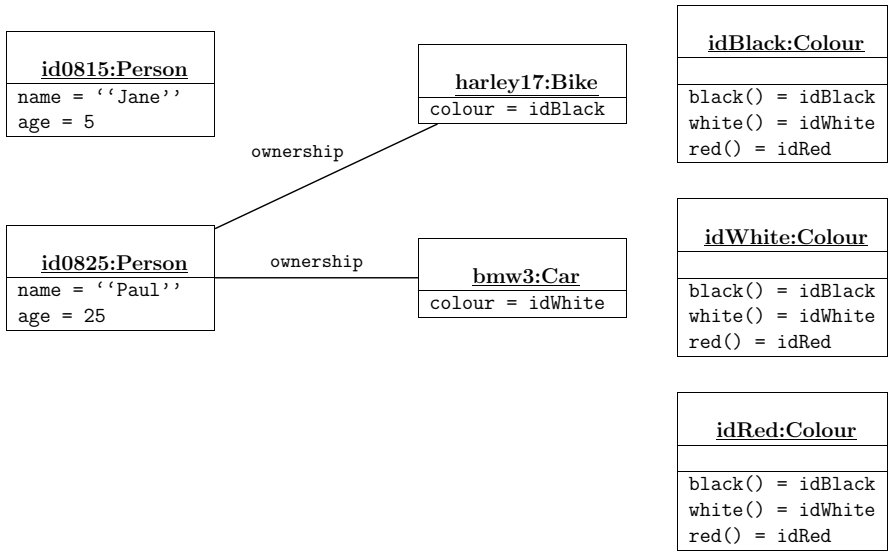

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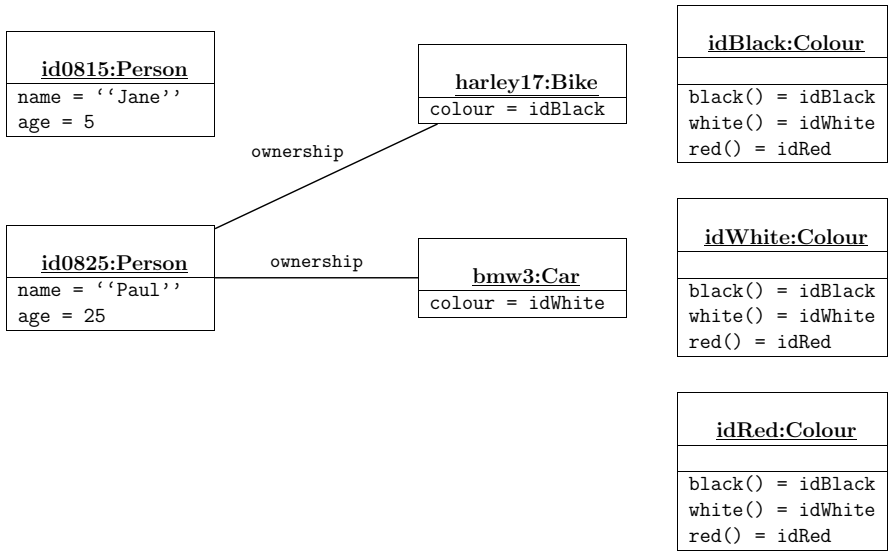

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- **(standard) interpretation for predefined primitive data types (e.g. Integer, String,. . .)**

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  Answer in three weeks.

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