MAMBA
Model-Based Software Analysis Utilizing OMG's SMM
WSR 2012

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Contents

1. Motivation
2. Structured Metrics Meta-Model
3. MAMBA
4. Conclusions

Goal: Model-Based Software Analysis with SMM [Obj12]

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- Re-usable metrics

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- OMG's Structured Metrics Meta-Model (SMM)
- Measurement Architecture for Model-Based Analysis (MAMBA) [FvHJ+11]

  `http://mamba-framework.sf.net/`

Bookstore - Example

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Example Metrics

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- Number of classes

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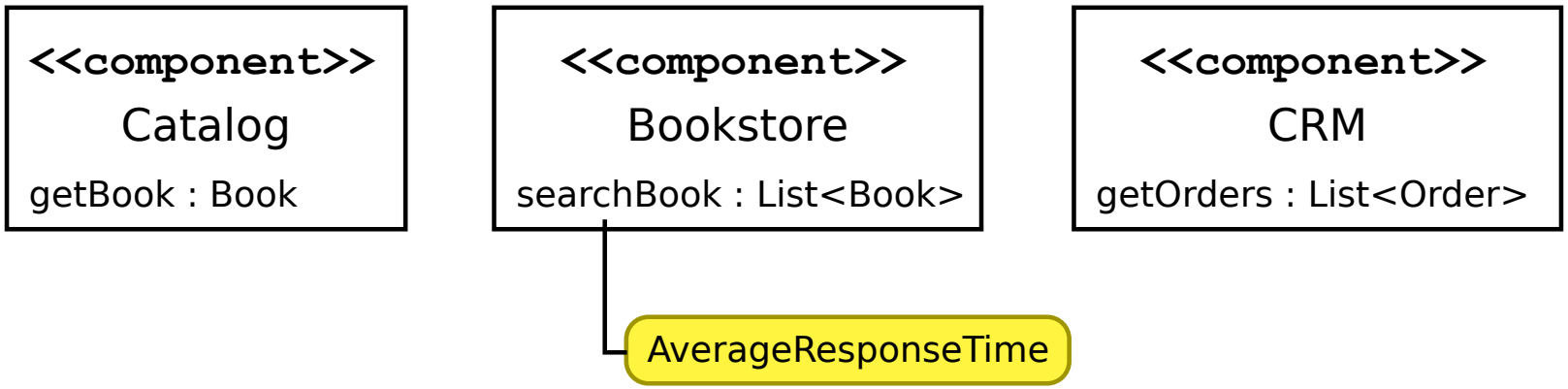
- Number of classes
- Average response time of methods

Bookstore - Example



Example Metrics

- Number of classes
- Average response time of methods (here `searchBook`)

Composition

- Definition of measures

Composition

- Definition of measures
- Definition of observations

Composition

- Definition of measures
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- Collection of measurement results

SMM Features

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Measures

- Direct measures, like a ClassRecognizer

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- Definition of measures
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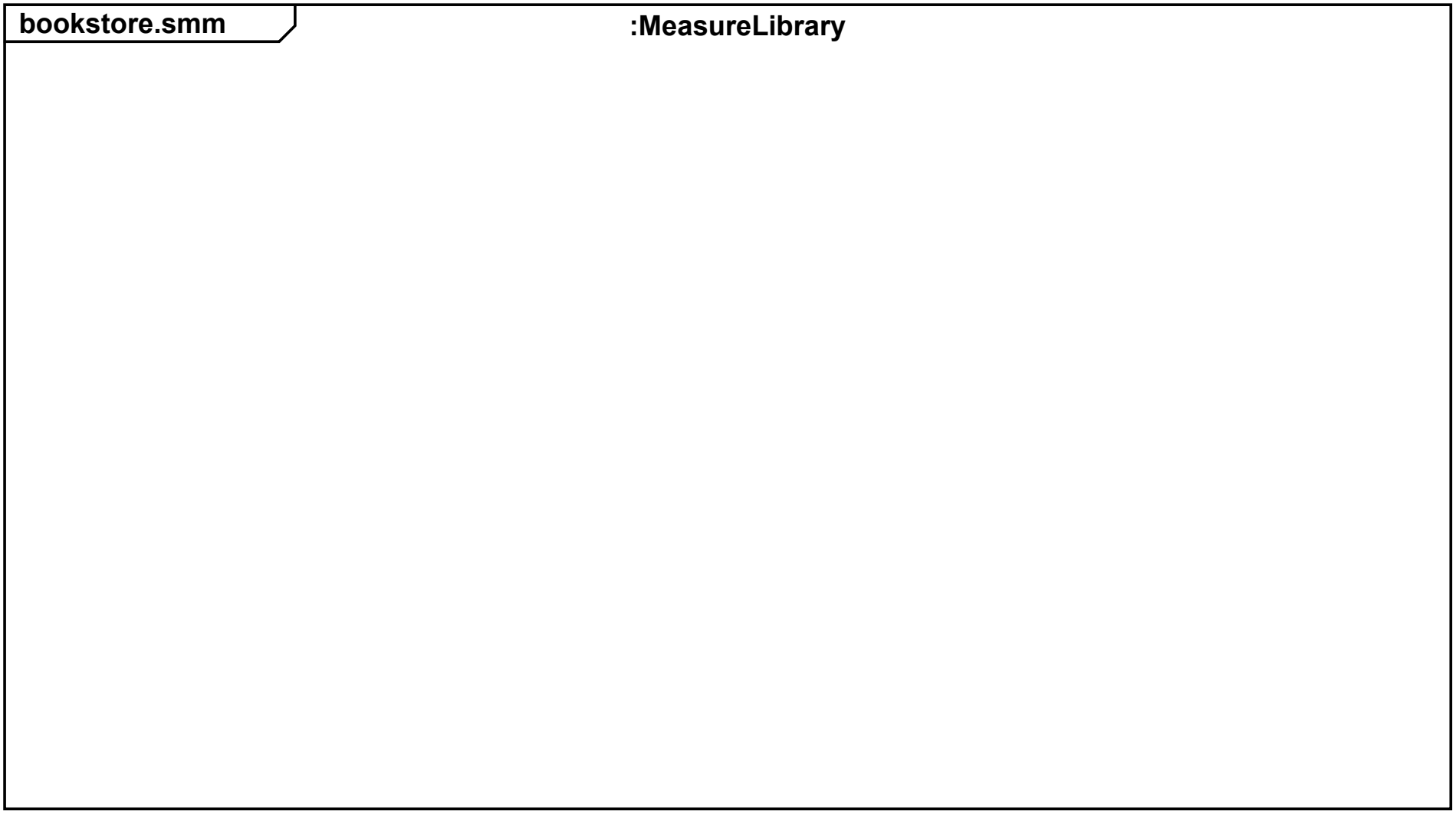
Measures

- Direct measures, like a ClassRecognizer
- Derived measures, like a NumberOfClasses

- Closed: rely only on SMM and observed model
- Open: require additional external data (e.g. monitoring data)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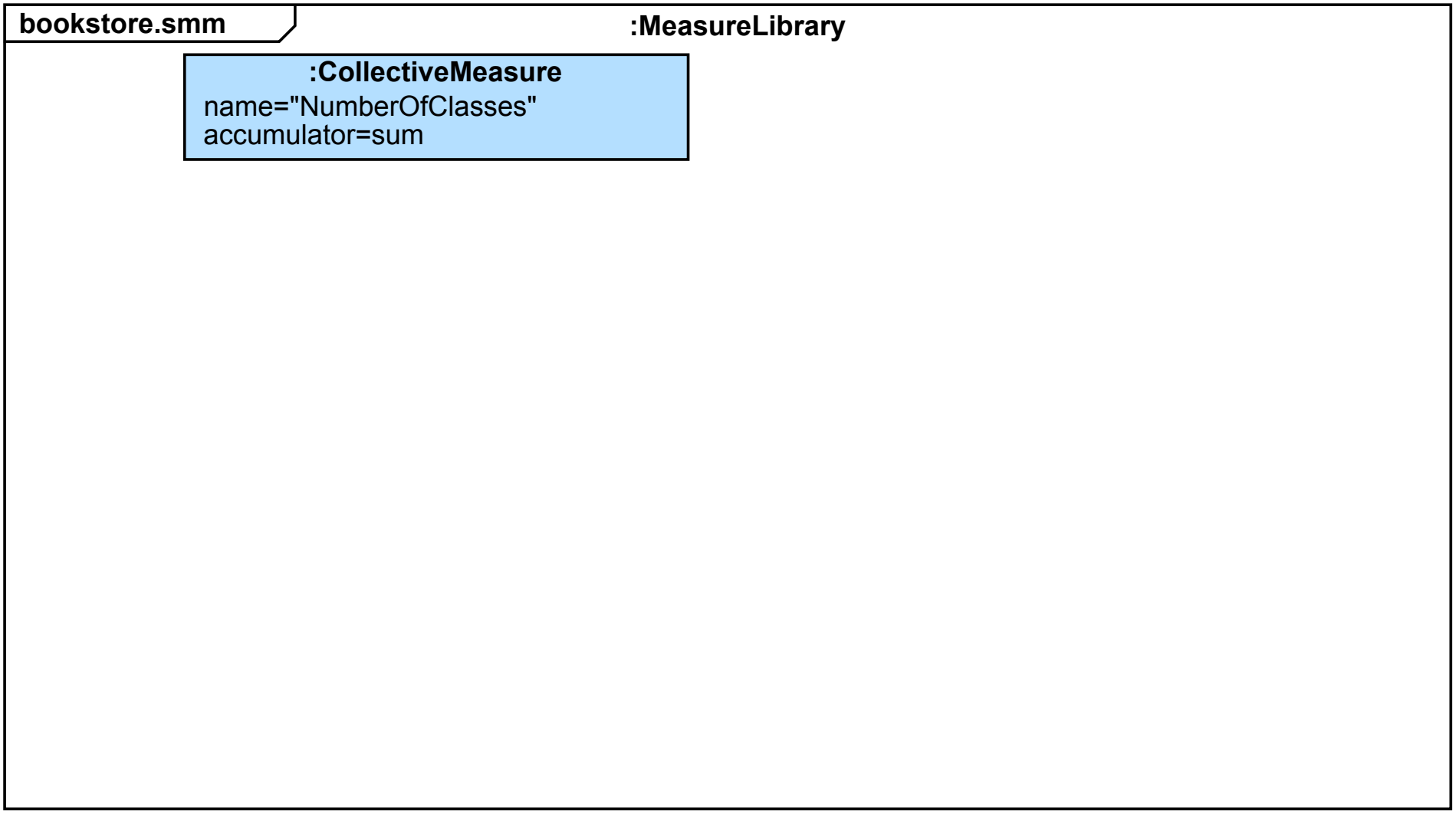
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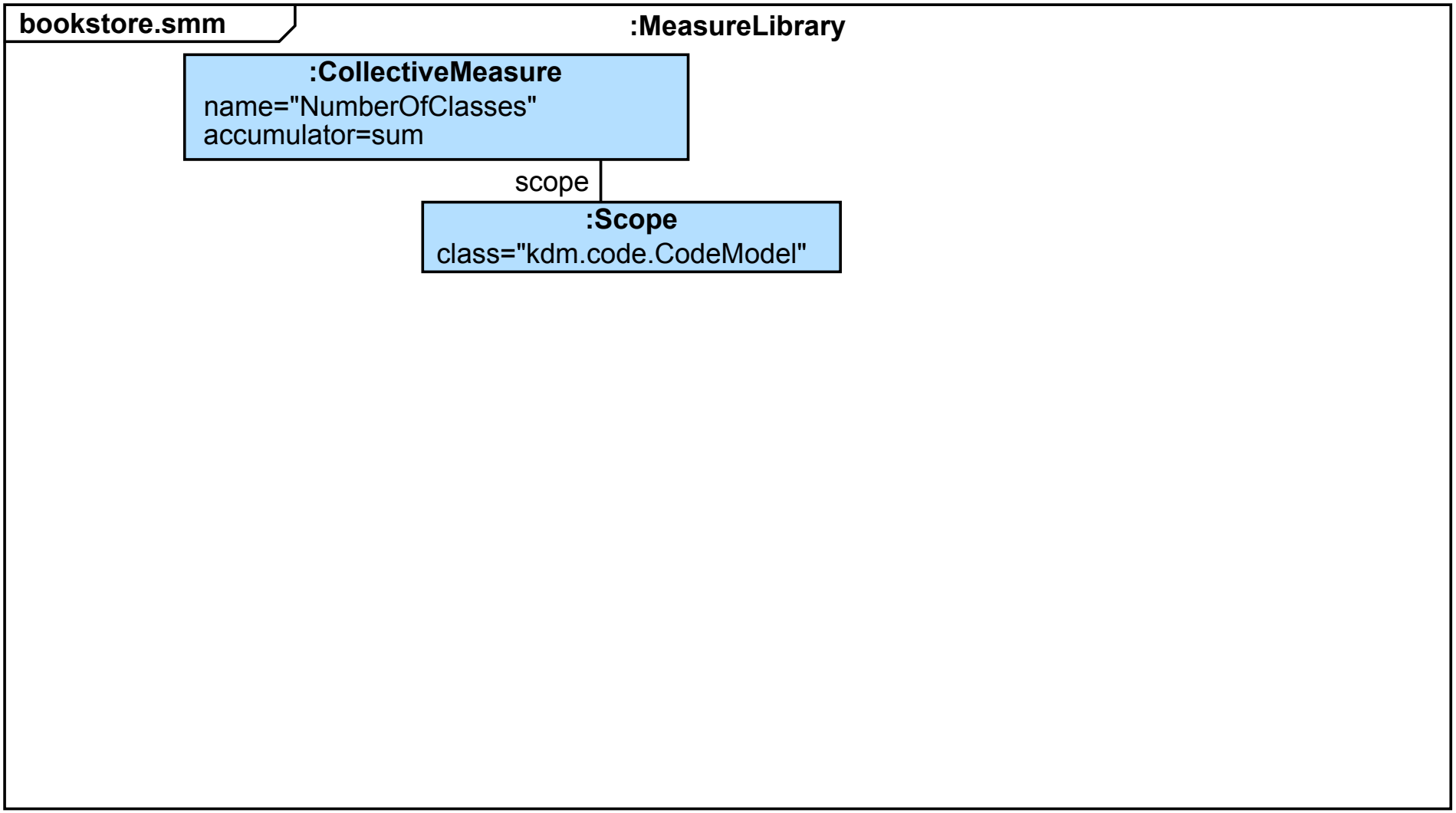
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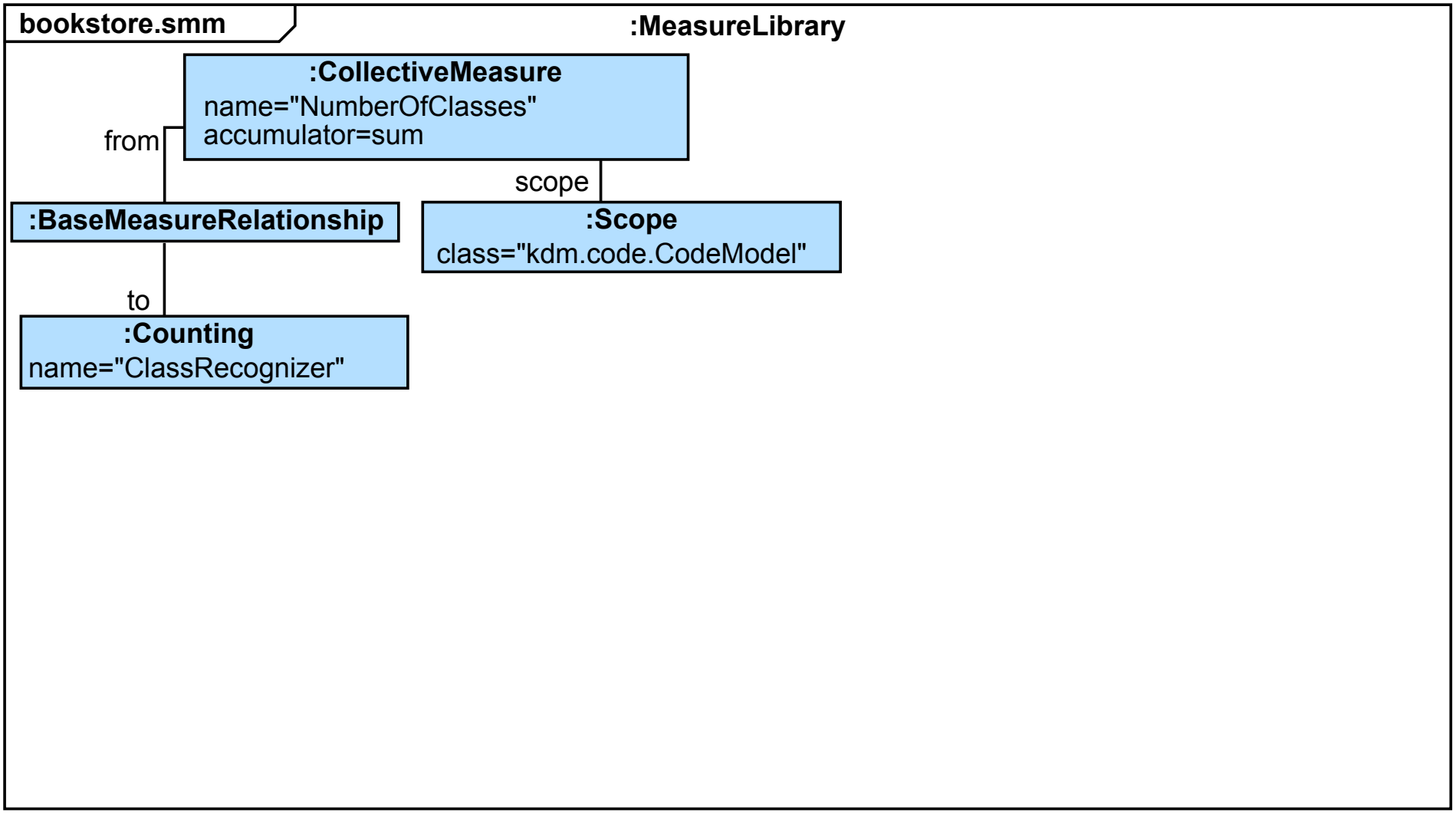
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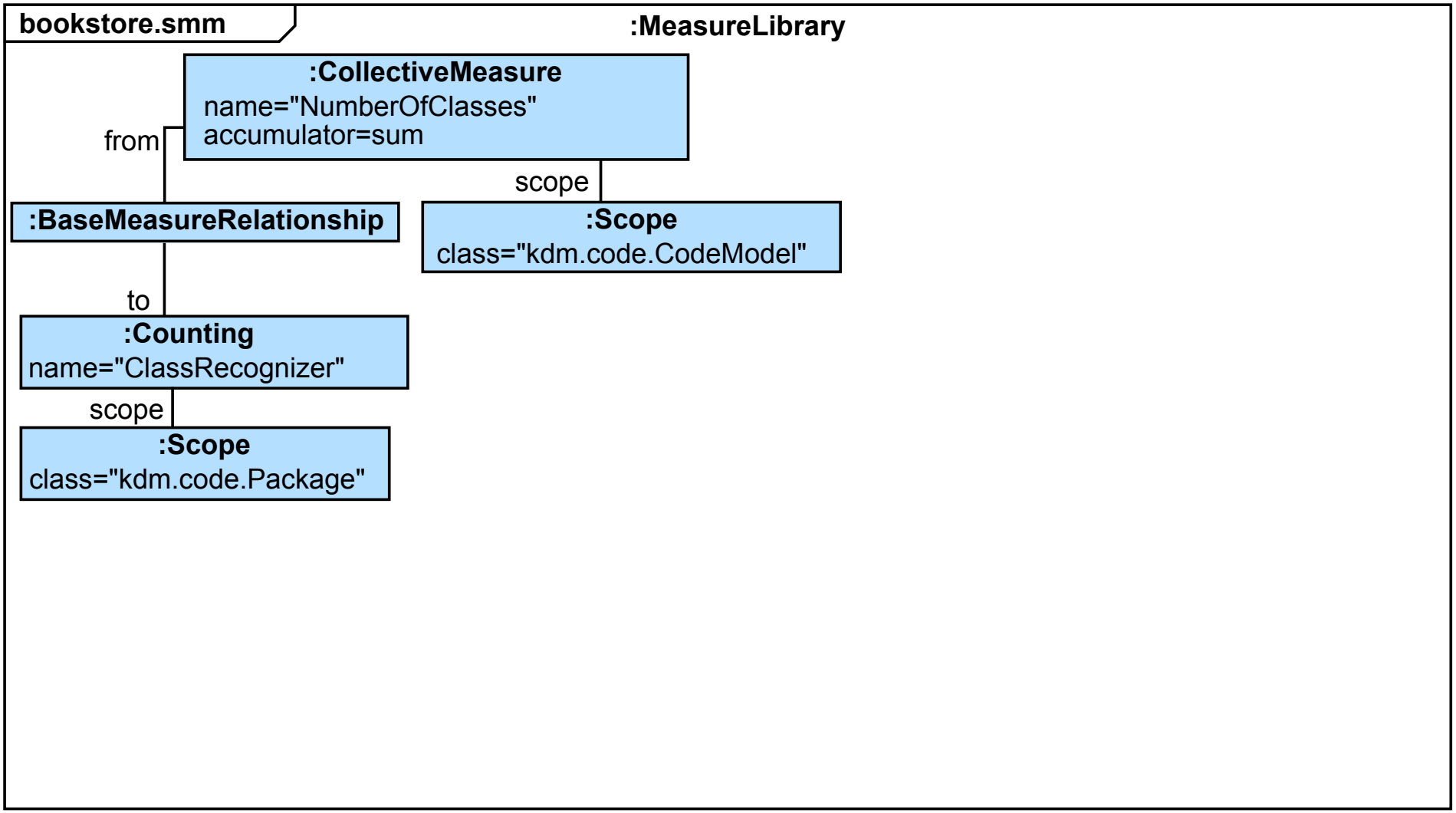
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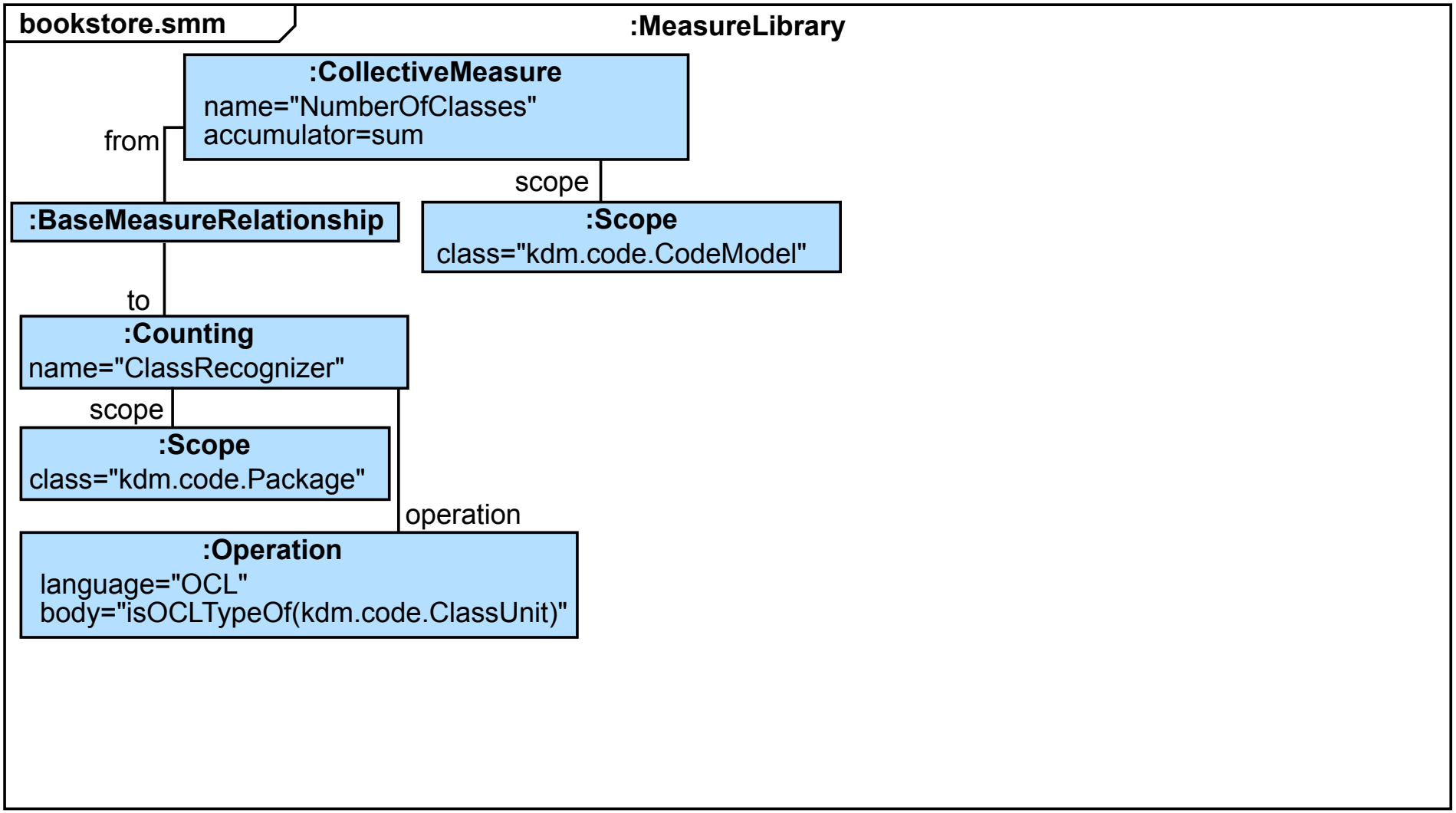
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operation
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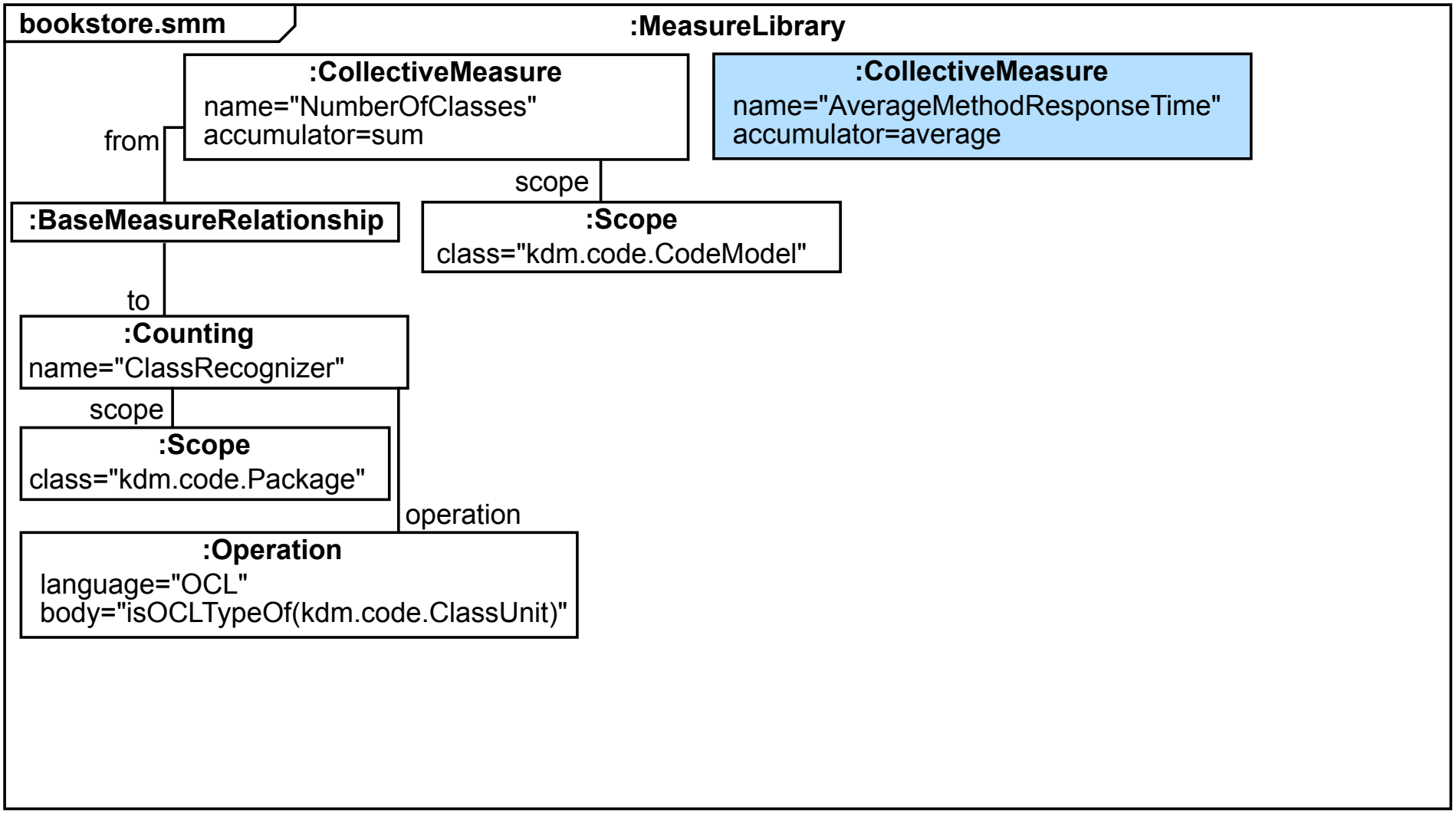
body="isOCLTypeOf(kdm.code.ClassUnit)"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accumulator=average
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to
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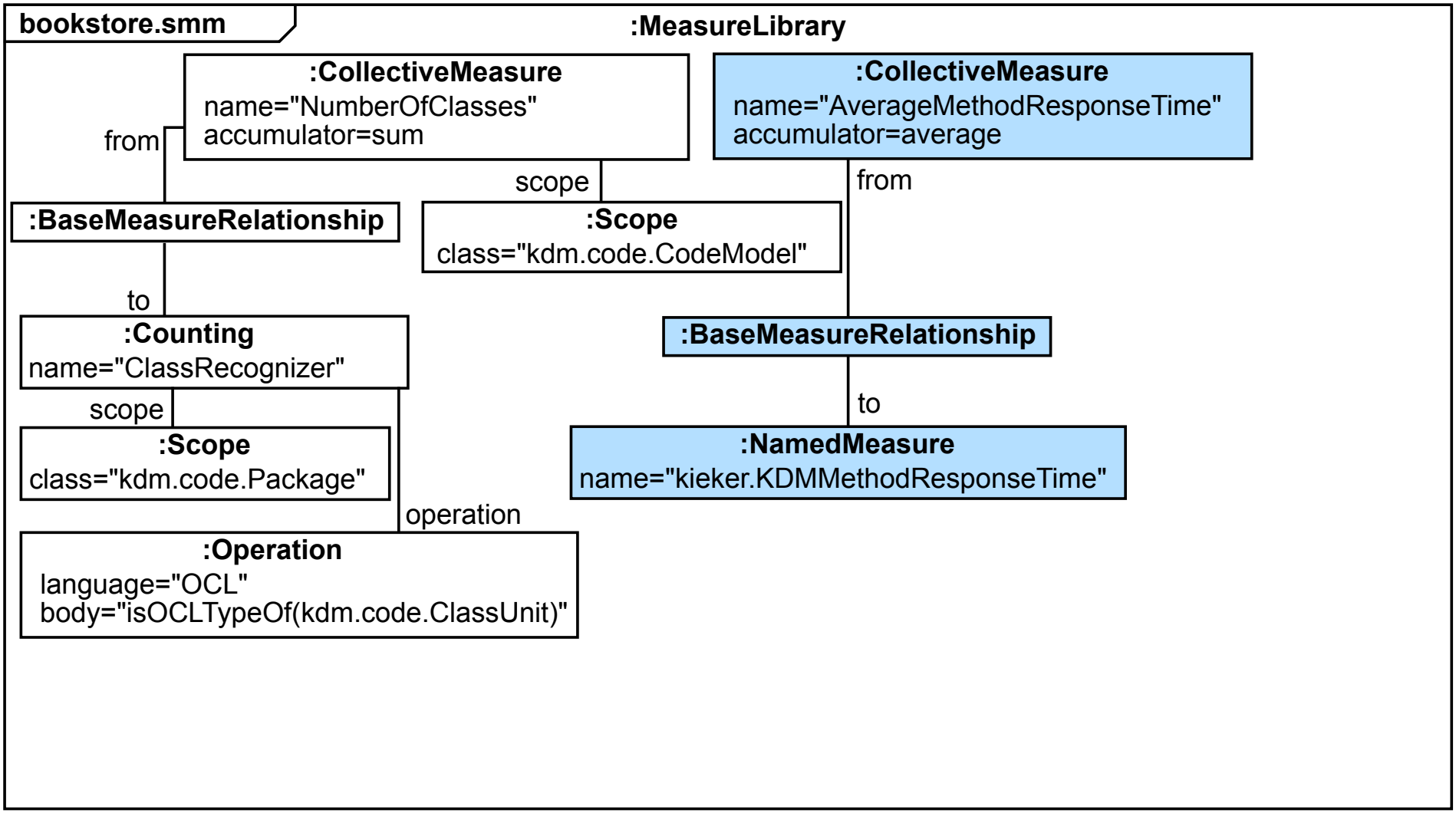
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accumulator=sum
:CollectiveMeasure
name="AverageMethodResponseTime"
accumulator=average
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from
:BaseMeasureRelationship
:Scope
class="kdm.code.CodeModel"
to
:Counting
name="ClassRecognizer"
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scope
to
:Scope
class="kdm.code.Package"
:NamedMeasure
name="kieker.KDMMethodResponseTime"
operation
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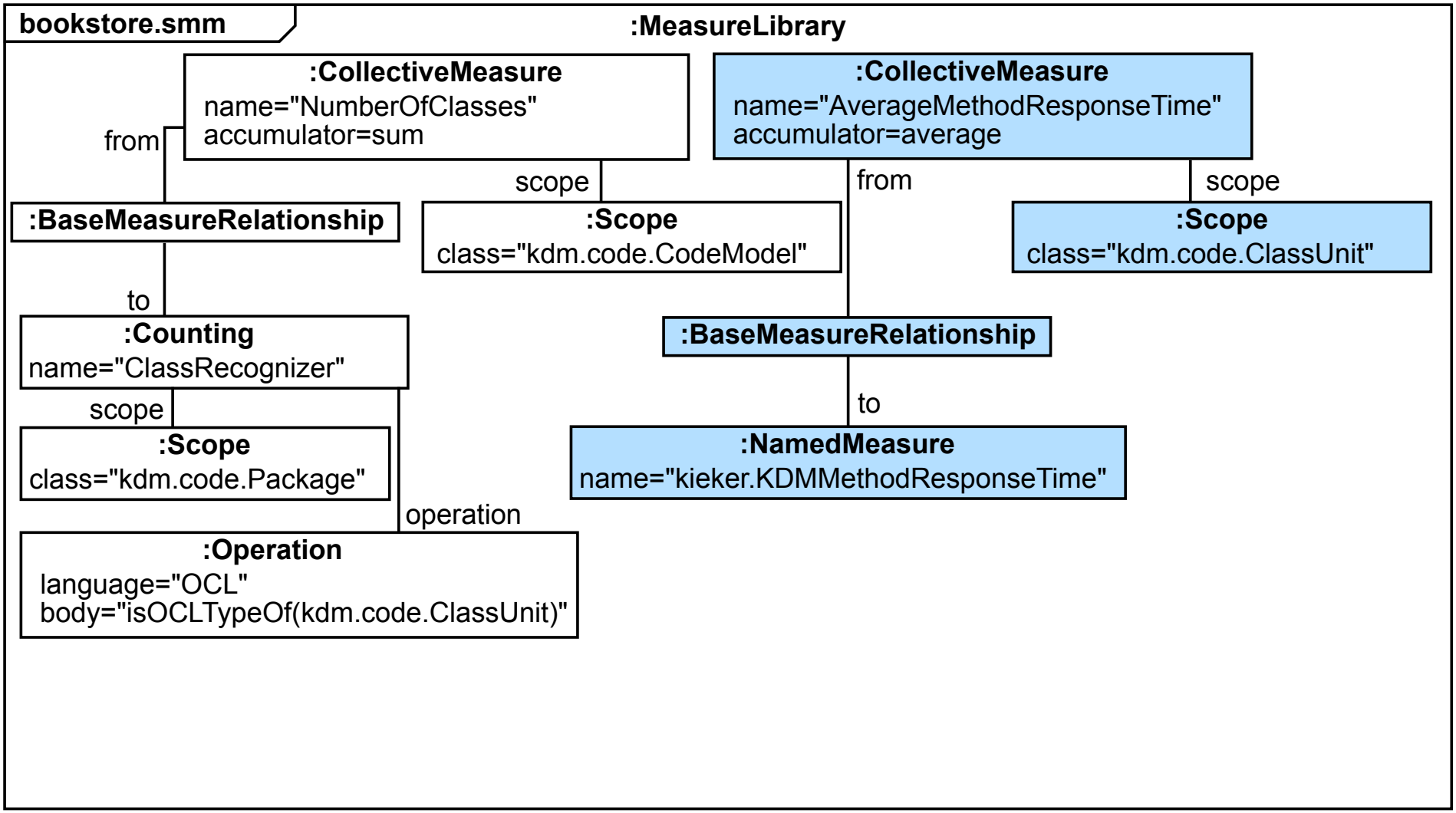
language="OCL"
body="isOCLTypeOf(kdm.code.ClassUnit)"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:Scope
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class="kdm.code.ClassUnit"
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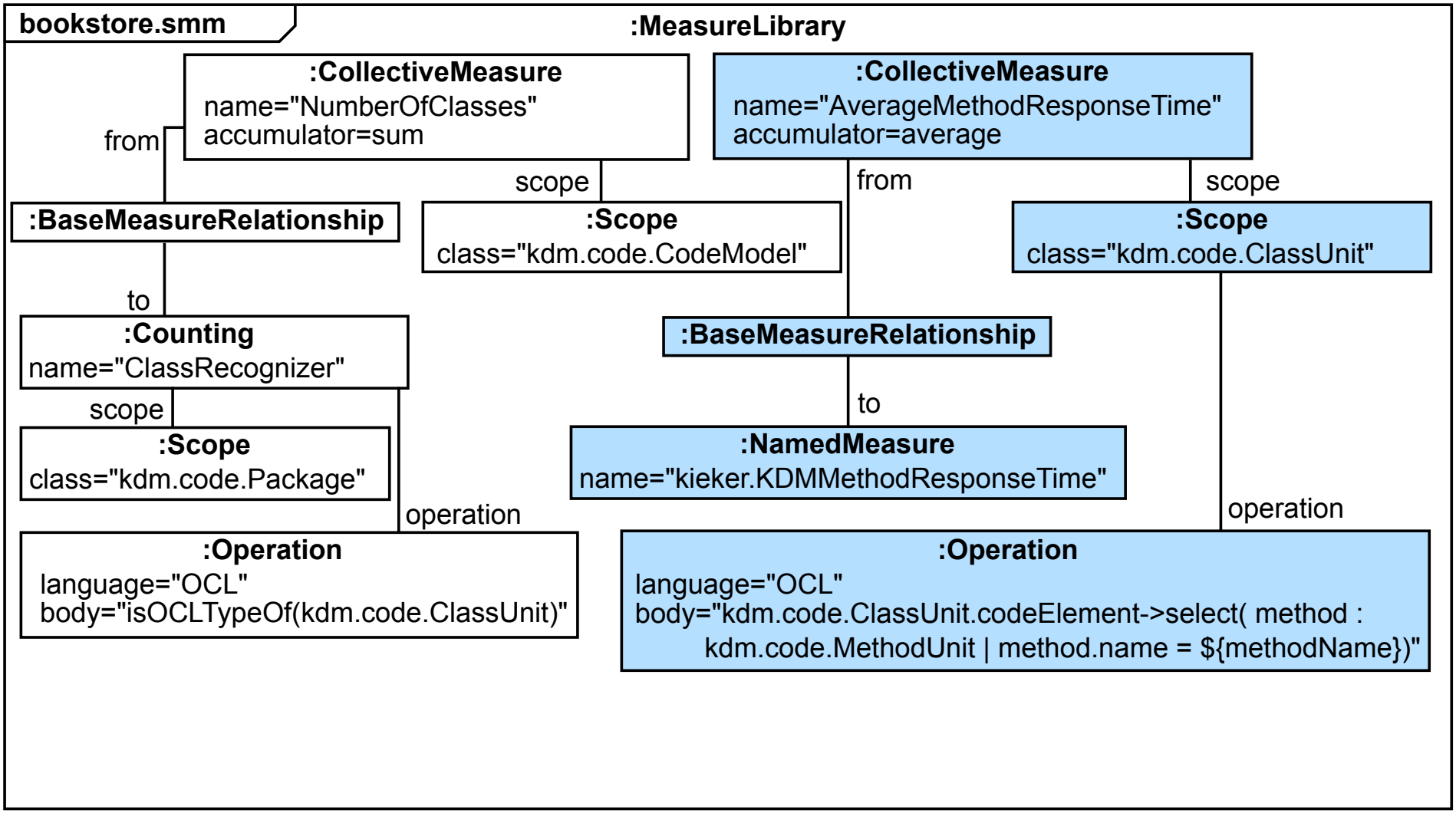
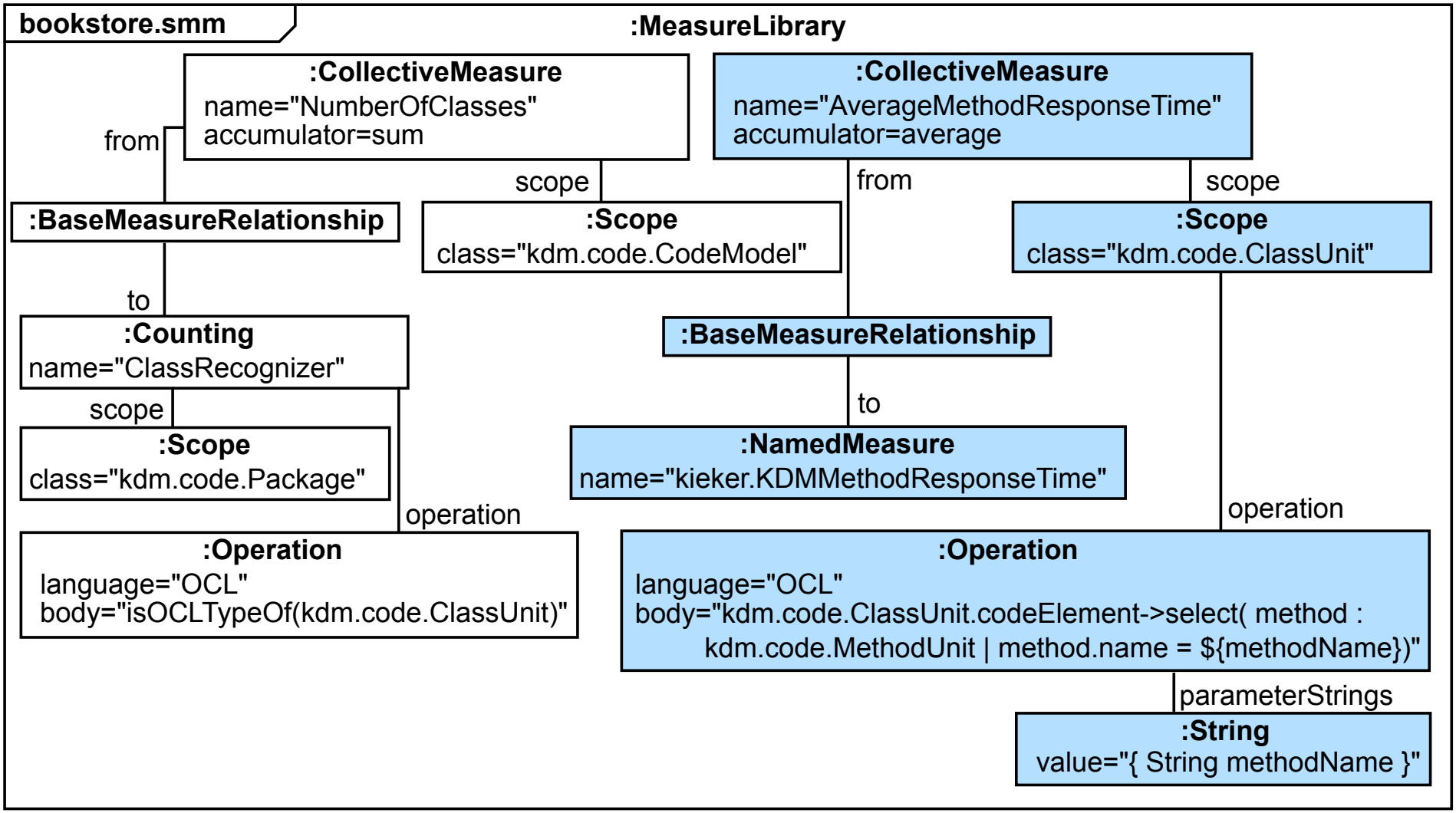
Measuring with SMM




bookstore.smm
:MeasureLibrary
:CollectiveMeasure
name="NumberOfClasses"
accumulator=sum
:CollectiveMeasure
name="AverageMethodResponseTime"
accumulator=average
from
scope
from
scope
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:Scope
class="kdm.code.CodeModel"
:Scope
class="kdm.code.ClassUnit"
to
:Counting
name="ClassRecognizer"
:BaseMeasureRelationship
scope
to
:Scope
class="kdm.code.Package"
:NamedMeasure
name="kieker.KDMMethodResponseTime"
operation
operation
:Operation
language="OCL"
body="isOCLTypeOf(kdm.code.ClassUnit)"
:Operation
language="OCL"
body="kdm.code.ClassUnit.codeElement->select(method :
kdm.code.MethodUnit | method.name = ${methodName})"
parameterStrings
:String
value="{ String methodName }"

Declaring an Observation

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- Observed measures

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- Referenced measures (selection of the measures)

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Advantages

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- No tool support

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- No support for periodic measures

A **M**easurement **A**rchitecture for **M**odel-**B**ased **A**nalysis

- Framework

C A U
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A **M**easurement **A**rchitecture for **M**odel-**B**ased **A**nalysis

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- Eclipse-based Tooling

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- Framework
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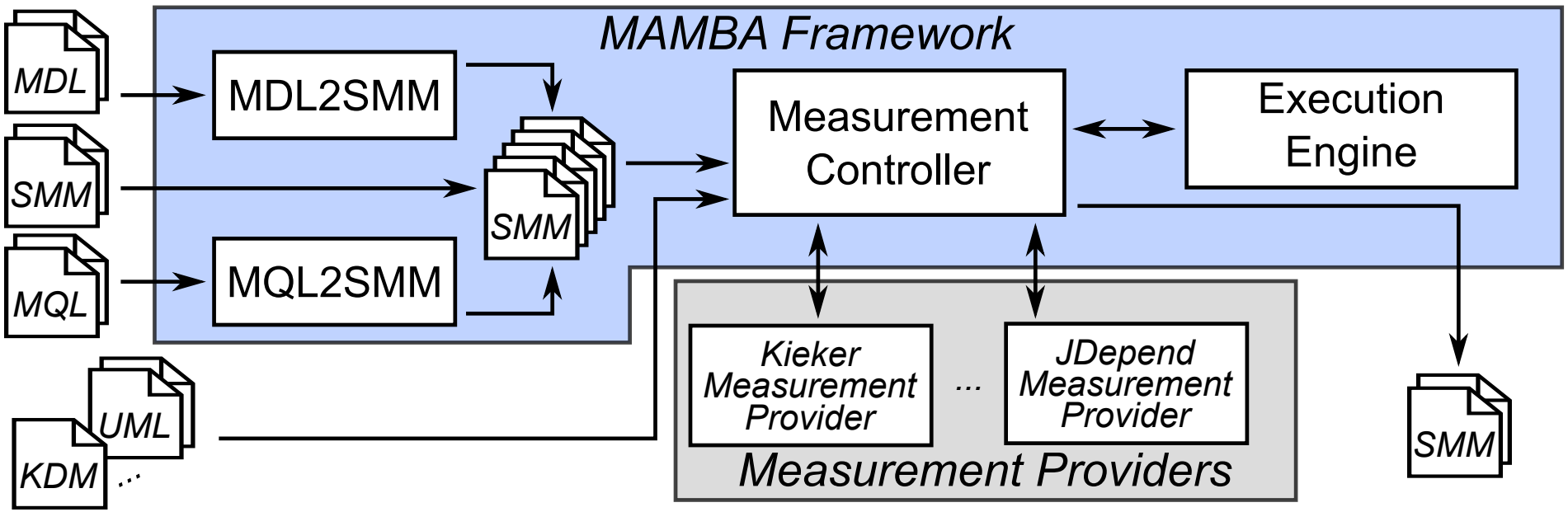
- Specification Languages

Framework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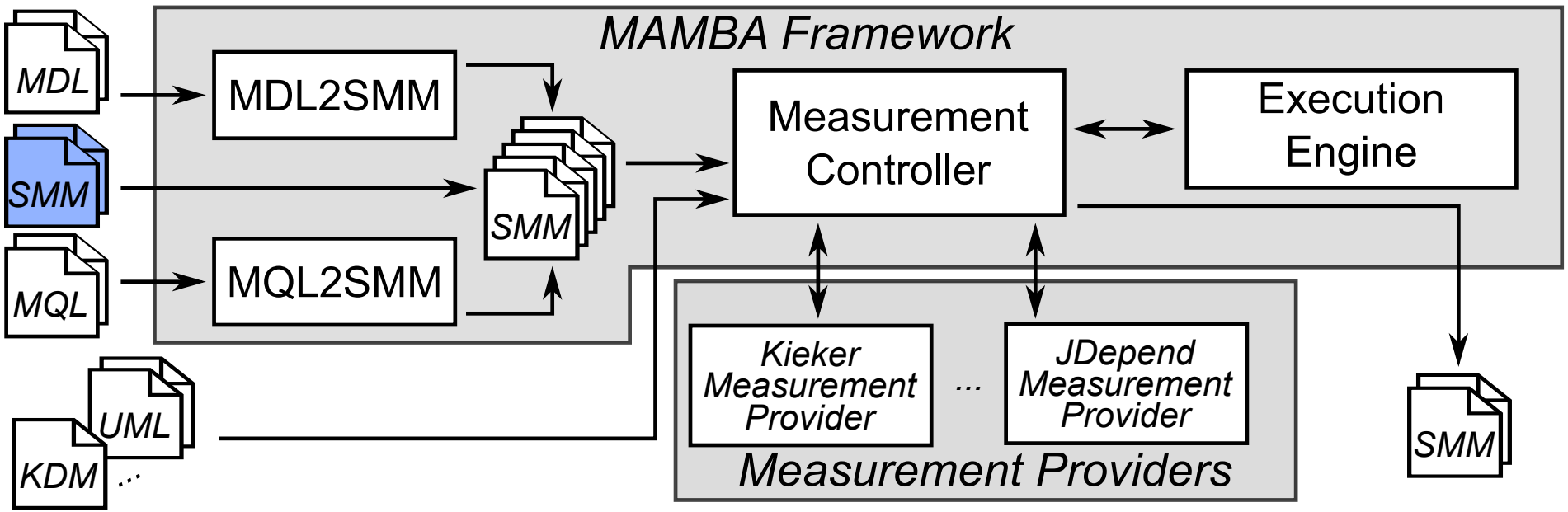
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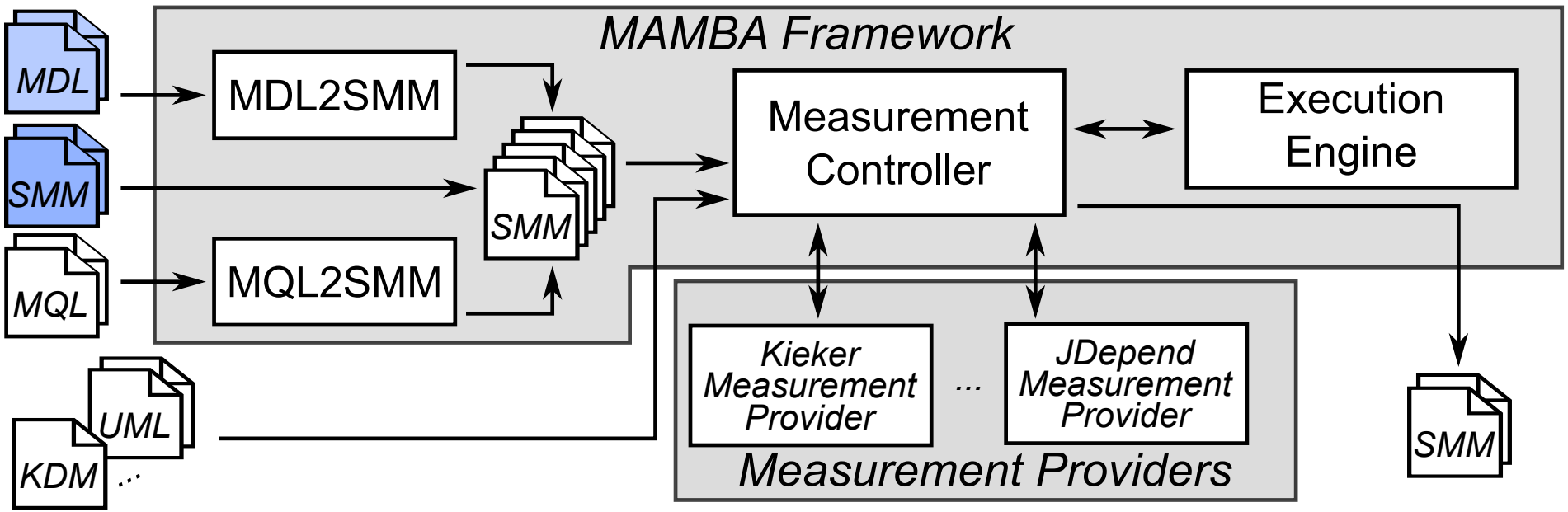
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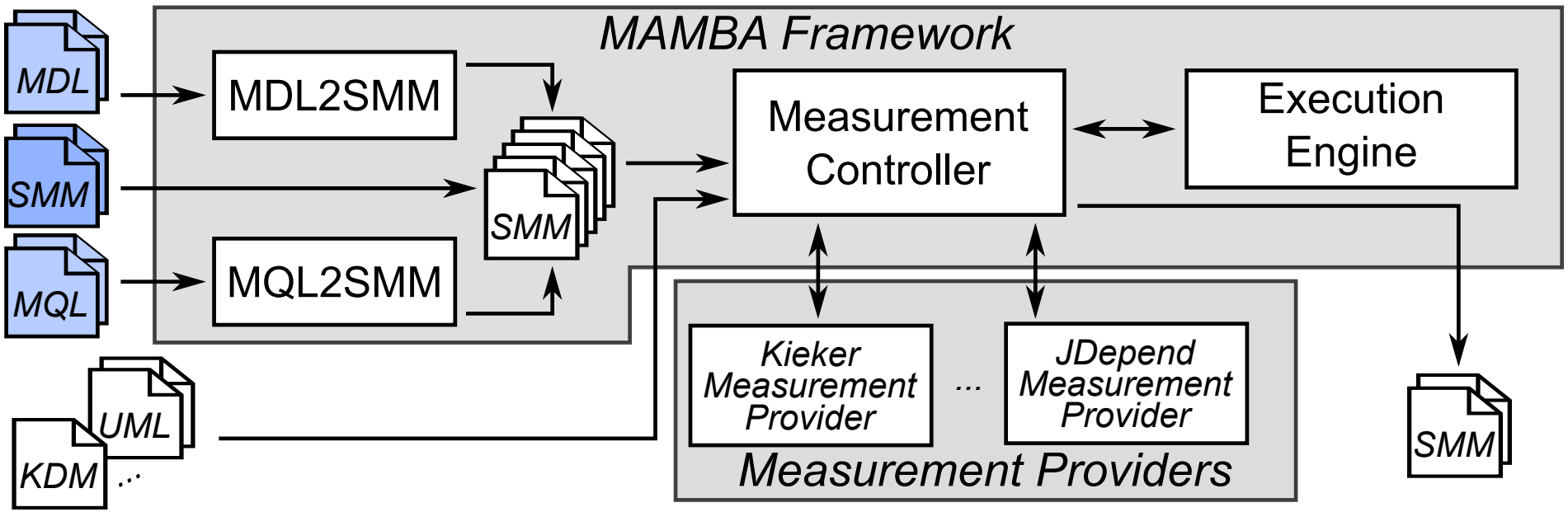
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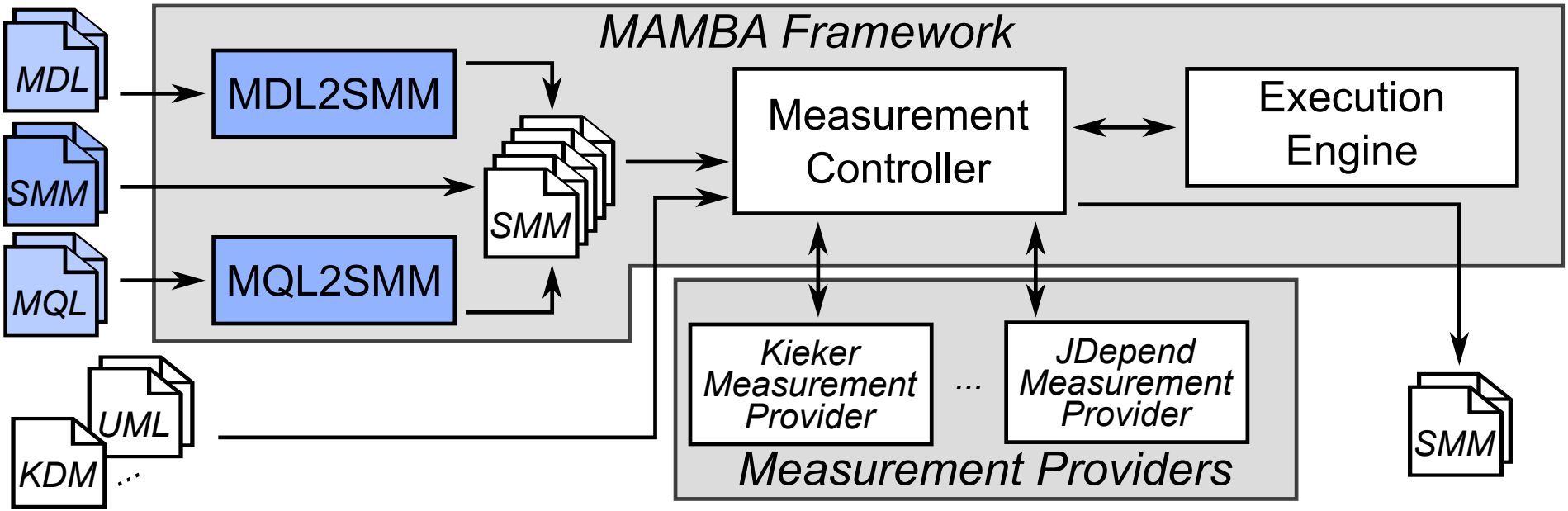
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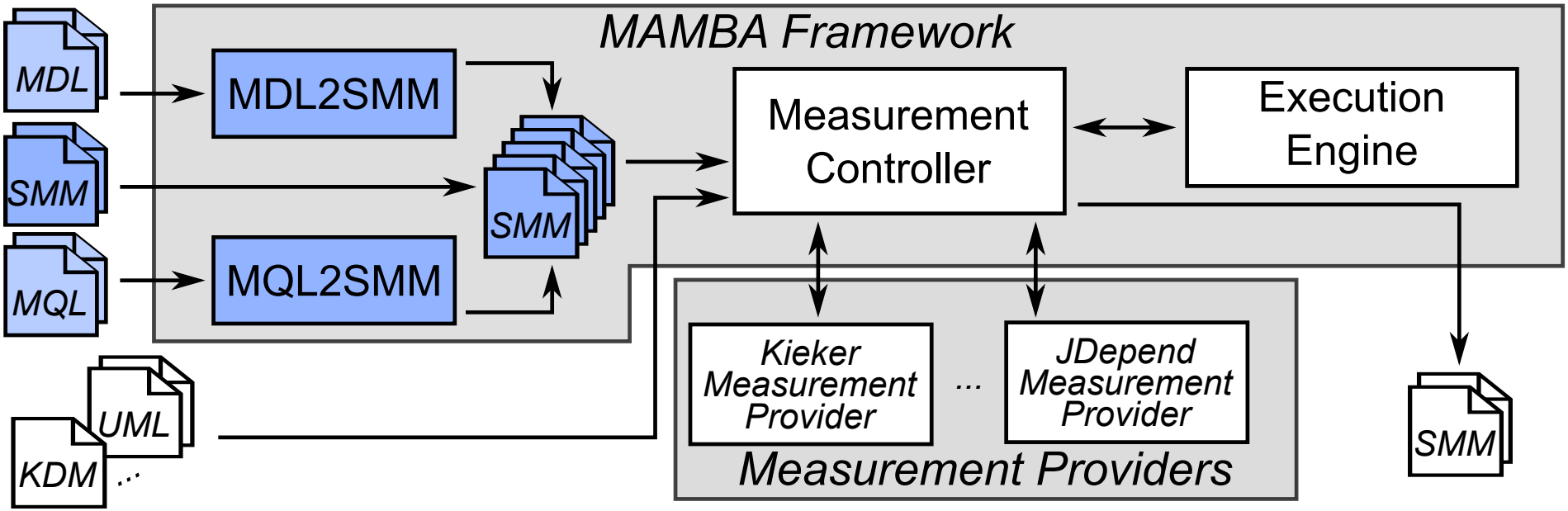
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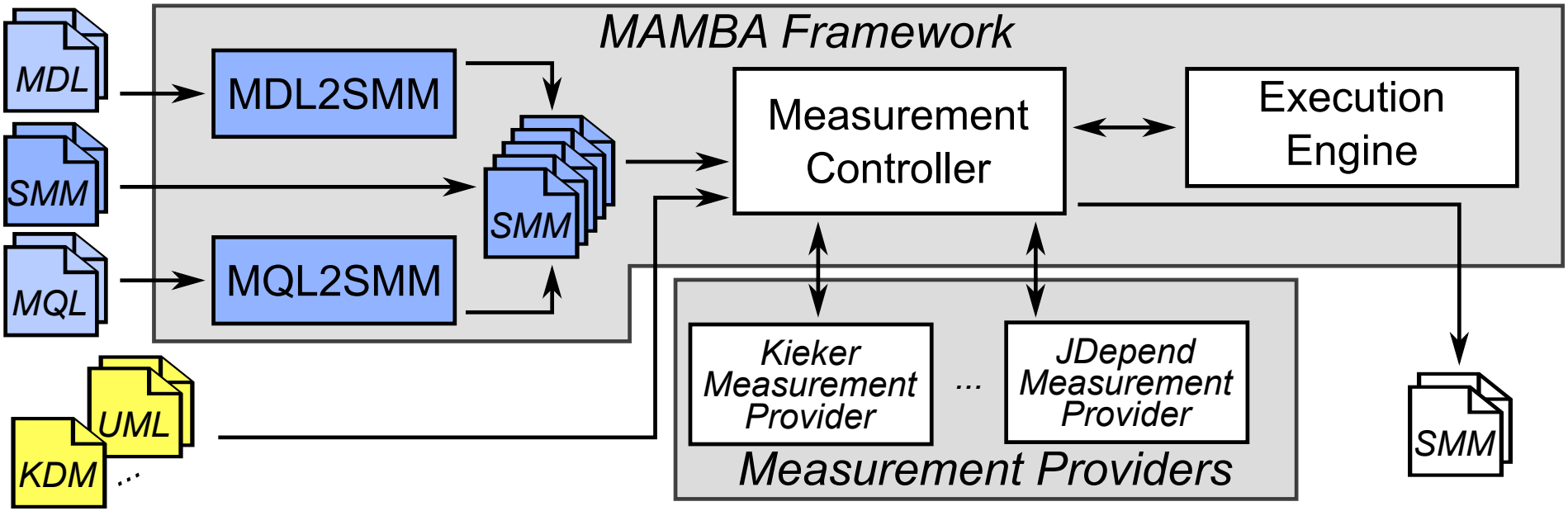
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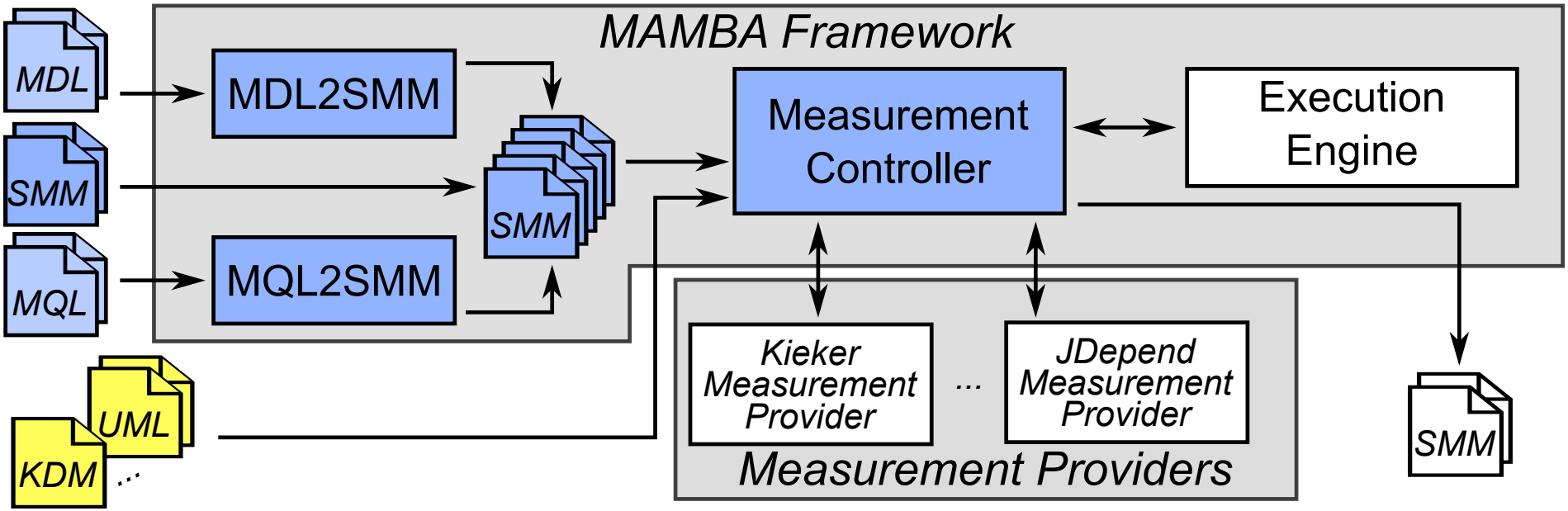
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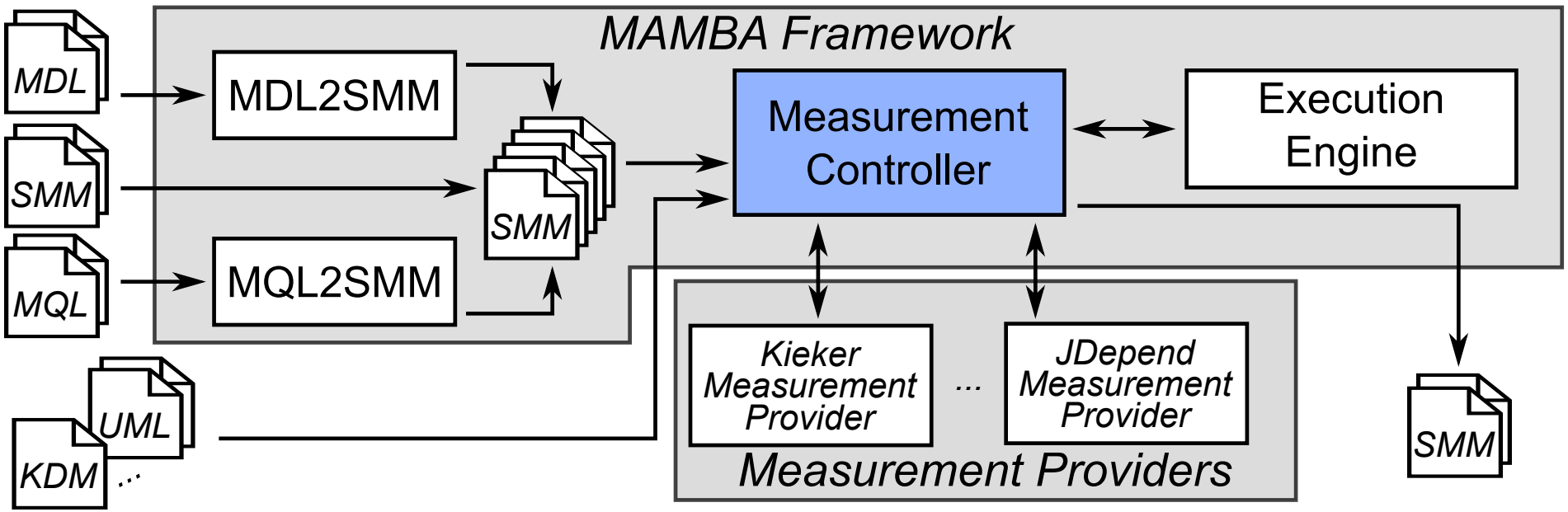
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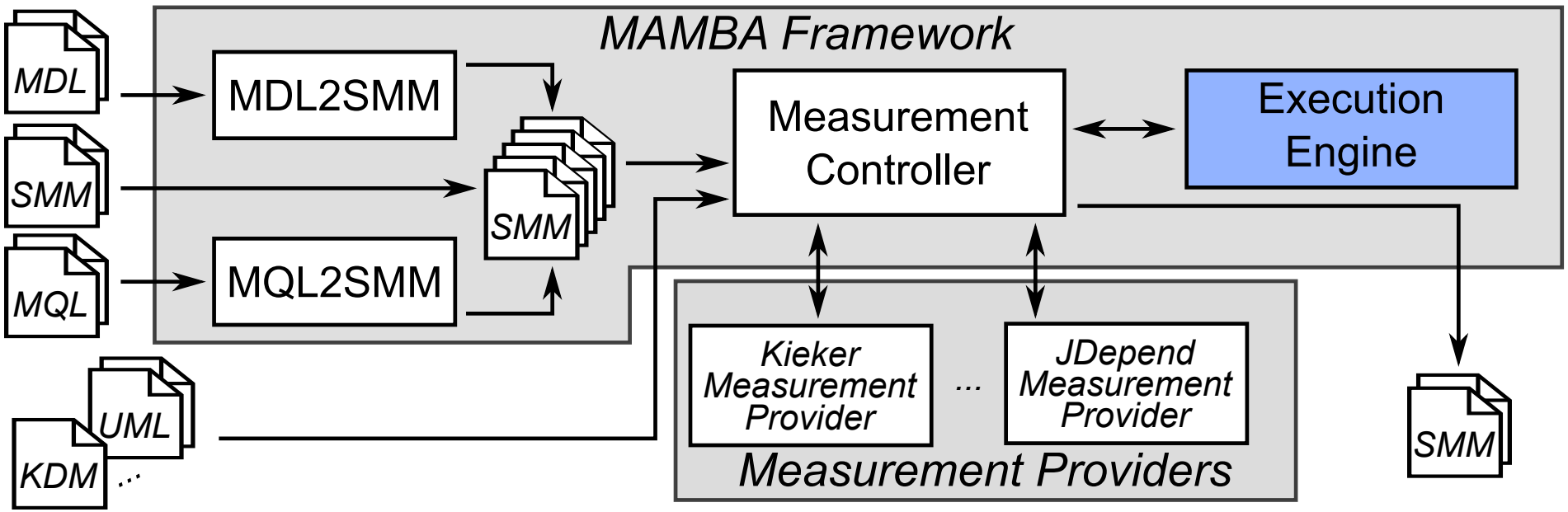
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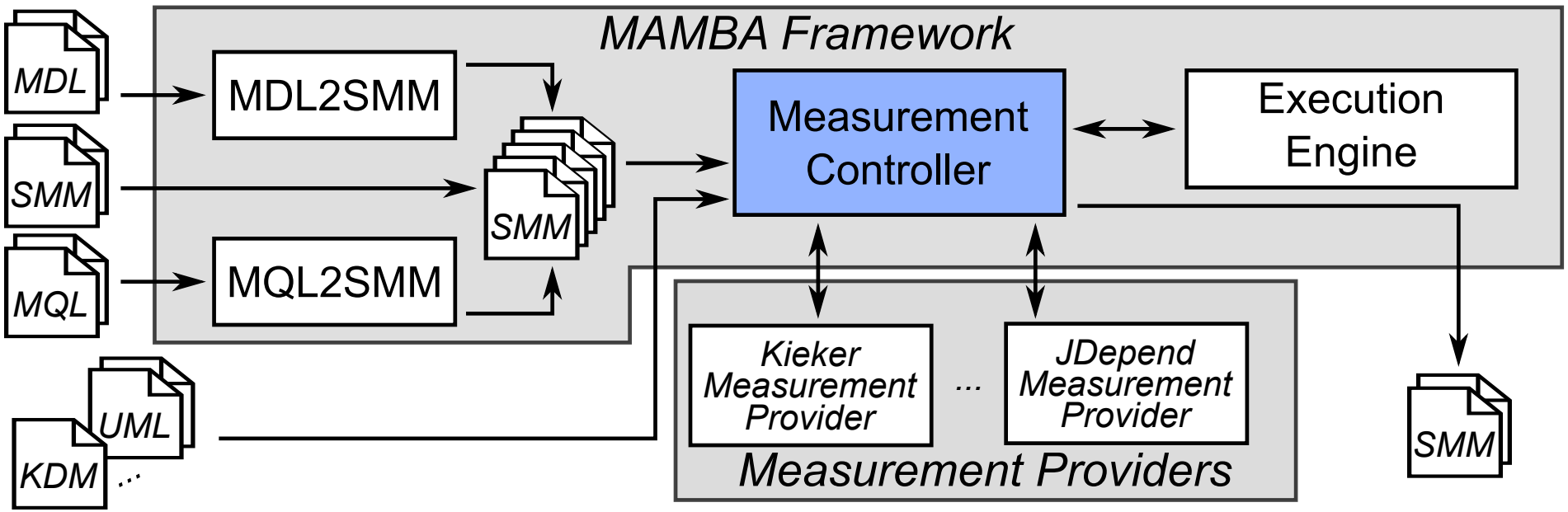
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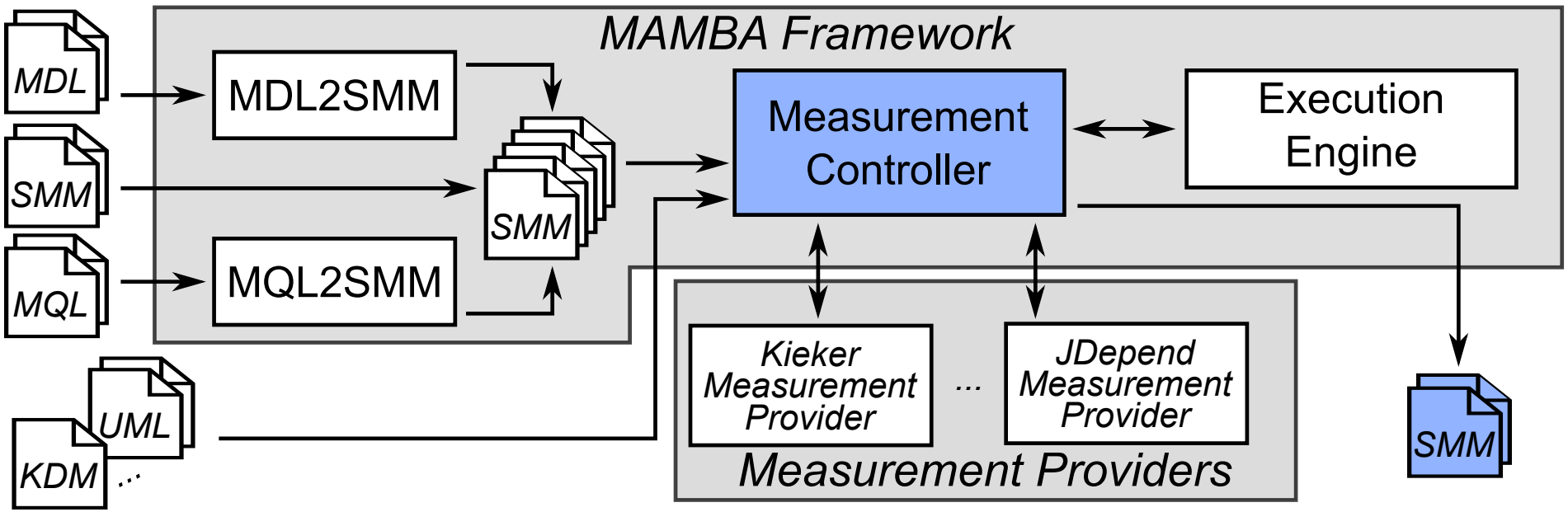
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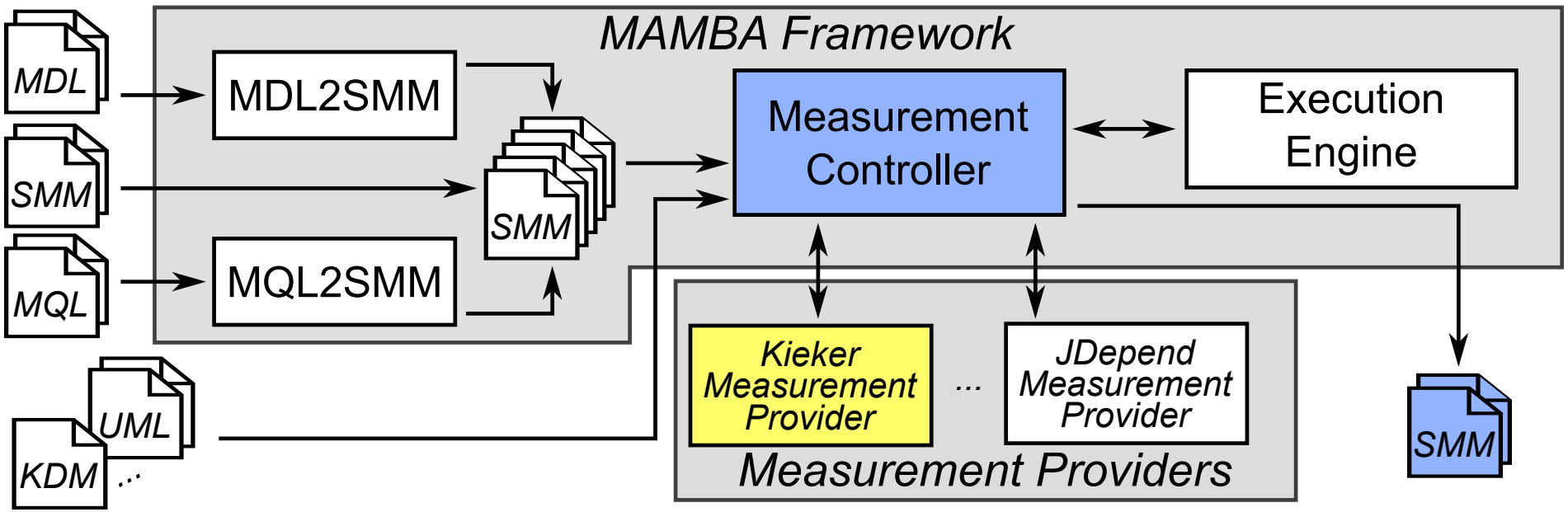
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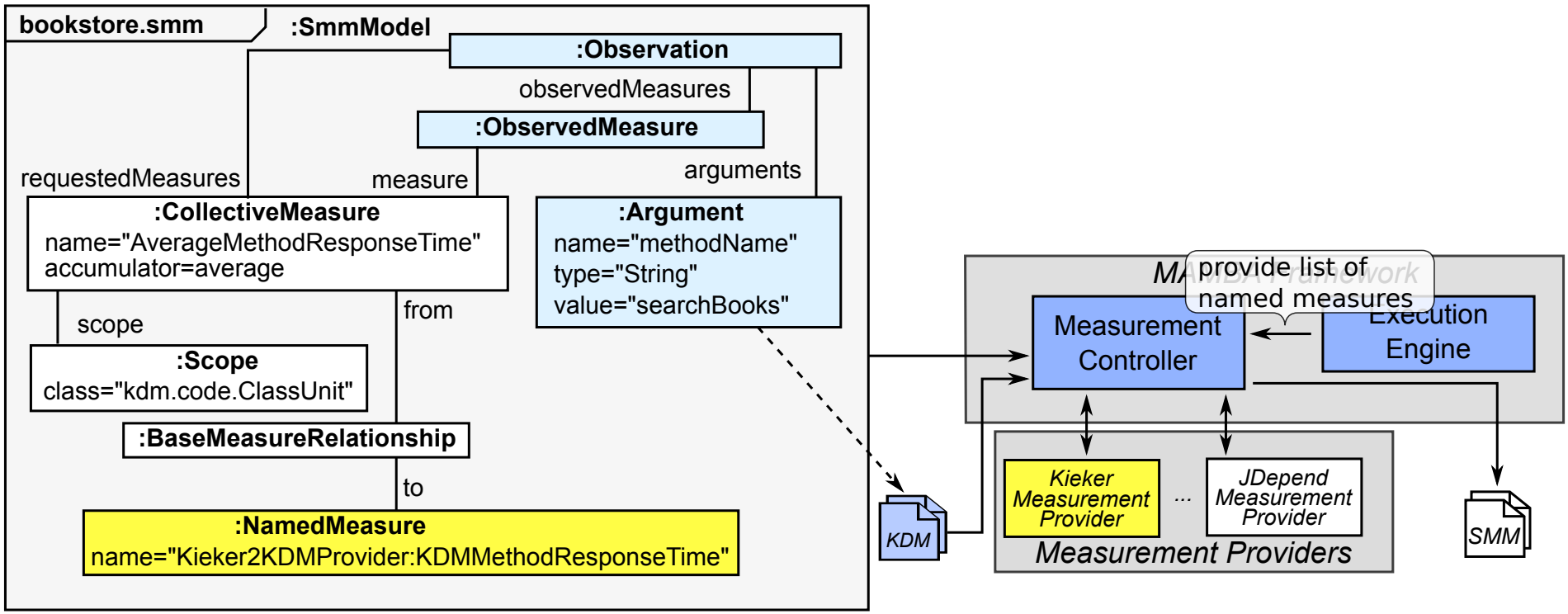
Workflow



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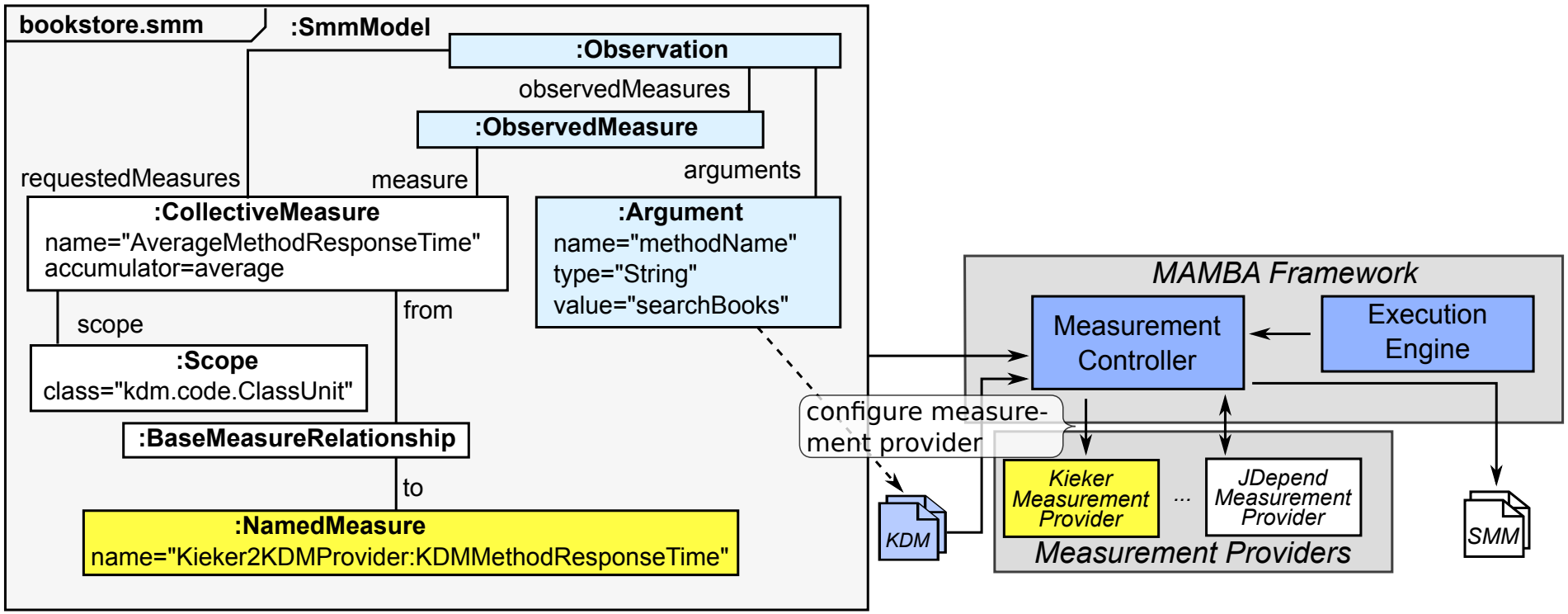

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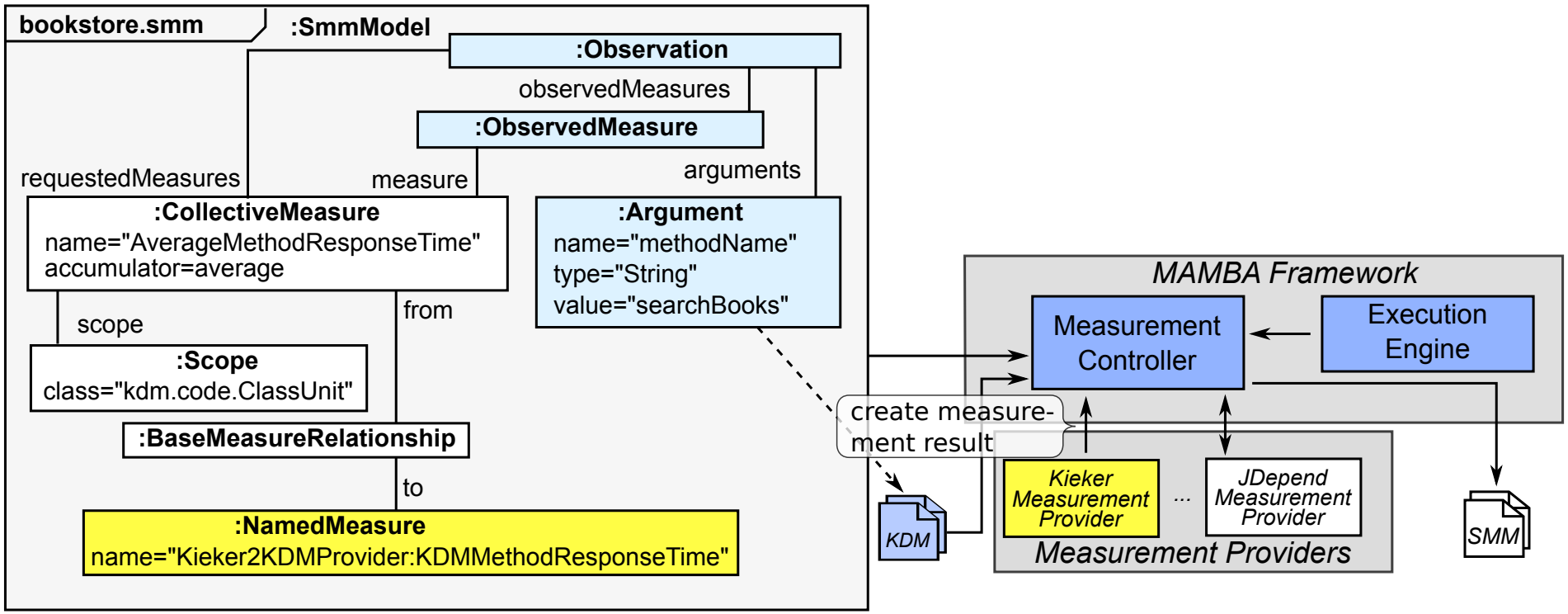

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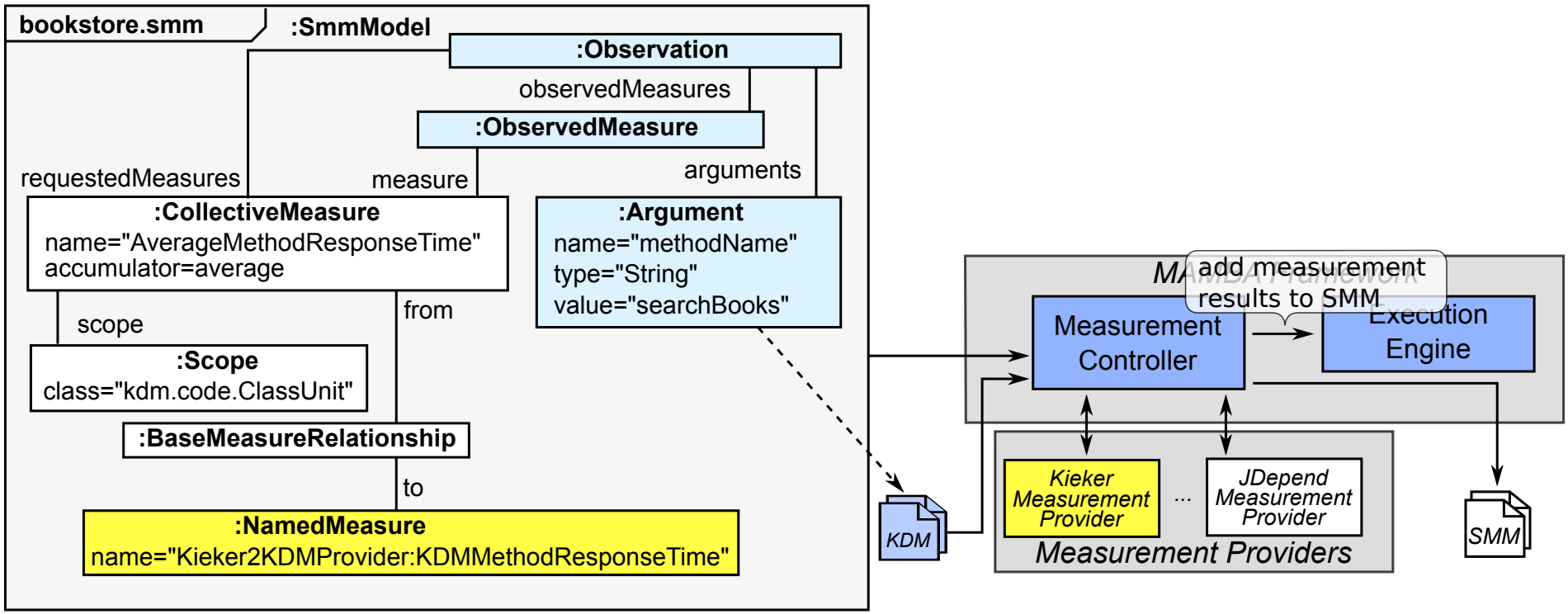

library.mdl | queries.mql | kdm.ecore

```
library example

model kdm "http://schema.omg.org/spec/KDM/1.2"

collect NumberOfClasses sum ClassRecognizer
   scope kdm.code.CodeModel

count ClassRecognizer
   select isOCLTypeof(kdm.code.ClassUnit)
   scope kdm.code.Package

collect AverageMethodResponseTime ( String methodName )
   average KDMMethodResponseTime
   scope ( kdm.code.ClassUnit.codeElement method |
           method.name == methodName && method instanceof kdm.code.MethodUnit)

measure KDMMethodResponseTime
```

MAMBA Measure Definition Language

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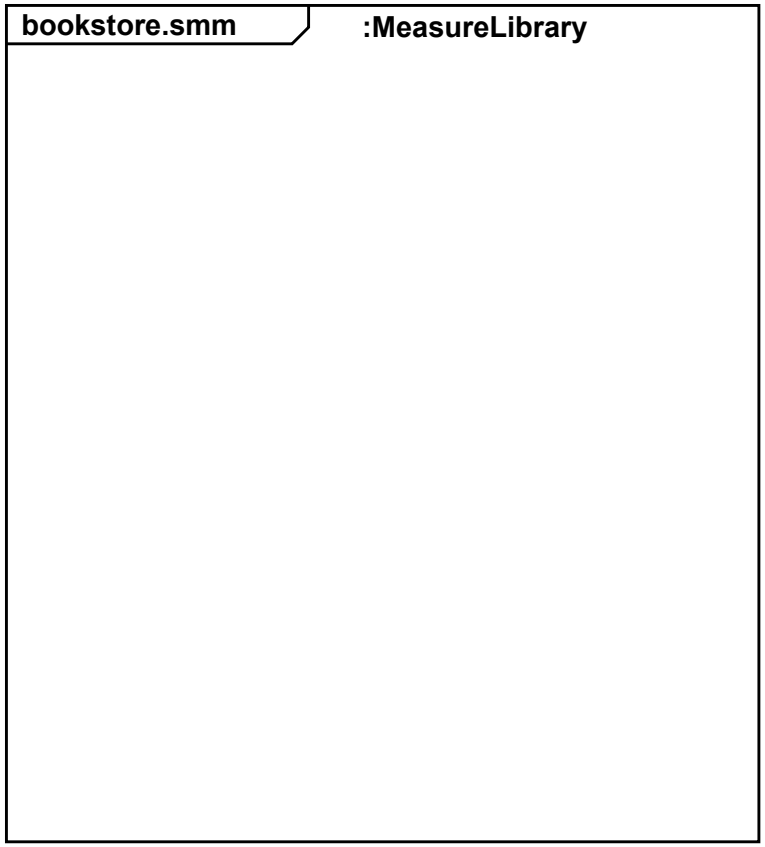
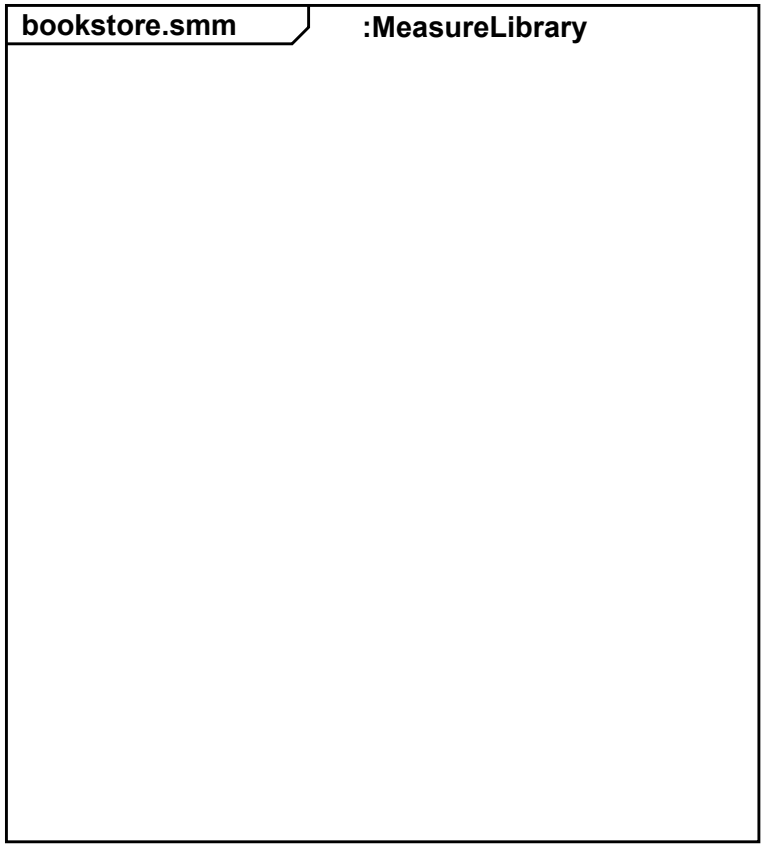
```
library bookstore
```



MAMBA Measure Definition Language


```
library bookstore

model kdm "http://schema.omg.↩
    org/spec/KDM/1.2"
```

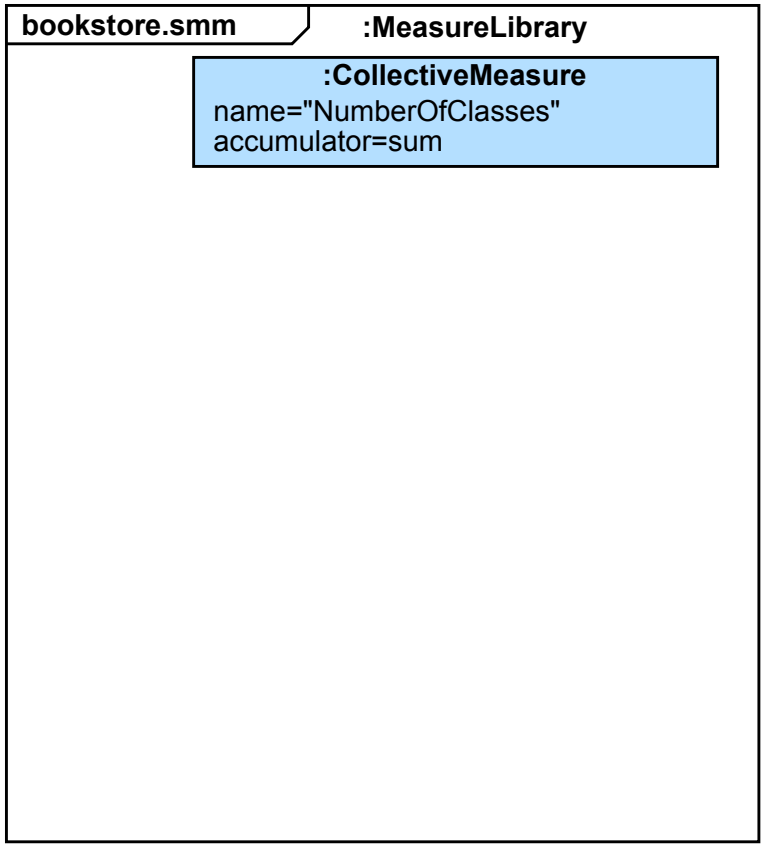


MAMBA Measure Definition Language

```
library bookstore

model kdm "http://schema.omg.org/spec/KDM/1.2"

collect NumberOfClasses
  sum ...
```

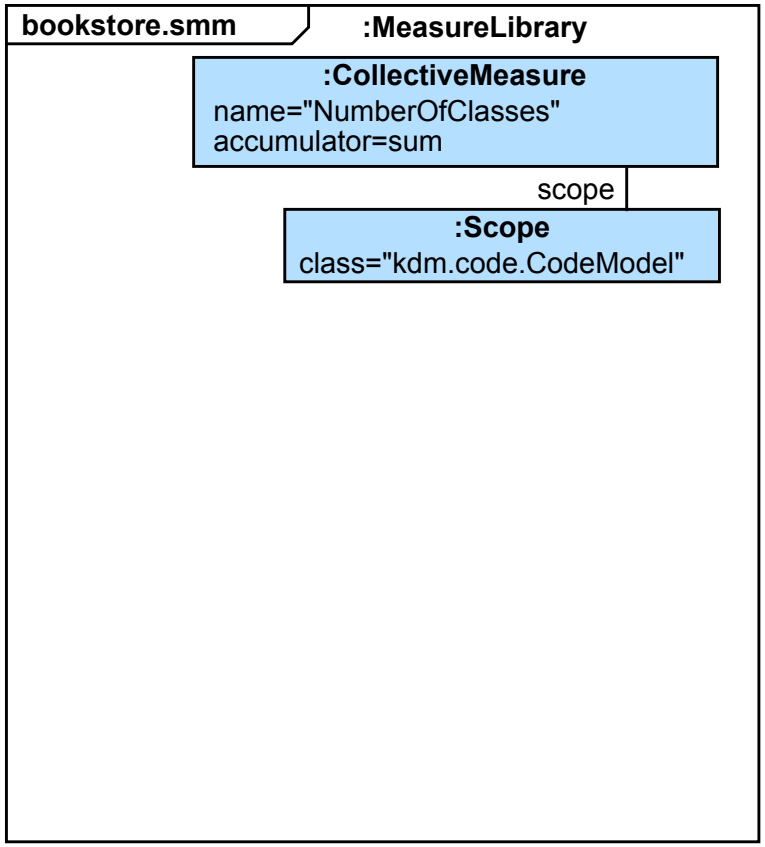


MAMBA Measure Definition Language

```
library bookstore

model kdm "http://schema.omg.↩
    org/spec/KDM/1.2"

collect NumberOfClasses
  sum ...
  scope kdm.code.CodeModel
```

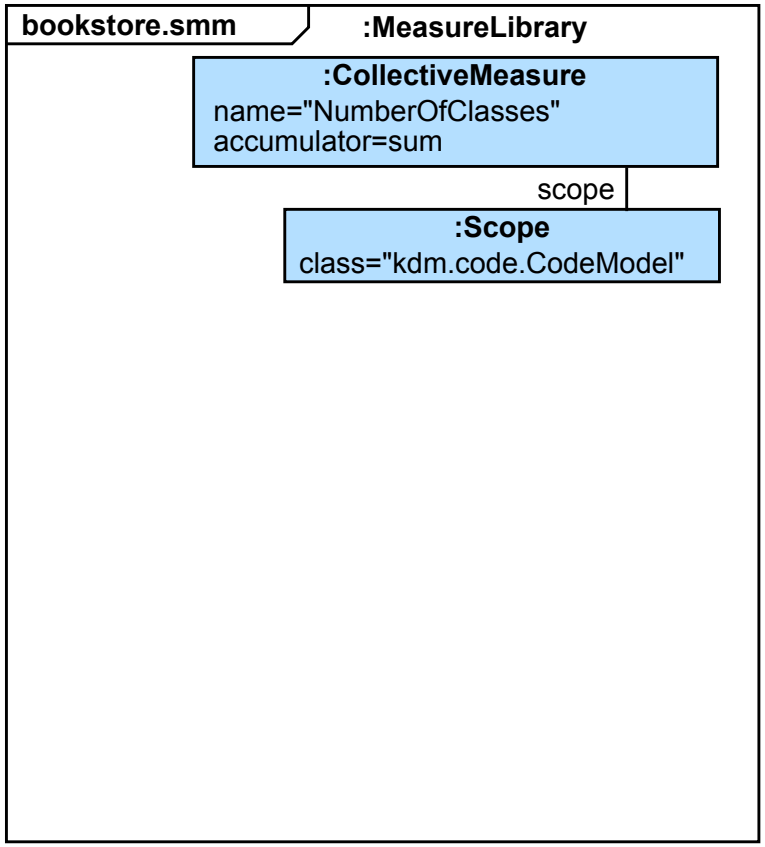


MAMBA Measure Definition Language

```
library bookstore

model kdm "http://schema.omg.↩
    org/spec/KDM/1.2"

collect NumberOfClasses
  sum ClassRecognizer
  scope kdm.code.CodeModel
```



MAMBA Measure Definition Language

```
library bookstore

model kdm "http://schema.omg.↩
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collect NumberOfClasses
  sum ClassRecognizer
  scope kdm.code.CodeModel

count ClassRecognizer
```
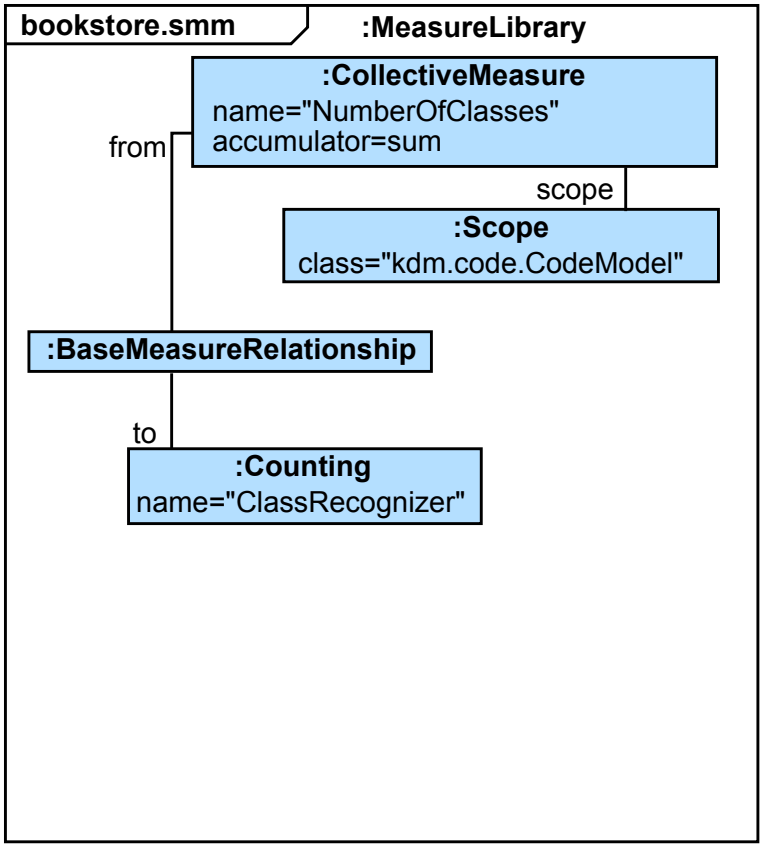
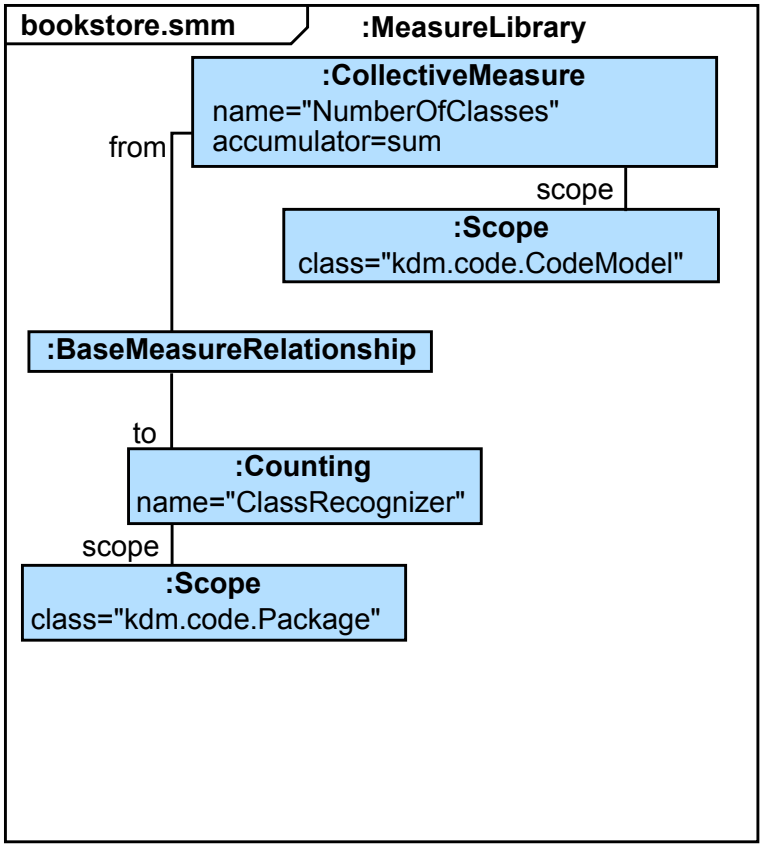



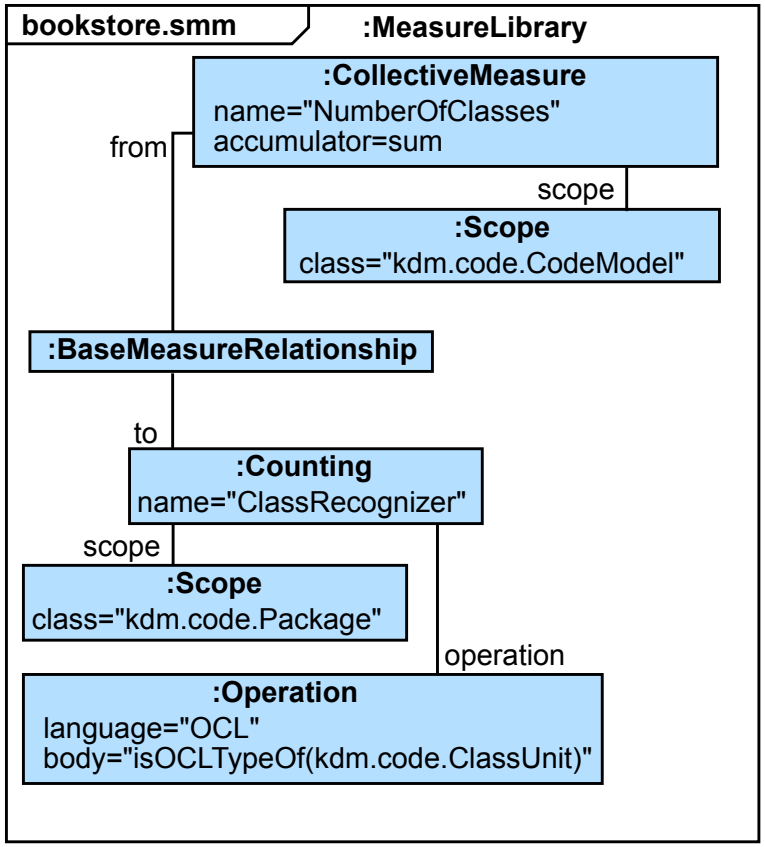
MAMBA Measure Definition Language

```
library bookstore

model kdm "http://schema.omg.org/spec/KDM/1.2"

collect NumberOfClasses
   sum ClassRecognizer
   scope kdm.code.CodeModel

count ClassRecognizer
   ...
   scope kdm.code.Package
```



MAMBA Measure Definition Language

```
library bookstore

model kdm "http://schema.omg.↩
    org/spec/KDM/1.2"

collect NumberOfClasses
  sum ClassRecognizer
  scope kdm.code.CodeModel

count ClassRecognizer
  select isOCLTypeOf(kdm.code.ClassUnit)
  scope kdm.code.Package
```



MAMBA Measure Definition Language


```
collect AverageMethodResponseTime ( String methodName )
  average KDMMethodResponseTime
  scope ( kdm.code.ClassUnit.codeElement method |
          method.name == methodName && method instanceof kdm.code.↩
              MethodUnit)

measure KDMMethodResponseTime
```

Defines measurement process

- Definition of the observations

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- If necessary, extension of the measure library
  Example can be found in [FvHJ+11]

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MAMBA Query Language

Defines measurement process

- Definition of the observations
- If necessary, extension of the measure library
  Example can be found in [FvHJ+11]
- Query over the collected measurements

Average response time

```
use bookstore
```

MAMBA Query Language

Defines measurement process

- Definition of the observations
- If necessary, extension of the measure library
  Example can be found in [FvHJ+11]
- Query over the collected measurements

Average response time

```
use bookstore

model appModel "bookstore-model.kdm"
```

Defines measurement process

- Definition of the observations
- If necessary, extension of the measure library
  Example can be found in [FvHJ+11]
- Query over the collected measurements

Average response time

```
use bookstore

model appModel "bookstore-model.kdm"

select AverageMethodResponseTime("searchBook") as avgrt
      from appModel where avgrt > 500
```

Features

- Computation engine for SMM and its MAMBA extensions

Features

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- Languages to define measures and queries

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Case Studies [FvHJ+11]

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- CouldMIG: Framework for cloud migration [FH10, FHS12]

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