Meta-Modelling as a Concept:
The Conceptualisation of Modelling Methods

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AGENDA

PART I:

- Motivation
- Foundations & Technologies
- Conceptualization & Development
- Best Practices

PART II:

- Hands-On Session

PART III:

- Conclusion
- Outlook

Tutorial Specific Scenarios

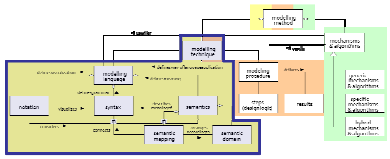
Selected Scenarios for Tutorial specific Hands-On:

1. Realising a **Modelling Language**
   - Case: Entity Relationship Model

2. Implementing an **Algorithm**
   - Case: Structural Similarities of Business Processes

3. API / Web-Service Invocations
   - Case: WIKI Interaction
   - Case: Google Map Interaction

4. Coupling Modelling Languages to support **Modelling Procedures**
   - Case: Coupling BPMN and UML-Use Case Diagram



CASE: Entity Relationship Model

1. SCENARIO: REALISING A MODELLING LANGUAGE

Scenario Description

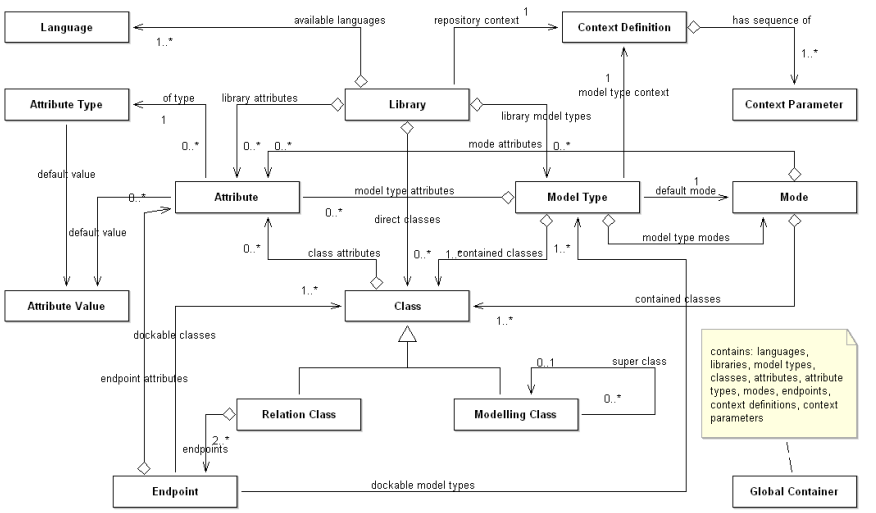
Case:

Realise a modelling tool for the Modelling Language “Entity Relationship Model”.

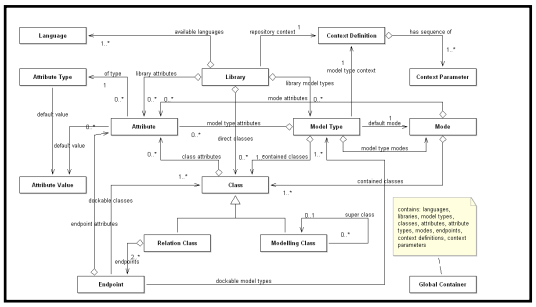
Goal:

Demonstrate the development of a model editor for a defined modelling languages using common constructs from ADOxx Meta^{2}Model.

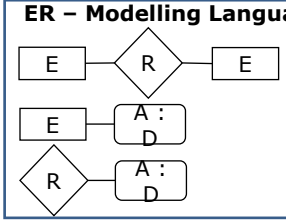
ADOxx Meta2Model



Mapping Meta2Model with ER-Meta Model



ER – Modelling Language Definition

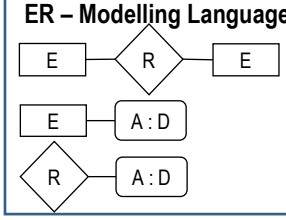


$E(A_1:D_1, \ldots,A_m:D_m)$
$E(A_1, \ldots,A_m)$
$R(A_1:D_1, \ldots,A_m:D_m)$
$R(A_1, \ldots,A_m)$

How to map generic Meta²Model to a concrete Modelling Language ?

Modelling Language Meta Model

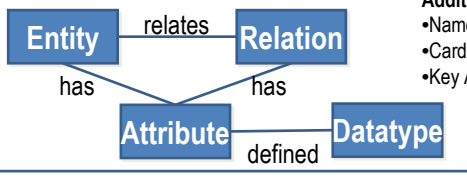
ER – Modelling Language Definition



$E(A_1:D_1, \ldots,A_m:D_m)$
$E(A_1, \ldots,A_m)$
$R(A_1:D_1, \ldots,A_m:D_m)$
$R(A_1, \ldots,A_m)$

Conceptualisation

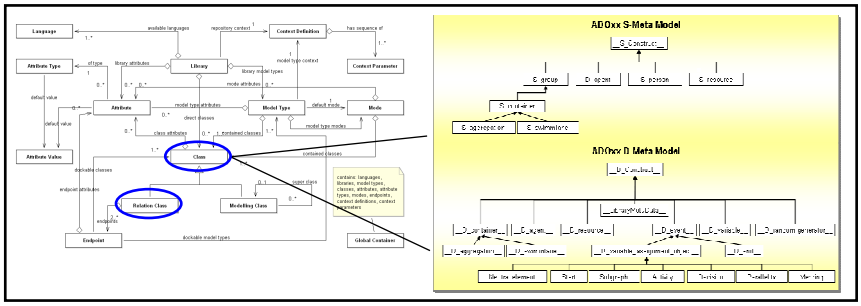
Conceptualised ER – Meta Model

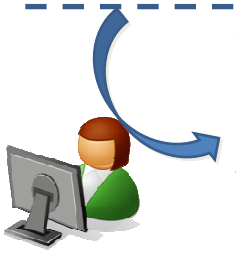


Additional Aspects:
- Name
- Cardinality
- Key Attribute

Specification for Operationalization:
CLASS: Entity, Relation, Attribute,
RELATIONCLASS: relates, has,
Attribute: name (String), cardinality (String),
key (Boolean), datatype (List)

Operationalization of “CLASS” Concept





Operationalisation : ER Modelling Language

CLASS: Entity, Relation, Attribute, _ER-Concept_
RELATIONCLASS: relates (Entity->Relation),
has (_ER-Concept_->Attribute),
Attribute: name (STRING), cardinality (STRING),
key (INTEGER), datatype (ENUMERATION)

Operationalisable Meta Model

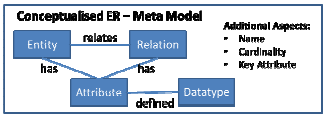
Meta²Model

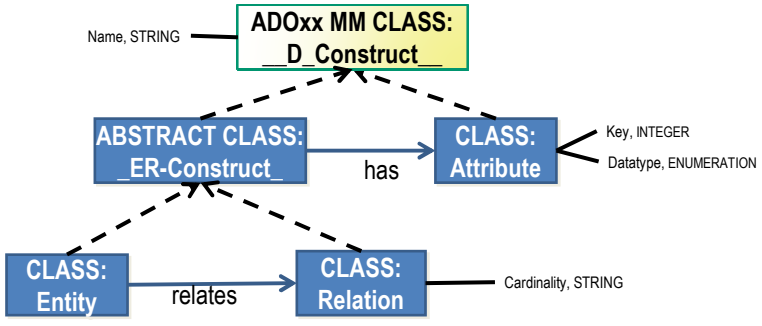
ABSTRACT CLASS
CLASS
RELATIONCLASS
ATTRIBUTE
ATTRIBUTETYPE
{STRING,...ENUMERATION}

Operationalisation MetaModel

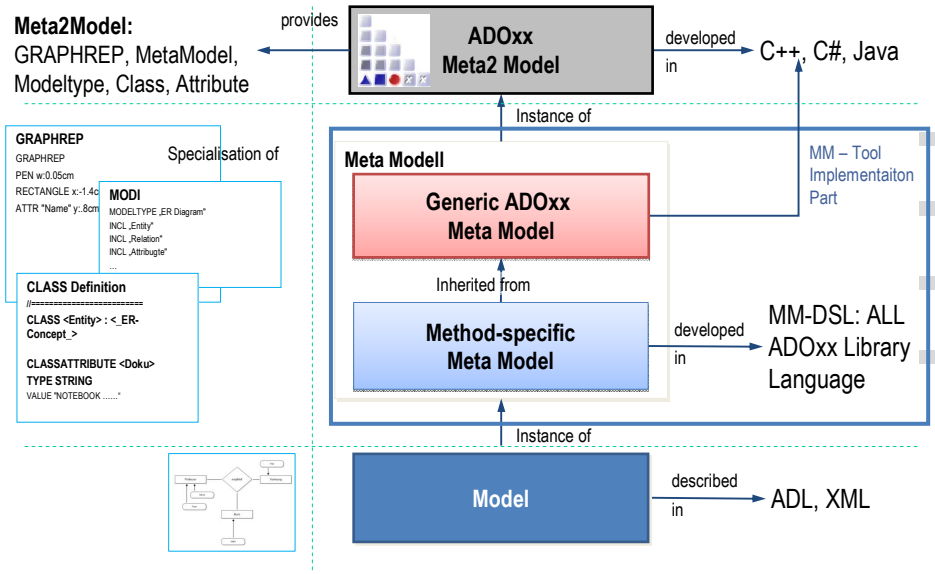
Class inheritance
_D_Construct_
GRAPHREP, ATTREP

ER-MetaModel





Realising Modelling Language



Provided Functionality of Metamodelling Platform

Used meta-modelling functionality :

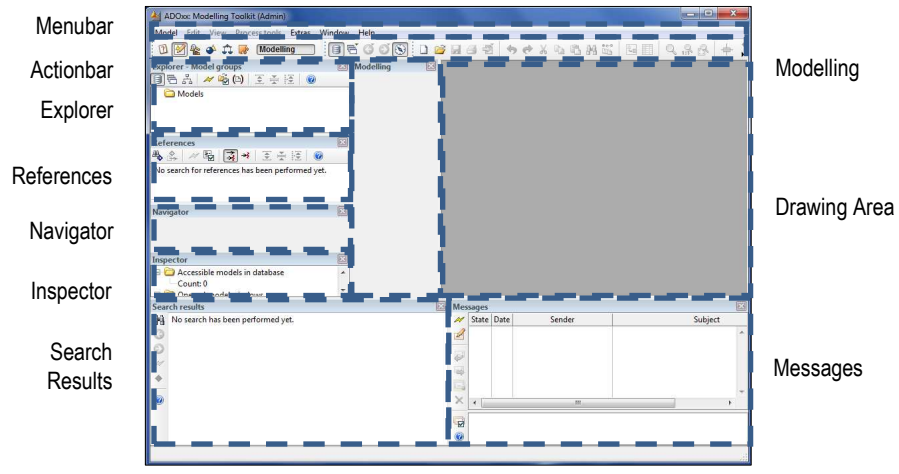
- **Meta²Model:** MODELTYPE, GRAPHREP, ATTREP, ATTRIBUTE TYPE, CLASS

- **ADOxx Meta2Model Component:**
  - Model Editor incl. Menubar
  - Query engine incl. AQL syntax
  - ADOscript interpreter and ADOscript syntax
  - Database

ADOxx Realisation HANDS-ON

1. Defining **MODELTYPES**
2. Inheriting **CLASSES** from ADOxx Meta Model
3. Implementing **GRAPHREP**
4. Inherit **RELATIONCLASSES** from ADOxx Meta Model
5. Defining **ATTRIBUTES** and **ATTREP**

GOAL: Development of Modelling Toolkit



Used ADOxx Functionality: Realising a Modelling Language

Introduction
Setup of Implementation Environment

Modelling Language Implementation
- **Classes** ✓
- **Relations**
- **Class Attributes and Attributes** ✓
  - **GRAPHREP** ✓
  - **ATTRREP**
  - CLASS Cardinality
  - **CONVERSION** ✓
  - **Model Pointer**
- Attribute Facets
- **Model Types** ✓

Mechanisms & Algorithms Implementation
- Core Functions for Model Manipulation
  - Database
  - Visualisation
  - Query
  - Transformation
- Configuration of ADOxx Components
  - Visualisation
  - Query
- External Coupling ADOxx Functionality
  - ADOscript Triggers
  - ADOscript Language Constructs
  - Visualisation AdoScripts
  - Visualisation Expression
  - Query ADOscript
  - Transformation ADOscript
- ADD-ON Implementation
  - ADOxx Web-Service
  - XML / ADL Import – Export
  - ADOscript Batch Mode

HANDS-ON

CASE: Entity Relationship Model

1. SCENARIO: REALISING A MODELLING LANGUAGE

ADOxx Realisation HANDS-ON

1. Defining **MODELTYPES**
2. Inheriting **CLASSES** from ADOxx Meta Model
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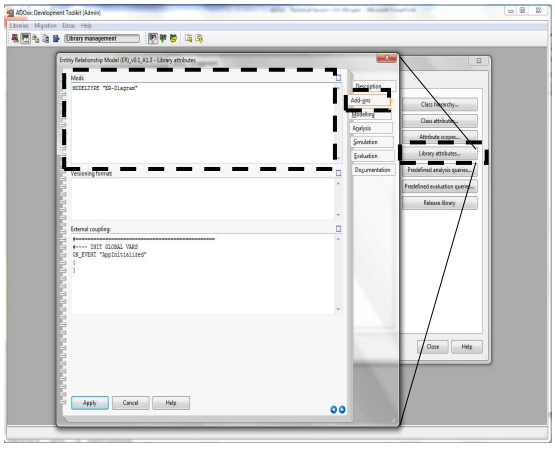
4. Inherit **RELATIONCLASSES** from ADOxx Meta Model
5. Defining **ATTRIBUTES** and **ATTREP**

Define Modeltype



Define the Model-Type:

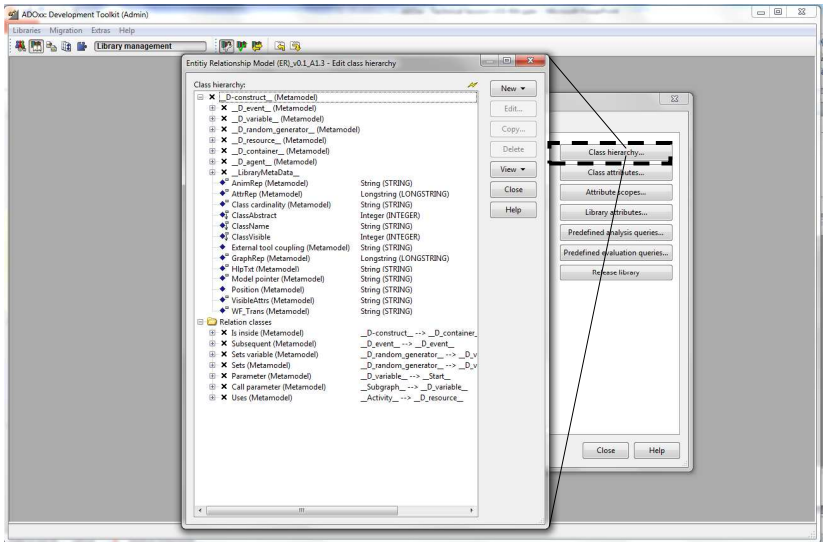
1.Click “Library attribute” of the ER-library

2.Go to “Add-on” chapter

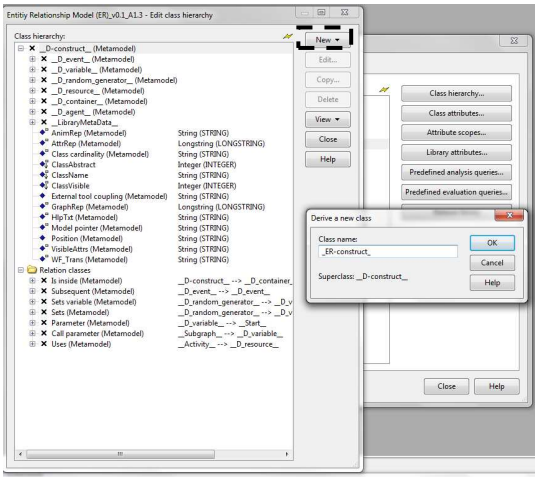
3.Define the Modeltype in the Modi textfield.

4.“MODELTYPE “ER-Diagram”

Library Management



Define new class



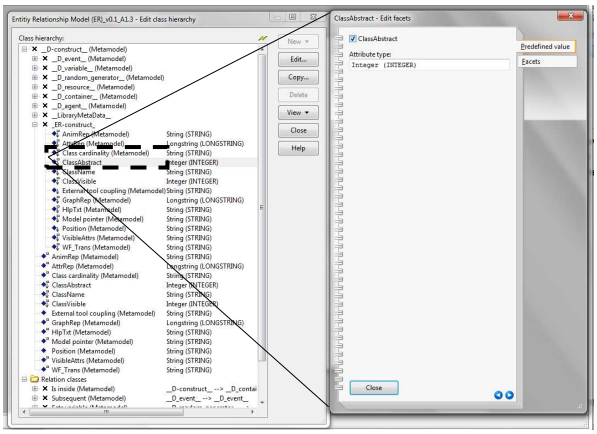
Define Abstract Class:

Add a new abstract class below the root element that is used to define "_ER-construct_" related issues

1.Select root class, click "New" -> "New class"

2.Name new class as an abstract class
Naming convention for abstract classes Pre- and Post-fix is "_".

Make Class Abstract

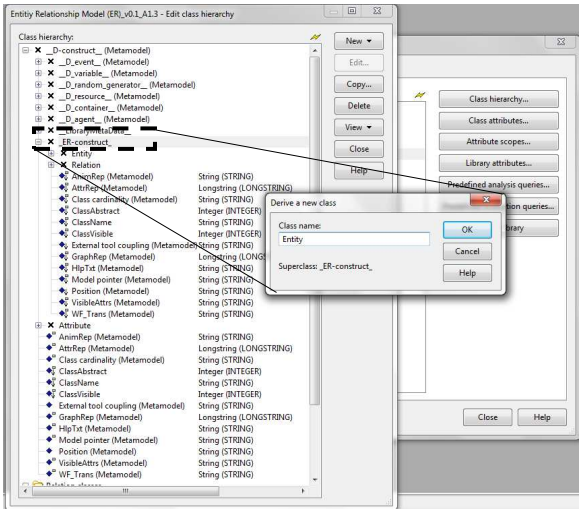


Make class abstract using “ClassAbstract“ attribute

-> Effect:

class can not be instantiated in the modelling tool.

Define ER-Classes



Make new classes:

Entity and Relation inherited from

ER-construct

and

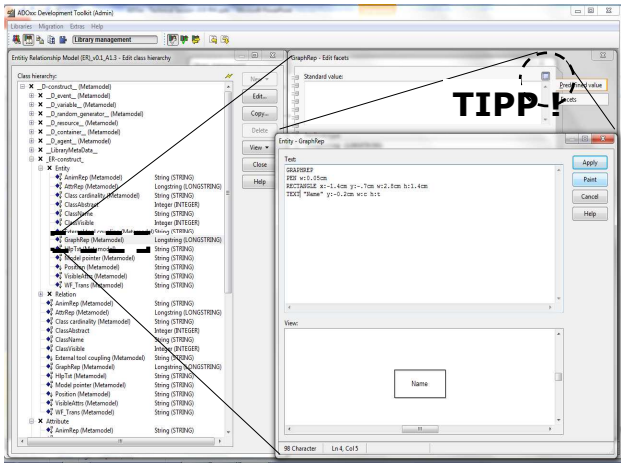
Attribute

Inherited from

__D-construct__

Leave them as classes, by not making them abstract.

Implement GRAPHREP

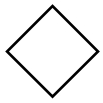


Implement GRAPHREP:

- Edit Attribute GRAPHREP
- Open GRAPHREP Editor
- Write GRAPHREP Code in Text field
- View current GRAPHREP with “Paint”
- Store the GRAPHREP with “Apply”

Implementing GRAPHREP

Entity



Relation

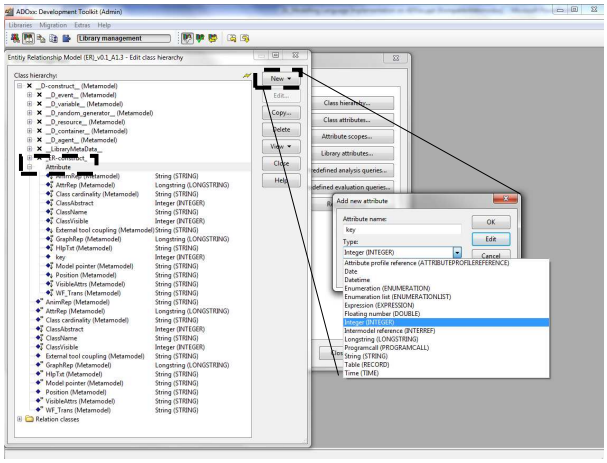
Attribute

```
GRAPHREP
PEN w:0.05cm
RECTANGLE x:-2cm y:-.5cm w:4cm h:1cm
ATTR "Name" x:0cm y:0cm w:c:3.5cm h:c:1cm line-
break:rigorous
```

```
GRAPHREP
PEN w:0.05cm
FILL color:white
POLYGON 4 x1:-1.9cm y2:1.6cm x3:1.9cm y4:-1.6cm
ATTR "Name" w:c:2.5cm h:c:0.8cm line-break:rigorous
```

```
GRAPHREP
PEN w:0.05cm
ELLIPSE x:0.00cm y:0.00cm rx:3.00cm ry:0.80cm
ATTR "Name" y:-0.2cm w:c:2.8cm h:t
# Advanced Attribute Dependent Graphical Notation
AVAL k:"key"
IF ( k = 1)
{
        LINE x1:-1.7cm y1:-0.5cm x2:-1.7cm y2:0.5cm
        LINE x1:-1.5cm y1:-0.6cm x2:-1.5cm y2:0.6cm
}
```

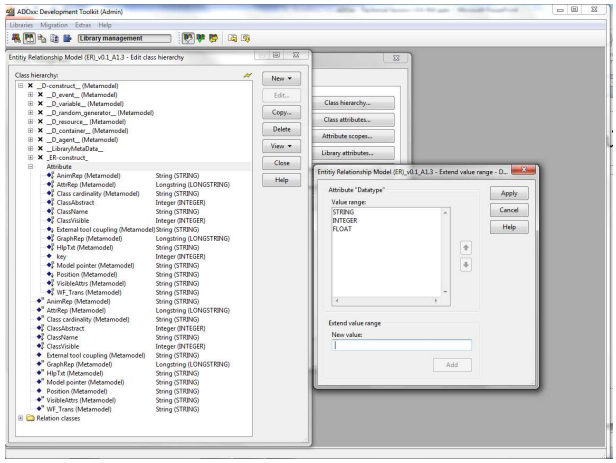
Attribute Dependent GRAPHREP



New Attribute

1.Select Class in which the new attribute has to be added
2.Add new attribute
3.Attribute name “key”
4.Type “INTEGER”

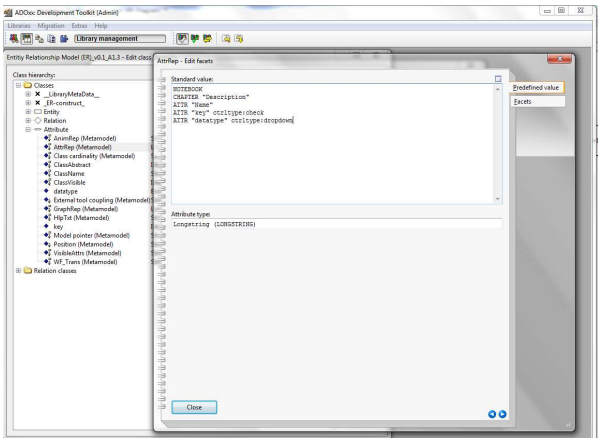
Attribute Definition



New Attribute

1.Select Class in which the new attribute has to be added
2.Add new attribute
3.Attribute name “Datatype”
4.Type “ENUMERATION”
5.Add value range

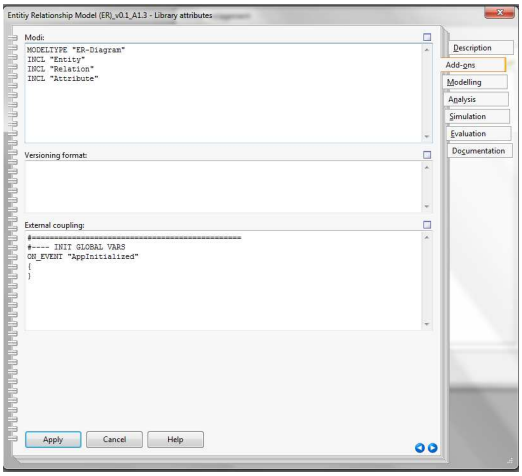
Implement ATTREP



Implement ATTREP

1.Select Class
2.Edit ATTREP Attribute
3.Define NOTEBOOK
- Chapter
- ATTR
- Group
- ctrltype

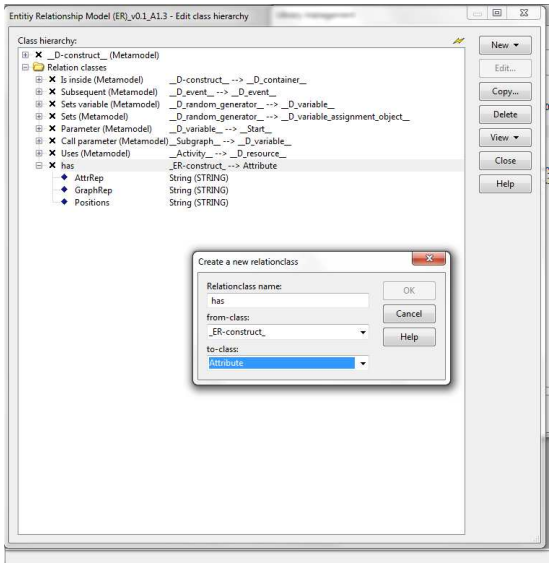
Modeltype: Inclusion of Classes



Define the Model-Type:

1.Click “Library attribute” of the ER-library
2.Go to “Add-on” chapter
3.Define the Modeltype in the Modi textfield.
4.“MODELTYPE “ER-Diagram”
5.Include classes:
- INCL “Entity”
- INCL “Relation”
- INCL “Attribute”

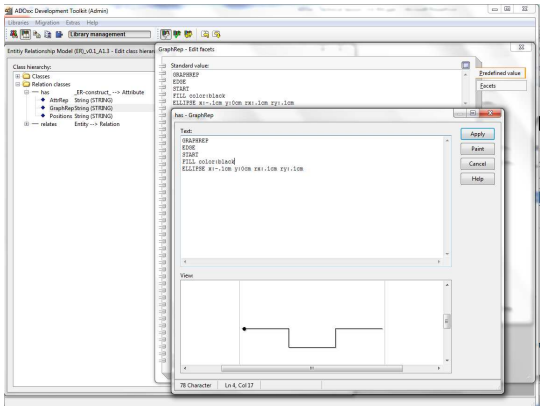
Definition of RELATIONCLASS



Define RELATIONCLASS:

1.Click new RelationClass
2.Define:
- Name
- From-class
- To-class

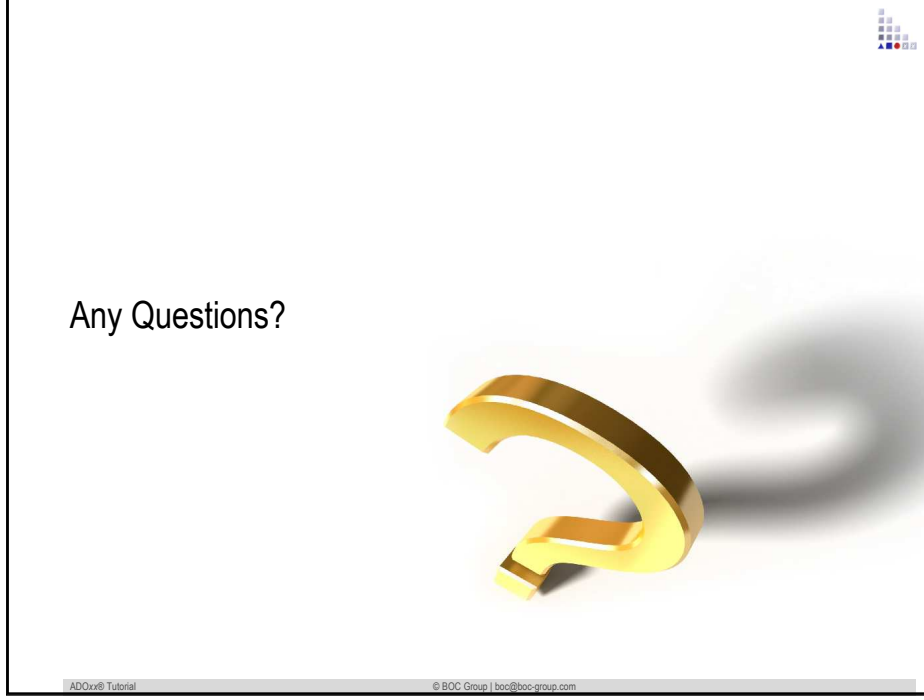
Implement RELATION GRAPHREP



Define RELATION GRAPHREP:

1.Edit Attribute GRAPHREP
2.Open GRAPHREP Editor
3.Write GRAPHREP Code in Text field
4.View current GRAPHREP with "Paint"
5.Store the GRAPHREP with "Apply"

```
GRAPHREP
EDGE
START
FILL color:black
ELLIPSE x:-.1cm y:0cm rx:.1cm ry:.1cm
```



Any Questions?