"Families to Persons"

A simple illustration of model-to-model transformation

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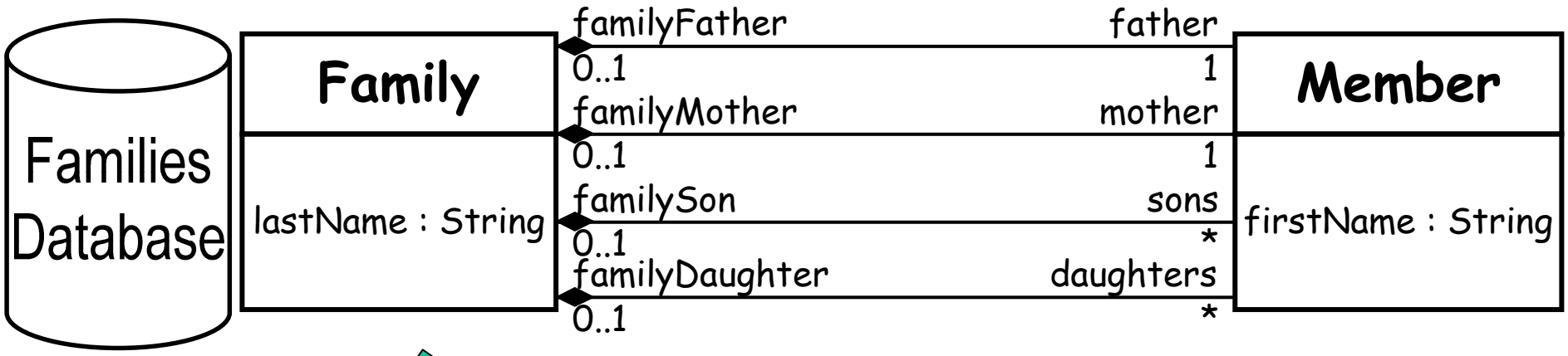
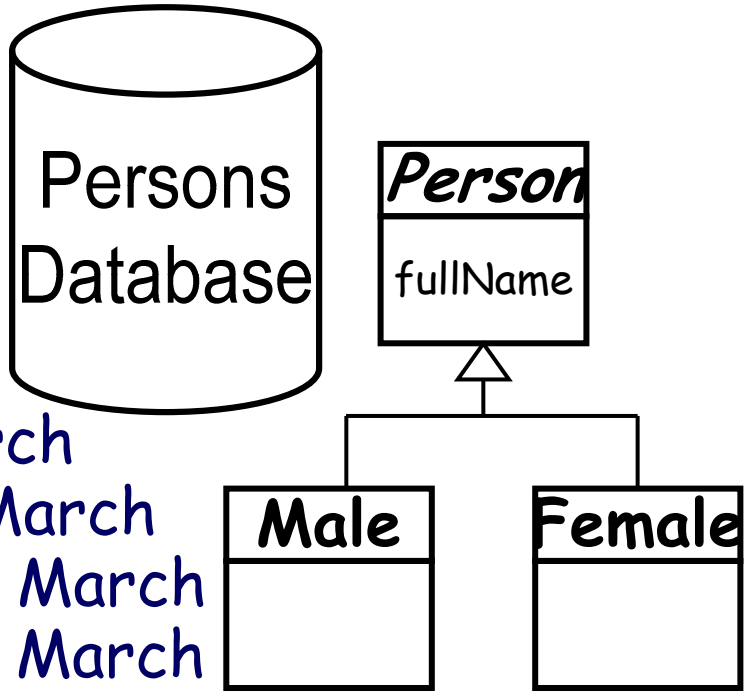
Motivation



...
Family March
Father: Jim
Mother: Cindy
Son: Brandon
Daughter: Brenda
... other Families

Migration

SQL script



...
Mr. Jim March
Mrs. Cindy March
Mr. Brandon March
Mrs. Brenda March
... other Persons

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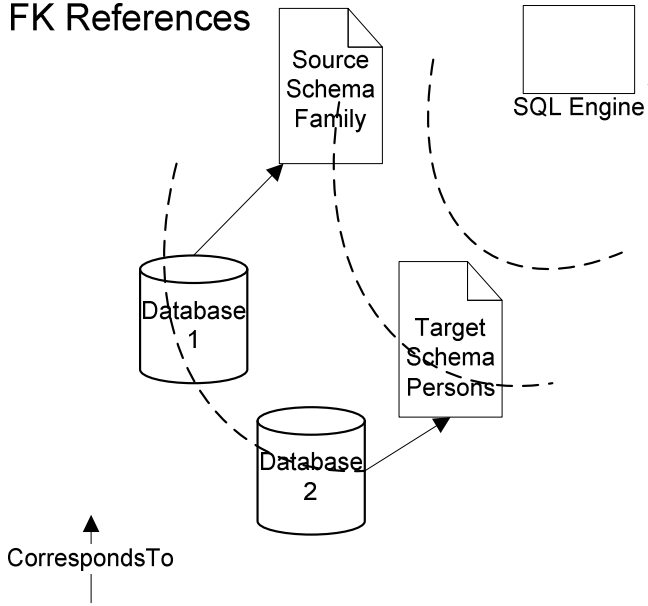
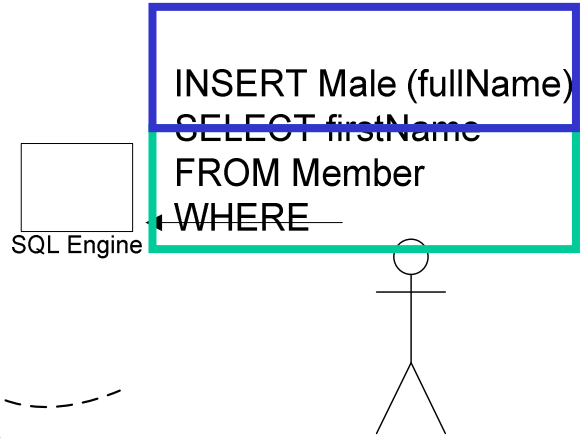
An analogy

Tables
Columns
FK References

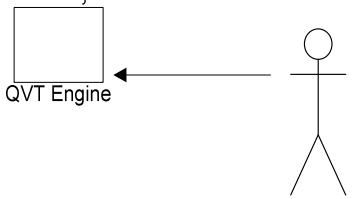




Databases

Migration

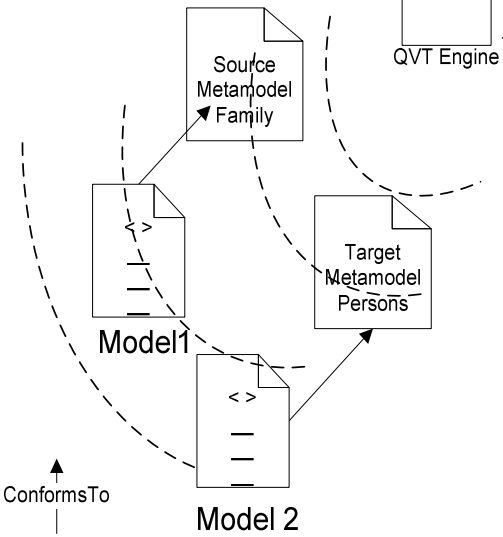
```
rule Member2Male {
from
s : Family!Member
    ()
to
t : Person!Male (
     fullName <- s.firstName
}
```



MDE

Model Transformation

Meta-classes
Meta-attributes
Meta-relations



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Overview

- This presentation describes how to migrate the Families database to the Persons database using MDE
- It is intended to be extended later.
- The presentation is composed of the following parts:
  - Prerequisites.
  - Introduction.
  - Metamodeling.
  - Transformation.
  - Conclusion.

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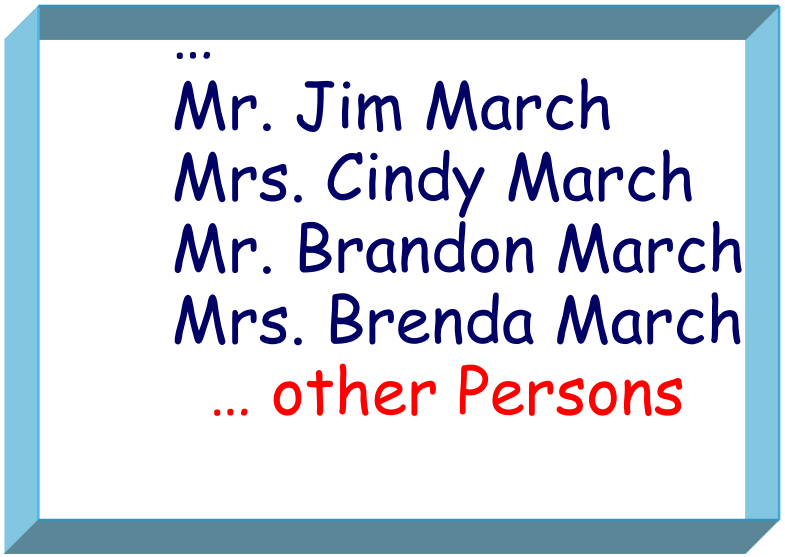
Goal of the ATL transformation we are going to write

Transforming this …

… into this.



Let's suppose these are not databases, but models
(we'll discuss the correspondence
between models and texts later).

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Input of the transformation is a model

Family March
Father: Jim
Mother: Cindy
Son: Brandon
Daughter: Brenda
Family Sailor
Father: Peter
Mother: Jackie
Son: David
Son: Dylan
Daughter: Kelly

This is the textual database representation.

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<xmi:XMI xmi:version="2.0" xmlns:xmi="http://
www.omg.org/XMI" xmlns="Families">
  <Family lastName="March">
    <father firstName="Jim"/>
    <mother firstName="Cindy"/>
    <sons firstName="Brandon"/>
    <daughters firstName="Brenda"/>
  </Family>
  <Family lastName="Sailor">
    <father firstName="Peter"/>
    <mother firstName="Jackie"/>
    <sons firstName="David"/>
    <sons firstName="Dylan"/>
    <daughters firstName="Kelly"/>
  </Family>
</xmi:XMI>
```

This is the corresponding model.
It is expressed in XMI,
a standard way to represent models.

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Output of the transformation should be a model

Mr. Dylan Sailor
Mr. Peter Sailor
Mr. Brandon March
Mr. Jim March
Mr. David Sailor
Mrs. Jackie Sailor
Mrs. Brenda March
Mrs. Cindy March
Mrs. Kelly Sailor

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<xmi:XMI xmi:version="2.0"
    xmlns:xmi="http://www.omg.org/XMI"
xmlns="Persons">
  <Male fullName="Dylan Sailor"/>
  <Male fullName="Peter Sailor"/>
  <Male fullName="Brandon March"/>
  <Male fullName="Jim March"/>
  <Male fullName="David Sailor"/>
  <Female fullName="Jackie Sailor"/>
  <Female fullName="Brenda March"/>
  <Female fullName="Cindy March"/>
  <Female fullName="Kelly Sailor"/>
</xmi:XMI>
```

This is the textual database representation.

This is the corresponding model (The corresponding XMI file is named "sample-Persons.ecore").

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Each model conforms to a metamodel

conformsTo

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<xmi:XMI xmi:version="2.0" xmlns:xmi="http://
www.omg.org/XMI" xmlns="Families">
  <Family lastName="March">
    <father firstName="Jim"/>
    <mother firstName="Cindy"/>
    <sons firstName="Brandon"/>
    <daughters firstName="Brenda"/>
  </Family>
  <Family lastName="Sailor">
    <father firstName="Peter"/>
    <mother firstName="Jackie"/>
    <sons firstName="David"/>
    <sons firstName="Dylan"/>
    <daughters firstName="Kelly"/>
  </Family>
</xmi:XMI>
```

Source model
"sample-Families.ecore"

conformsTo

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<xmi:XMI xmi:version="2.0"
    xmlns:xmi="http://www.omg.org/XMI"
xmlns="Persons">
  <Male fullName="Dylan Sailor"/>
  <Male fullName="Peter Sailor"/>
  <Male fullName="Brandon March"/>
  <Male fullName="Jim March"/>
  <Male fullName="David Sailor"/>
  <Female fullName="Jackie Sailor"/>
  <Female fullName="Brenda March"/>
  <Female fullName="Cindy March"/>
  <Female fullName="Kelly Sailor"/>
</xmi:XMI>
```

Target model
"sample-Persons.ecore"

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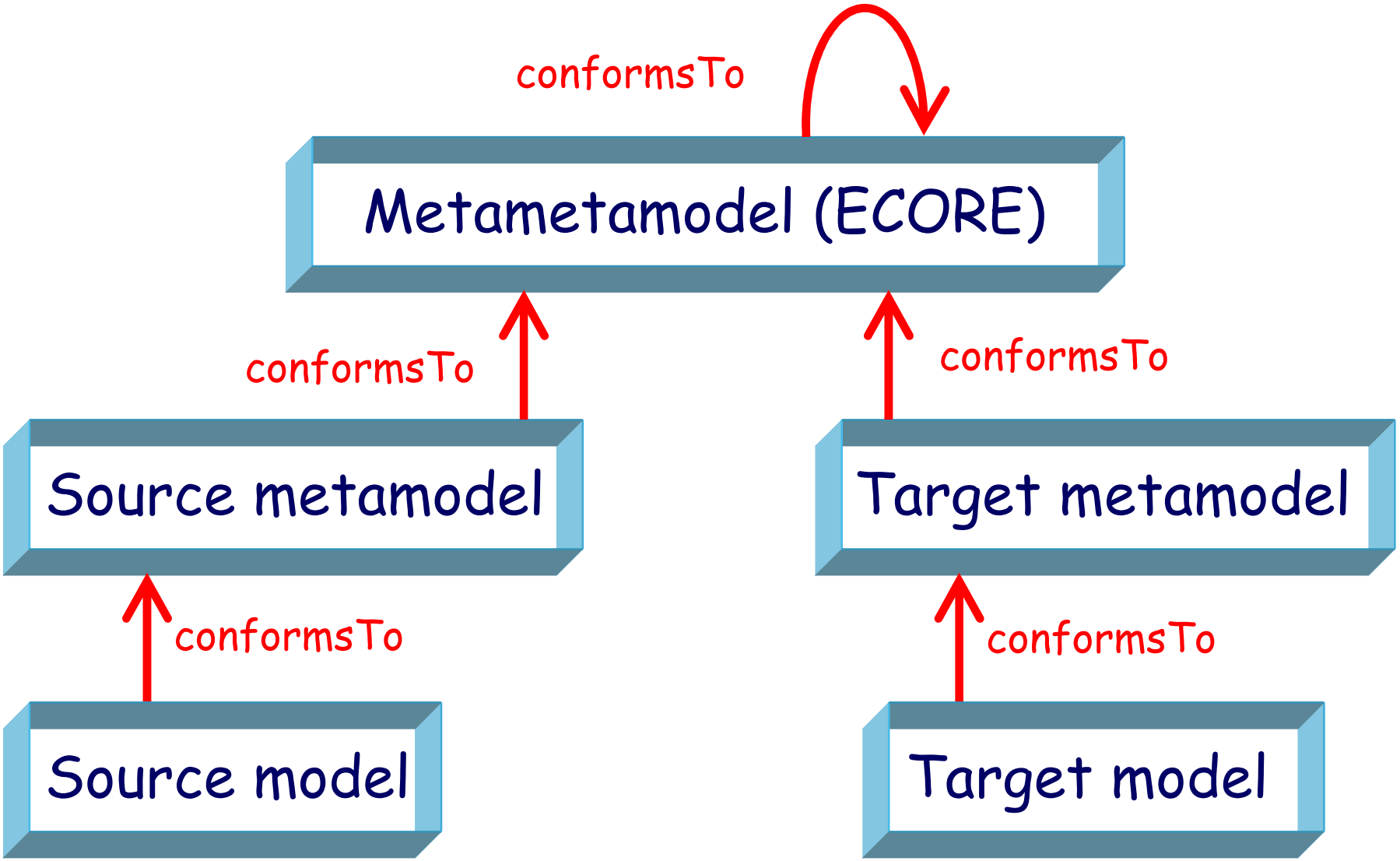
The general picture



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What we need to provide

- In order to achieve the transformation, we need to provide:
  1. A source metamodel in KM3 ("Families").
  2. A source model (in XMI) conforming to "Families".
  3. A target metamodel in KM3 ("Persons").
  4. A transformation model in ATL ("Families2Persons").
- When the ATL transformation is executed, we obtain:
  - A target model (in XMI) conforming to "Persons".

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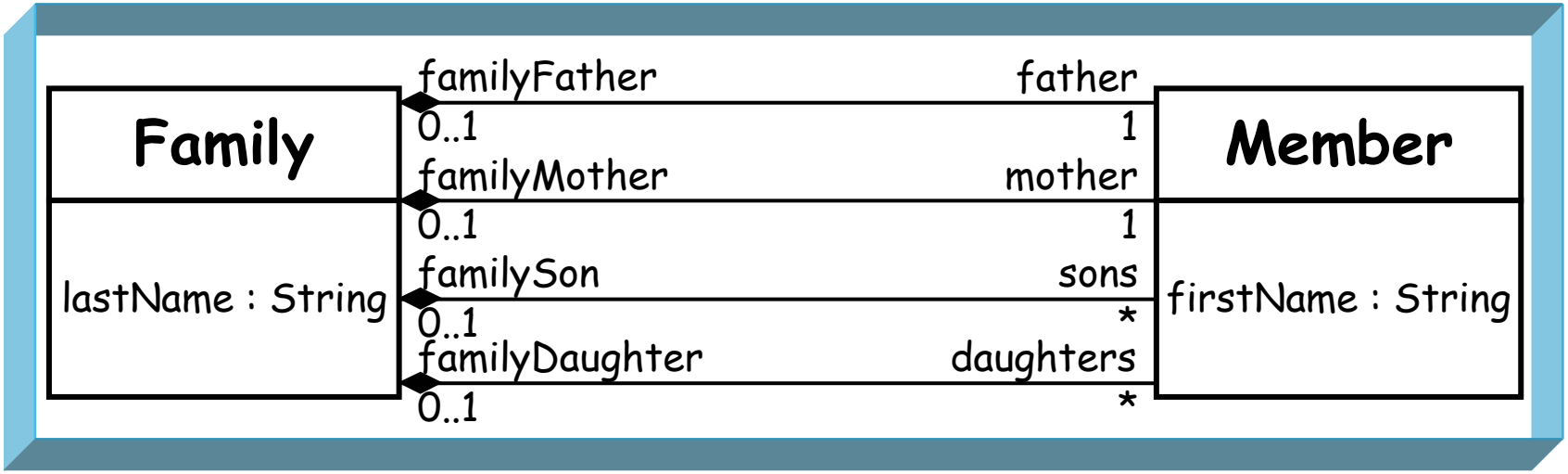
Definition of the source metamodel "Families"

What is "Families":

- A collection of families.
- Each family has a name and is composed of members:
  - A father
  - A mother
  - Several sons
  - Several daughters
- Each family member has a first name.

Family March
Father: Jim
Mother: Cindy
Son: Brandon
Daughter: Brenda
Family Sailor
Father: Peter
Mother: Jackie
Sons: David, Dylan
Daughter: Kelly



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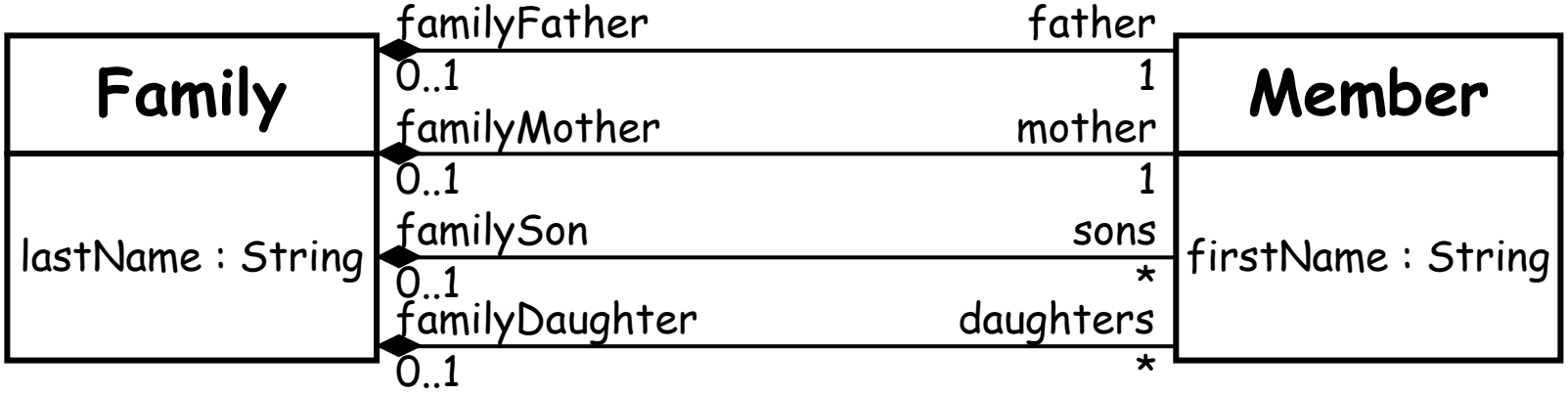
"Families" metamodel (visual presentation and KM3)




```
package Families {

	class Family {
		attribute lastName : String;
		reference father container : Member oppositeOf familyFather;
		reference mother container : Member oppositeOf familyMother;
		reference sons[*] container : Member oppositeOf familySon;
		reference daughters[*] container : Member oppositeOf familyDaughter;
	}

	class Member {
		attribute firstName : String;
		reference familyFather[0-1] : Family oppositeOf father;
		reference familyMother[0-1] : Family oppositeOf mother;
		reference familySon[0-1] : Family oppositeOf sons;
		reference familyDaughter[0-1] : Family oppositeOf daughters;
	}

}

package PrimitiveTypes {
	datatype String;
}
```

Let's create a model representing your family

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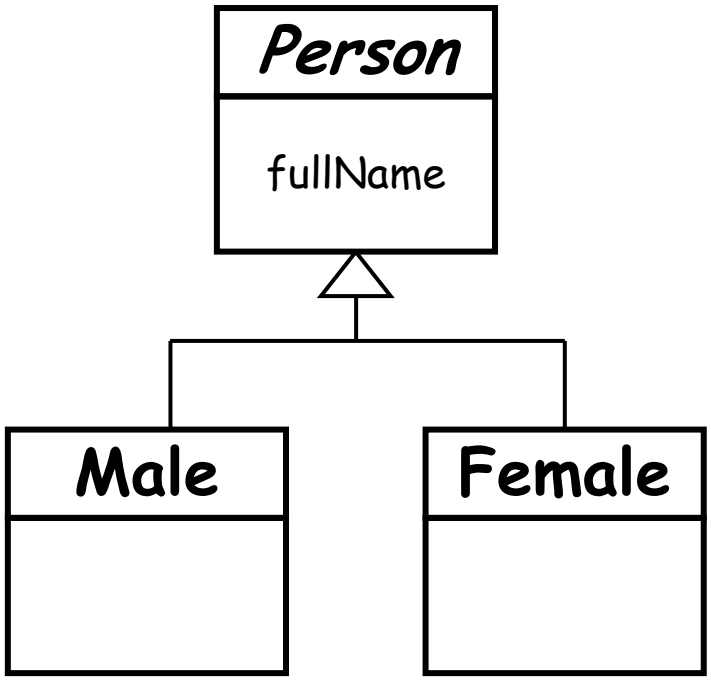
"Persons" metamodel (visual presentation and KM3)



Let's write the Person metamodel using the KM3 notation, and then extract it into Ecore format

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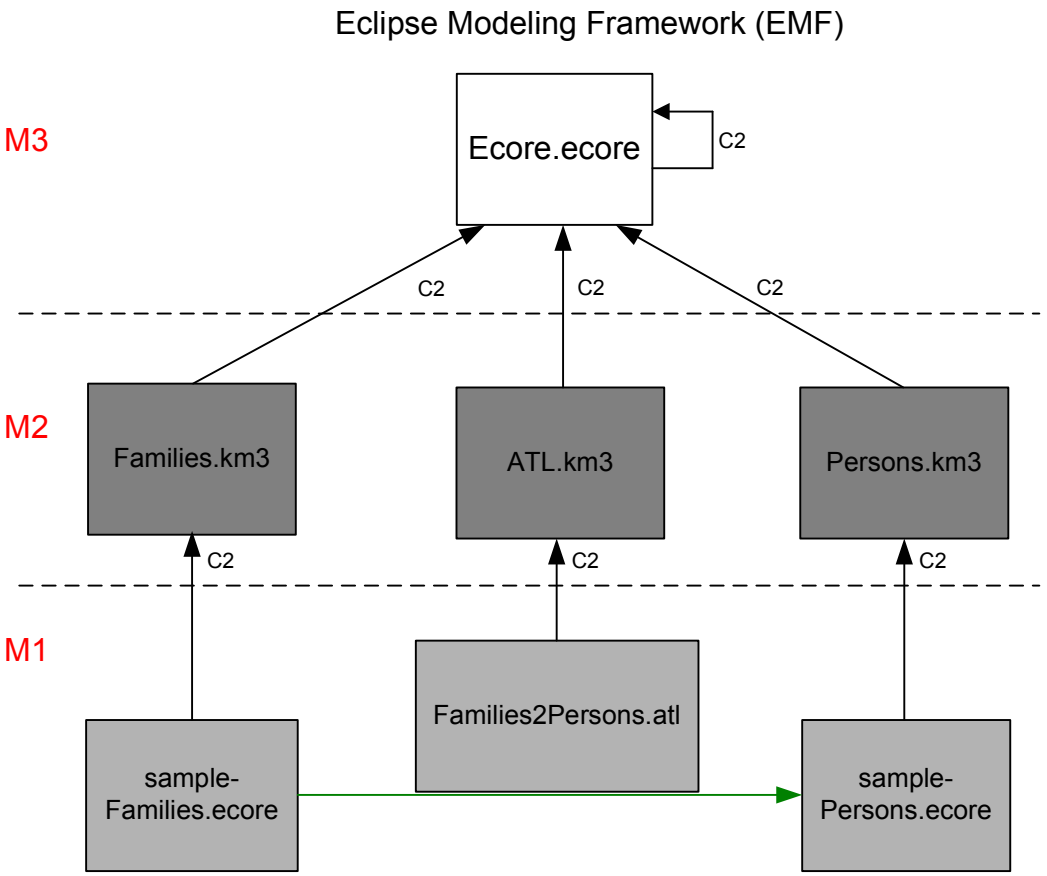
The big picture



1. Our goal in this mini-tutorial is to write the ATL transformation, stored in the "Families2Persons" file.

2. Prior to the execution of this transformation the resulting file "sample-Persons.ecore" does not exist. It is created by the transformation.

3. Before defining the transformation itself, we need to define the source and target metamodels ("Families.km3" and "Person.KM3").

4. We take for granted that the definition of the ATL language is available (supposedly in the "ATL.km3" file).

5. Similarly we take for granted that the environment provides the recursive definition of the metametamodel (supposedly in the "Ecore.ecore" file).

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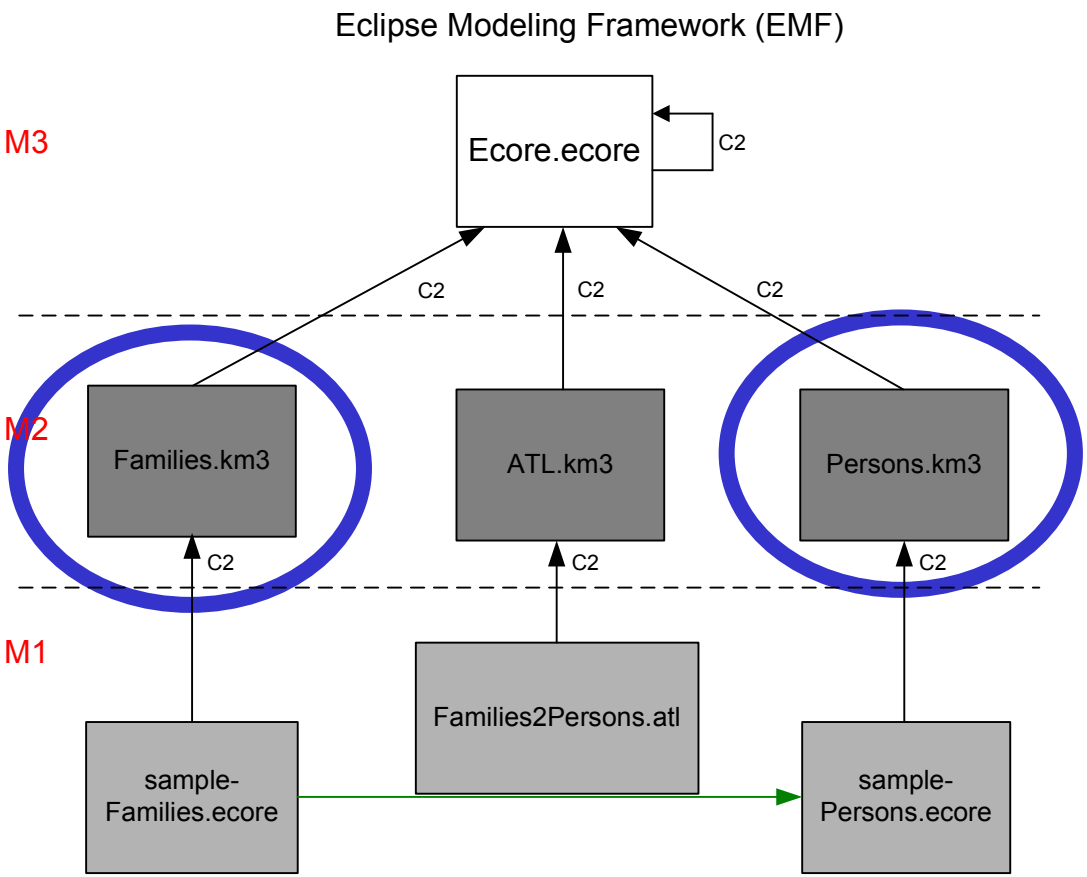
Families to Persons Architecture



1. *Families* and *Persons* metamodels have been created previously.
2. They have been written in the KM3 metamodel specification DSL (Domain Specific Language).

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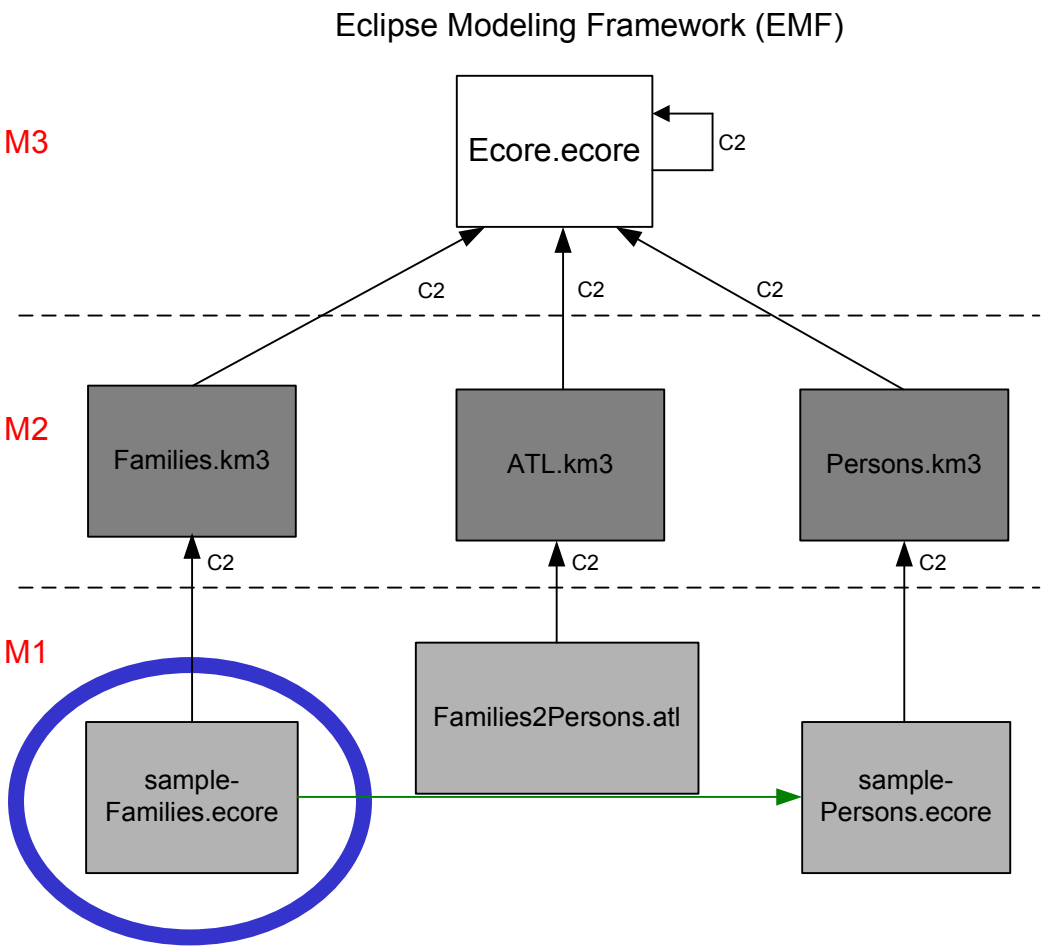
Families to Persons Architecture



1. We will use a file representing your family as source model. A family model example is:

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<xmi:XMI xmi:version="2.0" xmlns:xmi="http://
www.omg.org/XMI" xmlns="Families">
  <Family lastName="March">
    <father firstName="Jim"/>
    <mother firstName="Cindy"/>
    <sons firstName="Brandon"/>
    <daughters firstName="Brenda"/>
  </Family>
  <Family lastName="Sailor">
    <father firstName="Peter"/>
    <mother firstName="Jackie"/>
    <sons firstName="David"/>
    <sons firstName="Dylan"/>
    <daughters firstName="Kelly"/>
  </Family>
</xmi:XMI>
```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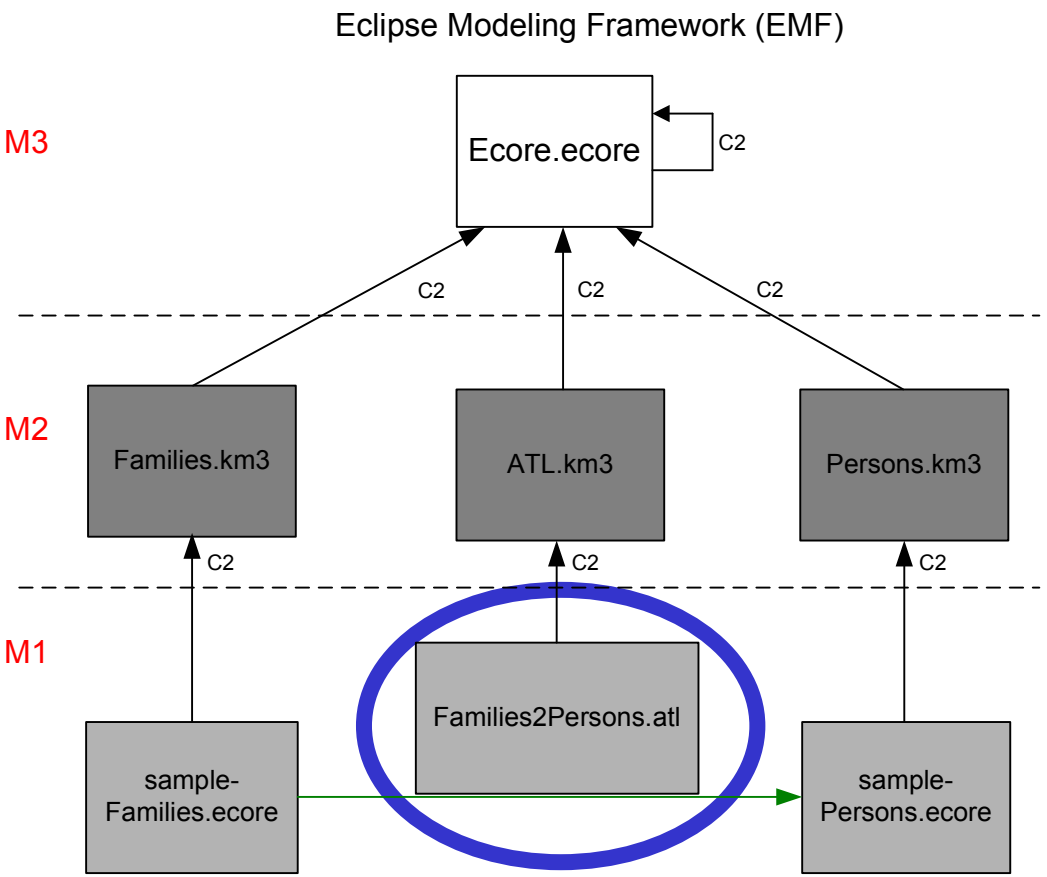
Families to Persons Architecture



1. Now, let us start the creation of the ATL transformation *Families2Persons.atl*.
2. We suppose the ATL environment is already installed.
3. The creation of the ATL transformation will follow several steps as described in the next slides.

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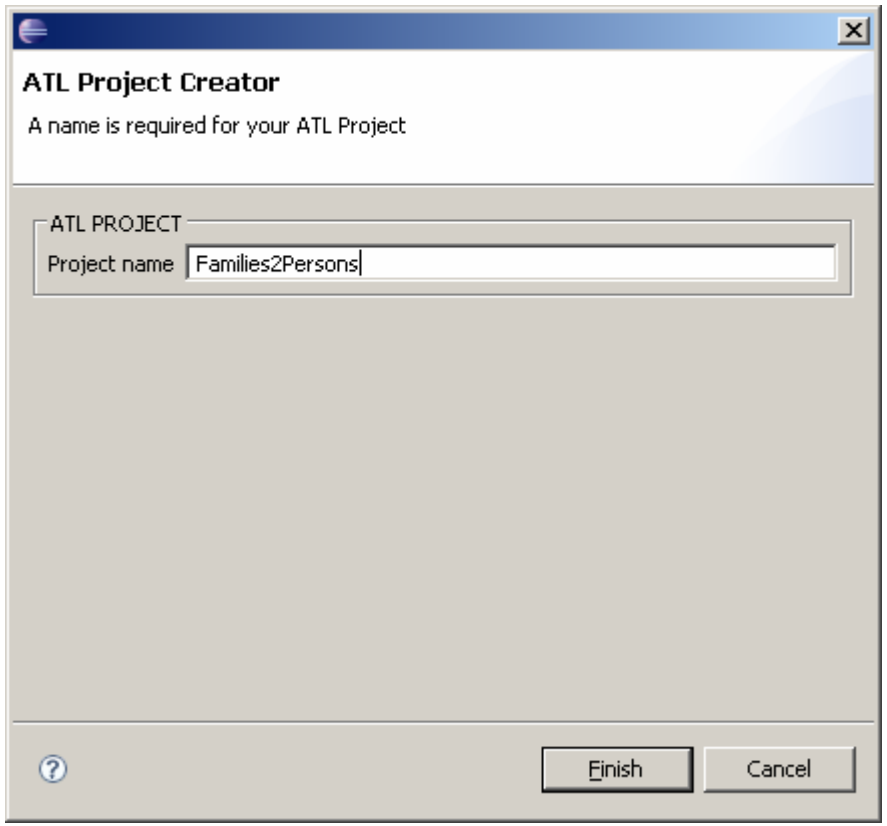
Families to Persons: project creation

- First we create an ATL project by using the ATL Project Wizard.



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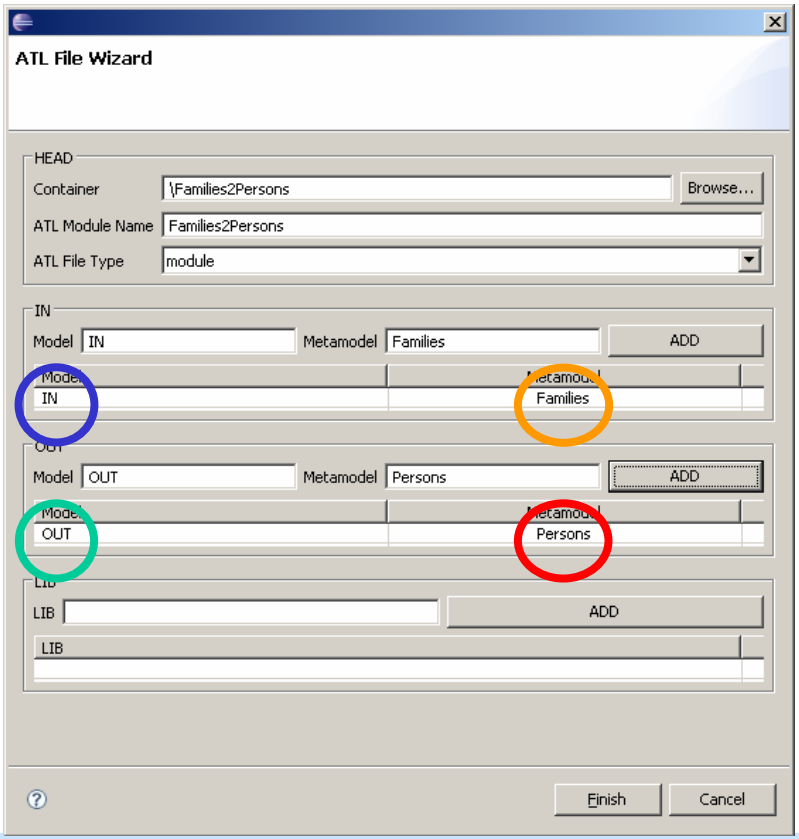
Families to Persons: ATL transformation creation

- Next we create the ATL transformation. To do this, we use the ATL File Wizard. This will generate automatically the header section.

IN:
Name of the source model in the transformation

OUT:
Name of the target model in the transformation



Families:
Name of the source metamodel in the transformation

Persons:
Name of the target metamodel in the transformation

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Families to Persons: header section

- The header section names the transformation module and names the variables corresponding to the source and target models ("IN" and "OUT") together with their metamodels ("Persons" and "Families") acting as types. The header section of "Families2Persons" is:

```
module Families2Persons;
create OUT : Persons from IN : Families;
```


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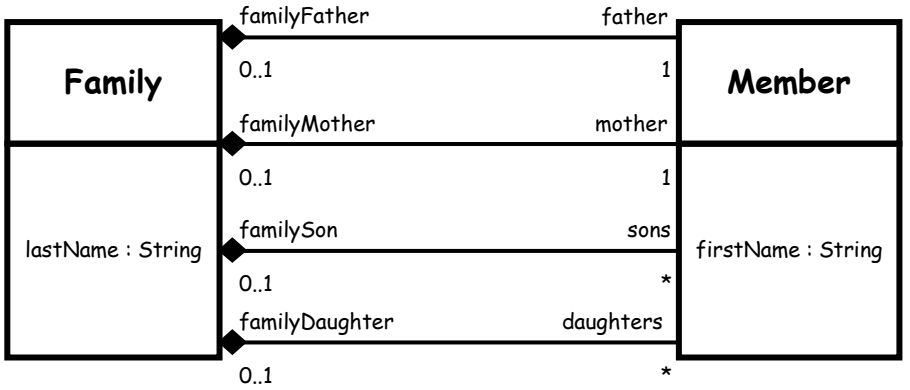
Families to Persons: helper "isFemale()"

- A helper is an auxiliary function that computes a result needed in a rule.
- The following helper "isFemale()" computes the gender of the current member:




```
helper context Families!Member def: isFemale() : Boolean =
      if not self.familyMother.oclIsUndefined() then
            true
      else
            if not self.familyDaughter.oclIsUndefined() then
                  true
            else
                  false
            endif
      endif;
```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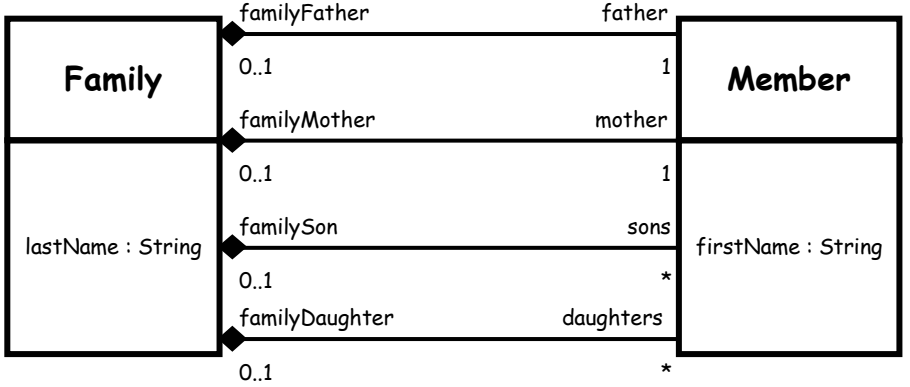
Families to Persons: helper "familyName"

- The family name is not directly contained in class "Member". The following helper returns the family name by navigating the relation between "Family" and "Member":




```
helper context Families!Member def: familyName : String =
      if not self.familyFather.oclIsUndefined() then
            self.familyFather.lastName
      else
            if not self.familyMother.oclIsUndefined() then
                  self.familyMother.lastName
            else
                  if not self.familySon.oclIsUndefined() then
                        self.familySon.lastName
                  else
                        self.familyDaughter.lastName
                  endif
            endif
      endif;
```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Families to Persons: writing the rules

- After the helpers we now write the rules:
  - Member to Male

```
rule Member2Male {
	from
		s : Families!Member (not s.isFemale())
	to
		t : Persons!Male (
			fullName <- s.firstName + ' ' + s.familyName
		)
```

  - Member to Female

```
rule Member2Female {
	from
		s : Families!Member (s.isFemale())
	to
		t : Persons!Female (
			fullName <- s.firstName + ' ' + s.familyName
		)
}
```


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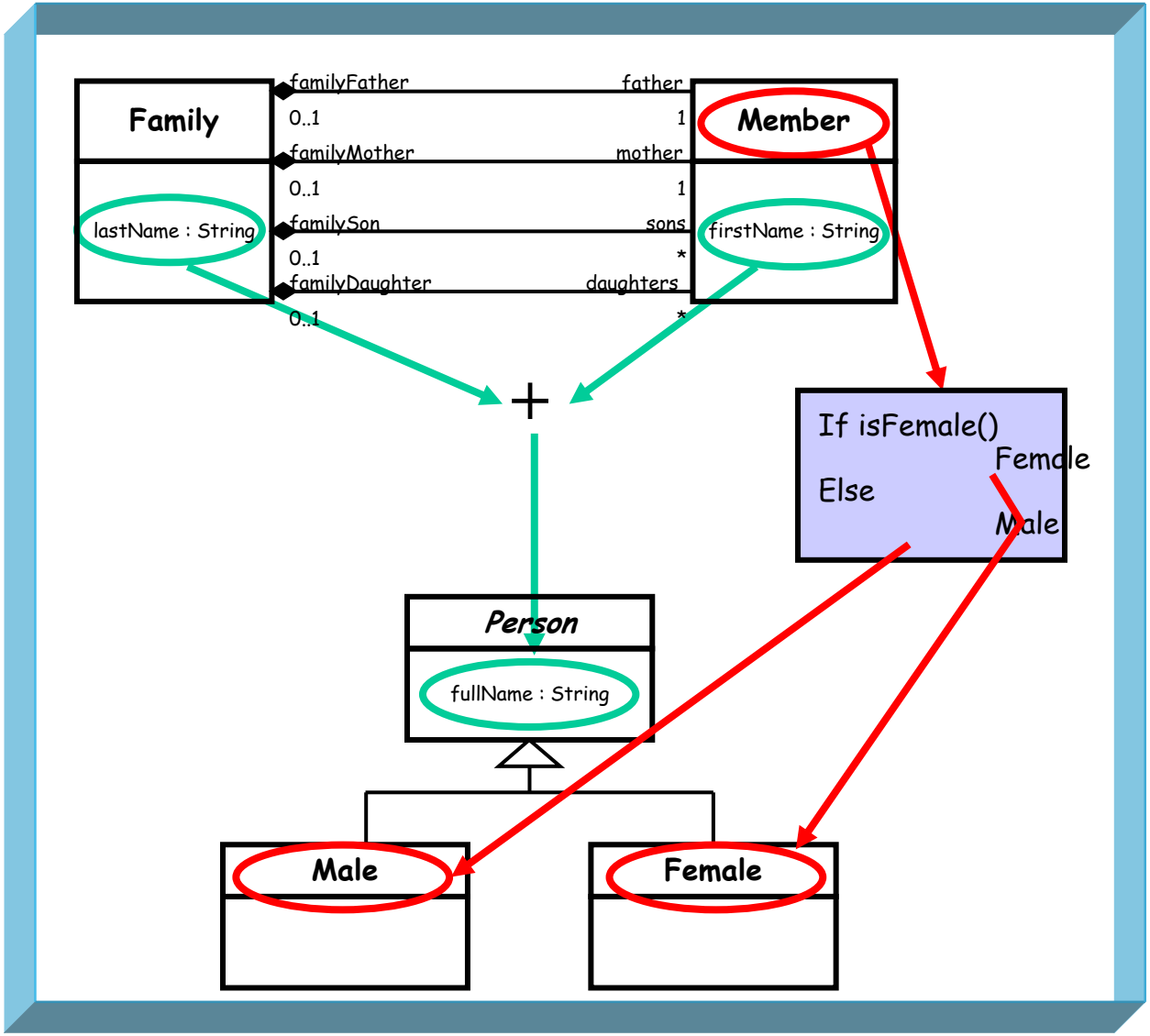
Summary of the Transformation



1. For each instance of the class "Member" in the IN model, create an instance in the OUT model.
2. If the original "Member" instance is a "mother" or one of the "daughters" of a given "Family", then we create an instance of the "Female" class in the OUT model.
3. If the original "Member" instance is a "father" or one of the "sons" of a given "Family", then we create an instance of the "Male" class in the OUT model.
4. In both cases, the "fullname" of the created instance is the concatenation of the Member "firstName" and of the Family "lastName", separated by a blank.

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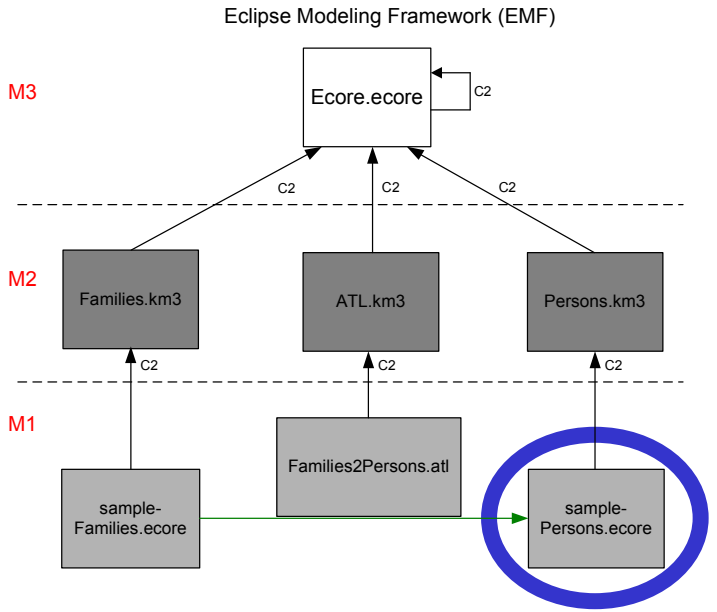
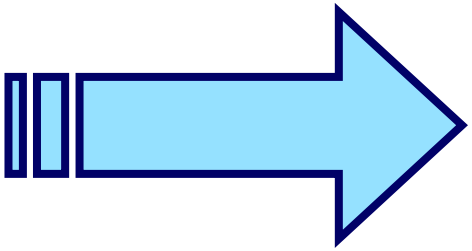
Families to Persons Architecture

1. Once the ATL transformation "Families2Persons" is created, we can execute it to build the OUT model.





```
<?xml version="1.0" encoding="ISO-8859-1"?>
<xmi:XMI xmi:version="2.0"
    xmlns:xmi="http://www.omg.org/XMI"
xmlns="Persons">
  <Male fullName="Dylan Sailor"/>
  <Male fullName="Peter Sailor"/>
  <Male fullName="Brandon March"/>
  <Male fullName="Jim March"/>
  <Male fullName="David Sailor"/>
  <Female fullName="Jackie Sailor"/>
  <Female fullName="Brenda March"/>
  <Female fullName="Cindy March"/>
  <Female fullName="Kelly Sailor"/>
</xmi:XMI>
```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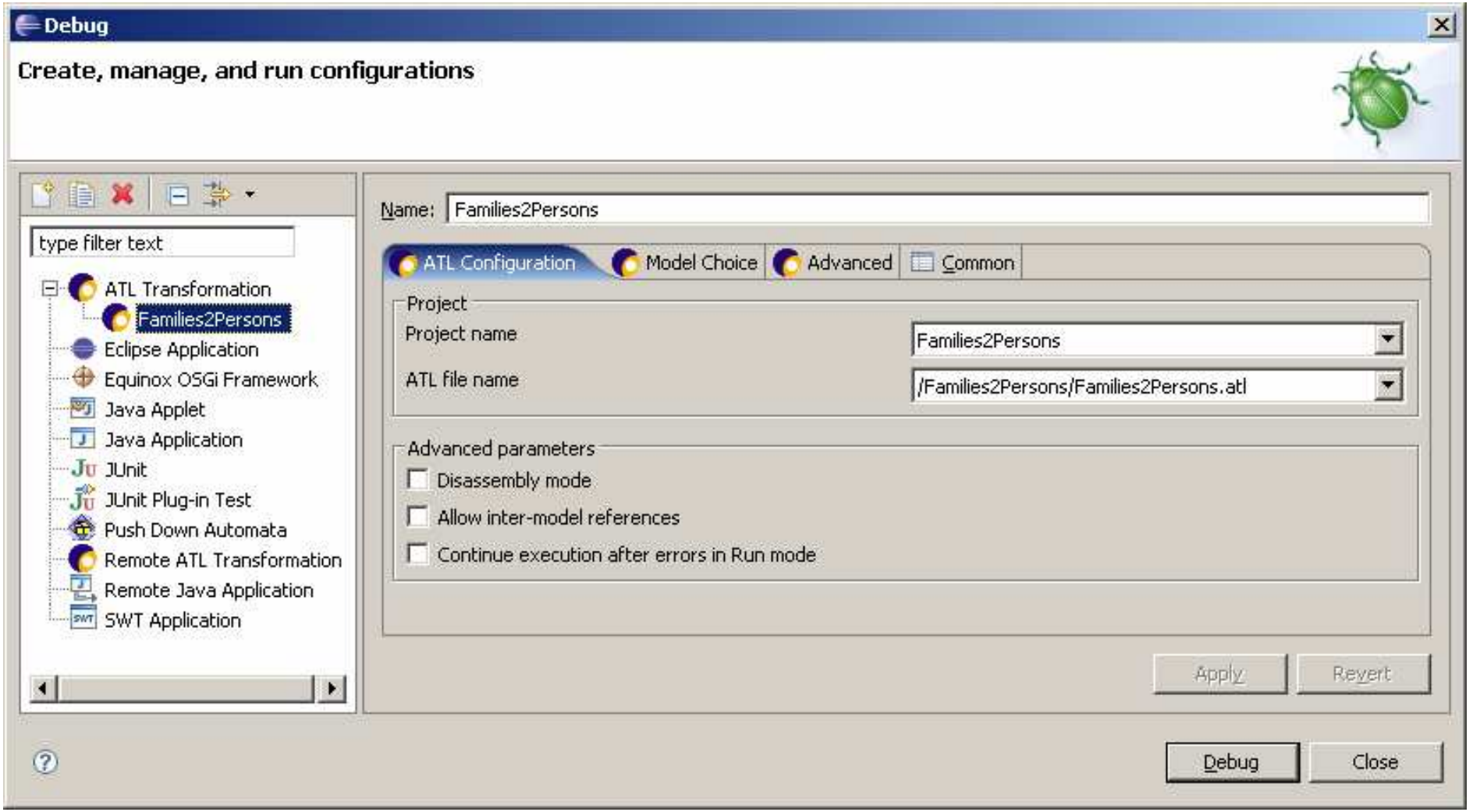
ATL Launch Configuration - 1



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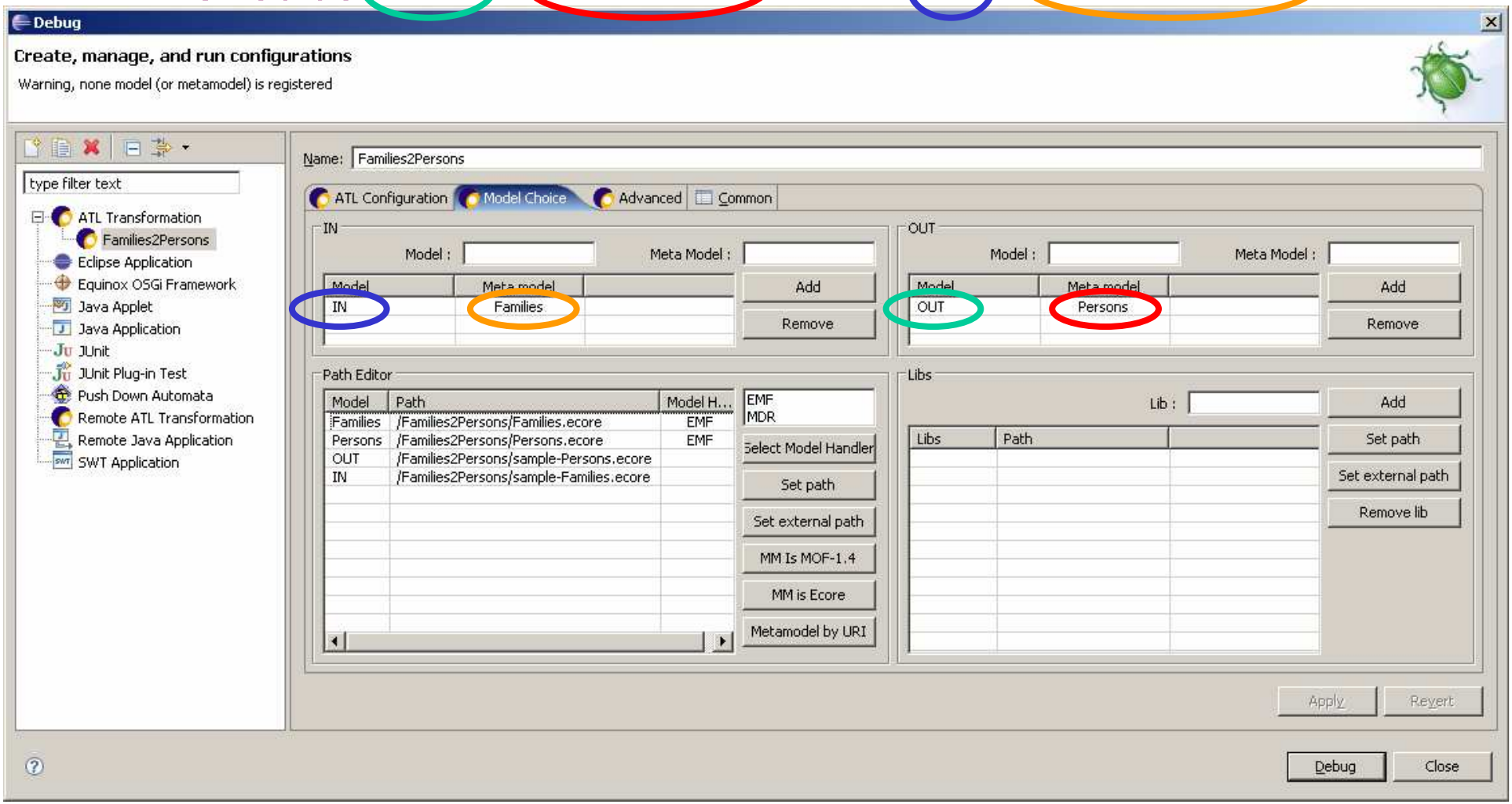
ATL Launch Configuration - 2

```
module Families2Persons;
create OUT : Persons from IN : Families;
```



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Summary

- We have presented here a "hello world" level basic ATL transformation.
- This is not a recommendation on how to program in ATL, just an initial example.
- We can use MD techniques to performs classical software tasks (e.g., database migration)
- Several questions have not been answered
  - Like how to transform database textual representation into an XMI-encoded model.
  - Or how to transform the XMI-encoded result into database textual representation.
- For any further questions, see the documentation mentioned in the resource page (FAQ, Manual, Examples, etc.).

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ATL Resource page

- ATL Home page
  - http://www.eclipse.org/m2m/atl/
- ATL Documentation page
  - http://www.eclipse.org/m2m/atl/doc/
- ATL Newsgroup
  - news://news.eclipse.org/eclipse.modeling.m2m
- ATL Wiki
  - http://wiki.eclipse.org/index.php/ATL

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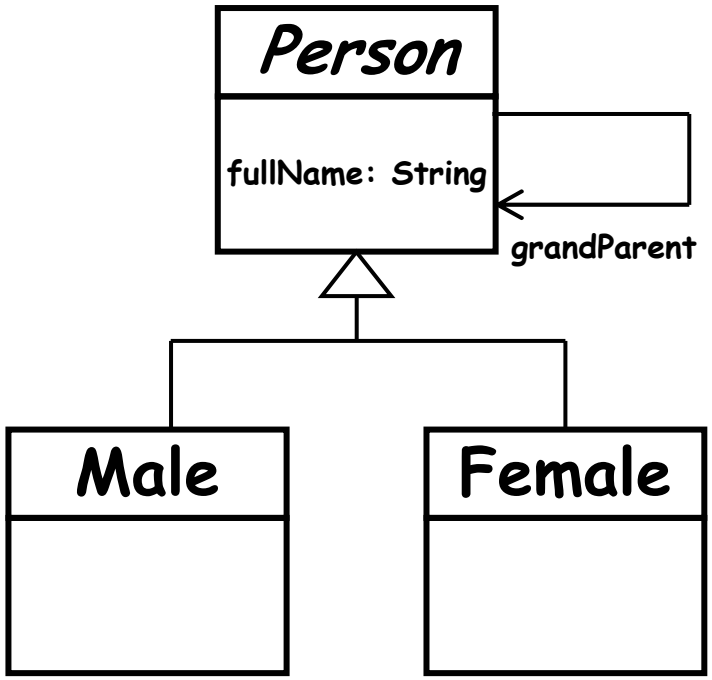
Working on the example



- There are a lot of exercise questions that could be based on this simple example.
- For example, modify the target metamodel as shown and compute the "grandParent" for any Person.
- The ATL console and the debugger are your friends

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