Introduction to the Eclipse Modeling Framework

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Model Driven Software Development

- Software is focused on manipulating data
- Data has abstract structure
  - It can be described at a high level
  - It can be represented in different ways
  - It's always a model of something
- The description of the data is yet more data
  - It's commonly referred to as metadata
  - Meta is a bit confusing
  - The model of a model is a model
- Whether it's recognized or not, models drive software development

Eclipse Modeling Framework

- A simple, pragmatic, Java-based approach that provides
  - The Ecore API for describing models
  - The EObject API for manipulating instances
  - A resource framework for RESTful persistence
  - A generator framework for producing development artifacts
  - A runtime along with utilities for traversing, indexing, copy, change recording, and so on
  - Tools for working with models and their instances
- EMF was used to develop EMF

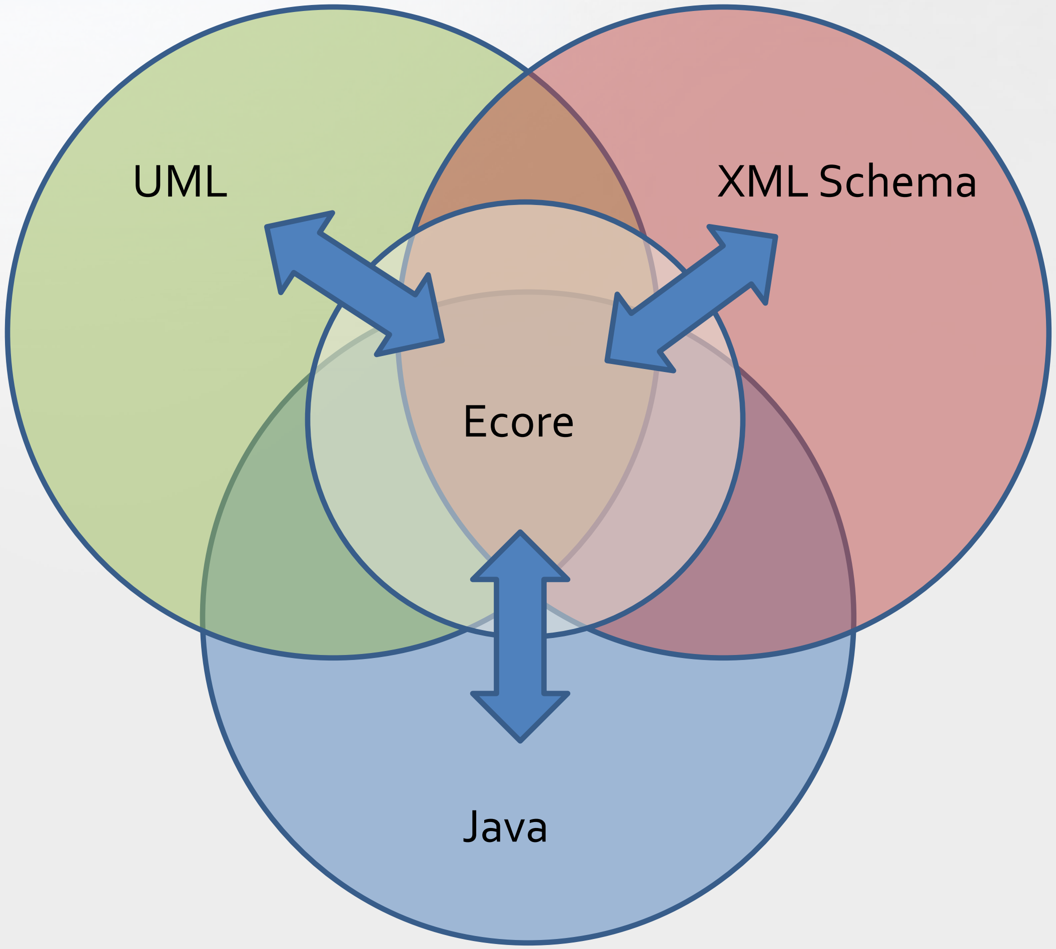
A Brief History of EMF

- Started at IBM in the late 90's
  - It supported Object Mangement Group (OMG) specifications
  - It implemented Meta Object Facility (MOF)
  - It used XML Metadata Interface (XMI)
  - It's closely related to Java Metadata Interface (JMI)
- Problems surfaced for adopters
  - The MOF model was far too complex
  - The generated code and runtime were bloated and performed poorly
- ETools Modeling Framework (EMF) was kicked off in 2000
  - Boiled MOF to its essential components resulting in Ecore
  - Revamped the runtime and tools to make them lean and mean
- Contributed to Eclipse in September 2002
  - Rebrand as the Eclipse Modeling Framework
  - Feedback to OMG resulting in Essential MOF/Complete MOF split

Ecore: The Model of Models

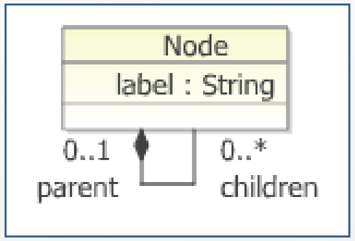
- A simple model for describing models
  - Classification of objects
  - Attributes of those objects
  - Relationships/associations between those objects
  - Operations on those objects
  - Simple constraints on those objects, and their attributes and relationships
- Ecore is self describing, i.e., it is its own model
- Models higher up in the meta levels tend to all look the same
  - They begin to conform to our mental model

Relationship of Ecore to Other Models

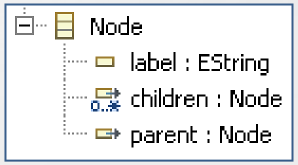


A Model is a Model is a Model

UML



Ecore



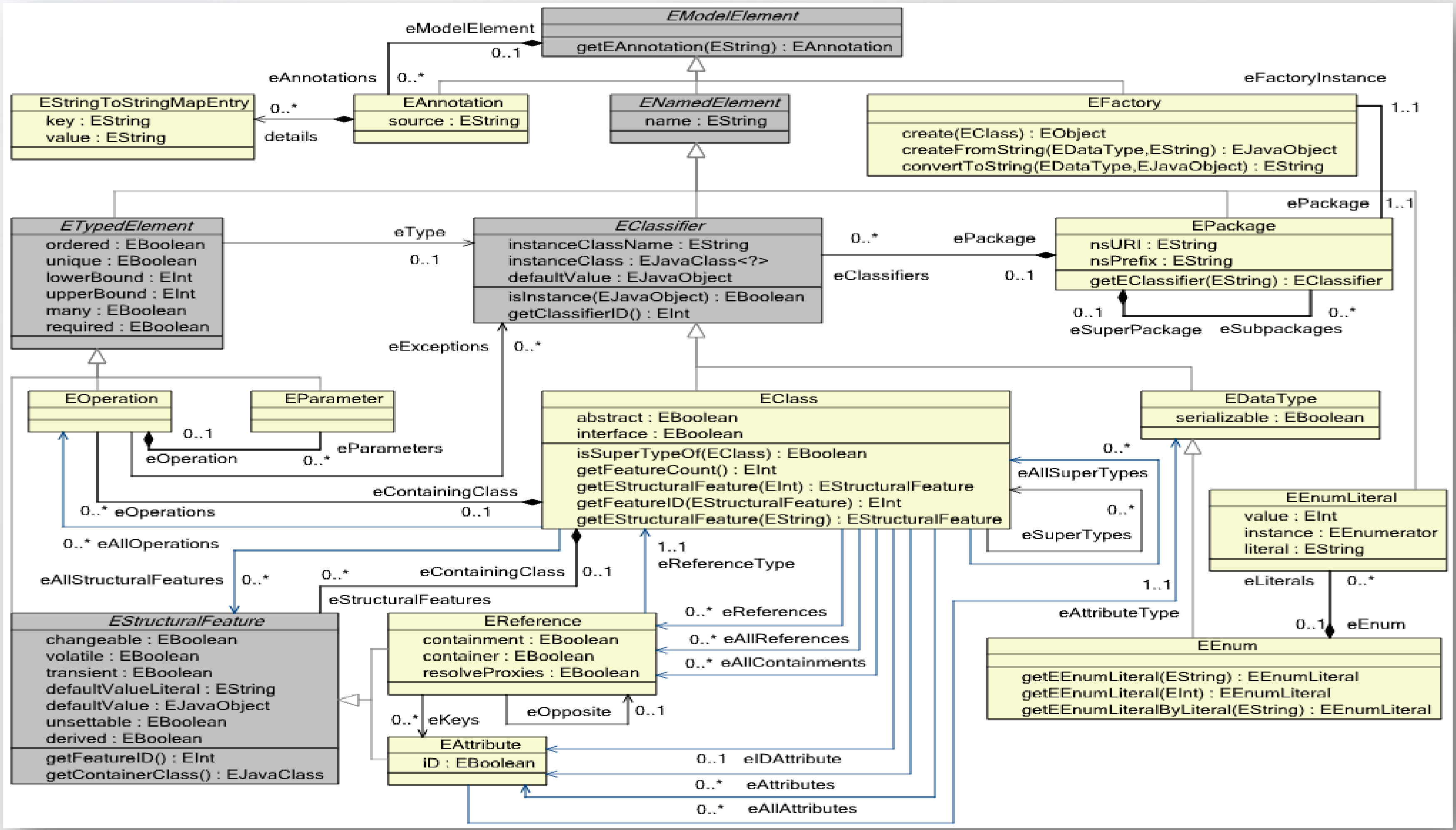
XML Schema

```
<xsd:complexType name="Node">
    <xsd:sequence>
      <xsd:element
        name="children"
        type="tree:Node"
        minOccurs="0"
        maxOccurs="unbounded"
        ecore:opposite="parent"/>
    </xsd:sequence>
    <xsd:attribute
      name="label"
      type="xsd:string"/>
</xsd:complexType>
```

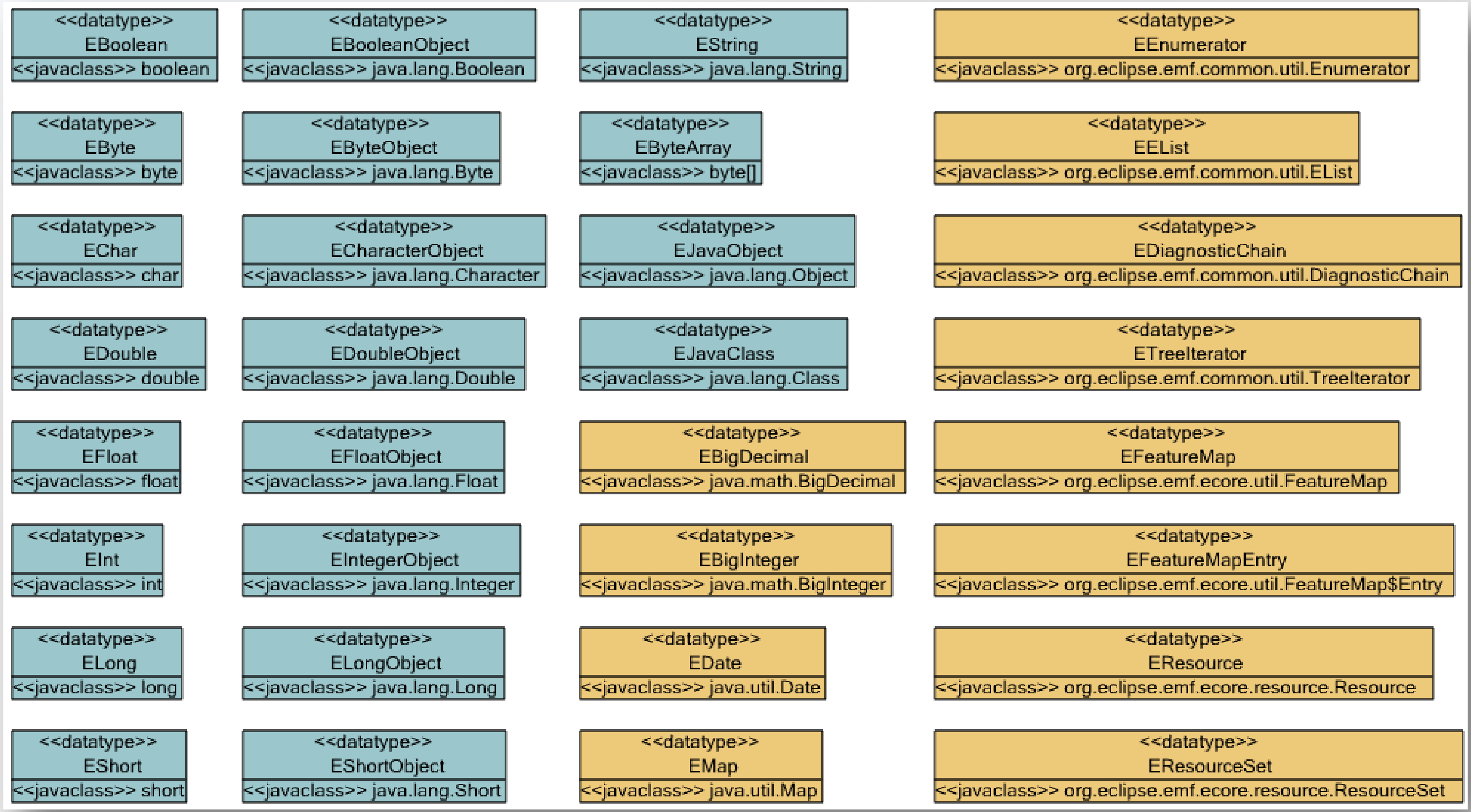
Java

```
public interface Node {
  String getLabel();
  void setLabel(String value);
  List<Node> getChildren();
  Node getParent();
  void setParent(Node value);
} // Node
```

Ecore Overview

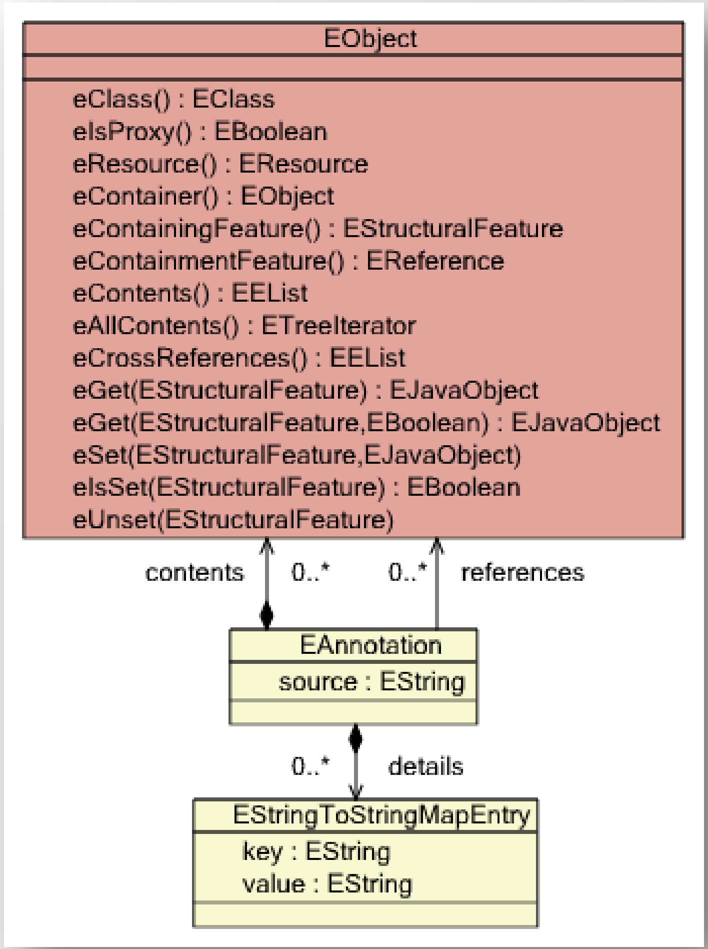


Ecore Data Types



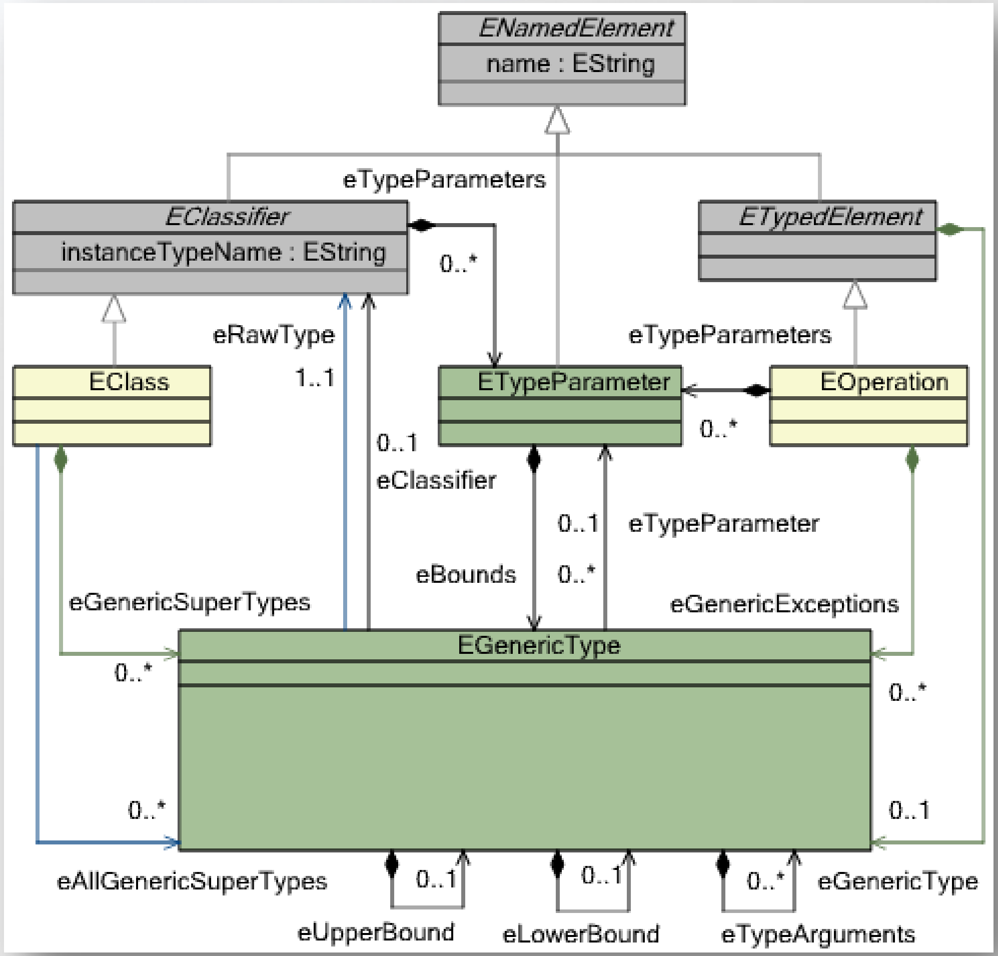
<<datatype>> EBoolean <<javaclass>> boolean	<<datatype>> EBooleanObject <<javaclass>> java.lang.Boolean	<<datatype>> EString <<javaclass>> java.lang.String	<<datatype>> EEnumerator <<javaclass>> org.eclipse.emf.common.util.Enumerator
<<datatype>> EByte <<javaclass>> byte	<<datatype>> EByteObject <<javaclass>> java.lang.Byte	<<datatype>> EByteArray <<javaclass>> byte[]	<<datatype>> EEList <<javaclass>> org.eclipse.emf.common.util.EList
<<datatype>> EChar <<javaclass>> char	<<datatype>> ECharacterObject <<javaclass>> java.lang.Character	<<datatype>> EJavaObject <<javaclass>> java.lang.Object	<<datatype>> EDiagnosticChain <<javaclass>> org.eclipse.emf.common.util.DiagnosticChain
<<datatype>> EDouble <<javaclass>> double	<<datatype>> EDoubleObject <<javaclass>> java.lang.Double	<<datatype>> EJavaClass <<javaclass>> java.lang.Class	<<datatype>> ETreeIterator <<javaclass>> org.eclipse.emf.common.util.TreeIterator
<<datatype>> EFloat <<javaclass>> float	<<datatype>> EFloatObject <<javaclass>> java.lang.Float	<<datatype>> EBigDecimal <<javaclass>> java.math.BigDecimal	<<datatype>> EFeatureMap <<javaclass>> org.eclipse.emf.ecore.util.FeatureMap
<<datatype>> EInt <<javaclass>> int	<<datatype>> EIntegerObject <<javaclass>> java.lang.Integer	<<datatype>> EBigInteger <<javaclass>> java.math.BigInteger	<<datatype>> EFeatureMapEntry <<javaclass>> org.eclipse.emf.ecore.util.FeatureMap$Entry
<<datatype>> ELong <<javaclass>> long	<<datatype>> ELongObject <<javaclass>> java.lang.Long	<<datatype>> EDate <<javaclass>> java.util.Date	<<datatype>> EResource <<javaclass>> org.eclipse.emf.ecore.resource.Resource
<<datatype>> EShort <<javaclass>> short	<<datatype>> EShortObject <<javaclass>> java.lang.Short	<<datatype>> EMap <<javaclass>> java.util.Map	<<datatype>> EResourceSet <<javaclass>> org.eclipse.emf.ecore.resource.ResourceSet

Ecore Annotations and EObject

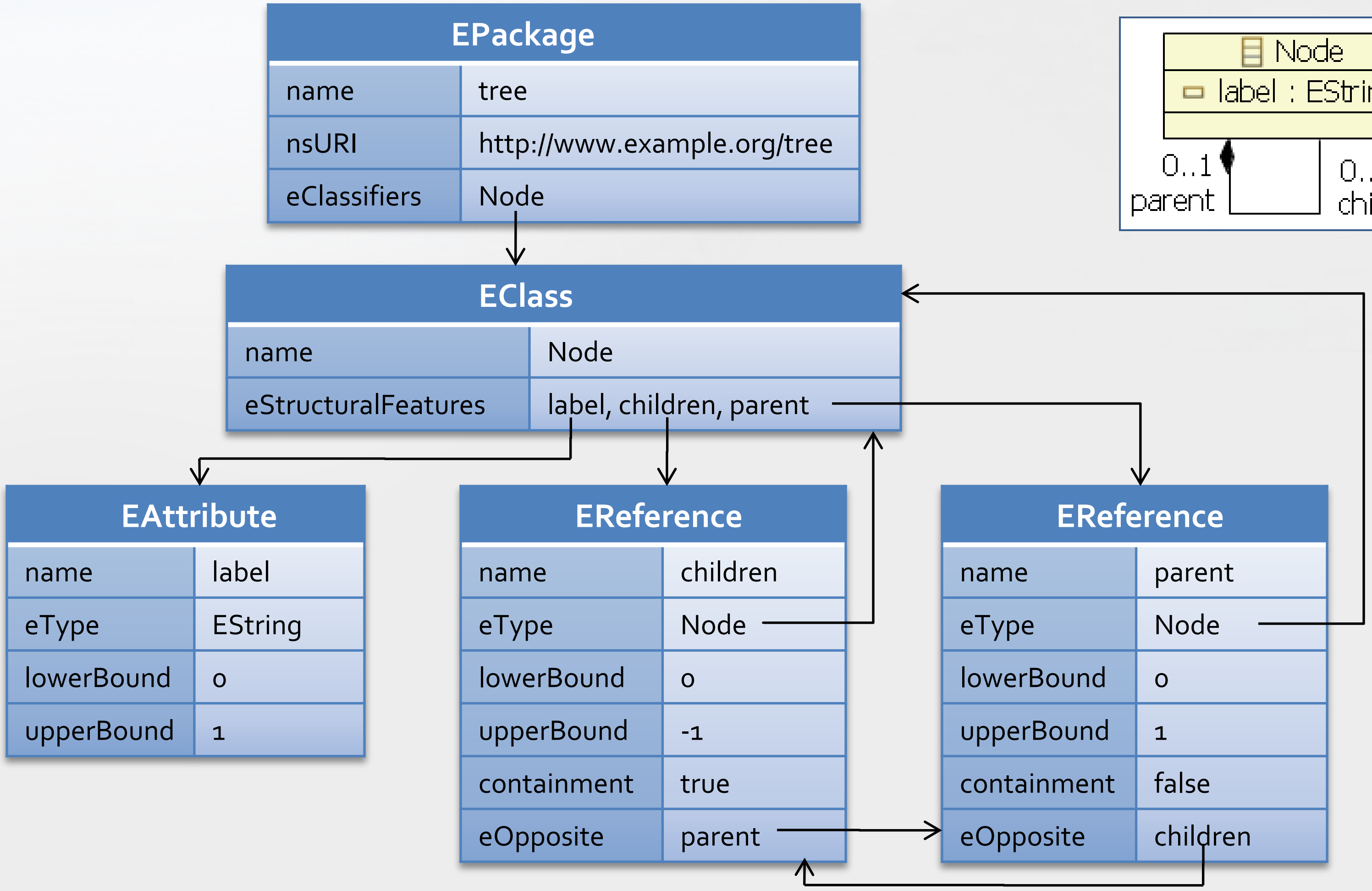


EObject
eClass() : EClass
eIsProxy() : EBoolean
eResource() : EResource
eContainer() : EObject
eContainingFeature() : EStructuralFeature
eContainmentFeature() : EReference
eContents() : EEList
eAllContents() : ETreeIterator
eCrossReferences() : EEList
eGet(EStructuralFeature) : EJavaObject
eGet(EStructuralFeature,EBoolean) : EJavaObject
eSet(EStructuralFeature,EJavaObject)
eIsSet(EStructuralFeature) : EBoolean
eUnset(EStructuralFeature)
contents
0..*
0..*
references
EAnnotation
source : EString
0..*
details
EStringToStringMapEntry
key : EString
value : EString

Ecore Generics



The Tree Ecore Model



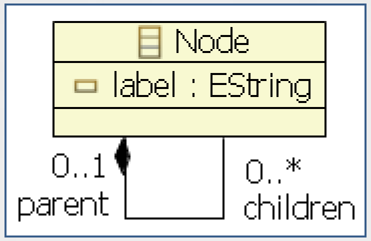
EPackage	
name	tree
nsURI	http://www.example.org/tree
eClassifiers	Node

EClass	
name	Node
eStructuralFeatures	label, children, parent

EAttribute	
name	label
eType	EString
lowerBound	0
upperBound	1

EReference	
name	children
eType	Node
lowerBound	0
upperBound	-1
containment	true
eOpposite	parent

EReference	
name	parent
eType	Node
lowerBound	0
upperBound	1
containment	false
eOpposite	children



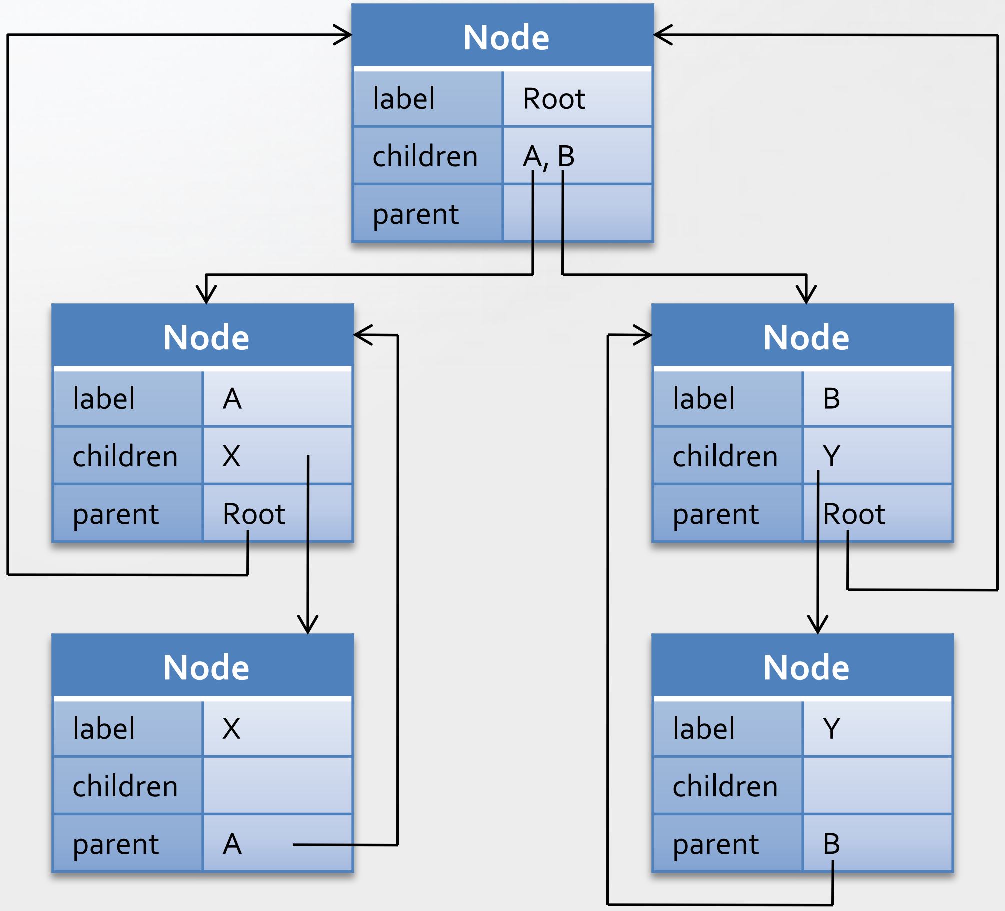
The Tree Ecore Model Serialized as XMI

```
<?xml version="1.0" encoding="UTF-8"?>
<ecore:EPackage xmi:version="2.0"
    xmlns:xmi="http://www.omg.org/XMI"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:ecore="http://www.eclipse.org/emf/2002/Ecore"
    name="tree"
    nsURI="http://www.example.org/tree"
    nsPrefix="tree">
  <eClassifiers xsi:type="ecore:EClass" name="Node">
    <eStructuralFeatures xsi:type="ecore:EAttribute" name="label"
        eType="ecore:EDataType http://www.eclipse.org/emf/2002/Ecore#//EString"/>
    <eStructuralFeatures xsi:type="ecore:EReference" name="children" upperBound="-1"
        eType="#//Node" containment="true" eOpposite="#//Node/parent"/>
    <eStructuralFeatures xsi:type="ecore:EReference" name="parent"
        eType="#//Node" eOpposite="#//Node/children"/>
  </eClassifiers>
</ecore:EPackage>
```

The Tree Ecore Model Serialized as EMOF

```
<?xml version="1.0" encoding="UTF-8"?>
<emof:Package xmi:version="2.0"
    xmlns:xmi="http://www.omg.org/XMI"
    xmlns:emof="http://schema.omg.org/spec/MOF/2.0/emof.xml"
    xmi:id="tree"
    name="tree"
    uri="http://www.example.org/tree">
  <ownedType xmi:type="emof:Class" xmi:id="tree.Node" name="Node">
    <ownedAttribute xmi:id="tree.Node.label" name="label"
        isOrdered="true" lower="0">
      <type xmi:type="emof:PrimitiveType"
          href="http://schema.omg.org/spec/MOF/2.0/emof.xml#String"/>
    </ownedAttribute>
    <ownedAttribute xmi:id="tree.Node.children" name="children"
       isOrdered="true" lower="0" upper="*" type="tree.Node"
       isComposite="true" opposite="tree.Node.parent"/>
    <ownedAttribute xmi:id="tree.Node.parent" name="parent"
        isOrdered="true" lower="0" type="tree.Node"
        opposite="tree.Node.children"/>
  </ownedType>
  <xmi:Extension extender="http://www.eclipse.org/emf/2002/Ecore">
    <nsPrefix>tree</nsPrefix>
  </xmi:Extension>
</emof:Package>
```

A Tree Instance Model

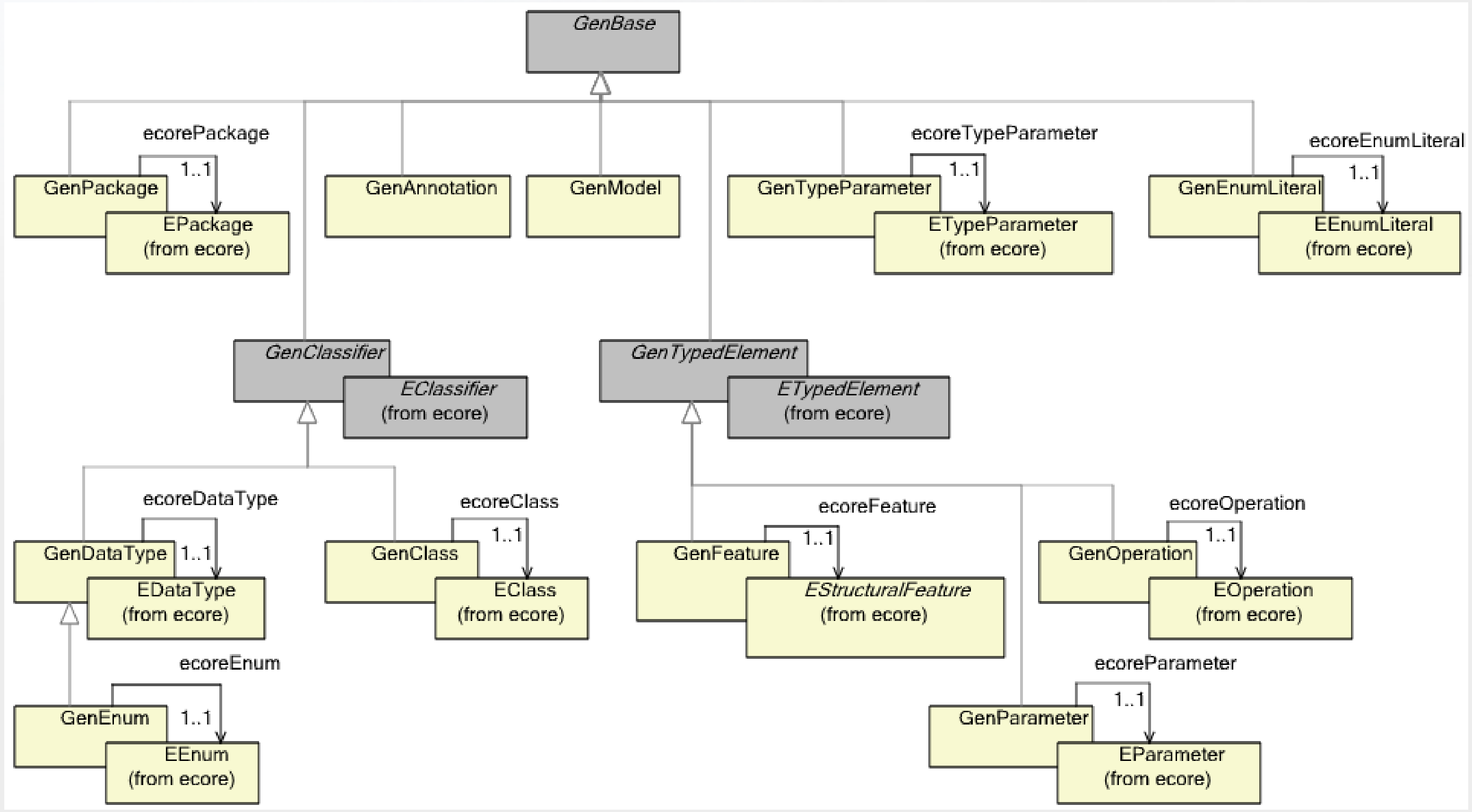


A Tree Instance Model Serialized as XMI

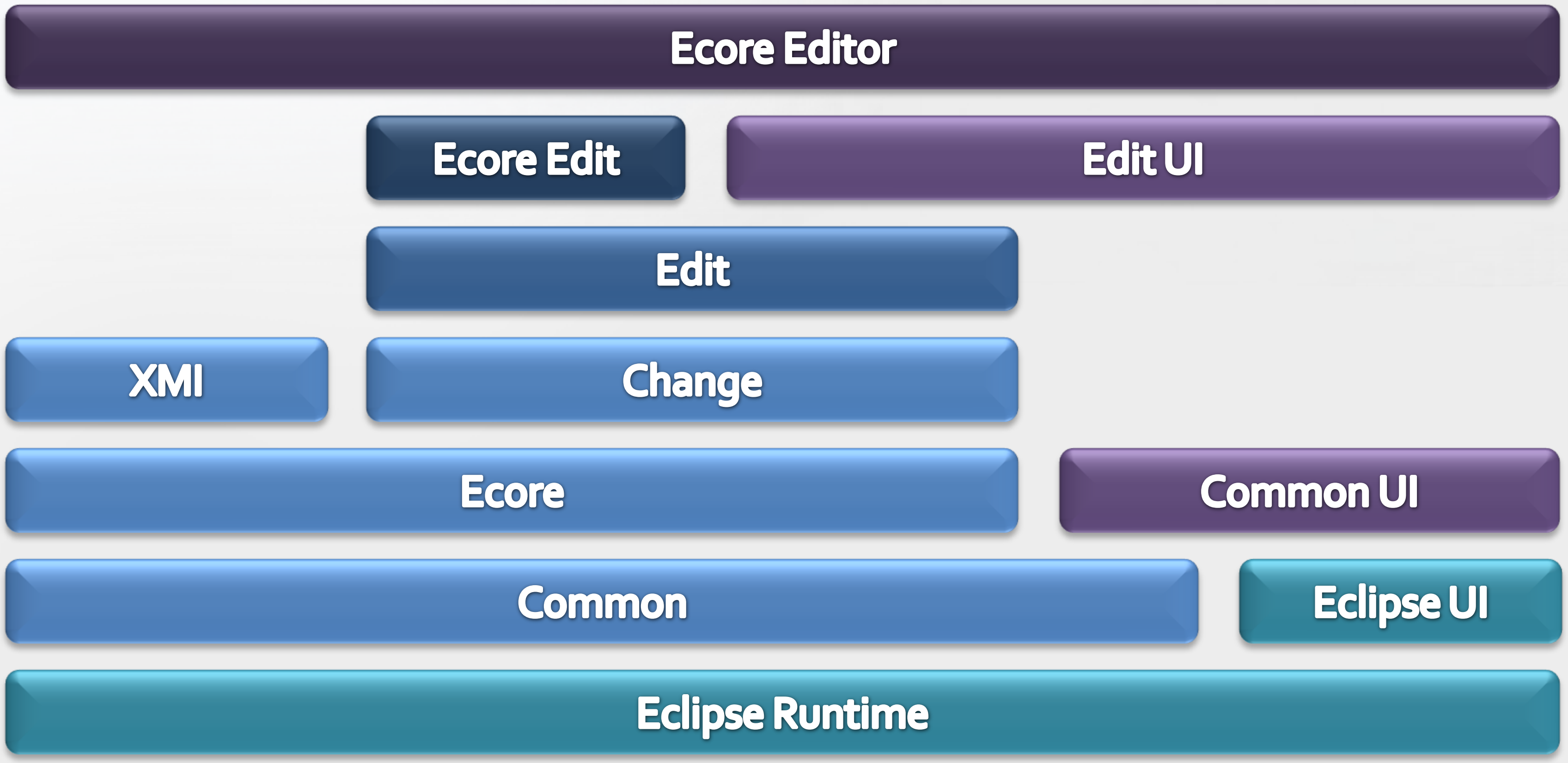
```
<tree:Node xmi:version="2.0"
    xmlns:xmi="http://www.omg.org/XMI"
    xmlns:tree="http://www.example.org/tree"
    label="root">
  <children label="A">
    <children label="X"/>
  </children>
  <children label="B">
    <children label="Y"/>
  </children>
</tree:Node>
```

The EMF Generator Model

- The GenModel is a decorator for tailoring the generated code



EMF Application Architecture



EMF in Action

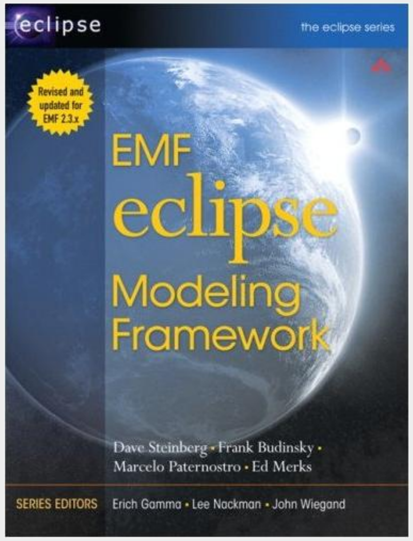
- Demo time!
  - Show how to create the Ecore Tree model from scratch using the Sample Ecore Editor
  - Show how to use Ecore Tools for diagrams
  - Show how to exploit dynamic models to create Tree instances
  - Demonstrate the interchangeable nature of models
    - Generate the Java realization
    - Export to XML Schema
    - Show how these round trip
    - Show how to run the example
    - Show how to run the generated editor

Summary

- EMF the defacto standard reference implementation
- EMF is a low cost modeling solution for Java
  - SD Times ranks it "top shelf" even relative to pricey commercial software
    - http://www.sdtimes.com/content/article.aspx?ArticleID=32287
- It exploits the models already underlying the application
- It supports iterative development that facilitates both model-based changes and hand-written changes equally well
- It boosts productivity by automating routine and mundane development tasks
- It's the foundation for data integration by providing a uniform way to access all models

Resources

- Online help
  - http://help.eclipse.org/helios/index.jsp?nav=/17
- Website
  - http://www.eclipse.org/emf
    - Downloads
    - Wiki
    - FAQ
    - Newsgroup
    - Documentation
- Books
  - Eclipse Modeling Framework
    - First Edition
      - http://safari.awprofessional.com/0131425420
    - Second Edition
      - http://my.safaribooksonline.com/9780321331885


eclipse
the eclipse series
Revised and updated for EMF 2.3.x
EMF
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