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Round-Trip Engineering and Comparison of Open-Source and Free Tools for UML Modelling

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About This Presentation

- It is intended to serve as a starting point on “usefullness” of modelling for students in several courses
- Software Construction (as in the RUP phase)
  - Round-trip engineering as a support of the software construction phases in model-first software development processes
- A bridge between
  - Modeling in the course *Analysis and Logical Design*
  - Development in the *Physical Design and Implementation*
- The student has to learn
  - How to “question” the processes and tools
  - Ask yourself what comes first – Model or Code?

Round-Trip Engineering (RTE)

- RTE is directly related to two concepts:
  - Forward Engineering and Reverse Engineering
- Forward Engineering (FE) is when you have a model and you construct code based on the model
  - Transformation or function from Model to Code
- Reverse Engineering (RE) is when you have code and you construct a model that represents the code
  - Transformation or function from Code to Model
- Ideally, when you do RE, you will get a model, that when put under FE, will result in the same initial piece of code
  - And vice versa (model → FE → code → RE → same model)
- This ideal case is what we wish of RTE to become

The Significance of RTE

- Whenever we need to understand a complicated concept or machine
    - We draw an illustration of the concept, a model diagram
- Usually after the first few modelling iterations development fully takes over and most of the meaning is left out of the model
    - The model becomes obsolete and out of date
    - Whenever someone new tries to understand the software
        - Will need to reinvent the model (ie. RE)
- Having a process that will do continuous RTE will result in code that is always an implementation of the model, and model that is always a representation of the code

How does it Differ from Visual Programming?

- Visual Programming usually means having in place a special IDE
  - Where one never writes a single line of code
  - The algorithm is constructed by connecting visual blocks and setting their properties
- This will mean that one has a full identical replica of the code in a visually rich interface, using a visual language
  - This is still implementation level representation of the code, so it is again the same code but translated in a new language
  - The point is to have an analysis level representation of he code, a model – being more generic, and easier to understand as an overall structure

What RTE usually is like today?

- Modelling done with UML
  - Why? UML has (most) precise specification on syntax and it's interpretation
  - UML model (when done right) can be understood in the same way by any reader, as originally envisioned by the author
- Transformation done automically in real-time or as a manually-invoked process in the IDE

Open-Source and Free UML Tools

- Open-source
  - Eclipse UML Tools
  - Modelio
  - Umbrello UML Modelier
  - UMLet
  - Netbeans
  - Dia
  - ArgoUML
  - GreenUML
  - BOUML
  - NClass
  - StarUML
  - Open Modelsphere

- Commercial and free
  - GenMyModel
  - Syngraph
  - yEd

- Commercial and free for Academic use
  - IBM Rational Software Architect
  - UML-LAB

Sorted by date of last release

Last open release <= 2011

Last open release <= 2009

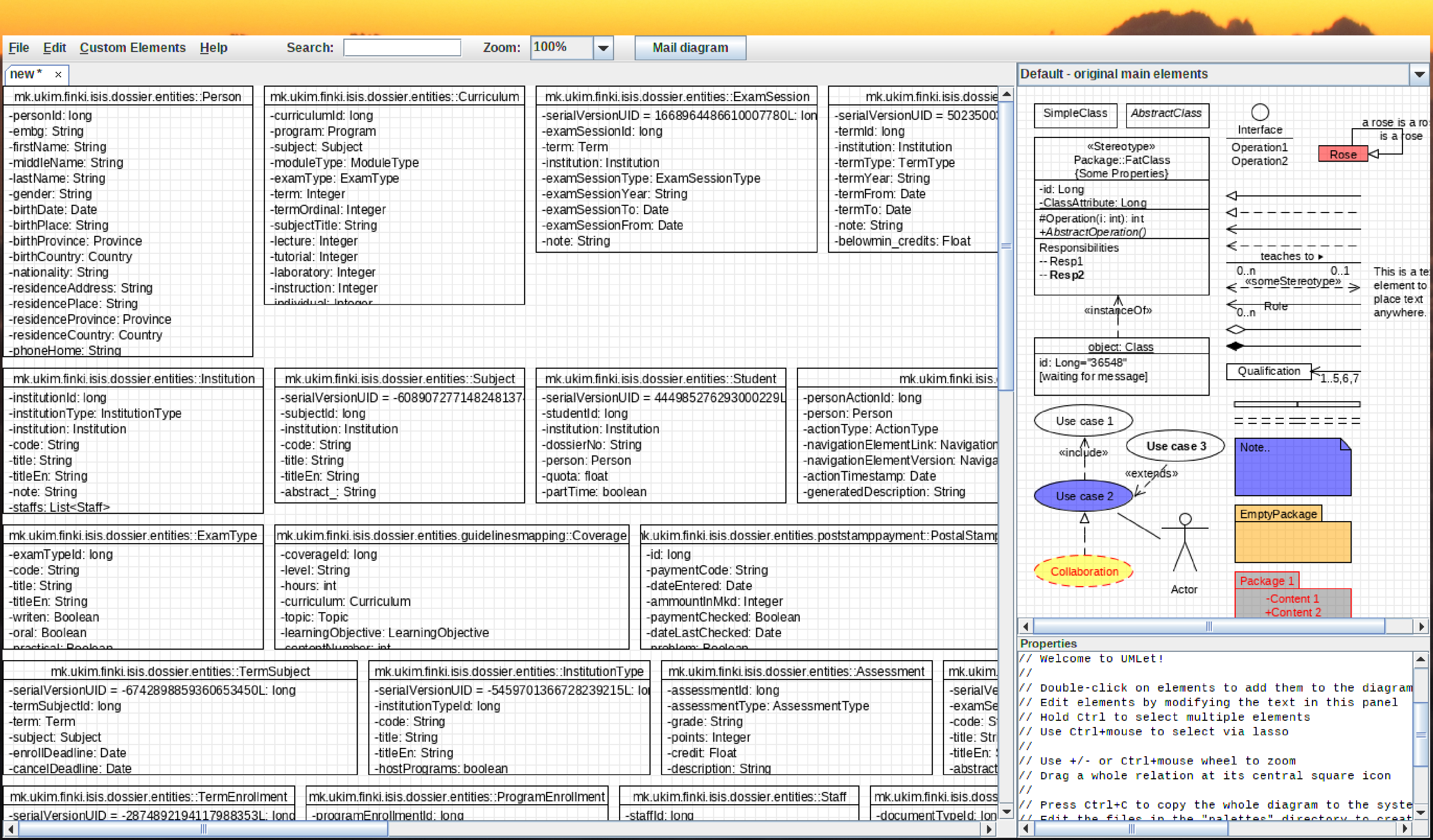
UMLET Notes

- UML Modeling and Diagramming
  - The Interface is rudimentary - but the editing is rather fast
  - Basic UML notation is supported (all types of elements and arrows, stereotypes)
  - There is no option to autolayout the elements on the diagram
  - Support for grouping elements and alignment
  - Easy on-thy-fly creation of custom UML elements
  - Change diagramming behaviour via parameters written in a text editor

UMLET Notes

- Exporting
  - Export to an image in several bitmap and vector-based formats
- RTE evaluation
  - Supports Java only
  - No support for Forward Engineering
  - Reverse engineering of many classes from a directory (or JAR) is partly supported
    - all class elements will be included in the current diagram
    - relations between classes are not recognized

UMLET



mk.ukim.finki.isis.dossier.entities::Person
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-embg: String
-firstName: String
-middleName: String
-lastName: String
-gender: String
-birthDate: Date
-birthPlace: String
-birthProvince: Province
-birthCountry: Country
-nationality: String
-residenceAddress: String
-residencePlace: String
-residenceProvince: Province
-residenceCountry: Country
-phoneHome: String

mk.ukim.finki.isis.dossier.entities::Curriculum
-curriculumId: long
-program: Program
-subject: Subject
-moduleType: ModuleType
-examType: ExamType
-term: Integer
-termOrdinal: Integer
-subjectTitle: String
-lecture: Integer
-tutorial: Integer
-laboratory: Integer
-instruction: Integer
-individual: Integer

mk.ukim.finki.isis.dossier.entities::ExamSession
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-examSessionId: long
-term: Term
-institution: Institution
-examSessionType: ExamSessionType
-examSessionYear: String
-examSessionTo: Date
-examSessionFrom: Date
-note: String

mk.ukim.finki.isis.dossie
-serialVersionUID = 5023500
-termId: long
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-termType: TermType
-termYear: String
-termFrom: Date
-termTo: Date
-note: String
-belowmin_credits: Float

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-institutionType: InstitutionType
-institution: Institution
-code: String
-title: String
-titleEn: String
-note: String
-staffs: List<Staff>

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-title: String
-titleEn: String
-abstract_: String

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-institution: Institution
-dossierNo: String
-person: Person
-quota: float
-partTime: boolean

mk.ukim.finki.isis.
-personActionId: long
-person: Person
-actionType: ActionType
-navigationElementLink: Navigation
-navigationElementVersion: Naviga
-actionTimestamp: Date
-generatedDescription: String

mk.ukim.finki.isis.dossier.entities::ExamType
-examTypeId: long
-code: String
-title: String
-titleEn: String
-writen: Boolean
-oral: Boolean
-practical: Boolean

mk.ukim.finki.isis.dossier.entities.guidelinesmapping::Coverage
-coverageId: long
-level: String
-hours: int
-curriculum: Curriculum
-topic: Topic
-learningObjective: LearningObjective
-contentNumber: int

k.ukim.finki.isis.dossier.entities.poststamppayment::PostalStamp
-id: long
-paymentCode: String
-dateEntered: Date
-ammountInMkd: Integer
-paymentChecked: Boolean
-dateLastChecked: Date
-problem: Boolean

mk.ukim.finki.isis.dossier.entities::TermSubject
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-termSubjectId: long
-term: Term
-subject: Subject
-enrollDeadline: Date
-cancelDeadline: Date

mk.ukim.finki.isis.dossier.entities::InstitutionType
-serialVersionUID = -5459701366728239215L: lo
-institutionTypeId: long
-code: String
-title: String
-titleEn: String
-hostPrograms: boolean

mk.ukim.finki.isis.dossier.entities::Assessment
-assessmentId: long
-assessmentType: AssessmentType
-grade: String
-points: Integer
-credit: Float
-description: String

mk.ukim.
-serialVe
-examSe
-code: S
-title: Str
-titleEn:
-abstract

mk.ukim.finki.isis.dossier.entities::TermEnrollment
-serialVersionUID = -2874892194117988353L: long

mk.ukim.finki.isis.dossier.entities::ProgramEnrollment
-programEnrollmentId: long

mk.ukim.finki.isis.dossier.entities::Staff
-staffId: long

mk.ukim.finki.isis.doss
-documentTypeId: lon

```
// Welcome to UMLet!
//
// Double-click on elements to add them to the diagram
// Edit elements by modifying the text in this panel
// Hold Ctrl to select multiple elements
// Use Ctrl+mouse to select via lasso
//
// Use +/- or Ctrl+mouse wheel to zoom
// Drag a whole relation at its central square icon
//
// Press Ctrl+C to copy the whole diagram to the syste
// Edit the files in the "palettes" directory to creat
```

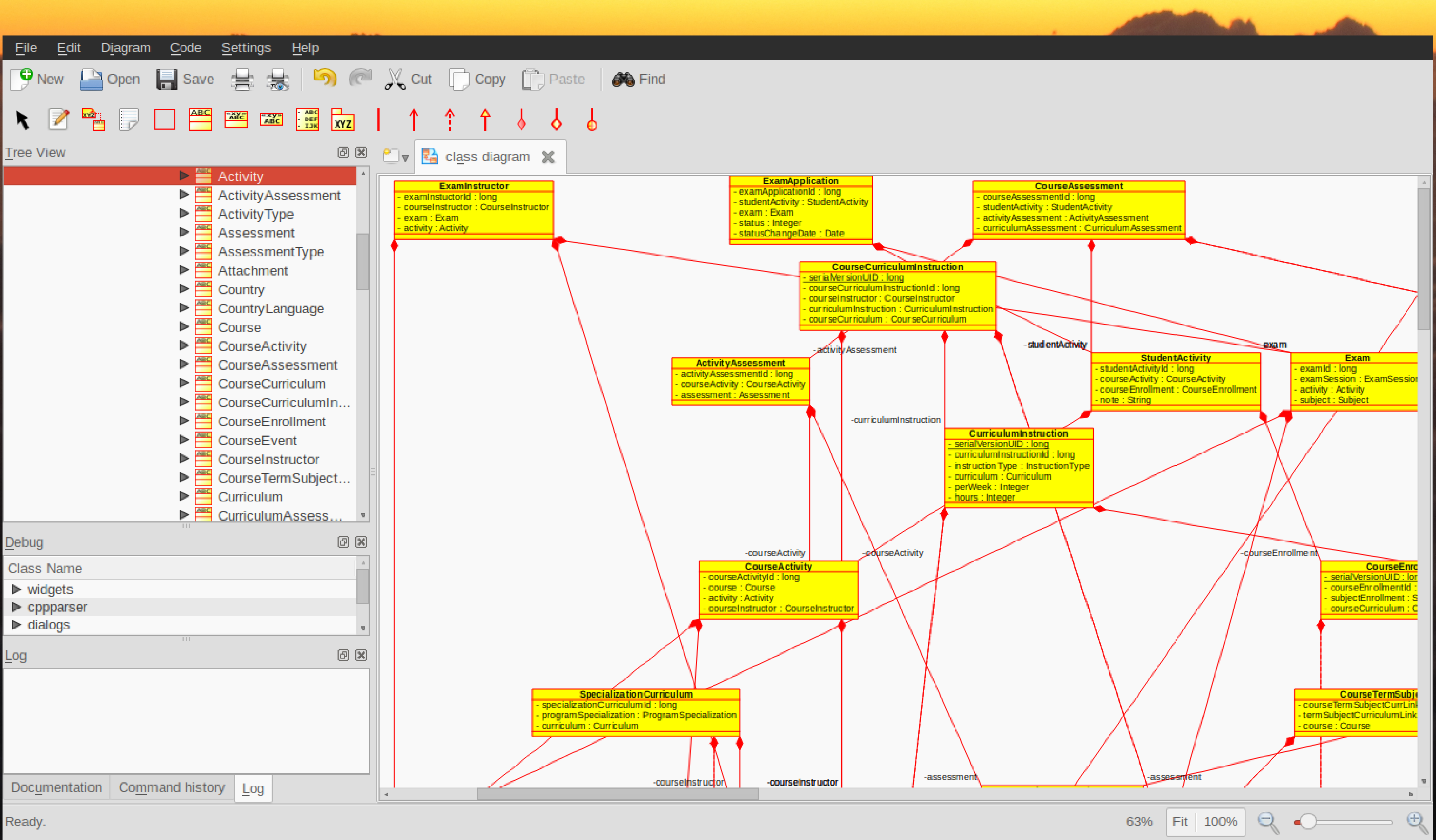
Umbrello Notes

- UML Modeling and Diagramming
  - 2 possible automatic diagram layouts, + manual layout
  - alignments, many possibilities to change the look
- RTE evaluation
  - FE is supported
    - javadoc comments are added based on the model
    - no annotations for mapping
    - RTE is not loss-less - when FE was used after RE, in our example the original annotations already present in the source code were lost, and the newly generated code needed extra modifications to make it work

Umbrello Notes

- RE is supported
  - RE of many classes from a directory (or JAR) is supported
    - the whole structure of the original sources is recreated
    - the relations between classes are recognized
  - Normally class element will NOT be included in a diagram
  - It can be done manually with drag & drop, but only 1 class at a time
  - All relations in the example used, were understood as compositions... and that is not the case

Umbrello


File
Edit
Diagram
Code
Settings
Help
New
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Save
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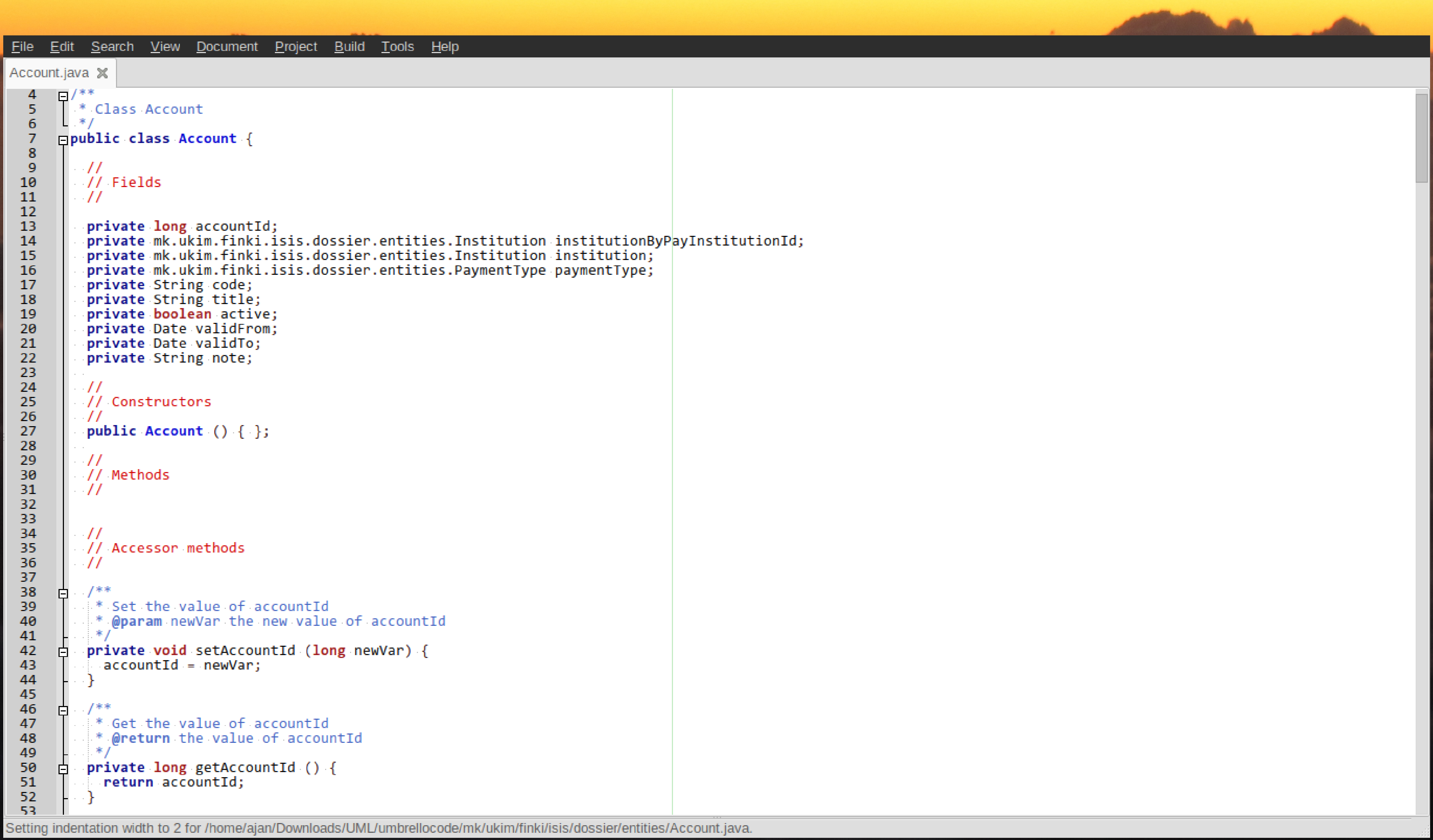
Copy
Paste
Find
Tree View
Activity
ActivityAssessment
ActivityType
Assessment
AssessmentType
Attachment
Country
CountryLanguage
Course
CourseActivity
CourseAssessment
CourseCurriculum
CourseCurriculumIn...
CourseEnrollment
CourseEvent
CourseInstructor
CourseTermSubject...
Curriculum
CurriculumAssess...
Debug
Class Name
widgets
cppparser
dialogs
Log
Documentation
Command history
Log
class diagram
ExamInstructor
- examInstuctorId : long
- courseInstructor : CourseInstructor
- exam : Exam
- activity : Activity
ExamApplication
- examApplicationId : long
- studentActivity : StudentActivity
- exam : Exam
- status : Integer
- statusChangeDate : Date
CourseAssessment
- courseAssessmentId : long
- studentActivity : StudentActivity
- activityAssessment : ActivityAssessment
- curriculumAssessment : CurriculumAssessment
CourseCurriculumInstruction
- serialVersionUID : long
- courseCurriculumInstructionId : long
- courseInstructor : CourseInstructor
- curriculumInstruction : CurriculumInstruction
- courseCurriculum : CourseCurriculum
-activityAssessment
-studentActivity
-exam
ActivityAssessment
- activityAssessmentId : long
- courseActivity : CourseActivity
- assessment : Assessment
StudentActivity
- studentActivityId : long
- courseActivity : CourseActivity
- courseEnrollment : CourseEnrollment
- note : String
Exam
- examId : long
- examSession : ExamSessio
- activity : Activity
- subject : Subject
-curriculumInstruction
CurriculumInstruction
- serialVersionUID : long
- curriculumInstructionId : long
- instructionType : InstructionType
- curriculum : Curriculum
- perWeek : Integer
- hours : Integer
-courseActivity
-courseActivity
-courseEnrollment
CourseActivity
- courseActivityId : long
- course : Course
- activity : Activity
- courseInstructor : CourseInstructor
CourseEnro
- serialVersionUID : lor
- courseEnrollmentId :
- subjectEnrollment : S
- courseCurriculum : C
SpecializationCurriculum
- specializationCurriculumId : long
- programSpecialization : ProgramSpecialization
- curriculum : Curriculum
CourseTermSubje
- courseTermSubjectCurrLink
- termSubjectCurriculumLink
- course : Course
-courseInstructor
-courseInstructor
-assessment
-assessment
Ready.
63%
Fit
100%

Umbrello Generated Source



```java
/**
 * Class Account
 */
public class Account {

  //
  // Fields
  //

  private long accountId;
  private mk.ukim.finki.isis.dossier.entities.Institution institutionByPayInstitutionId;
  private mk.ukim.finki.isis.dossier.entities.Institution institution;
  private mk.ukim.finki.isis.dossier.entities.PaymentType paymentType;
  private String code;
  private String title;
  private boolean active;
  private Date validFrom;
  private Date validTo;
  private String note;

  //
  // Constructors
  //
  public Account () { };

  //
  // Methods
  //


  //
  // Accessor methods
  //

  /**
   * Set the value of accountId
   * @param newVar the new value of accountId
   */
  private void setAccountId (long newVar) {
    accountId = newVar;
  }

  /**
   * Get the value of accountId
   * @return the value of accountId
   */
  private long getAccountId () {
    return accountId;
  }
```

Setting indentation width to 2 for /home/ajan/Downloads/UML/umbrellocode/mk/ukim/finki/isis/dossier/entities/Account.java.

Modelio Notes

- UML Modeling and Diagramming
  - The Interface is Eclipse-like (and based) and is an advanced interface, with many styling and diagramming options
  - Support for hierarchical structure of a project (thru folders/packages)
  - Drag & Drop UML elements from the project structure to a diagram
  - UML 2 notation is supported (all types of elements and arrows, stereotypes, icons for stereotypes)
  - There is no option to autolayout the elements on the diagram
  - No support for grouping elements and alignment
  - Support for arrow routing
  - Automatic inclusion of relations and related elements starting from one selected diagram element

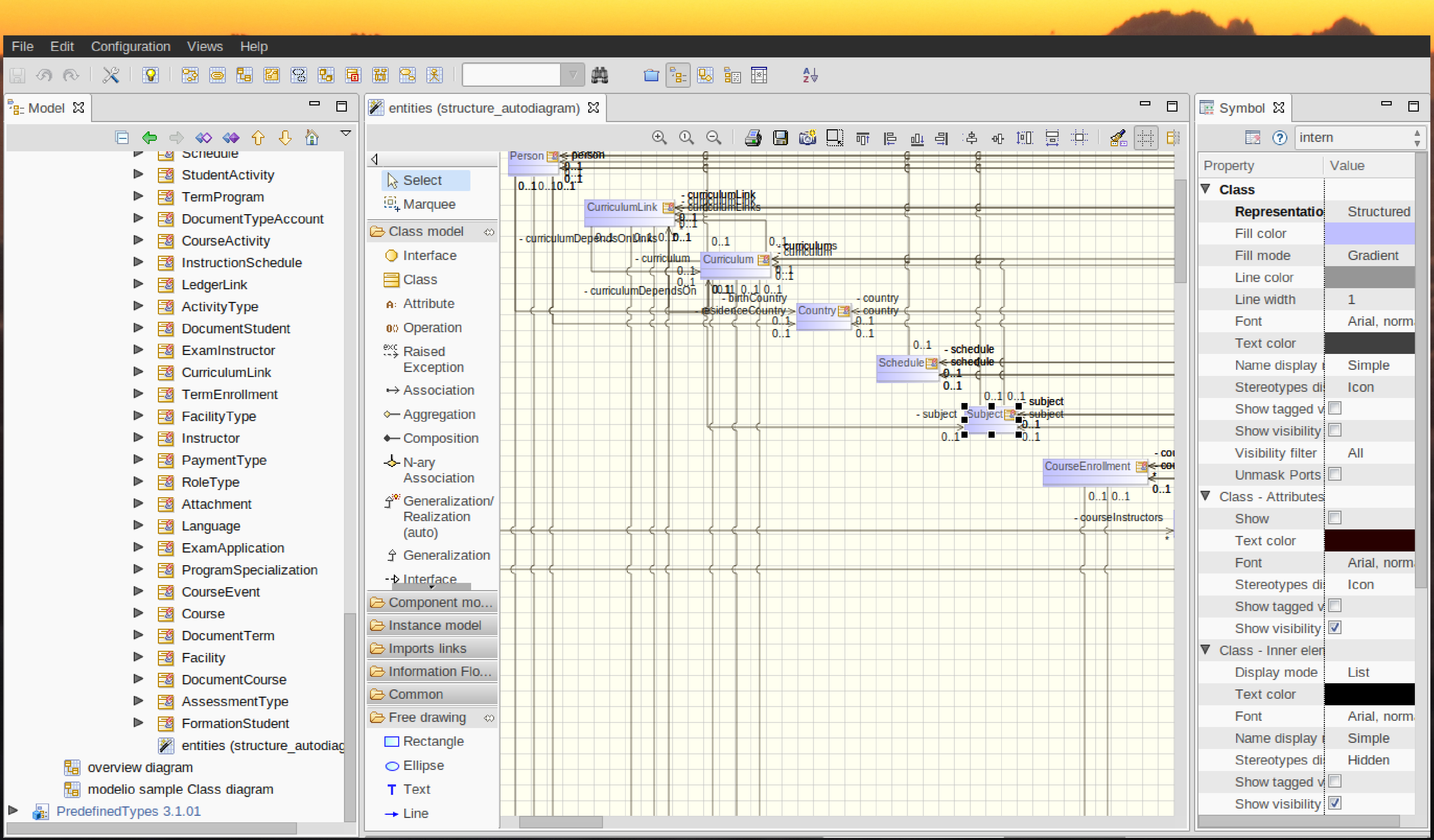
Modelio Notes

- Exporting
  - Export to an image in several bitmap formats, no vector-based support
  - Export to XMI (OMG UML 2.1.1 or EMF UML 3.0.0)
- RTE evaluation
  - Plugin mechanism to introduce new feature, for example Java Designer with RTE support
  - FE is supported
    - annotations are used to establish mapping between the model and generated code
    - three types of FE - forward only, reversible and round-trip

Modelio Notes

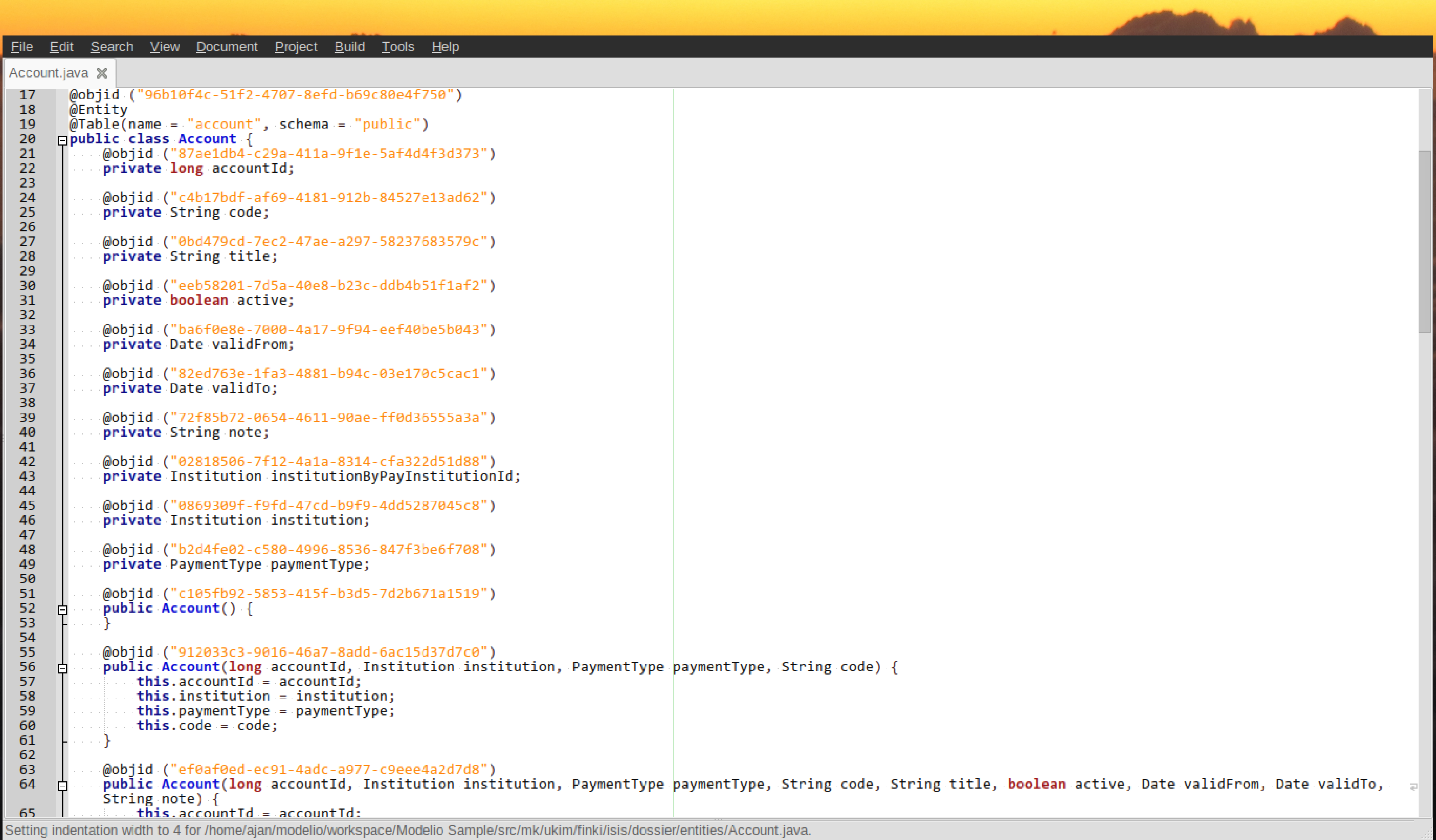
- RE of many classes from a directory (or JAR) is supported
  - The whole packages structure of the original sources is recreated
  - The relations between classes are recognized
  - Normally class element will NOT be included in a diagram
  - It can be done manually with drag & drop
  - It can be done automatically for a whole package

Modelio



Property	Value
Class	
Representatio	Structured
Fill color	🟦
Fill mode	Gradient
Line color	⬛
Line width	1
Font	Arial, norm
Text color	⬛
Name display i	Simple
Stereotypes di	Icon
Show tagged v	□
Show visibility	□
Visibility filter	All
Unmask Ports	□
Class - Attributes	
Show	□
Text color	⬛
Font	Arial, norm
Stereotypes di	Icon
Show tagged v	□
Show visibility	☑
Class - Inner elen	
Display mode	List
Text color	⬛
Font	Arial, norm
Name display i	Simple
Stereotypes di	Hidden
Show tagged v	□
Show visibility	☑

Modelio Generated Source



```java
@objid ("96b10f4c-51f2-4707-8efd-b69c80e4f750")
@Entity
@Table(name = "account", schema = "public")
public class Account {
    @objid ("87ae1db4-c29a-411a-9f1e-5af4d4f3d373")
    private long accountId;

    @objid ("c4b17bdf-af69-4181-912b-84527e13ad62")
    private String code;

    @objid ("0bd479cd-7ec2-47ae-a297-58237683579c")
    private String title;

    @objid ("eeb58201-7d5a-40e8-b23c-ddb4b51f1af2")
    private boolean active;

    @objid ("ba6f0e8e-7000-4a17-9f94-eef40be5b043")
    private Date validFrom;

    @objid ("82ed763e-1fa3-4881-b94c-03e170c5cac1")
    private Date validTo;

    @objid ("72f85b72-0654-4611-90ae-ff0d36555a3a")
    private String note;

    @objid ("02818506-7f12-4a1a-8314-cfa322d51d88")
    private Institution institutionByPayInstitutionId;

    @objid ("0869309f-f9fd-47cd-b9f9-4dd5287045c8")
    private Institution institution;

    @objid ("b2d4fe02-c580-4996-8536-847f3be6f708")
    private PaymentType paymentType;

    @objid ("c105fb92-5853-415f-b3d5-7d2b671a1519")
    public Account() {
    }

    @objid ("912033c3-9016-46a7-8add-6ac15d37d7c0")
    public Account(long accountId, Institution institution, PaymentType paymentType, String code) {
        this.accountId = accountId;
        this.institution = institution;
        this.paymentType = paymentType;
        this.code = code;
    }

    @objid ("ef0af0ed-ec91-4adc-a977-c9eee4a2d7d8")
    public Account(long accountId, Institution institution, PaymentType paymentType, String code, String title, boolean active, Date validFrom, Date validTo,
    String note) {
        this.accountId = accountId;
```

Setting indentation width to 4 for /home/ajan/modelio/workspace/Modelio Sample/src/mk/ukim/finki/isis/dossier/entities/Account.java.