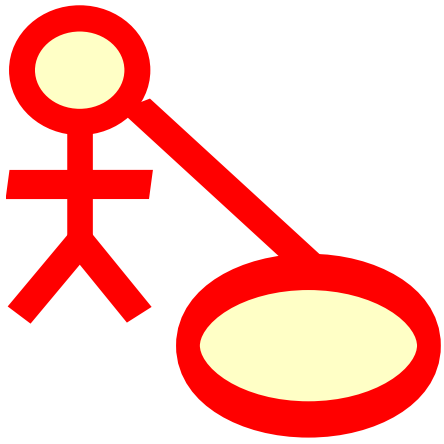
Umbrello UML Modeller Handbook



Contents

Abstract

Umbrello UML Modeller helps the software development process by using the industry standard Unified Modelling Language (UML) to enable you to create diagrams for designing and documenting your systems.

Chapter 1

Introduction

Umbrello UML Modeller is a UML diagram tool that can support you in the software development process. Especially during the analysis and design phases of this process, Umbrello UML Modeller will help you to get a high quality product. UML can also be used to document your software designs to help you and your fellow developers.

Having a good model of your software is the best way to communicate with other developers working on the project and with your customers. A good model is extremely important for medium and big-size projects, but it is also very useful for small ones. Even if you are working on a small one man project you will benefit from a good model because it will give you an overview that will help you code things right the first time.

UML is the diagramming language used for describing such models. You can represent your ideas in UML using different types of diagrams. Umbrello UML Modeller 2.11 supports the following types:

- Class Diagram
- Sequence Diagram
- Collaboration Diagram
- Use Case Diagram
- State Diagram
- Activity Diagram
- Component Diagram
- Deployment Diagram
- Entity Relationship Diagram

More information about UML can be found at the website of OMG, http://www.omg.org who create the UML standard.

We hope you enjoy Umbrello UML Modeller and that it helps you create high quality software. Umbrello UML Modeller is Free Software and available at no cost, the only thing we ask from you is to report any bugs, problems, or suggestions to the Umbrello UML Modeller developers at umbrello-devel@kde.org or https://bugs.kde.org.

Chapter 2

UML Basics

2.1 About UML

This chapter will give you a quick overview of the basics of UML. Keep in mind that this is not a comprehensive tutorial on UML but rather a brief introduction to UML which can be read as a UML tutorial. If you would like to learn more about the Unified Modelling Language, or in general about software analysis and design, refer to one of the many books available on the topic. There are also a lot of tutorials on the Internet which you can take as a starting point.

The Unified Modelling Language (UML) is a diagramming language or notation to specify, visualize and document models of Object Oriented software systems. UML is not a development method, that means it does not tell you what to do first and what to do next or how to design your system, but it helps you to visualize your design and communicate with others. UML is controlled by the Object Management Group (OMG) and is the industry standard for graphically describing software.

UML is designed for Object Oriented software design and has limited use for other programming paradigms.

UML is composed of many model elements that represent the different parts of a software system. The UML elements are used to create diagrams, which represent a certain part, or a point of view of the system. The following types of diagrams are supported by Umbrello UML Modeller:

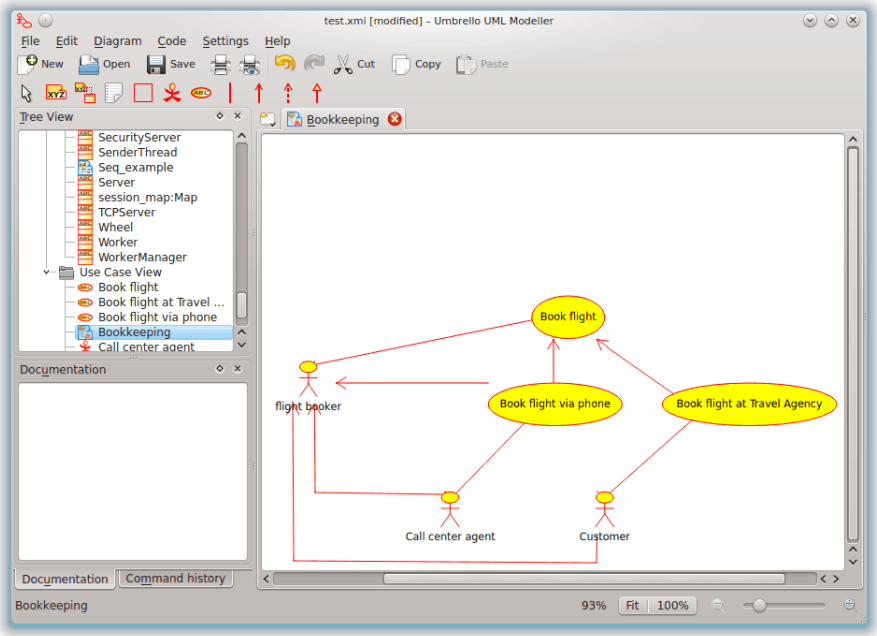
- *Use Case Diagrams* show actors (people or other users of the system), use cases (the scenarios when they use the system), and their relationships
- *Class Diagrams* show classes and the relationships between them
- *Sequence Diagrams* show objects and a sequence of method calls they make to other objects.
- *Collaboration Diagrams* show objects and their relationship, putting emphasis on the objects that participate in the message exchange
- *State Diagrams* show states, state changes and events in an object or a part of the system
- *Activity Diagrams* show activities and the changes from one activity to another with the events occurring in some part of the system
- *Component Diagrams* show the high level programming components (such as KParts or Java Beans).
- *Deployment Diagrams* show the instances of the components and their relationships.
- *Entity Relationship Diagrams* show data and the relationships and constraints between the data.

2.2 UML Elements

2.2.1 Use Case Diagram

Use Case Diagrams describe the relationships and dependencies between a group of *Use Cases* and the Actors participating in the process.

It is important to notice that Use Case Diagrams are not suited to represent the design, and cannot describe the internals of a system. Use Case Diagrams are meant to facilitate the communication with the future users of the system, and with the customer, and are specially helpful to determine the required features the system is to have. Use Case Diagrams tell, *what* the system should do but do not — and cannot — specify *how* this is to be achieved.



Umbrello UML Modeller showing a Use Case Diagram

2.2.1.1 Use Case

A *Use Case* describes — from the point of view of the actors — a group of activities in a system that produces a concrete, tangible result.

Use Cases are descriptions of the typical interactions between the users of a system and the system itself. They represent the external interface of the system and specify a form of requirements of what the system has to do (remember, only what, not how).

When working with Use Cases, it is important to remember some simple rules:

- Each Use Case is related to at least one actor
- Each Use Case has an initiator (i.e. an actor)
- Each Use Case leads to a relevant result (a result with 'business value')

Use Cases can also have relationships with other Use Cases. The three most typical types of relationships between Use Cases are:

- *«include»* which specifies that a Use Case takes place *inside* another Use Case
- *«extends»* which specifies that in certain situations, or at some point (called an extension point) a Use Case will be extended by another.
- *Generalization* specifies that a Use Case inherits the characteristics of the 'Super'-Use Case, and can override some of them or add new ones in a similar way as the inheritance between classes.

2.2.1.2 Actor

An actor is an external entity (outside of the system) that interacts with the system by participating (and often initiating) a Use Case. Actors can be in real life people (for example users of the system), other computer systems or external events.

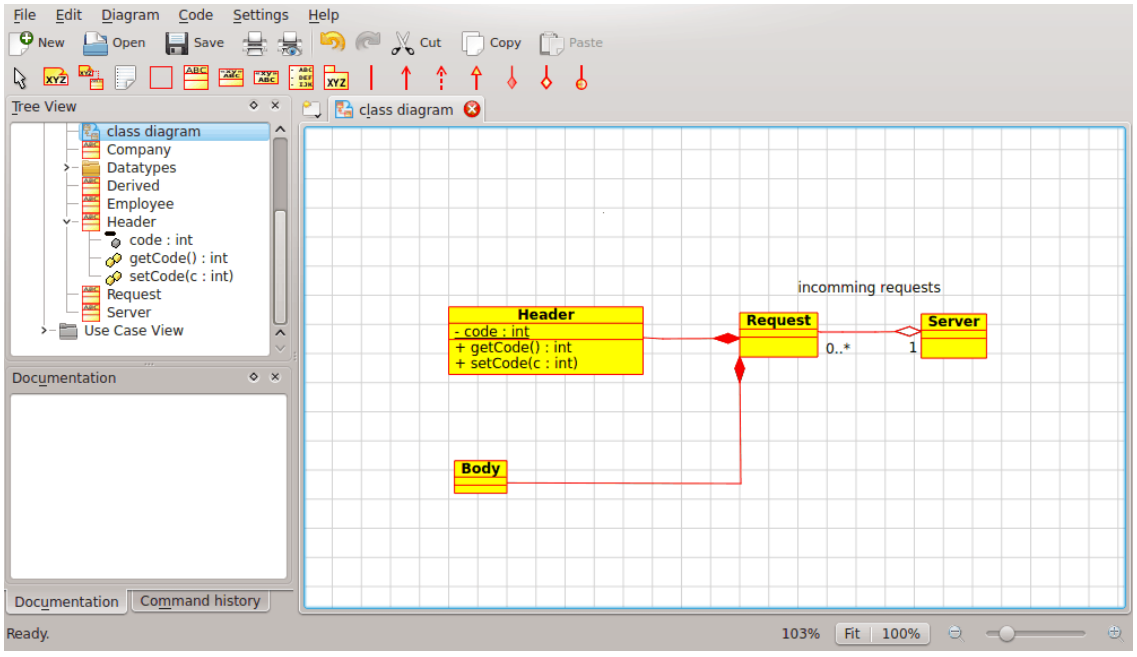
Actors do not represent the *physical* people or systems, but their *role*. This means that when a person interacts with the system in different ways (assuming different roles) he will be represented by several actors. For example a person that gives customer support by the telephone and takes orders from the customer into the system would be represented by an actor 'Support Staff' and an actor 'Sales Representative'

2.2.1.3 Use Case Description

Use Case Descriptions are textual narratives of the Use Case. They usually take the form of a note or a document that is somehow linked to the Use Case, and explains the processes or activities that take place in the Use Case.

2.2.2 Class Diagram

Class Diagrams show the different classes that make up a system and how they relate to each other. Class Diagrams are said to be 'static' diagrams because they show the classes, along with their methods and attributes as well as the static relationships between them: which classes 'know' about which classes or which classes 'are part' of another class, but do not show the method calls between them.

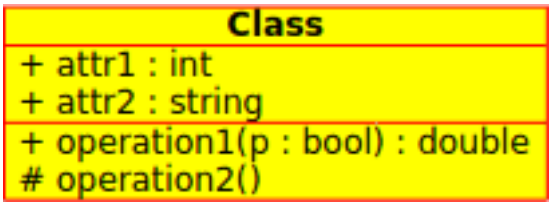


Umbrello UML Modeller showing a Class Diagram

2.2.2.1 Class

A Class defines the attributes and the methods of a set of objects. All objects of this class (instances of this class) share the same behavior, and have the same set of attributes (each object has its own set). The term 'Type' is sometimes used instead of Class, but it is important to mention that these two are not the same, and Type is a more general term.

In UML, Classes are represented by rectangles, with the name of the class, and can also show the attributes and operations of the class in two other 'compartments' inside the rectangle.



Visual representation of a Class in UML

2.2.2.1.1 Attributes

In UML, Attributes are shown with at least their name, and can also show their type, initial value and other properties. Attributes can also be displayed with their visibility:

- \+ Stands for *public* attributes
- \# Stands for *protected* attributes
- \- Stands for *private* attributes

2.2.2.1.2 Operations

Operations (methods) are also displayed with at least their name, and can also show their parameters and return types. Operations can, just as Attributes, display their visibility:

- \+ Stands for *public* operations
- \# Stands for *protected* operations
- \- Stands for *private* operations

2.2.2.1.3 Templates

Classes can have templates, a value which is used for an unspecified class or type. The template type is specified when a class is initiated (i.e. an object is created). Templates exist in modern C++ and will be introduced in Java 1.5 where they will be called Generics.

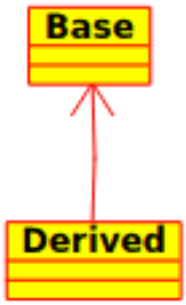
2.2.2.2 Class Associations

Classes can relate (be associated with) to each other in different ways:

2.2.2.2.1 Generalization

Inheritance is one of the fundamental concepts of Object Oriented programming, in which a class 'gains' all of the attributes and operations of the class it inherits from, and can override/modify some of them, as well as add more attributes and operations of its own.

In UML, a *Generalization* association between two classes puts them in a hierarchy representing the concept of inheritance of a derived class from a base class. In UML, Generalizations are represented by a line connecting the two classes, with an arrow on the side of the base class.



Visual representation of a generalization in UML

2.2.2.2.2 Associations

An association represents a relationship between classes, and gives the common semantics and structure for many types of 'connections' between objects.

Associations are the mechanism that allows objects to communicate to each other. It describes the connection between different classes (the connection between the actual objects is called object connection, or *link*.

Associations can have a role that specifies the purpose of the association and can be uni- or bidirectional (indicates if the two objects participating in the relationship can send messages to the other, of if only one of them knows about the other). Each end of the association also has a multiplicity value, which dictates how many objects on this side of the association can relate to one object on the other side.

In UML, associations are represented as lines connecting the classes participating in the relationship, and can also show the role and the multiplicity of each of the participants. Multiplicity is displayed as a range [min..max] of non-negative values, with a star (*) on the maximum side representing infinite.

Visual representation of an Association in UML

2.2.2.2.3 Aggregation

Aggregations are a special type of associations in which the two participating classes don't have an equal status, but make a 'whole-part' relationship. An Aggregation describes how the class that takes the role of the whole, is composed (has) of other classes, which take the role of the parts. For Aggregations, the class acting as the whole always has a multiplicity of one.

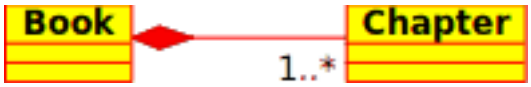
In UML, Aggregations are represented by an association that shows a rhomb on the side of the whole.

Visual representation of an Aggregation relationship in UML

2.2.2.2.4 Composition

Compositions are associations that represent *very strong* aggregations. This means, Compositions form whole-part relationships as well, but the relationship is so strong that the parts cannot exist on its own. They exist only inside the whole, and if the whole is destroyed the parts die too.

In UML, Compositions are represented by a solid rhomb on the side of the whole.



2.2.2.3 Other Class Diagram Items

Class diagrams can contain several other items besides classes.

2.2.2.3.1 Interfaces

Interfaces are abstract classes which means instances cannot be directly created of them. They can contain operations but no attributes. Classes can inherit from interfaces (through a realisation association) and instances can then be made of these classes.

2.2.2.3.2 Datatypes

Datatypes are primitives which are typically built into a programming language. Common examples include integers and booleans. They cannot have relationships to classes but classes can have relationships to them.

2.2.2.3.3 Enums

Enums are a simple list of values. A typical example is an enum for days of the week. The options of an enum are called Enum Literals. Like datatypes they cannot have relationships to classes but classes can have relationships to them.

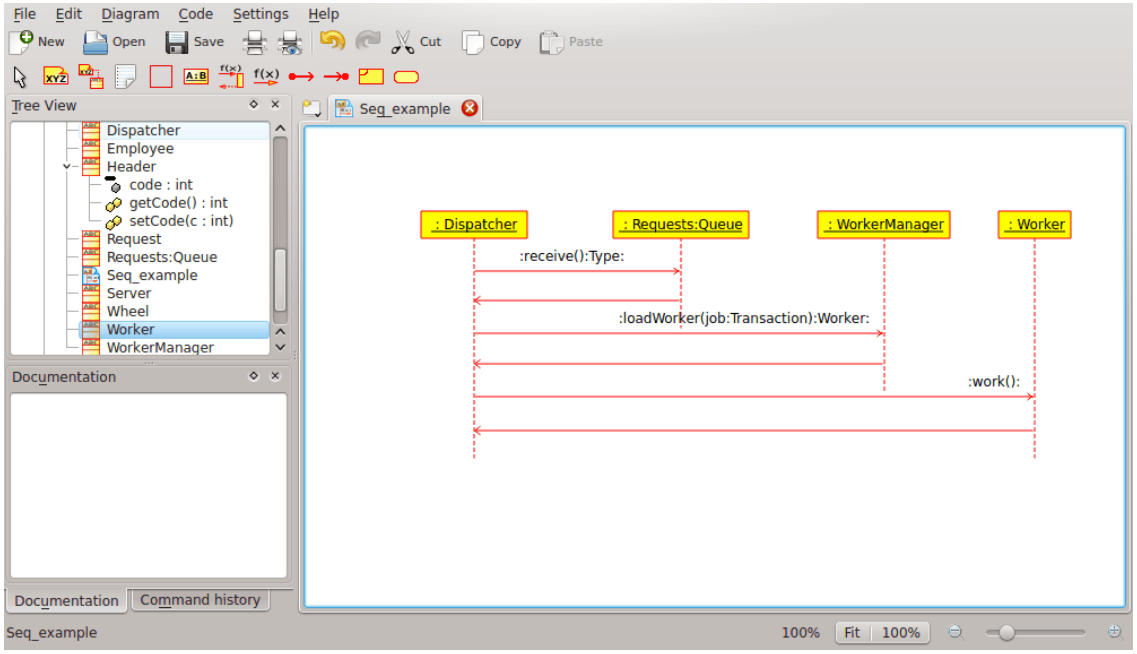
2.2.2.3.4 Packages

Packages represent a namespace in a programming language. In a diagram they are used to represent parts of a system which contain more than one class, maybe hundereds of classes.

2.2.3 Sequence Diagrams

Sequence Diagrams show the message exchange (i.e. method call) between several Objects in a specific time-delimited situation. Objects are instances of classes. Sequence Diagrams put special emphasis in the order and the times in which the messages to the objects are sent.

In Sequence Diagrams objects are represented through vertical dashed lines, with the name of the Object on the top. The time axis is also vertical, increasing downwards, so that messages are sent from one Object to another in the form of arrows with the operation and parameters name.



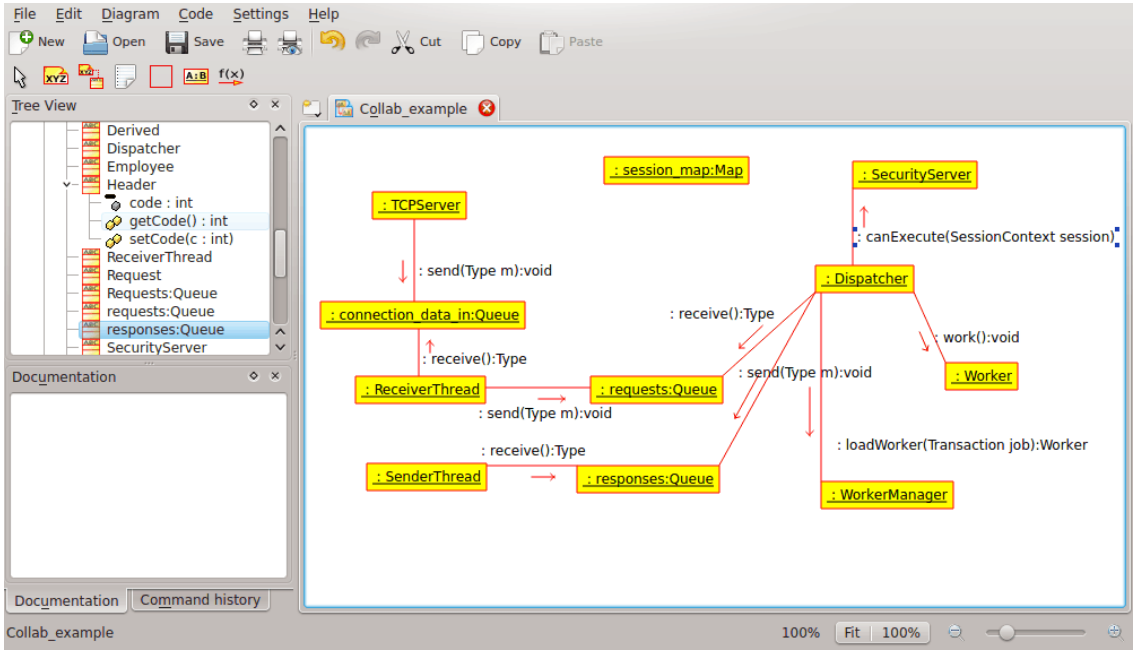
Umbrello UML Modeller showing a Sequence Diagram

Messages can be either synchronous, the normal type of message call where control is passed to the called object until that method has finished running, or asynchronous where control is passed back directly to the calling object. Synchronous messages have a vertical box on the side of the called object to show the flow of program control.

2.2.4 Collaboration Diagrams

Collaboration Diagrams show the interactions occurring between the objects participating in a specific situation. This is more or less the same information shown by Sequence Diagrams but there the emphasis is put on how the interactions occur in time while the Collaboration Diagrams put the relationships between the objects and their topology in the foreground.

In Collaboration Diagrams messages sent from one object to another are represented by arrows, showing the message name, parameters, and the sequence of the message. Collaboration Diagrams are specially well suited to showing a specific program flow or situation and are one of the best diagram types to quickly demonstrate or explain one process in the program logic.



Umbrello UML Modeller showing a Collaboration Diagram

2.2.5 State Diagram

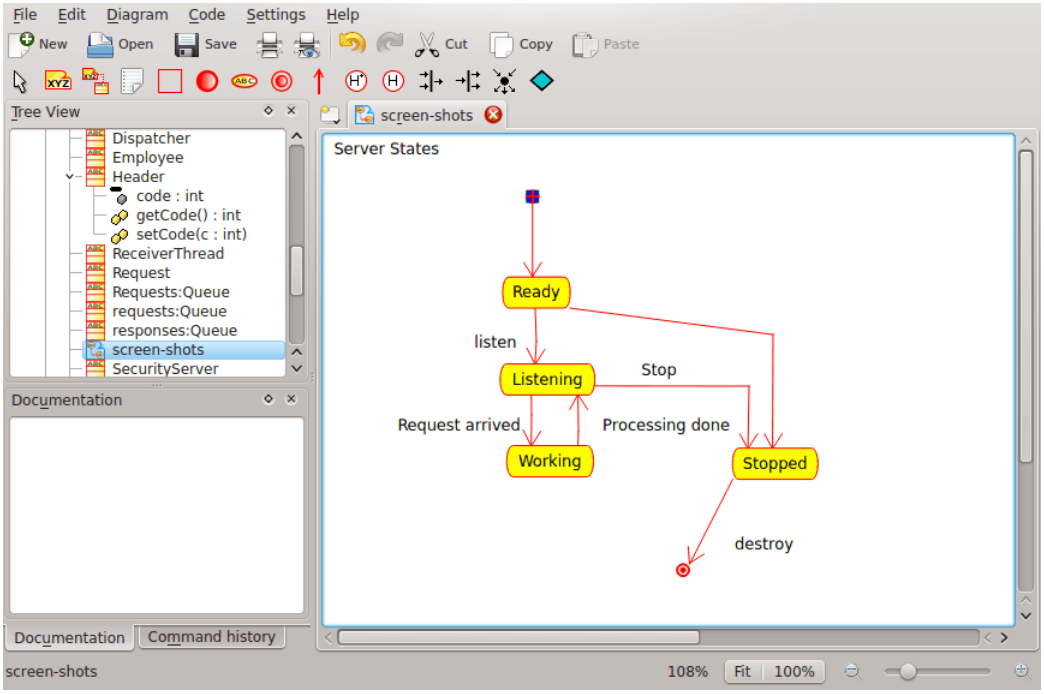
State Diagrams show the different states of an Object during its life and the stimuli that cause the Object to change its state.

State Diagrams view Objects as *state machines* or finite automates that can be in one of a set of finite states and that can change its state via one of a finite set of stimuli. For example an Object of type *NetServer* can be in one of following states during its life:

- Ready
- Listening
- Working
- Stopped

and the events that can cause the Object to change states are

- Object is created
- Object receives message listen
- A Client requests a connection over the network
- A Client terminates a request
- The request is executed and terminated
- Object receives message stop
- etc



Umbrello UML Modeller showing a State Diagram

2.2.5.1 State

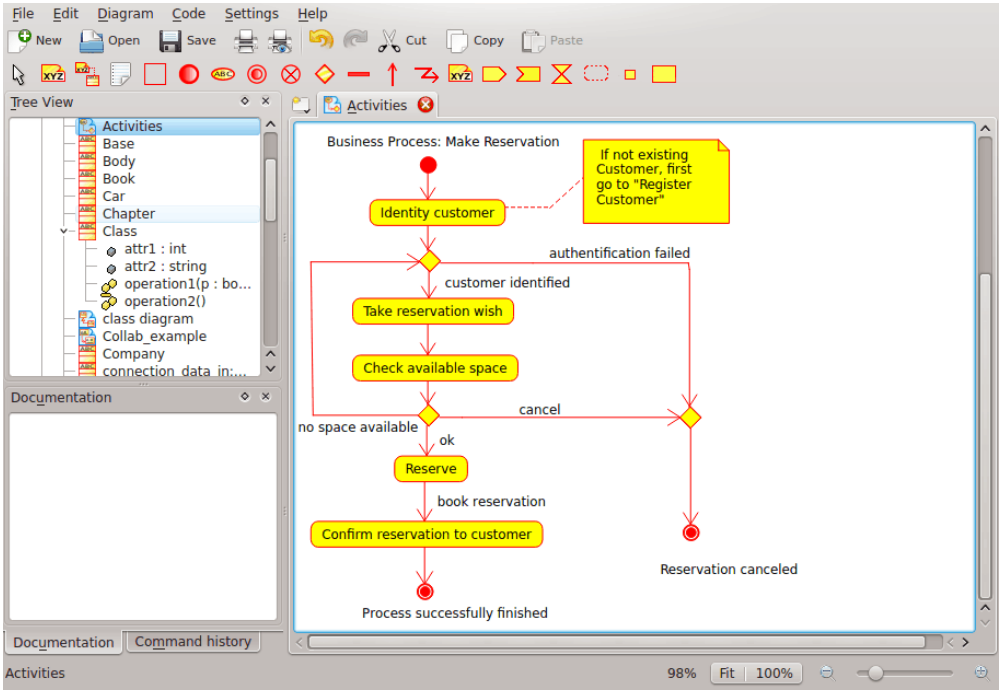
States are the building block of State Diagrams. A State belongs to exactly one class and represents a summary of the values the attributes of a class can take. A UML State describes the internal state of an object of one particular class

Note that not every change in one of the attributes of an object should be represented by a State but only those changes that can significantly affect the workings of the object

There are two special types of States: Start and End. They are special in that there is no event that can cause an Object to return to its Start state, in the same way as there is no event that can possible take an Object out of its End state once it has reached it.

2.2.6 Activity Diagram

Activity Diagrams describe the sequence of activities in a system with the help of Activities. Activity Diagrams are a special form of State Diagrams, that only (or mostly) contains Activities.



Umbrello UML Modeller showing an Activity Diagram

Activity Diagrams are similar to procedural Flux Diagrams, with the difference that all Activities are clearly attached to Objects.

Activity Diagrams are always associated to a *Class*, an *Operation* or a *Use Case*.

Activity Diagrams support sequential as well as parallel Activities. Parallel execution is represented via Fork/Wait icons, and for the Activities running in parallel, it is not important the order in which they are carried out (they can be executed at the same time or one after the other)

2.2.6.1 Activity

An Activity is a single step in a process. One Activity is one state in the system with internal activity and, at least, one outgoing transition. Activities can also have more than one outgoing transition if they have different conditions.

Activities can form hierarchies, this means that an Activity can be composed of several 'detail' Activities, in which case the incoming and outgoing transitions should match the incoming and outgoing transitions of the detail diagram.

2.2.7 Helper Elements

There are a few elements in UML that have no real semantic value for the model, but help to clarify parts of the diagram. These elements are

- Text lines
- Text Notes and anchors
- Boxes

Text lines are useful to add short text information to a diagram. It is free-standing text and has no meaning to the Model itself.

Notes are useful to add more detailed information about an object or a specific situation. They have the great advantage that notes can be anchored to UML Elements to show that the note 'belongs' to a specific object or situation.

Boxes are free-standing rectangles which can be used to group items together to make diagrams more readable. They have no logical meaning in the model.

2.2.8 Component Diagrams

Component Diagrams show the software components (either component technologies such as KParts, CORBA components or Java Beans or just sections of the system which are clearly distinguishable) and the artifacts they are made out of such as source code files, programming libraries or relational database tables.

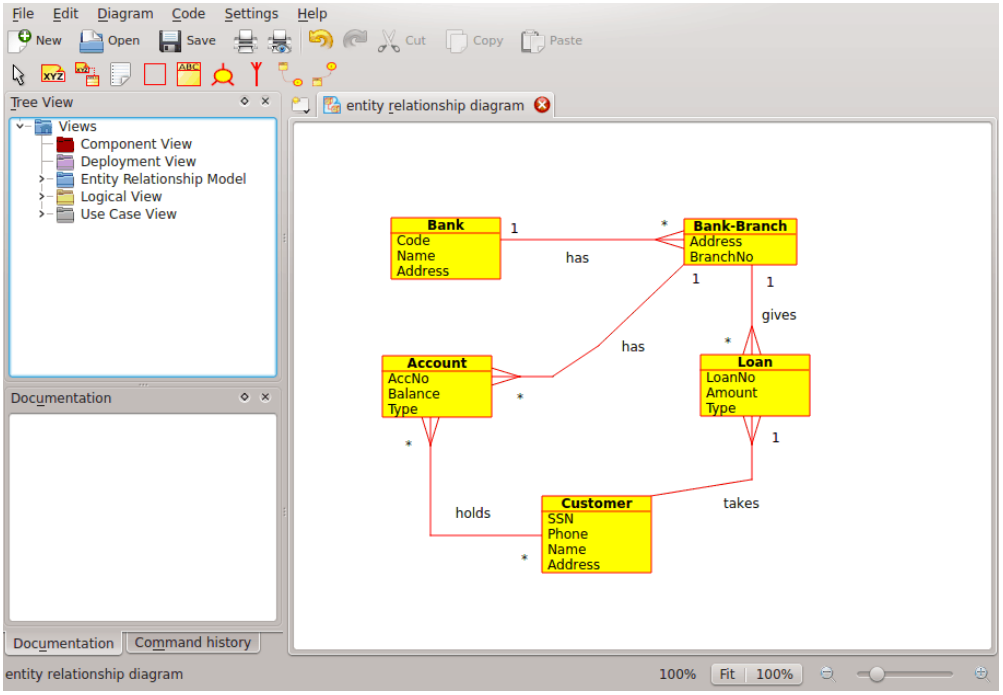
Components can have interfaces (i.e. abstract classes with operations) that allow associations between components.

2.2.9 Deployment Diagrams

Deployment diagrams show the runtime component instances and their associations. They include Nodes which are physical resources, typically a single computer. They also show interfaces and objects (class instances).

2.2.10 Entity Relationship Diagrams

Entity Relationship Diagrams (ER Diagrams) show the conceptual design of database applications. They depict the various entities (concepts) in the information system and the existing relationships and constraints between them. An extension of Entity Relationship Diagrams named 'Extended Entity Relationship Diagrams' or 'Enhanced Entity Relationship Diagrams' (EER), are used to incorporate Object Oriented design techniques in ER Diagrams.



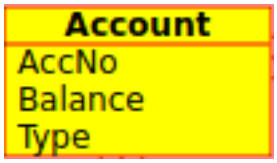
Umbrello showing an Entity Relationship Diagram

2.2.10.1 Entity

An *Entity* is any concept in the real world with an independent existence. It may be an object with a physical existence (example, Computer, Robot) or it may be an object with a conceptual existence (eq: University Course). Each entity has a set of attributes which describe the properties of the Entity.

Note: No standard notations exist for depicting ER Diagrams. Different texts on this subject use different notations. The concepts and notations for EER diagrams used in Umbrello are from the following book : *Elmasri R. and Navathe S. (2004). Fundamentals of Database Systems 4th edn. Addison Wesley*

In an ER Diagram, Entities are represented by rectangles, with the name of the entity at the top, and can also show the attributes of the entity in another 'compartment' inside the rectangle.



Visual representation of an entity in an ER Diagram

2.2.10.1.1 Entity Attributes

In ER Diagrams , Entity Attributes are shown with their name in a different compartment of the Entity to which they belong.

2.2.10.1.2 Constraints

Constraints in ER Diagrams specify the restrictions on data in the information schema.

There are four types of constraints supported in Umbrello :

- *Primary Key:* The set of attributes declared as *primary key* are unique to the entity. There can be only one primary key in an Entity and none of its constituent attributes can be NULL.
- *Unique Key:* The set of attributes declared as *unique* are unique to the entity. There can be many unique constraints on an Entity. Its constituent attributes can be NULL. Unique Keys and Primary Keys uniquely identify a row in a table (entity)
- *Foreign Key:* A Foreign Key is a referential constraint between two tables. The foreign key identifies a column or a set of columns in one (referencing) table that refers to a column or set of columns in another (referenced) table. The columns in the referenced table must form a primary key or unique key.
- *Check Constraint:* A check constraint (also known as table check constraint) is a condition that defines valid data when adding or updating an entry in a table of a relational database. A check constraint is applied to each row in the table. The constraint must be a predicate. It can refer to a single or multiple columns of the table.

  Example: price >= 0

2.2.11 Extended Entity Relationship (EER) Diagram Concepts

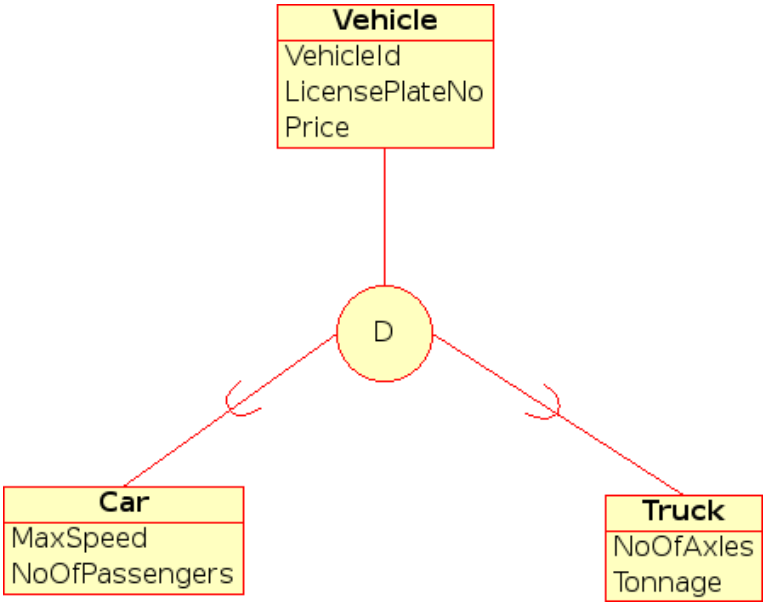
2.2.11.1 Specialization

Specialization is a way to form new entities using entities that have already been defined. The new entities, known as derived entities, take over (or inherit) attributes of the pre-existing entities, which are referred to as base entities . It is intended to help reuse existing data with little or no modification.

In Umbrello, one can specify Disjoint and Overlapping Specialization

2.2.11.1.1 Disjoint Specialization

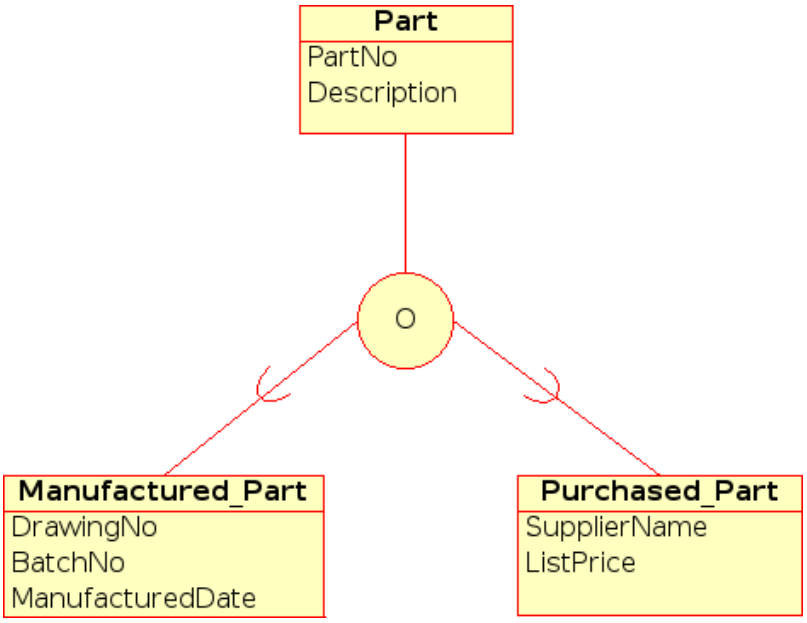
Disjoint Specialization specifies that the subclasses of the specialization must be disjoint. This means that an entity can be a member of at most one of the derived entities of the specialization



Visual representation of Disjoint Specialization in EER Diagram

2.2.11.1.2 Overlapping Specialization

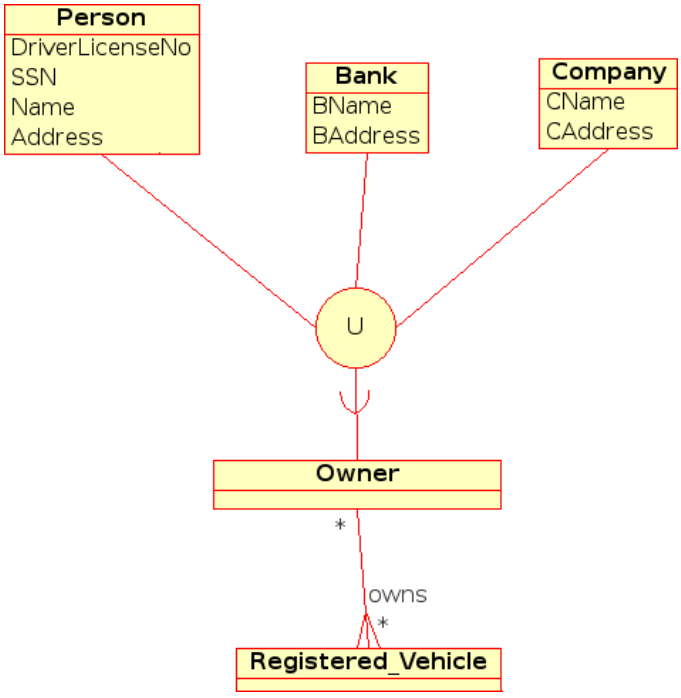
When the derived entities are not constrained to be disjoint, their set of entities are said to be in overlapping specialization. This means that the same real world entity may be a member of more than one derived entity of the specialization



Visual representation of Overlapping Specialization in EER Diagram

2.2.11.1.3 Category

A derived Entity is said to be a *Category* when it represents a collection of objects that is a subset of Union of the distinct entity types. A Category is modelled when the need arises for a single superclass/subclass relationship with more than one superclass, where the superclasses represent different entity types. (Much like multiple inheritance in Object Oriented Programming).



Visual representation of a Category in EER Diagram

Chapter 3

Working with Umbrello UML Modeller

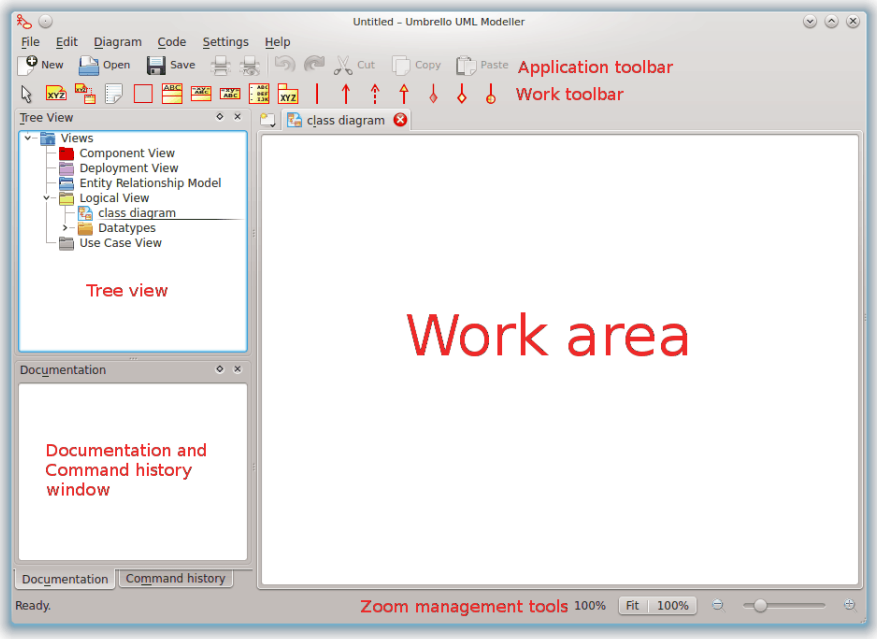
This chapter will introduce you to Umbrello UML Modeller's user interface and will tell you all you need to know to start modelling. All actions in Umbrello UML Modeller are accessible via the menu and the toolbars, but Umbrello UML Modeller also makes extensive use of right mouse button context menus. You can right mouse button click on almost any element in Umbrello UML Modeller's work area or tree view to get a menu with the most useful functions that can be applied to the particular element you are working on. Some users find this a little confusing at the beginning because they are more used to working with the menu or tool bars, but once you get used to right clicking it will greatly speed up your work.

3.1 User Interface

Umbrello UML Modeller's main window is divided in three areas that will help you keep an overview of your entire system and access the different diagrams quickly while working on your model.

These areas are called:

- Tree View
- Work Area
- Documentation and Command history Window



Umbrello UML Modeller's User Interface

3.1.1 Tree View

The Tree View is usually located on the top left hand side of the window and shows the all the diagrams, classes, actors and use cases that build up your model. The Tree View allows you to have a quick overview of the elements composing your model. The Tree View also gives you a quick way to switch between the different diagrams in your model and inserting elements from your model into the current diagram.

If you are working on a model with more than just a few classes and diagrams, the Tree View may help you stay on top of things by organizing your model elements in folders. You can create folders by selecting the appropriate option from the context menu (right mouse button click on one of the folders in the tree view) and you can organize your elements by moving them to the appropriate folder (drag and drop)

3.1.2 Documentation and Command History Window

The Documentation and Command history Window is the small window located on the left bottom of Umbrello UML Modeller, and it gives you a quick preview of the documentation for the currently selected item and the command history of your work session. The Documentation Window is rather small because it is intended to allow you just a quick pick into the element's documentation and the overview of the command history while taking as little screen space as possible. If you need to view the documentation in more detail you can always open the item's properties.

3.1.3 Work Area

The Work Area is the main window in Umbrello UML Modeller and is where the real action takes place. You use the Work Area to edit and view the diagrams in your model. The Work Area shows the currently active diagram. Currently only one diagram can be shown on the Work Area at any time.

3.2 Creating, Loading and Saving Models

The first thing you need to start doing something useful with Umbrello UML Modeller is to create a model to work on. When you start Umbrello UML Modeller it always loads the last used model or creates a new, empty model (depending on your preferences set in the configuration dialog). This will allow you to start working right away.

3.2.1 New Model

If at any time you need to create a new model you can do this by selecting the **New** entry from the **File** menu, or by clicking on the **New** icon from the application toolbar. If you are currently working on a model which has been modified Umbrello UML Modeller will ask you if it should save your changes before loading the new model.

3.2.2 Save Model

You can save your model at any time by selecting the option **Save** from the **File** Menu or by clicking on the **Save** button from the application toolbar. If you need to save your model under a different name you can use the option **Save As** from the **File** Menu.

For your convenience Umbrello UML Modeller also offers you the option to automatically save your work each certain time period. You can configure if you want this option as well as the time intervals in the **Settings** from Umbrello UML Modeller

3.2.3 Load Model

For loading an already existing model you may select the option **Open** from the **File** Menu or click on the **Open** icon from the application toolbar. The most recently used models are also available under the submenu **Open Recent** in the **File** Menu to speed up access to your most frequently used models.

Umbrello UML Modeller can only work on one model at a time, so if you ask the program to load a model for you and your current model has been modified since the last time you save it, Umbrello UML Modeller will ask you whether your changes should be saved to prevent any loss of work. You can start two or more instances of Umbrello UML Modeller at any one time, you can also copy and paste between instances.

3.3 Editing Models

In Umbrello UML Modeller, there are basically two ways for editing the elements in your model.

- Edit model elements directly through the Tree View
- Edit model elements through a Diagram

Using the context menu of the different items in the Tree View you are able to add, remove, and modify almost all the elements in your model. Right clicking on the folders in the Tree View will give you options for creating the different types of diagrams as well as, depending on whether the folder is a *Use Case View* or a *Logical View*, Actors, Use Cases, Classes, etc.

Once you have added elements to your model you can also edit an element by accessing its properties dialog, which you find by selecting the option *Properties* from the context menu shown when right clicking on the items in the Tree View.

You can also edit your model by creating or modifying elements through diagrams. More details on how to do this are given in the following sections.

3.4 Adding and Removing Diagrams

Your UML model consists of a set of UML elements and associations between them. However you cannot see the model directly, you use *Diagrams* to look at it.

3.4.1 Creating Diagrams

To create a new diagram in your model simply select the diagram type you need from the **New** submenu in the **Diagram** menu and give a name to it. The diagram will be created and made active, and you will immediately see it in the tree view.

Remember that Umbrello UML Modeller makes extensive use of context menus: you can also right mouse button click on a folder in the Tree View and select the appropriate diagram type from the **New** submenu in the context menu. Note that you can create Use Case Diagrams only in Use Case View folders, and the other types of diagram can only be created in the Logical View folders.

3.4.2 Removing Diagrams

Should you need to remove a diagram from your model, you can do this by making it active and selecting **Delete** from the **Diagram** Menu. You can also achieve this by selecting **Delete** from the diagrams context menu in the Tree View

Since deleting a diagram is something serious that could cause loss of work if done by accident, Umbrello UML Modeller will ask you to confirm the delete operation before actually removing the Diagram. Once a diagram has been deleted and the file has been saved there is no way to undo this action.

3.4.3 Renaming Diagrams

If you want to change the name of an existing diagram you can easily do this by selecting the Rename option from its right mouse button menu in the Tree View.

Another way to rename a diagram is to do this via its properties dialog, which you obtain by selecting Properties from its Context Menu or by double clicking on it in the Tree View.

3.5 Editing Diagrams

When working on a diagram, Umbrello UML Modeller will try to guide you by applying some simple rules as to which elements are valid in the different types of diagrams, as well as the relationships that can exist between them. If you are an UML expert you will probably not even notice it, but this will help UML novices create standard-conformant diagrams.

Once you have created your diagrams it is time to start editing them. Here you should notice the (for beginners subtle) difference between editing your diagram, and editing the *model*. As you already know, Diagrams are *views* of your model. For example, if you create a class by editing a Class Diagram, you are really editing both, your Diagram and your model. If you change the color or other display options of a Class in your Class Diagram, you are only editing the Diagram, but nothing is changed in your model.

3.5.1 Insert Elements

One of the first things you will do when editing a new diagram is to insert elements into them (Classes, Actors, Use Cases, etc.) There is basically two ways of doing this:

- Dragging existing elements in your model from the Tree View
- Creating new elements in your model and adding them to your diagram at the same time, by using one of the edit Tools in the Work Toolbar

To insert elements that already exist in your model, just drag them from the Tree View and drop them where you want them to be in your diagram. You can always move elements around in your Diagram using the Select Tool

The second way of adding elements to your diagram is by using the Work Toolbar's edit tools (note that this will also add the elements to your model).

The Work Toolbar was by default located on the top of the window. The tools available on this toolbar (the buttons you see on it) change depending on the type of diagram you are currently working on. The button for the currently selected tool is activated in the toolbar. You can switch to the select tool by pressing the **Esc** key.

When you have selected an edit tool from the Work Toolbar (for example, the tool to insert classes) the mouse pointer changes to a cross, and you can insert the elements in your model by single clicking in your diagram. Note that elements in UML must have a *Unique Name*. So that if you have a class in one diagram whose name is 'ClassA' and then you use the insert Class tool to insert a class into another diagram you cannot name this new class 'ClassA' as well. If these two are supposed to be two different elements, you have to give them a unique name. If you are trying to add the *same* element to your diagram, then the Insert Class is not the right tool for that. You should drag and drop the class from the Tree View instead.

3.5.2 Deleting Elements

You can delete any element by selecting the option **Delete** from its context menu.

Again, there is a *big* difference between removing an object from a diagram, and deleting an object from your model: If you delete an object from within a diagram, you are only removing the object from that particular diagram: the element will still be part of your model and if there are other diagrams using the same element they will not suffer any change. If, on the other hand, you delete the element from the Tree View, you are actually deleting the element from your *model*. Since the element no longer exist in your model, it will be automatically removed from all the diagrams it appears in.

3.5.3 Editing Elements

You can edit most of the UML elements in your model and diagrams by opening its Properties dialog and selecting the appropriate options. To edit the properties of an object, select **Properties** from its context menu (right mouse button click). Each element has a dialog consisting of several pages where you can configure the options corresponding to that element. For some elements, like actors you can only set a couple of options, like the object name and documentation, while for other elements, like classes, you can edit its attributes and operations, select what you want to be shown in the diagram (whole operation signature or just operation names, etc) and even the colors you want to use for the line and fill of the class' representation on the diagram.

For UML elements you can also open the properties dialog by double clicking on it if you are using the selection tool (arrow).

Note that you can also select the properties option from the context menu of the elements in the Tree View. This allows you to also edit the properties for the diagrams, like setting whether the grid should be shown or not.

3.5.4 Editing Classes

Even though editing the properties of all objects was already covered in the previous section, classes deserve a special section because they are a bit more complicated and have more options than most of the other UML elements.

In the properties dialog for a class you can set everything, from the color it uses to the operations and attributes it has.

3.5.4.1 Class General Settings

The General Settings page of the properties dialog is self-explanatory. Here you can change the class' name, visibility, documentation, etc. This page is always available.

3.5.4.2 Class Attribute Settings

In the Attributes Settings page you can add, edit, or delete attributes (variables) of the class. You can move attributes up and down the list by pressing the arrow button on the side. This page is always available.

3.5.4.3 Class Operations Settings

Similar to the Attribute Settings Page, in the Operation Settings Page you can add, edit, or remove operations for your class. When adding or editing an operation, you enter the basic data in the *Operation Properties* dialog. If you want to add parameters to your operation you need to click the **New Parameter** button, which will show the *Parameter Properties* dialog. This page is always available

3.5.4.4 Class Template Settings

This page allows you to add class templates which are unspecified classes or datatypes. In Java 1.5 these will be called Generics.

3.5.4.5 Class Associations Page

The **Class Associations** page shows all the associations of this class in the current diagram. Double clicking on an association shows its properties, and depending on the type of association you may modify some parameters here such as setting multiplicity and Role name. If the association does not allow such options to be modified, the Association Properties dialog is read-only and you can only modify the documentation associated with this association.

This page is only available if you open the Class Properties from within a diagram. If you select the class properties from the context menu in the Tree View this page is not available.

3.5.4.6 Class Display Page

In the **Display Options** page, you can set what is to be shown in the diagram. A class can be shown as only one rectangle with the class name in it (useful if you have many classes in your diagram, or are for the moment not interested in the details of each class) or as complete as showing packages, stereotypes, and attributes and operations with full signature and visibility

Depending on the amount of information you want to see you can select the corresponding options in this page. The changes you make here are only *display options* for the diagram. This

means that 'hiding' a class' operations only makes them not to be shown in the diagram, but the operation are still there as part of your model. This option is only available if you select the class properties from within a Diagram. If you open the class properties from the Tree View this page is missing since such Display Options do not make sense in that case

3.5.4.7 Class Style Page

In the **Widget Style** page you can configure the colors you want for the line and the fill of the widget. This option obviously makes sense only for classes displayed in diagrams, and is missing if you open the class' properties dialog from the Tree View.

3.5.5 Associations

Associations relate two UML objects to each other. Normally associations are defined between two classes, but some types of associations can also exists between use cases and actors.

To create an association select the appropriate tool from the Work Toolbar (generic Association, Generalization, Aggregation, etc.) and single click on the first element participating in the association and then single click on the second item participating. Note that those are two clicks, one on each on the objects participating in the association, it is *not* a drag from one object to the other.

If you try to use an association in a way against the UML specification Umbrello UML Modeller will refuse to create the association and you will get an error message. This would be the case if, for example, a Generalization exists from class A to class B and then you try to create another Generalization from Class B to class A

Right clicking on an association will show a context menu with the actions you can apply on it. If you need to delete an association simply select the **Delete** option from this context menu. You can also select the **Properties** option and, depending on the association type edit attributes such as roles and multiplicity.

3.5.5.1 Anchor Points

Associations are drawn, by default, as a straight line connecting the two objects in the diagram.

You can add anchor points to bend an association by double clicking some where along the association line. This will insert an anchor point (displayed as a blue point when the association line is selected) which you can move around to give shape to the association

If you need to remove an anchor point, double click on it again to remove it

Note that the only way to edit the properties of an association is through the context menu. If you try to double click on it as with other UML objects, this will only insert an anchor point.

3.5.6 Notes, Text and Boxes

Notes, Lines Of Text and Boxes are elements that can be present in any type of diagram and have no real semantic value, but are very helpful to add extra comments or explanations that can make your diagram easier to understand.

To add a Note or a Line Of Text, select the corresponding tool from the Work Toolbar and single click on the diagram where you want to put your comment. You can edit the text by opening the element through its context menu or in the case of notes by double clicking on them as well.

3.5.6.1 Anchors

Anchors are used to link a text note and another UML Element together. For example, you normally use a text note to explain or make some comment about a class or a particular association, in which case you can use the anchor to make it clear that the note 'belongs' to that particular element.

To add an anchor between a note and another UML element, use the anchor tool from the work toolbar. You first need to click on the note and then click on the UML element you want the note to be linked to.

Chapter 4

Code Import and Code Generation

Umbrello UML Modeller is a UML modelling tool, and as such its main purpose is to help you in the *analysis and design* of your systems. However, to make the transition between your design and your *implementation*, Umbrello UML Modeller allows you to generate source code in different programming languages to get you started. Also, if you want to start using UML in an already started C++ project, Umbrello UML Modeller can help you create a model of your system from the source code by analysing your source code and importing the classes found in it.

4.1 Code Generation

Umbrello UML Modeller can generate source code for various programming languages based on your UML Model to help you get started with the implementation of your project. The code generated consists of the class declarations, with their methods and attributes so you can 'fill in the blanks' by providing the functionality of your classes' operations.

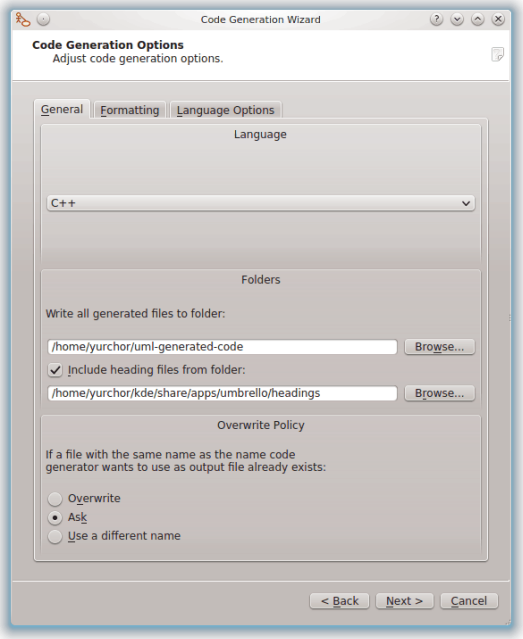
Umbrello UML Modeller 2 comes with code generation support for ActionScript, Ada, C++, C#, D, IDL, Java™, JavaScript, MySQL, Pascal, Perl, PHP, PHP5, PostgreSQL, Python, Ruby, Tcl, Vala, and XMLSchema.

4.1.1 Generating Code

In order to generate code with Umbrello UML Modeller, you first need to create or load a Model containing at least one class. When you are ready to start writing some code, select the **Code Generation Wizard** entry from the **Code** menu to start a wizard which will guide you trough the code generation process.

The first step is to select the classes for which you want to generate source code. By default all the classes of your model are selected, and you can remove the ones for which you do not want to generate code by moving them to the left-hand side list.

The next step of the wizard allows you to modify the parameters the Code Generator uses while writing your code. The following options are available:



Options for the Code Generation in Umbrello UML Modeller

4.1.1.1 Generation Options

4.1.1.1.1 Comment Verbosity

The option **Write documentation comments even if empty** instructs the Code Generator to write comments of the /** blah */ style even if the comment blocks are empty. If you added documentation to your classes, methods or attributes in your Model, the Code Generator will write these comments as Doxygen documentation regardless of what you set here, but if you select this option Umbrello UML Modeller will write comment blocks for all classes, methods and attributes even if there is no documentation in the Model, in which case you should document your classes later directly in the source code.

Write comments for sections even if section is empty causes Umbrello UML Modeller to write comments in the source code to delimit the different sections of a class. For example 'public methods' or 'Attributes' before the corresponding sections. If you select this option Umbrello UML Modeller will write comments for all sections of the class even if the section is empty. For example, it would write a comment saying 'protected methods' even if there are no protected methods in your class.

4.1.1.1.2 Folders

Write all generated files to folder. Here you should select the folder where you want Umbrello UML Modeller to put the generated sources.

The **Include heading files from folder** option allows you to insert a heading at the beginning of each generated file. Heading files can contain copyright or licensing information and contain variables that are evaluated at generation time. You can take a look at the template heading files shipped with Umbrello UML Modeller to see how to use these variables for replacing your name or the current date at generation time.

4.1.1.1.3 Overwrite Policy

This option tells Umbrello UML Modeller what to do if the file it wants to create already exists in the destination folder. Umbrello UML Modeller *cannot modify existing source files*, so you have to choose between overwriting the existing file, skipping the generation of that particular file or letting Umbrello UML Modeller choose a different file name. If you choose the option to use a different name, Umbrello UML Modeller will add a suffix to the file name.

4.1.1.1.4 Language

Umbrello UML Modeller will by default generate code in the language you have selected as Active Language, but with the Code Generation Wizard you have the option to change this to another language.

4.1.1.2 Generation Wizard Generation

The third and last step of the wizard shows the status of the Code Generation process. You need only to click on the Generate button to get your classes written for you.

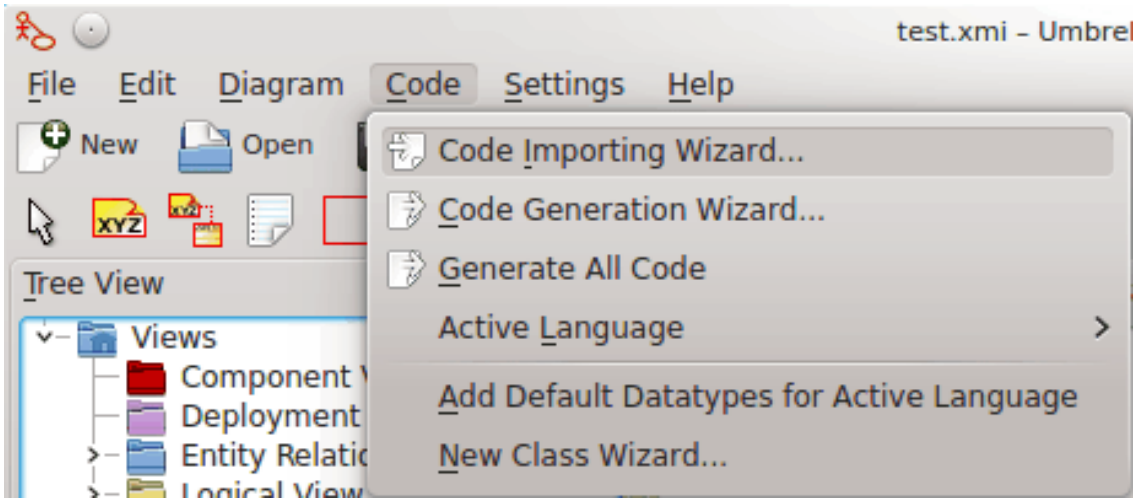
Note that the Options you select during the Code Generation Wizard are only valid for the current generation. The next time you run the wizard you will need to re-select all the options (your headings folder, overwrite policy, and so on). You can set the defaults used by Umbrello UML Modeller in the **Code Generation** section of the Umbrello UML Modeller settings, available at **Settings** → **Configure Umbrello UML Modeller...**

If you have set your Code Generation options to the right settings and want to generate some code right away without going through the wizard, you can select the entire **Generate All Code** from the **Code** menu. This will generate code for all the classes in your Model using the current settings (including Output Folder and Overwrite Policy, so use with care).

4.2 Code Import

Umbrello UML Modeller can import source code from your existing projects to help you build Model of your systems. Umbrello UML Modeller 2 supports ActionScript, Ada, C++, C#, D, IDL, Java™, Javascript, MySQL, Pascal, PHP, and Vala source code.

To import classes into your Model, select the entry **Code Importing Wizard...** from the **Code** menu. In the file dialog select the files containing class declarations and press **Next >** then **Start import** and **Finish**. The classes will be imported and you will find them as part of your Model in the Tree View. Note that Umbrello UML Modeller will not create any kind of Diagram for showing your classes, they will only be imported into your Model so that you can use them later in any diagram you want.



Menu for importing source code in Umbrello UML Modeller

Chapter 5

Other Features

5.1 Other Umbrello UML Modeller Features

This chapter will briefly explain some other features Umbrello UML Modeller offers you.

5.1.1 Copying objects as PNG images

Apart from offering you the normal copy, cut and paste functionality that you would expect to copy objects between different diagrams, Umbrello UML Modeller can copy the objects as PNG pictures so that you can insert them into any other type of document. You do not need to do anything special to use this feature, just select an object from a diagram (Class, Actor, etc.) and copy it (**Ctrl-C**, or using the menu), then open a Calligra Words document (or any program into which you can paste images) and select **Paste**. This is a great feature to export parts of your diagram as simple pictures.

5.1.2 Exporting to an Image

You can also export a complete diagram as an image. The only thing you need to do is select the diagram you want to export, and then the option **Export as Picture...** from the **Diagram** menu.

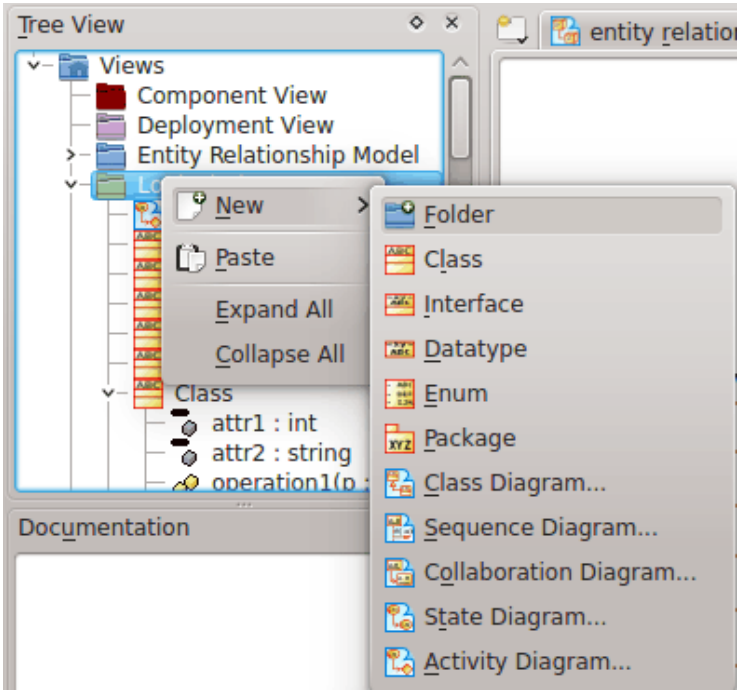
You can export multiple diagrams at once using the **Export Diagrams as Pictures...** option from the **File** menu. With this, you can also set the image resolution, so that the images won't be as blurry.

5.1.3 Printing

Umbrello UML Modeller allows you to print individual diagrams. Press the **Print** button on the application toolbar or selecting the **Print** option from the **File** menu will give you a standard KDE Print dialog from where you can print your diagrams.

5.1.4 Logical Folders

To better organize your model, especially for larger projects, you can create logical folders in the Tree View. Just select the option **New** → **Folder** from the context menu of the default folders in the Tree View to create them. Folders can be nested, and you can move objects around by dragging them from one folder and dropping them into another.

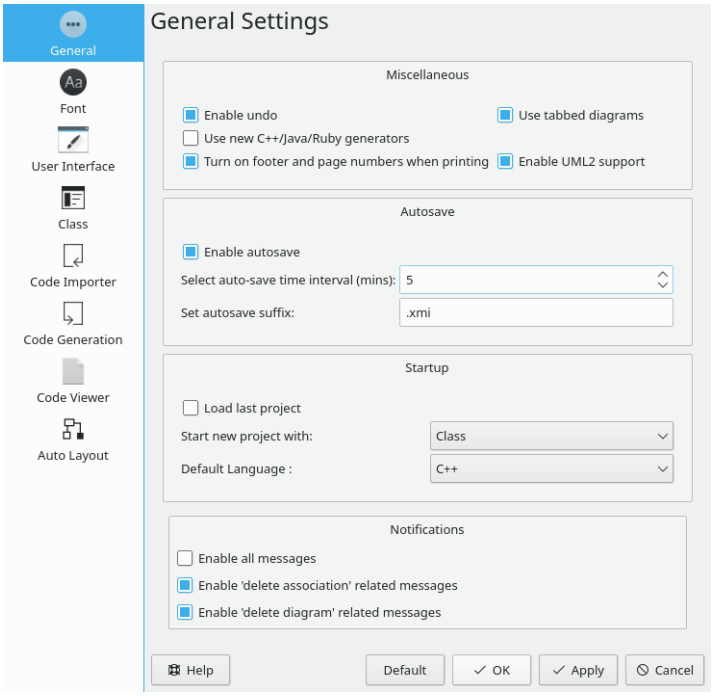


Organizing a Model with Logical Folders in Umbrello UML Modeller

Chapter 6

Settings

6.1 General Settings



Options for the General Settings in Umbrello UML Modeller

6.1.1 Miscellaneous

- The option **Enable undo** allows undoing a previous action.
- **Use new C++/Java/Ruby generators** lets the user select either the old or new code generators
- **Turn on footer and page numbers when printing** when selected, prints diagram information for the diagram being printed and the page number.
- **Use tabbed diagrams** gives the option of having multiple tabbed diagram windows open at a time.

6.1.2 Autosave

- **Enable autosave** gives a choice to autosave the file.
- **Select auto-save time interval (mins):** allows setting the time before the file is autosaved.
- **Set autosave suffix:** defaults to .xmi but allows a different file extension to be set.

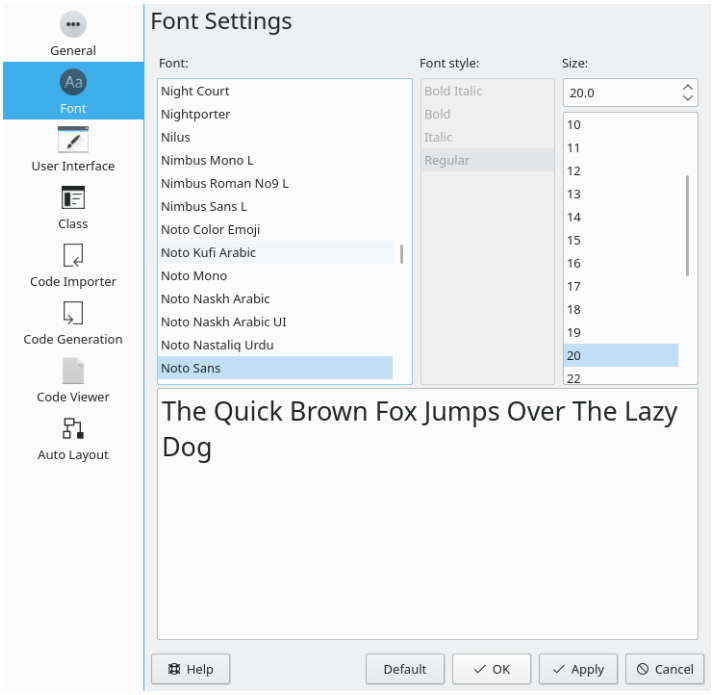
6.1.3 Startup

- **Load last project** if set, always loads the last work project upon program startup.
- **Start new project with:** gives a choice of which UML diagram type to start with in a new project.
- **Default Language:** is a setting for the default programming language used.

6.1.4 Notifications

- **Enable all messages** is an option to either see all notifications or a reduced set of notifications.
- **Enable 'delete association' related messages** ensures that you will receive all messages of this type if checked.
- **Enable 'delete diagram' related messages** will enable all messages of this type if checked.

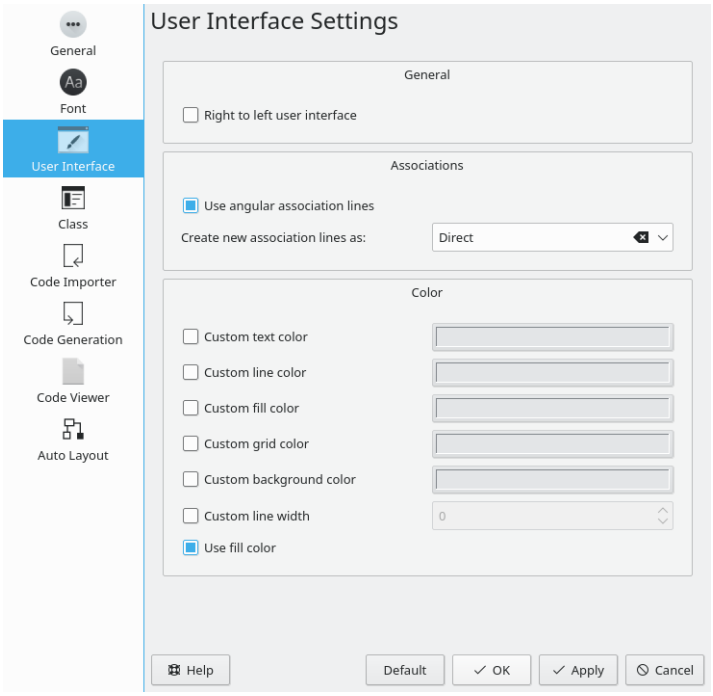
6.2 Font Settings



Options for the Diagram Font Settings in Umbrello UML Modeller

These font settings set the characteristics of the text in the diagrams. Font style and size are the only selectable options.

6.3 User Interface Settings



Options for the User Interface Settings in Umbrello UML Modeller

6.3.1 General

Right to left user interface configures the interface for the right to left languages.

6.3.2 Associations

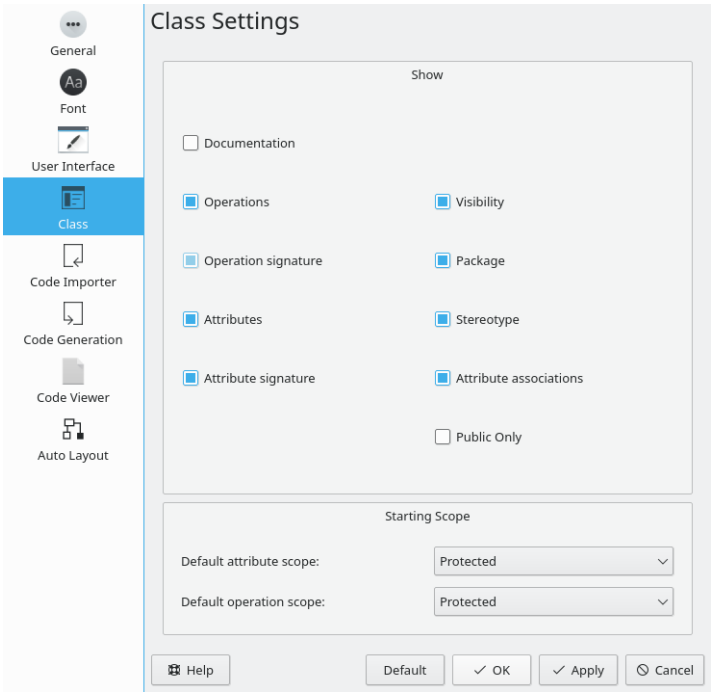
Use angular associating lines allows association lines to vary at any angle.

Create new association lines as: gives the ability to change the association line style.

6.3.3 Color

The color section gives several options to change the text, line, fill, grid and background colors as well as the line width.

6.4 Class Settings



Options for the Class Settings in Umbrello UML Modeller

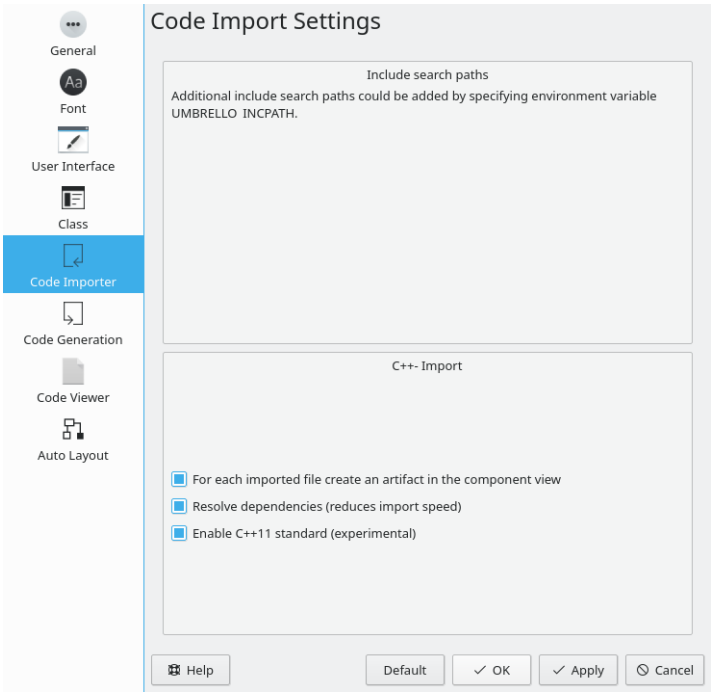
6.4.1 Show

The Show section has numerous settings that determine which class characteristics are shown in the Class Diagram.

6.4.2 Starting Scope

Choices for attribute and operation default settings, public, private or protected.

6.5 Code Import Settings



Options for the Code Import Settings in Umbrello UML Modeller

6.5.1 Include Search Paths

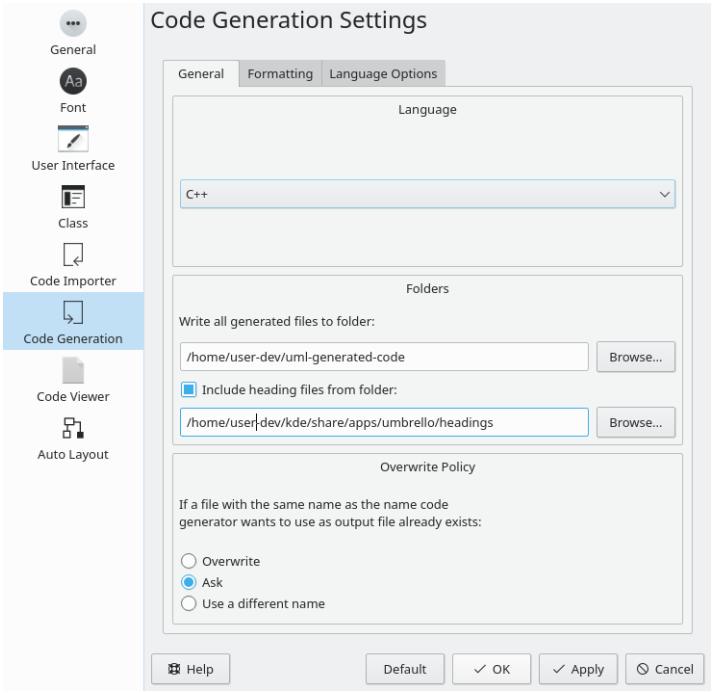
A general recommendation is given to improve searching by including UMBRELLO INCPATH as an environment variable.

6.5.2 C++-Import

- **For each imported file create an artifact in the component view** The artifact created can then be dragged into the Class Diagram view where dependencies can be easily seen along with the attributes and functions of each file.
- **Resolve dependencies (reduces import speed)** Ensures all file dependencies are resolved which then shows up in class dependencies in the Class Diagram.
- **Enable C++11 standard (experimental)** An experimental feature to conform to C++11, disable if not needed.

6.6 Code Generation Settings

6.6.1 Code Generation Settings General Tab



Options for the Code Generation General Settings in Umbrello UML Modeller

Umbrello UML Modeller can generate source code for various programming languages based on your UML Model to help you get started with the implementation of your project. The code generated consists of the class declarations, with their methods and attributes so you can ″fill in the blanks″ by providing the functionality of your classes' operations.

6.6.1.1 Language

Choose the programming language to use for projects. The choices offered are ActionScript, Ada, C++, C#, D, IDL, Java, JavaScript, MYSQL, Pascal, Perl, PHP, PHP5, PastgreSQL, Python, Ruby, SQL, Tcl, Vala and XMLSchema

6.6.1.2 Folders

Write all generated files to folder: has an editable field for the desired path for generated files or optionally a browse button to select the path.

Include heading files from folder: if checked, lets the user specify a path in an editable field or choose it with a browse button.

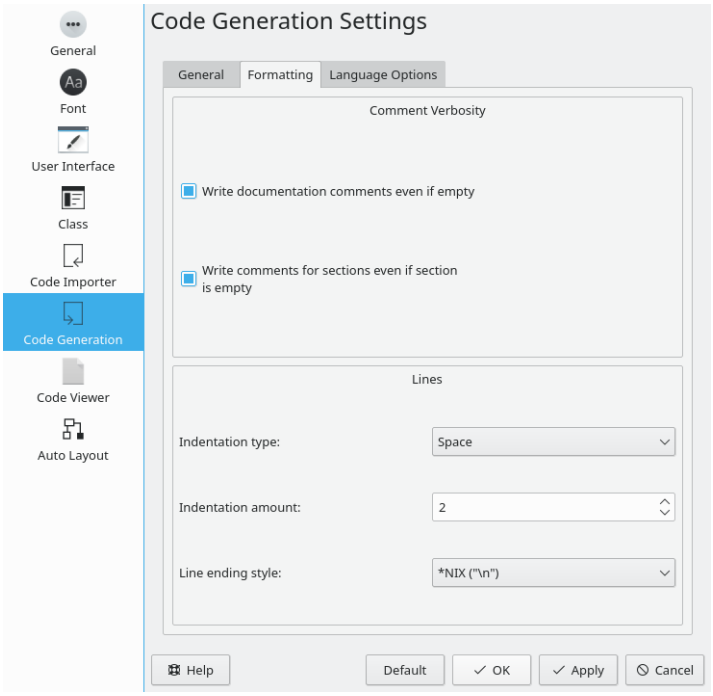
6.6.1.3 Overwrite Policy

When the code is generated into the specified folder, this setting determines what happens if a file with the same name is encountered.

- **Overwrite** the file without a warning or option.

- **Ask** whether to overwrite the file or rename it.
- **Use a different name** when a file already exists by renaming it using a suffix.

6.6.2 Code Generation Settings Formatting Tab



Options for the Code Generation Formatting Settings in Umbrello UML Modeller

6.6.2.1 Comment Verbosity

Write documentation comments even if empty Generates comments for classes and functions even if they are empty.

Write comments for sections even if section is empty Writes comments for the private, protected and public sections even if they are empty.

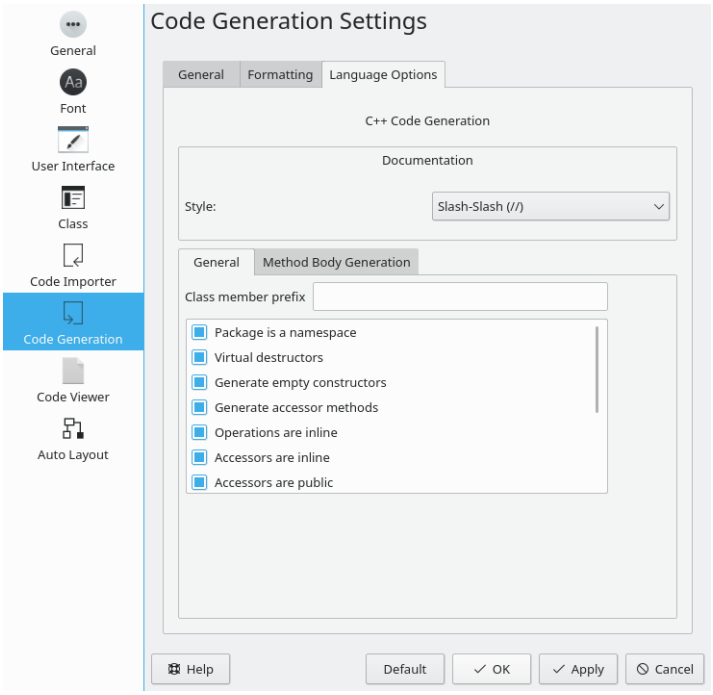
6.6.2.2 Lines

Indentation type: offers a choice between no indentation, tab or space.

Indentation amount: lets the user specify the number of spaces for the tab or space indentation choice.

Line ending style: is a choice between the line ending styles of *NIX, Windows and Mac.

6.6.3 Language Options



Options for the Code Generation Language Settings in Umbrello UML Modeller

This page changes for each programming language selected under the General tab. Currently the only options available are for the C++ language.

6.6.3.1 C++ Code Generation

6.6.3.1.1 Documentation

Style: gives a choice to use either "/** */" or "//" as the documentation style

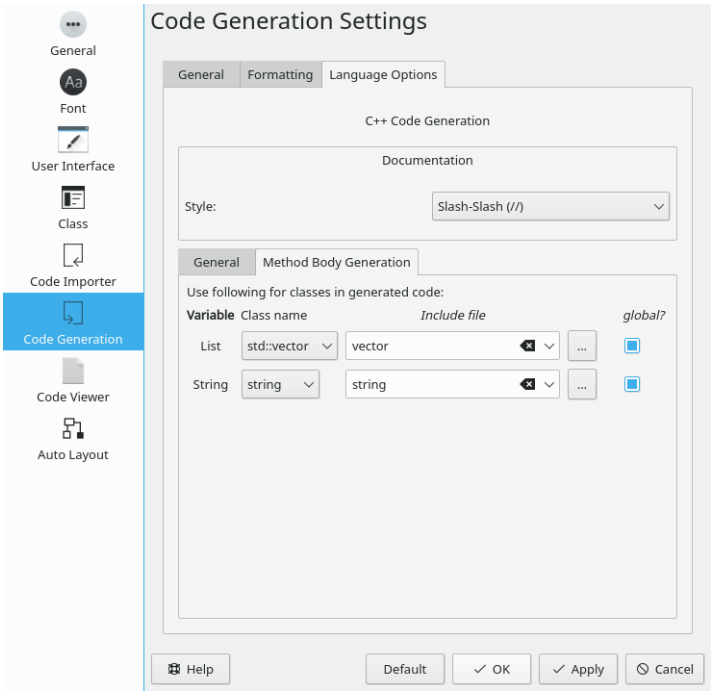
6.6.3.1.2 General

Under the **General** tab of the **Language Options** tab, several code generation options are listed.

- **Class member prefix**
  An option that allows a prefix determined by the user, to be added to class members when code is generated.
- **Package is a namespace**
  Namespaces provide a method for preventing name conflicts in large projects. Symbols declared inside a namespace block are placed in a named scope that prevents them from being mistaken for identically-named symbols in other scopes.
- **Virtual destructors**
  Even though destructors are not inherited, if a base class declares its destructor virtual, the derived destructor always overrides it. This makes it possible to delete dynamically allocated objects of polymorphic type through pointers to base.
- **Generate empty constructors**
  This will generate constructors that have empty braces.

- **Generate accessor methods**
  Will generate methods to access datatypes.
- **Operations are inline**
  Generate the methods as inline, but compilers are free to choose not to inline the method.
- **Accessors are inline**
  Methods that access the class' data will be generated inline, but compilers are free to choose not to inline the method.
- **Accessors are public**
  Methods that are generated as public will be available to any instantiation of the class.
- **Create getters with 'get' prefix**
  This will put the prefix "get" on the methods that get/return the class data.
- **Remove prefix '[a-zA-Z]_' from accessor method names**
  If a prefix was entered in **Class member prefix**, this will remove it.
- **Accessor methods start with capital letters**
  This capitalizes the first letter of the method name.
- **Use '\' as documentation tag instead of @**
  A tag choice to use when documenting parameters of a method.

6.6.3.1.3 Method Body Generation



Options for the Code Generation Language Method Body Settings in Umbrello UML Modeller

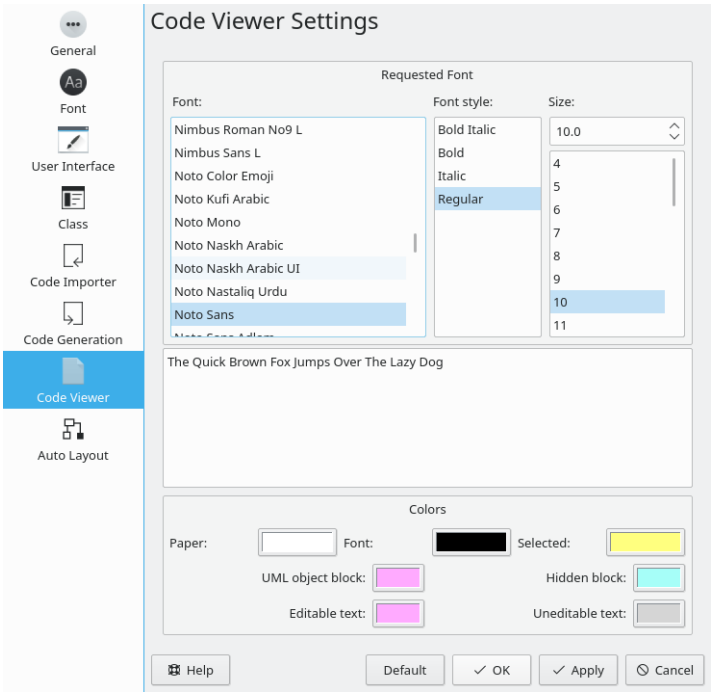
List

Has options of QPtrList, vector, and std::vector for the list type. An editable or selectable field follows to specify the include file along with a browse button to find a select the include file. There is also an option to make the list global.

String

Options of string or QString for the string type. An editable or selectable field follows to specify the include file along with a browse button to find a select the include file. There is also an option to make the string global.

6.7 Code Viewer Settings

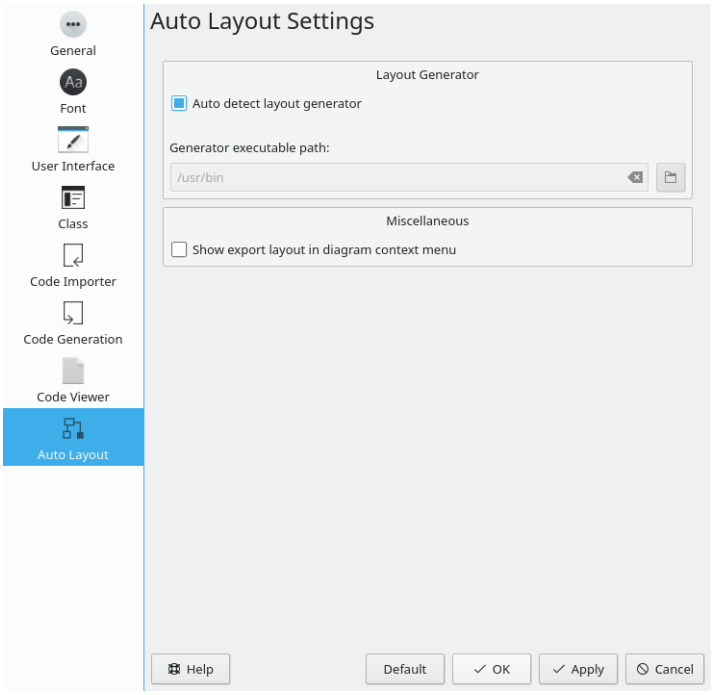


Options for the Code Viewer Settings in Umbrello UML Modeller

Allows customization of the Code Viewer. The **Requested Font** section allows the selection of the font, font style, and font size. A representation of your choices is shown below the choices.

In the **Colors** section, changes can be made to Paper, Font, Selected, UML object block, Hidden block, Editable text, and Uneditable text. Changes to the colors can be made by clicking on the color box by the respective label.

6.8 Auto Layout Settings



Options for the Auto Layout Settings in Umbrello UML Modeller

Auto detect layout generator

The auto layout feature depends on layout generators provided by the GraphViz package, which is normally installed alongside Umbrello by a package manager. Umbrello has built-in support for detecting the installed location of these layout generators. For cases where this dependency is not available or does not fit, a different installation path could be selected.

Show export layout in diagram context menu

Dot file export is performed by using the export layout. With this option checked, the export layout is added to the list of available diagram layouts and enables a quick dot export preview.

Chapter 7

Authors and History

This project was started by Paul Hensgen as one of his University projects. The original name of the application was UML Modeller. Paul did all the development until the end of 2001 when the program reached version 1.0.

Version 1.0 already offered a lot of functionality, but after the project had been reviewed at Paul's University, other developers could join and they started making valuable contributions to UML Modeller, like switching from a binary file format to an XML file, support for more types of UML Diagrams, Code Generation and Code Import just to name a few.

Paul had to retire from the development team in Summer 2002 but, as Free and Open Source Software, the program continues to improve and evolve and is being maintained by a group of developers from different parts of the world. In September 2002 the project changed its name from UML Modeller, to Umbrello UML Modeller. There are several reasons for the change of names, the most important ones being that just 'uml' — as it was commonly known — was a much too generic name and caused problems with some distributions. The other important reason is that the developers think Umbrello is a much cooler name.

The development of Umbrello UML Modeller as well as discussions as to where the program should head for future versions is open and takes place over the Internet. If you would like to contribute to the project, please do not hesitate to contact the developers. There are many ways in which you can help Umbrello UML Modeller:

- Reporting bugs or improvements suggestions
- Fixing bugs or adding features
- Writing good documentation or translating it to other languages
- And of course...coding with us!

As you see, there are many ways in which you can contribute. All of them are very important and everyone is welcome to participate.

The Umbrello UML Modeller developers can be reached at umbrello-devel@kde.org.

Chapter 8

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